ENHANCING CONSUMER ACCEPTABILITY AND COMMERCIAL UTILISATION OF GOAT MEAT THROUGH PROCESSING VALUE-ADDED PRODUCTS IN NORTHERN KWAZULU-NATAL, SOUTH AFRICA

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ABSTRACT

In the Southern African region, consumer acceptance of goat meat as part of a healthy diet for human well-being remains low. Due to cultural beliefs and consumer preferences, goat meat commonly known as chevon is primarily used in cultural rites within South African rural communities. Consequently, it is underutilized and under-consumed. However, goat meat is considered nutritious by the researchers, and its advancement into innovative products could maximize its utilization and acceptability. The rising consumer demand for healthy red meat options necessitates a reconsideration of chevon meat product development and its acceptability among current and future consumers. Therefore, the study goal is to assess the acceptability of value-added goat meat products for both household and commercial use.

The study was conducted in the city of uMhlathuze Local Municipality under King Cetshwayo District Municipality in the northeast of KwaZulu-Natal, South Africa. The study employed a descriptive research design with a phenomenological approach, supplemented by experimental research elements. The observational study was conducted to profile types of goat meat products available and accessible at the retail market with the classifications of retail stores as per living standard measures. Key informant interviews for a qualitative study were conducted with the retail representatives (*n=15*) to verify product availability, purchasing frequency, and consumer perceptions towards goat meat/products commercialisation in various meat markets through a quota purposive sample. Key informants (KIs) with expertise in preparing goat meat were identified for complementary interviews. The knowledge holders (KHs) provided insights into various cooking methods and preservation techniques for goat meat at the community level.

The experimental phase involved the initial sensory evaluation of goat meat products which used the original recipes of the indigenous knowledge holders in their originality. Therefore, the production of variant innovative value-added chevon products was reformulated from the three best original recipes of the indigenous knowledge holders, classified as moist, dry and processed. Sensory evaluation of three innovative chevon products (goat curry, dry-wors and burgher patty) on tenderness, juiciness, flavour, aroma and taste was conducted using 120 untrained panellists who are goat meat consumers, including staff and students from the University of Zululand and Owen Sithole College of Agriculture at a 60:60 ratio. Samples from the variant goat meat product were analysed for microbiological quality, texture and colour, sensory evaluation for the benefit of consumers' health, safety and satisfaction, as well as the

consumer willingness to purchase these products (goat curry, burger patties and dried wors) if are available in the market.

The study findings revealed that although goat products are available and accessible in commercial and informal markets, they are not accessible to all individuals. There exists an issue of affordability and physical access, as the majority of these products are found exclusively in upper-class markets. This indicates that certain goat products may only be accessible to specific economic groups. Conversely, value-added products were all deemed acceptable in terms of overall acceptability. However, the preference rating scale on the variance of (highly preferred, moderately preferred and least preferred) indicated that 61.7% of consumers highly preferred goat curry, followed by 57.5% of consumers who moderately preferred the burger, with 76.7% of the participants rated dried wors being the least preferred product. Consequently, dried wors was indicated less favoured compared to curry and burger patties among the participants, due to unfamiliarity with the product specific characteristics. These results were found to correlate with the food action rating scale, which determined consumer willingness to purchase the product. Goat meat curry (48%) and burger patty (38%) were the highest rated products for the consumer willingness to purchase (WTP). However, the overall acceptability results indicated none of the three products rated extremely unpleasant on a variance of 1= extremely pleasant, 3 = average, and 5 = extremely unpleasant. The results showed 70% of the participants considered goat curry extremely pleasant, 49% regarded burgers extremely pleasant, 30% considered dried wors extremely pleasant and 62% pleasant respectively.

The research concludes that processing goat meat into value-added products has a potential to improve its utilization and acceptability, thereby promoting local-based food systems and contributing to the reduction of food and nutrition insecurity. Adding value to goat meat may additionally enhance the economic prospects of local producers through increased economic value of the value-added products. Therefore, connecting future global food demand to the role of food technology in producing and stabilising foods to meet the global consumer demands is recommended. The study perspective of the food-based approach links agricultural production, food safety, health and nutrition, processing and supply chain efficiency to food and nutrition security. Thus, enabling technologies to enhance goat meat consumption in an innovative version, within an acceptable and affordable context is required for healthy and nutritionally secured nations.

DECLARATION

I, Thembelihle Buthelezi, hereby declare that:

1. The research work presented in this dissertation is my original work, and all the materials used are appropriately acknowledged and explicitly referenced.
2. The dissertation has not been submitted in any of its parts or entirety for any degree in any other university locally or internationally.
3. This thesis does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged, and the source is detailed in the thesis and the relevant reference section
4. Therefore, I permit that my work be available for replication and/or for re-printing, for inter-library loan, and for the title and abstract of my dissertation to be made available to other educational institutions and students that might need it.

Name: Thembelihle Buthelezi (Candidate)

Signed: [redacted] Date: 13 January 2025

As supervisors of the candidate, we agree to the submission of this dissertation for examination.

Name: Prof Unathi Kolanisi (Supervisor) Date: 27 January 2025

Signed: [redacted]

Name: Dr Karina Palmer (Co-supervisor) Date: 27 January 2025

Signed: [redacted]

DEDICATION

I dedicate this dissertation to:

My mom and dad, Bongi and Livingstone Nzuza.

My parents, I know you have been longing to see this study reaching the end with success. Thank you for your endless love and support and for always praying for me. Your encouragement and wisdom always reassured me when I needed it the most. You both have played an instrumental role in completing this study and dissertation.

To all mothers and daddies, be available and let your presence be significantly enjoyable to your sons and daughters while you can.

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DECLARATION OF RESEARCH OUTPUT

A. The following are the research outputs in DHET accredited Journals

1. Chapter 4. Title of paper: Goat Meat and Goat Products Consumer Market Accessibility and Household Utilisation in uMhlathuze Municipality, KwaZulu-Natal.
   Submitted to African Journal of Hospitality, Tourism and Leisure
   (Accepted for publication in AJHTL).
2. Chapters 5 and 6. Title of paper: Development and Quality Assessment of South African Indigenous Goat Meat Products.
   Submitted to African Journal of Hospitality, Tourism and Leisure
   (Accepted for publication in AJHTL).

B. Conference – Book of Abstracts published

1. Title – Sensory evaluation versus microbial, instrumental texture and colour qualities in chevon value-added dried-wors. Published in South African Association for Food Science and Technology (SAAFoST) book of abstracts, 28 - 31August 2023. Theme: "Future Foods: Smarter and More Sustainable Solutions", is a clarion call to explore sustainable solutions to the many issues food professionals face to provide healthy food, that is safe, affordable and delicious - 25th Biennial SAAFoST Congress.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASF	Animal Source Foods
DAFF	Department of Agriculture, Forestry and Fisheries
DARD	Department of Agriculture and Rural Development
FACT	Food Action Rating Scale
GM	Goat Meat
HBV	High Biological Value
HMRs	Home Meal Replacements
IK	Indigenous Knowledge
IKHs	Indigenous Knowledge Holders
KZN	KwaZulu-Natal
LSM	Living Standard Measure
NUS	Neglected and Underutilised Animal Species
OSCA	Owen Sithole College of Agriculture
RM	Retail Managers
RR	Retail Representatives
RTE	Ready-to-eat
RTH	Ready-to-heat
RTC	Ready-to-cook
SA	South Africa
SANS	South African National Standards
SD	Standard Deviation
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
STATS SA	Statistics South Africa
TPA	Texture Profile Analysis
TPC	Total Plate Count
UNIZULU	University of Zululand
US	United States
VAGMPs	Value-Added Goat Meat Products
WTP	Willingness to purchase

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CHAPTER 1: THE PROBLEM STATEMENT AND ITS SETTING

1.1 Background of the study

From 2011, the global per capita meat consumption increased from 23.1 kg to 42.2 kg (Sans and Combris, 2015), with an annual increase of 2.7 percent in meat production and 3.2 percent in milk production (Nouman et al., 2014). The United Nations Food and Agriculture Organization (FAO) has predicted that global meat consumption will double by 2050, with meat consumption of ± 465 million tons. Additionally, FAOSTAT (2015) projected that, as the global population grows, the demand for food will increase, with meat, eggs, and dairy products expected to rank highest on consumers' shopping lists. The protein demand from red meat, poultry, dairy milk, and eggs is expected to increase by 14% and 38% per person, respectively between 2020 and 2050.

Unfortunately, this phenomenon of increased meat consumption has not received much attention in Africa, similar to South Africa (Hall et al., 2015). In contrast, the overarching desire for meat and animal-derived foods has stimulated a rigorous search for alternative meat and meat products from various animals and novel sources (Stephens et al., 2018). Mazhangara et al. (2019) reported that red meat is expensive and high in saturated fat and cholesterol. Owing to its high-fat content, Boada et al. (2016) and Mazhangara et al. (2019) confirmed that excessive consumption of red meat is associated with an increased risk of developing metabolic disorders such as obesity, insulin resistance, metabolic dysfunction, and metabolic diseases.

On the other hand, studies conducted by van der Weele et al. (2019) and Mazhangara et al. (2019) reported that goat meat (chevon), as is known in other nations, has been found to display distinct nutritional and healthy attributes of lower saturated fats and cholesterol levels when equated to other red meat types such as beef and lamb. Thus, the chemical composition of goat meat makes it healthier than that of other red meats. Additionally, Mazhangara et al. (2019) declared consumers as as health-conscious bodies, concerned about the effect of food on their health status, including the meat they consume. Therefore, increasing consumer awareness through goat meat advancement and value-added products for innovative consumption patterns could perpetuates the demand of this healthy food.

Based on the literature, goats are the second most domesticated species in terms of livestock populations in developing countries (Webb, 2014), and goats are considered the most important source of red meat, especially in many of the world’s rural communities (Webb, 2014,

Khumalo, 2017; Mowa; 2018; Luthuli et al., 2019). According to Cawthorn and Hoffman (2014), more than 90% of these animals are concentrated in Africa and Asia and most goats are kept by small-scale farmers (Mertzlufft, 2014). Although goat meat consumption has been reported to be lower than that of beef (Madruga and Bressan, 2011), research by Webb (2014), Khumalo (2017), Manowa (2018), and Luthuli (2019) has affirmed that goats are the primary source of red meat in developing countries. Similarly, Devendra (2010) reported that approximately 98% of domesticated goats are found in developing countries, where more than 30 improved and indigenous breeds remain under-utilized.

In the past decade, rigorous research has been conducted worldwide on goat meat and its value-added products. Goat meat currently exceeds the global consumer demand and preference for sheep meat, with an increasing trend of 75% and 42% in the production of goats and sheep, respectively (Teixeira et al., 2020). Countries with a long tradition of consuming goat meat, such as Northern Europe, Turkey, South America, Northern Brazil, Asia, and Southern Africa, also show a steady increase in the consumption of goat meat and products (Leite et al., 2015; Teixeira et al., 2020). Goat meat is typically limited to traditional utilization and is consumed as a dry-cured goat meat product; however, the utilization patterns and limitations are swiftly changing. Previous studies conducted in Mediterranean countries on processed goat meat products have reported interesting results regarding the acceptability of processed chevon meat (Leite et al., 2015; Teixeira et al., 2020).

Currently, meat processing is no longer exclusively for preservation purposes but mostly to satisfy consumer demand and the acceptability of products with traditional palatability and flavour characteristics (Teixeira et al., 2020). However, the gap in knowledge regarding consumer acceptability of goat meat is still existing, particularly in South Africa. Studies by Xazela et al. (2011) and Mdladla et al. (2017) confirmed that consumer acceptability of chevon meat is still less appreciated and acceptable as a healthy food for human well-being in the Southern Africa region, given the cultural beliefs and consumer preferences attached to it as food for the poor and mostly utilized for cultural rituals in South African rural communities (Mowa, 2018; Luthuli et al., 2019). Thus, the chevon remains underutilized and underconsumed. With the recent global consumer food preferences for the consumption of healthy foods, studies on the development of value-added goat meat products as a healthy meat option are necessary, with a focus on the needs of contemporary and future consumers.

Recent studies have reported that consumers demand traditional products that adapt and interface traditional methods with modern methods to improve palatability and acceptability

(Teixeira et al., 2020). The fact that consumers prefer convenience foods without compromising health cannot be denied, as long as the products suit consumer demands (Teixeira et al., 2020). Therefore, based on the sound nutritional background of Chevon and limitations on acceptability, a range of value-added product development could be the mode of improving consumer acceptability of Chevon. According to Dolojan (2015), innovation and technology pave the way for chevon retailing and serve as an option for current and future marketing systems.

1.2 Problem statement

Although global consumer trends reflect an increasing demand for healthier red meat alternatives, goat meat (chevon) remains significantly underutilized and poorly accepted by mainstream consumers, particularly in Northern KwaZulu-Natal, South Africa. This underutilization persists despite chevon's well-documented nutritional advantages, such as lower saturated fat and cholesterol content compared to other red meats like beef and pork. In rural South African communities, goats are the second most commonly reared livestock among small-scale farmers. However, their meat is predominantly consumed during traditional rituals or special occasions, often with minimal processing or value addition. This limited use is largely attributed to cultural beliefs, consumer misconceptions, and the lack of innovative product development, which collectively constrain the integration of goat meat into daily diets and formal markets.

The resulting gap between the health-driven demand for red meat alternatives and the low consumer acceptability of goat meat hinders its commercial viability and broader dietary adoption. Despite previous research highlighting its nutritional benefits, chevon remains largely unknown or undervalued in formal meat markets. Furthermore, value-added goat meat products have shown limited market success due to persistent issues of consumer perception and preference. This issue has critical implications for smallholder farmers, local economies, public health, and food security. Enhancing the acceptability and commercial utilization of goat meat through product innovation and value addition could significantly improve income for rural farmers, diversify consumer options, and promote healthier eating habits. Therefore, this study aims to determine the acceptability of convenient, value-added chevon products for both household and commercial use in Northern KwaZulu-Natal. The findings are expected to contribute toward practical strategies for product development, consumer education, and market

expansion, ultimately bridging the gap between consumer preferences and the potential of goat meat as a sustainable and nutritious red meat alternative.

1.3 Aim of the study

The general aim of this study was to investigate consumer acceptability of goat meat through the processing of value-added products for household and commercial utilization.

1.4 Specific Objectives

1.4.1 To conduct a market profiling of the Chevon products available in the retail market,

1.4.2 Document the traditional methods and recipes used to preserve and prepare chevons at the community level.

1.4.3 To develop three value-added chevon products (dried, cooked and processed) integrating traditional and modern processing technologies,

1.4.4 To assess the food quality characteristics (tenderness and colour) of value-added Chevon products, and

1.4.5 To assess consumer acceptability (aroma, tenderness, flavour, and aftertaste) of Chevon value-added products.

1.5 Research question

1.5.1 What is the profile of chevon products availability in the market?

1.5.2 How has goat meat traditionally been prepared, preserved, cooked, and utilized at the community level?

1.5.3 What methods or recipes have been used in the community for traditional goat meat consumption?

1.5.4 What is the food quality of the value-added chevon products?

1.5.5 What is the consumer acceptability of the value-added chevon products?

1.6 Study assumptions

It was assumed that all participants in various phases of the research would be available to participate in the study and be free to provide honest and unbiased responses during interview sessions and sensory evaluation.

1.7 Significance of the study

Considering the nature of this study, it should make a significant contribution to understanding consumers' perceptions of interfaced chevon consumption. Furthermore, it should encourage raising awareness and altering attitudes and perceptions regarding the nutritional and health benefits of goat meat consumption, not occasional meat. This study may provide a fundamental approach to optimizing the utilization of underexploited agricultural commodities (indigenous goats), whereby the effects of chevon value-addition and processing practices on the production of natural healthy foods for healthy consumption can be elucidated. Understanding how consumers prefer and respond to this innovative strategy could, therefore, enable goat farmers, processors, and policymakers to position themselves towards transforming goat meat consumption. Consequently, the integration of smallholder goat meat farming into food systems will be stimulated, while policies and strategies will be enacted to inform and advise product developers, particularly regarding natural, healthy, and nutritious goat meat products.

Moreover, current and future food and nutrition security needs could be enhanced through the provision of an alternative source of red meat (goat meat products) in a convenient form. Therefore, value-added Chevon products could present an optimal opportunity to increase the acceptability of Chevon meat for current and future consumers, thus ensuring its convenience and healthy consumption.

1.8 Limitations of the study

- The study was conducted in a local municipality in one province. Therefore, these results may not be generalizable.
- Sensory evaluation of developed products was limited to only goat meat consumers.

1.9 Definition of terms

Cabrito is a form of goat meat obtained from young animals between 1-6 months (Mazhangara et al., 2019).

Chevon – is a form of goat meat obtained from a two-year-old animal weighing 20–30 kg live weight (KOŞUM et al., 2019 cited Simelane et al., 2004).

Convenient products are fast, ready-to-eat, or ready-to-serve foods (Dolojan, 2015).

Functional foods are foods of natural origin that can be whole, fortified, enhanced, or enriched to provide benefits beyond basic nutrition while also lowering or minimizing the risk of certain diseases and health problems (Sahay et al., 2017).

Indigenous goats – goats that are predominantly found in a particular area and distinguished from other Indigenous breeds by appearance and productivity characteristics, Nguni goats in this case (Mdladla et al., 2017).

Indigenous knowledge refers to traditional and local knowledge systems that involve social, economic, and environmental variables that are unique to a particular culture or society (Ubisi, 2016).

Underutilized indigenous species are non-commodity animals that are part of a larger biodiversity portfolio that were once common but are now ignored by the users' community due to a variety of genetic, economic, social, and cultural factors. Goats and other wildlife species are examples of animals that are not part of an organized commodity market (Cawthorn and Hoffman, 2014).

Value addition refers to adding value, which implies improving the quality of raw produce; hence, consumer acceptability rises, and market demand provides better economic returns. It also serves as a means of transferring technology to the industry concerned (Dolojan, 2015).

Value-added products refer to the improvement in raw produce in terms of time, place, and form of commodity utility to meet consumers' tastes and preferences (Dolojan, 2015).

1.10 Structure of the thesis

The chapters of this dissertation are reported below:

Chapter 1: Introduction of the Problem and its Setting

This chapter introduces the research problem and provides a background for its contextualization. This highlights the significance of this study and outlines its key objective.

Chapter 2: Literature Review: This chapter explores the impact of consumer dynamics and innovation techniques on food consumption patterns and examines how these factors influence consumer behaviour and food intake.

Chapter 3: Methodology: This chapter details the study's methodological approach, including the conceptual model framework, study population, sampling methods, research design, and the research procedures followed throughout the study.

Chapter 4: Results and Discussion: This chapter presents and analyzes the types of products available in both formal and informal markets. It also explores participants' perceptions of goat meat consumption and its commercialization within these markets.

Chapter 5: Goat Meat Product Development and Quality Assessment: This chapter reports on the development of goat meat products, assessing the quality of value-added products in terms of microbial content, physicochemical properties (such as tenderness and colour), and sensory qualities.

Chapter 6: Consumer Acceptability and the Willingness to pay for innovative Goat meat Products, this chapter reports on sensory evaluation characteristics and consumer acceptability of goat meat value-added products, while also determining the consumer winningness to purchase these products.

Chapter 7: Conclusion and Recommendations: This final chapter provides a summary of the study's findings, offering general conclusions and recommendations for future research or practical applications.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter aims to evaluate the relevant literature in a broader overview of goat meat utilization and consumption at the global level, within the context of sustainable food systems for food and nutrition security. This chapter reviews goat meat as a sustainable food source that can be used as a standard red meat option according to households' dietary requirements and consumption trends globally, as well as in South Africa. This chapter synthesizes the related literature on the types of products derived from goat meat, consumption patterns, and preferences for consumer satisfaction and acceptability.

2.2 Food and Nutrition Security Status at global level

According to the 2021 Global Nutrition Report (GNR), few nations have been on track to reach global nutrition goals by 2050. This implies that a poor dietary lifestyle leading to malnutrition needs to be addressed sustainably to ensure the health status of all people across the world (Global Nutrition Report 2021). To minimize the double burden of malnutrition and meet global nutrition targets, long-term and better-coordinated nutrition efforts must extend far beyond the nutrition community (Global Nutrition Report 2021). It is therefore for this reason that the 2022 State of Food and Nutrition Security (FNS) in the World report advocates for the repurposing of agricultural policies to enhance the affordability of healthy diets. It further recommends that government stakeholders allocate resources to prioritize food consumption and incentivize sustainable production, supply, and consumption of nutritious foods (FAO, IFAD, UNICEF, WFP, and WHO 2022). However, little progress has been made towards achieving food security. The primary factors of current increases in food insecurity and malnutrition include conflict, climate extremes, economic slowdowns, downturns, and the high cost of healthy food. Furthermore, the COVID-19 pandemic has brought to light the fragilities of the world's agri-food systems, and when combined with socioeconomic imbalances, world hunger and severe food insecurity continue to rise. In 2021, between 702 and 828 million people globally suffered from hunger. From 2019 to 2020, the prevalence of malnutrition mounted from 8.0 to 9.3 percent; however, it has increased at a slower rate, reaching 9.8 percent by 2021 (FAO, IFAD, UNICEF, WFP, and WHO 2022). The prevalence of hunger continues to show wide discrepancies worldwide. In addition to Africa, increases were also noted in Asia (+1.1 percentage points), Latin America, and the Caribbean (+2.8 percentage points) (FAO, IFAD,

UNICEF, WFP, and WHO 2022). Clapp et al. (2022) presented a case for agency and sustainability to be explicitly recognized as components of food and nutrition security.

2.3 The South African Food and Nutrition Security Status

South Africa typically produces sufficient food and diverse food types. However, it faces a triple burden of malnutrition: undernutrition, micronutrient deficiencies, and overweight or obesity (FAO et al., 2022). While the country has developed food and nutrition security and approved agricultural policies, seven million South Africans experience chronic hunger, while 21 million people are overweight or obese (FAO et al., 2022). Major gains were made from 2002 to 2018, showing a downward trend, when 13.5 million people were food insecure (FAO et al. 2022). Although self-reported hunger has reduced drastically, the impact of COVID-19 has altered these numbers as the protracted nature of the pandemic has contributed to the slow recovery of the level of household and child hunger, as seen before the pandemic (van der Berg, Patel and Bridgman, 2022). According to the National Income Dynamics Study - Coronavirus Rapid Mobile Survey (NIDS-CRAM survey), 18% of households suffered moderate to severe hunger in 2020 (Bridgman, van der Berg, and Patel, 2020). Furthermore, a recent assessment by Govender et al. (2017) identified the availability and accessibility of nutrient-dense, varied, and balanced diets as important barriers to achieving food and nutrition security, as well as increasing human health and well-being.

A review of food and nutrition policies enacted in South Africa between 2002 and 2018 found that the majority of the policies were written without consulting important stakeholders who would benefit from the policies. Food Systems (FS) play an essential role in food and nutrition security; hence, any policy focused on addressing food and nutrition security must take a multifaceted approach to be effective. When comparing policies, the authors discovered some discrepancies, indicating the need to review and restructure these rules based on key stakeholders to minimize duplication and ensure clarity (Boatemaa, Drimie, and Pereira 2018). The Sustainable Development Goal (SDG 2) focuses not only on addressing hunger but also on nutrition and sustainable agriculture. Diversification of farming practices and crop and livestock selection is critical for addressing food security in Africa (Waha et al., 2018). Diet quality has been identified as a vital link between food and nutrition security; nonetheless, the majority of the population cannot afford good and nutritious diets (FAO, 2020). Proactive diversification techniques include specialized product markets and food supplies suitable for drought-prone locations (Waha et al. 2018). Various crops and livestock that can withstand harsh climatic conditions are considered viable coping methods (Ngcamu and Chari 2020).

2.4 Sustainable food systems for food and nutrition Security

For food systems to be sustainable, long-term food and nutrition security must be ensured in terms of food access and use. While agency and sustainability are recently added as essential factors to maintain long-term food and nutrition security (Clapp et al., 2022). All food system components must be efficient, robust, and sustainable (High-Level Panel of Experts 2020). The two primary paradigms in food systems are food security and food sustainability; nonetheless, they are commonly discussed separately in scientific literature. This disparity makes it impossible to have a coherent debate about sustainability transitions, which is important for solving the environmental, social, economic, and health challenges caused by conventional food systems (High-Level Panel of Experts 2020). The sustainable development approach is beyond the ability to provide healthy and environmentally sustainable diets, and there is increasing concern about the constant accessibility and utilization of healthy, nutritious, and sufficient food by all people, and at all times. However, the State of Food Security and Nutrition in the World (SOFI 2020) has reported that healthy diets are approximately five times more expensive than energy-sufficient diets and 60% more expensive than adequate nutrient diets (Turner et al., 2018). This demonstrates that current food production and consumption practices are not sustainable (Steenson and Butriss 2020). Some authors advocate the shift to plant-based foods to reduce global warming and its associated consequences (Aschemann-Witzel et al., 2021). Concerns have been raised regarding the nutritional sufficiency of plant-based food equivalents and the amount required to replace animal-sourced foods, particularly in terms of protein quality and micronutrients (iron, zinc, vitamin B12, and fatty acids) (Leroy & Cofnas 2020). Sustainable, low-input requirements and resilient alternatives to animal food sources, such as insects and seaweed, have been considered. However, acceptance of these alternatives is still in its infancy, and barriers (both cultural and social) must be fully explored and tested for consumer acceptance (Siddiqui et al., 2022).

2.5 Sustainable food production

Sustainable agricultural development is described as "agricultural development that contributes to improving resource efficiency, strengthening resilience, and securing social equity/responsibility of agriculture and food systems to ensure food and nutrition security for all, now and in the future" (Gitz, 2016). This concept demonstrates that agricultural development can only be considered sustainable if the significance of linking production and consumption is recognized (Bilali et al., 2019). Though the global population is expected to reach 10 billion by 2050, and this statistic represents an annual growth rate of roughly 1.07

percent (Worldometers 2019). This consequently indicates a strain on livestock production practices and products due to the rising population in sub-Saharan Africa (SSA) and the need to feed a growing population (Assan 2021). Thus, the food supply must be adequate to meet the needs of the rising population; however, agriculture and livestock production have major environmental effects. This has sparked debate regarding all aspects that link the concepts of food safety and sustainability, not just food alternatives (Fasolin et al. 2019).

2.6 Goat meat as an animal-based source of food (ASF)

Goats (*Capra hircus*) are believed to be the second most domesticated mammals, following dogs. It is also thought that the first goats arrived in Egypt at approximately 5000 B.C. and expanded south and west across Africa (Pereira & Amorim, 2010). Sub-Saharan Africa and Asia account for over 89% of the global goat population of approximately one billion (FAOSTAT, 2019). Of the world's goat population, 33% is found in Africa. This accounts for one of the reasons why the consumption of goat meat is also very high in this region. However, the consumption of goat meat in other regions of the world has increased dramatically recently because of its distinct nutritional attributes compared to other red meats (Mazhangara et al., 2019). Unfortunately, the phenomenon of increased meat consumption has not received much attention in South Africa. Although much emphasis is placed on rural communities of the African region, where goats are considered the most important source of highly nutritious red meat (Webb, 2014; Khumalo, 2017; Mowa, 2018; Luthuli et al., 2019). African goats are divided into three families: dwarf goats in West and Central Africa, Savannah goats in Sub-Saharan Africa, and Nubian-type goats in North Africa (Yami and Merkel 2008). A survey conducted by the Department of Agriculture and Forestry (2015) on South African goat breeds reported the existence of indigenous breeds, meat breeds, and dairy breeds. Images of the goat breeds are shown in Figure 2.1.

Indigenous goat breeds		
		
a) Nguni/Mbuzi	b) Cape lop-ear	c) Kunene goat
Meat production breeds		
		
d) Boer goat	e) Kalahari goat	f) Savanna goat
Dairy goat breeds		**Mohair goat breed**
		
g) Saanen goat	h) Toggenburg goat	j) Angora goat

Figure 2.1: Goat breeds in South Africa (Department of Agriculture and Forestry, 2018)

Indigenous breeds (Nguni/Mbuzi, Cape lob, and Kunene) have been naturally chosen for adaptation to severe settings and are largely utilized for meat production; however, they are also culturally significant (Figure 2.1). In South Africa, breeds bred primarily for meat production include Boer, Savanna, and Kalahari Red goats (Figure 2.1) (Department of Agriculture and Rural Development et al., 2018). Dairy breeds are all imported, with the majority being Saanen and Toggenburg goats, as well as the less popular Savanna goats, which are used to produce milk and processed milk products, such as cheese and yoghurt. These breeds are susceptible to various illnesses and parasites. In South Africa, Angora goats are raised to produce mohairs (Department of Agriculture and Rural Development et al. 2018).

2.6.1 Gat meat from various breeds

Goat meat is increasingly being recognized for its nutritional benefits and culinary versatility. Different goat breeds have been specifically developed for meat production, each offering unique characteristics that influence their suitability for various farming conditions and consumer preferences. Below are some of the most notable meat goat breeds. Therefore, choosing the right goat breed is crucial to maximising the productivity and profitability of meat production. Each breed offers distinct advantages based on growth rate, meat quality, and adaptability to different farming conditions. Therefore, as consumer demand for goat meat continues to rise, it is important to understand these traits to help farmers and/or consumers select the most suitable breeds for their operations. A comparison of the goat breeds in South Africa is presented in Table 2.1.

Table 2.1: Goat breeds in South Africa and Comparison of their Key Individuals

Type of breeds	Characteristics	Advantages	Meat quality	References
1. Meat goats:				
• Boer goats • Savanna goats • Kalahari goats	Known for rapid growth rates, High meat-to-bone ratios. Muscular built with minimal fat,	Excellent carcass quality, Yield over 50% of their body weight in meat. Easier to handle, due to docile nature.	Lean, Flavourful, Suitable for health-conscious consumers.	Gawat et al., 2023
	Medium to large body frame, Drought-resistant breed, Produce lean carcasses with good muscle conformation, Adaptable to both intensive and extensive grazing systems.	Thrive in harsh conditions, an asset for arid regions	Learn	Vincent, B (2018)
	Large and long deep bodies, thrive in arid and semi-arid climates, are Resilient to extreme temperatures, and are suitable for harsh environments.	Efficient meat production capabilities, low maintenance requirement, faster growth weight than any other goat breed, strong maternal instincts, suitable for both commercial farming and small-scale operations.	High-quality meat, tender, and flavourful	Casey & Webb (2010)
• Nguni goats	The less structured goat type, ess meat production, and high bone	Adaptable to harsh conditions, thrives in arid	Produces tough meat, lean, distinctive flavour	Pophiwa et al. (2017)

• Cape lop-ear, • Kunene goat	content are attributed to poor muscling.	and semi-arid climates, with potential for goat meat production.		
2. Dairy breeds				
• Sannen goats • Toggenburg goats	Comprise a large portion of the goat meat market.	Large body sizes suitable for meat production can have multiple births.	Goat meat from dairy goats is from culled goats (5–6 years) Produces tough meat, discriminated meat by consumers.	Vincent, B. 2018. Scholtens et al. (2017) Purslow (2017)

2.6.2 Goat meat as a Sustainable Red Meat Option

Goat meat is increasingly being recognized as a sustainable red meat option, offering various environmental and nutritional benefits compared to traditional meats, such as beef and lamb (van der Weele et al., 2019; Mazhangara et al., 2019). Goats are found to positively contribute to environmental sustainability in various ways, and in terms of environmental impact, they are found to be:

a) Resource efficiency

Goats are resource-efficient owing to fewer resource requirements. Goat farming requires less land and water than cattle farming does. Producing one kilogram of goat meat requires approximately 4,000 litres of water, which is significantly lower than beef (14,800 litres) and even less than lamb (6,000 litres) (Sierra, 2022). Goats are browsers rather than grazers, allowing them to consume brushes and weeds, which helps restore pasture quality and prevent soil erosion (Triple Pundit, 2011; Mazhangara et al., 2019).

b) Soil Health

Goats are healthy soil-keepers when properly managed. Goats improve soil health by promoting nutrient cycling, through their waste product which nourishes the soil. Their grazing habits help improve soil quality, which can enhance carbon storage (Sierra, 2022). Therefore, these characteristic positions are beneficial for sustainable land management.

c) Lower Carbon Footprint

Goats have a lower carbon footprint and are a potential for greenhouse gas; therefore, their overall carbon dioxide emissions are low per kilogram of meat compared to cows. Goats produce roughly 23.8 kg of carbon dioxide (CO2) per kg of meat, whereas cows produce approximately 46.2 kg (Sierra, 2022). Therefore, goat meat is a more climate-friendly choice for ruminants.

In terms of nutritional benefits, goats are found to be:

a) Healthier Meat Options

This is because goats are notably leaner than other red meats, with only approximately 3% fat content, making it a healthier alternative for those concerned about fat intake (Mazhangara et al., 2019). It also has lower cholesterol levels than beef, pork, and lamb (Yalcintan et al., 2018; Gawat et al., 2023).

b) Rich in Nutrients

Goat meat is rich in essential nutrients, such as iron, potassium, and vitamin B12. Its low-fat content, combined with high protein levels, makes it an excellent choice for a balanced diet (Mazhangara et al., 2019).

c) Digestibility:

Although goat meat is known to be a source of lean and tough meat, the processes applied to enhance goat meat acceptability indicate that goat meat is digestible. However, they may not meet the digestibility standards of the leading meat types in the market, such as poultry, pork, lamb, and beef (Mazhangara et al., 2020). Goat meat toughness can be attributed to the combination of high pH, high collagen content, and low-fat content. Goat milk is also highly regarded for its nutritional profile; however, it is easier to digest than cow milk and contains more calcium and vitamins (Vincent, 2018).

2.6.3 Goat Meat Production and Marketing in the Context of Developed and under-developed Nations

Goat meat stands out as a sustainable red meat option because of its low environmental impact, nutritional advantages, and potential for market growth. However, it still needs to be established as a valuable player in the red meat marketing industry and export marketing. As awareness of these benefits increases, goat meat could play a significant role in sustainable dietary practices. However, researchers still affirm that, despite the health and nutritional benefits of goat meat consumption, it remains low in countries like South Africa compared to global trends, where it is the most consumed red meat (Leite et al., 2015; Mazhangara et al., 2019; Teixeira et al., 2020; Gawat et al., 2023).

Goat meat is traded chilled in global markets, mostly from adult goats. It is mainly produced in developing regions, such as Asia and Africa, with less-organized farming systems. However, these regions have a low contribution to goat meat exports, as goat meat production is mainly for domestic consumption (Dubeuf et al., 2004; Mazhangara et al., 2019; FAOSTAT, 2023). Goat meat is considered exotic in developed countries, primarily consumed by migrants, and not extensively farmed (Skapetas et al., 2016). It is also the preferred meat in Muslim countries and is influenced by religious beliefs. The top destinations for goat meat exports next to the United States of America (U.S.A.) are developed Muslim countries, such as the United Arab Emirates, Saudi Arabia, and Qatar. The evidence is presented in Table 2.2 according to Gawat

et al. (2023). India, China, Pakistan, and Bangladesh are also major goat meat importers (Nguyen et al., 2023; National Agricultural Marketing Council – NAMC, 2024).

Table 2.2: The top goat meat (fresh or chilled) importing countries in the past 10 years (2011-2021)

Country	Average Value (Tonnes)	Total Volume (%)
United States of America (U.S.A.)	17,387.13	28
United Arab Emirates (U.A.E.)	13,163.40	21
China	5630.54	9
Saudi Arabia	3652.07	6
Qatar	3343.52	5
China, Taiwan Province	3261.14	5
Oman	2707.72	4
Canada	1750.69	3
Portugal	1489.11	2
China, Hong Kong S.A.R.	1439.02	2
Other countries	8553.72	14

Source: (Gawat et al., 2023)

South Africa's goat population has been increasing due to rising health consciousness and cultural shifts towards ethnic foods (Mazhangara et al., 2019; Gawat et al., 2023). South Africa has a significant population of goats and goat meat, which play an essential role in the country's livestock sector and local cuisine. Goats are bred for meat production in various regions of South Africa, including commercial farms and smallholder farms (NAMC, 2024). NAMC (2024), further alluded that market demand, cultural preferences, and economic considerations are all factors that influence goat meat production in South Africa. However, data on the volume of goat meat produced in Brazil are limited. Goats are commonly reared without a specific product goal and with less exposure, knowledge, and understanding of the possible value-added goat meat products of different forms that could be developed and consumed from conventional goat meat. The demand for goat meat in South Africa has fluctuated over the years and is influenced by factors such as consumer preferences, pricing, and availability. There has been an increasing interest in goat meat among urban consumers, driven by the desire for more diverse culinary experiences and the perceived health benefits of lean meat; for example, Gauteng has a great demand for goat meat “due to its diverse cultural community’ (NAMC, 2024).

In terms of goat meat export, Australia has consistently dominated the global goat meat export market, accounting for approximately 44% of total exports over the past decade. Ethiopia is the second-largest exporter, with a 22% share, while Kenya holds approximately 7%. European countries, such as France and Spain, along with Pakistan, also contribute significantly to export figures (Gawat et al., 2023). The top goat meat (fresh or chilled) exporting countries in the past 10 years (2011–2021) are depicted in **Table 2.3.**

Table 2.3: The top goat meat (fresh or chilled) exporting countries in the past 10 years (2011-2021)

Country	Average Value (Tonnes)	Total Volume (%)
Australia	26,818.61	44
Ethiopia	13,797.09	22
Kenya	4143.68	7
France	2459.98	4
Pakistan	2416.82	4
China	2212.84	4
China, mainland	2160.47	4
Spain	2056.20	3
New Zealand	1183.23	2
Jordan	884.40	1
Other countries	3424.81	6

Source, (Gawat et al., 2023; FOSTAT, 2023)

The primary markets for goat meat exports include regions with high demand due to culinary traditions and cultural preferences, particularly in Muslim-majority countries and areas with significant immigrant populations from goat-eating cultures. The United States is a major importer alongside countries such as the United Arab Emirates and China (Gawar et al., 2023, Department of Agriculture, Fisheries and Forestry – Australian Government, 2023).

These data reflect a growing global interest in goat meat as an alternative protein source, influenced by dietary trends and shifts in consumer preference (DE Andrade et al., 2017; Mazhangara et al., 2019).

2.6.4 Goat meat structures and value chain systems in South Africa (SA)

Most goats marketed in South Africa are sold and purchased in the informal market through private transactions. Therefore, the informal market drives the South African goat industry. According to Mogala (2018), the South African goat industry is mostly driven by the informal market that sells and buys the majority of goats in the country through individual transactions.

In 2004, a private company in the Western Cape launched a marketing campaign to raise awareness of the chevon and its benefits. Since then, goat meat has only been available in a few formal stores, as only a small percentage of goats is slaughtered at registered abattoirs that meet retail store standards. Goat meat is now available in several supermarkets in South Africa, making it more accessible to average consumers. Strategies such as these are crucial in boosting awareness, acceptance, and ultimately, the intake of chevon. In rural communities, goats are perceived as financially stable rather than a saleable product. Therefore, a shift in thinking is needed before goats can be viewed as commercial enterprises in rural communities (Mogala 2018).

The nature of goat meat contributes to a growing desire for a lean and nutritious meat source. In South Africa, the benefits of goat meat are overshadowed by misunderstandings about its sensory characteristics, which influence its consumption and general acceptance (Pophiwa, Webb, & Frylinck 2017). In South Africa, the goat meat business is dominated by the popular Boer goat (an enhanced breed well-known for meat production) and other unimproved local breeds, known as indigenous variations. Local Indigenous goats are noted for their geographical position and resilience to extreme environmental circumstances (Pophiwa et al.,2020).

Goats are typically butchered in traditional events. As a result, the collection, slaughtering, and preparation processes are unique to the ritual or ceremonial rituals (Mogala 2012; Soji and Muchenje 2017). Even though South Africa has a well-developed animal product processing industry, goat meat is rarely processed, only when the price of mutton is prohibitively high (Mogala 2012). Misconceptions or strong beliefs about goat meat include that it is only used for rituals, goats are pets and should not be eaten, and other animals such as beef and mutton are tastier, while goat meat has an awful odour (Mogala 2018). Therefore, awareness programs, including live tasting sessions, are necessary to promote the consumption of goat meat as a low-fat, nutritional meat source.

2.7 Nutritional Composition of Goat meat

The nutritional composition of goat meat has been reviewed by several authors. Goat meat consumption for beef and pork has recently increased because of its unique flavour, lean meat, and universal socio-religious acceptability (Umaraw et al., 2015). The nutritional value of Oat meat is considered a good source of protein and has lower fat, cholesterol, and saturated fatty acid content than other red meats. It is also high in potassium and low in sodium, making it a

healthy choice for people with heart, kidney, or hypertension disease (Mazhangara et al., 2019). Mazhangara et al. (2019), reported that the global consumption of goat meat increased largely because of the distinct nutritional attributes that determine goat meat meeting the consumers' expectations for healthy foods, leading to growing popularity and demand. The rise in popularity and demand for chevons is critical for meeting the growing demand for animal-derived protein sources for human consumption, which is driven by urbanization, rising affluence, and the desire for a better lifestyle.

Despite chevon being established as lean red meat with low content of fat, cholesterol, and saturated fatty acids, there are misconceptions among some consumers regarding the perceived inferior quality of chevon compared to beef, pork, and lamb (Mazhangara et al., 2019). However, goat meat consumption for human daily foods is still in its infancy compared to other red meats available in the market. Irrespective of the incredible nutritional profile of goat meat, as described previously (Umaraw et al., 2015; Ivanović et al., 2016; and Mazhangara et al., 2019).

2.8 Goat Meat Consumption

The consumption of goat meat depends on consumer demographics, where factors such as religion, nationality, heritage, region, and gross income play important roles (Sans and Combris, 2015). The major consumers of goat meat are Hispanics, Muslims, and the Caribbean (Meat and Livestock Australia (MLA), 2020). Countries such as Northern Europe, Turkey, South America, Northern Brazil, Asia, and Southern Africa, with a long tradition of goat meat consumption, have also shown a steady increase in the consumption of goat meat and forms of goat meat products (Teixeira et al., 2020). Goat meat is typically limited to traditional utilization and is consumed as a dry-cured goat meat product, but the dynamics of consumption and utilization patterns are changing (Leite et al., 2015; Teixeira et al., 2020). However, this is not the case in South Africa. There is a concern about preparation methods that have been reported as monotonous (Mdladla et al., 2017) and unpleasant presented (Khumalo, 2017; Manowa, 2018), given the cultural beliefs and preparation preferences attached to them as food for cultural or ritual performances.

Animal age is another important determinant of the meat quality and consumer acceptability of goat meat (Abhijith et al., 2023). The traditional perception that goat meat is associated with off-smells, off-flavours, unappealing colours, and perceived toughness is one reason for the low preference for goat meat, despite the health benefits of goat meat recognized by consumers

from other demographics (Mazhangara et al., 2019; Mandolesi et al., 2020). Thus, consumer perceptions of goat meat are reported to be a major driving factor for lower acceptability (Luning and Marcelis, 2015). Therefore, this study aimed to determine the intrinsic qualities of value-added goat meat products in the form of tenderness, colour, and sensory qualities, as previously most criticized chevon characteristics.

Additionally, these reports indicate that a lack of innovation and convenience in food product development that meets consumer demands and preferences could lead to the rejection of highly profiled indigenous animal foods. However, the food value chain faces significant challenges for the next century, as food producers must adapt to the evolving demands of consumers while ensuring their profitability. This adaptation involves navigating through several key consumer trends and expectations. Therefore, the food value chain must evolve in response to the sophisticated consumer demands for health, transparency, sustainability, convenience, and flavour diversity. By aligning production practices with these trends, food producers can satisfy consumer needs, while ensuring their economic viability in an increasingly competitive market (Panni Management, 2021). Current consumer trends look for convenient food, easy–to–-prepare, and cater to "grab and go," while not compromising the quality of food.

2.8.1 Goat meat types available in the market

Goat meat, commonly known as chevon by scholars from an academic perspective, is product descriptive. Chevon is a popular term used worldwide to describe goat meat as meat from adult or mature goats. Hence, export and domestic markets classify goat meat in terms of age and weight into two types: *capretto/cabrito* and chevon (Nguyen et al., 2023; Abhijith et al., 2023). The two primary varieties of goat meat available in the market are *cabrito or capretto,* and goat meat from lactated animals is popular in various European regions. Cabrito meat is a significant goat meat product in Portugal, as part of the country's culinary tradition, and is popular in the Mediterranean lifestyle (Teixeira et al., 2011). Together with lamb, goat meat is a popular source of meat for traditional Mediterranean dishes, which typically use lean meat - capretto is the term used in Italy, France, many parts of Latin America, and the Caribbean (Vincent, B. 2018; Borgogno et al., 2015). The distinct flavour and texture of the younger animal make it a premium goat meat product, and its light carcass makes it ideal for consumption entirely by a family on significant occasions.

Chevon is a common meat traded for export and consumed in various developing countries. However, developed countries are the dominant market for goat meat products. While developing countries are exposed to frozen or chilled meat, most are older or mature goats. Processed goat meat products have the potential to become major earners in foreign exchange for developing countries (Nguyen et al., 2023; National Agricultural Marketing Council (NAMC), 2024). Chevon is a popular meat choice in India (Vincent, 2018; Nguyen et al., 2023). In European countries, most of this meat is used in processed products, which makes it more appealing to a wider range of consumers. Hence, the market structure for goat meat in developing countries remains underdeveloped in these regions, with most goat products being imported rather than produced domestically (Nguyen et al., 2023; NAMC, 2024). Chevons are often discriminated against capretto/cabrito because fresh suckling kid meat is regarded to have higher edible quality (Abhijith et al., 2023; Nguyen et al., 2023). Moreover, chevon is a tough meat characterized by its beautiful aroma/sweaty aroma" (Mazhangara et al., 2019; Teixeira et al., 2020), a flavour that resembles that of mutton or lamb (Teixeira et al., 2011).

2.8.2 The future of the goat meat market

Madruga and Bressan (2011) proposed that despite the strong growth potential of the goat meat market, efforts should be directed toward quality assurance and uniformity, data collection on consumer preferences, and determining the type of meat products and processing methods that should be used to promote consumption. Unlike other regularly consumed meats, goat meat is consumed locally within developing country populations rather than being widely exported. The market structure for goat meat is underdeveloped, limiting its consumption (Skapetas and Bampidis 2016). Production strategies and meat processing can increase the value and acceptance of goat meat (Font-i-Furnols and Guerrero, 2014). When designing innovative food products based on meat, special considerations are required because the composition of goat meat influences modifications that can be made to fulfil consumer preferences (Hathwar et al. 2012).

McMillin and Brook (2005) anticipated that the value and visibility of goat meat in consumer markets could be enhanced by increasing goat meat availability and creating easy goat meat products. Hathwar et al. (2012) proposed ways to change the nutritional and functional properties of goat meat, such as reducing fat content, modifying fatty acid and cholesterol levels, adding natural antioxidants, limiting sodium chloride content, and using probiotics, as in fermented meat. While goat meat is not as widely available in retail stores as beef and

mutton, goat milk products such as cheese and yoghurt are available in the retail market. Goat milk is becoming increasingly popular, particularly because it is known to contain health-benefiting substances (has a lower risk of allergies and is easier to digest than bovine milk) (Verruck, Dantas, and Prudencio 2019; Idamokoro et al. 2019).

2.9 The overview of goat meat value-addition and processing

Chevon has gained significant attention owing to its nutritional benefits and growing market demand, particularly among ethnic groups. The value addition and processing of chevon involve several practices aimed at enhancing its marketability and consumer appeal. Value addition, according to Dolojan (2015), refers to adding value, which implies an improvement in the quality of the raw produce; hence, consumer acceptability rises, and market demand provides better economic returns in that way. It also serves as a means of transferring technology to the industry. The value addition and processing of goat meat vary significantly between developed and underdeveloped countries and are influenced by factors such as market demand, production systems, and technological advancements. Value addition in goat meat refers to the process of transforming raw goat meat into processed or value-added products that offer additional benefits, convenience, or appeal to consumers (Gawat et al., 2024). The development of value-added chevon products involves the use of processing techniques to transform goat meat into convenient, ready-to-eat, and innovative products.

Researchers have explored various methods to add value to goat meat, including smoking, curing, fermentation, and incorporation into processed products. Smoking and curing have been found to improve the flavour, texture, and shelf life of goat meat products. Fermentation techniques, such as sausage production, have also been investigated to enhance sensory properties and extend the shelf life of goat meat products. Moreover, incorporating goat meat into processed products, such as burgers, sausages, and meatballs, has shown the potential to appeal to a wider consumer base accustomed to these familiar food formats. However, the limited effort in the South African context in terms of goat meat consumption is the consumer's unfamiliarity with diverse and modernized preparations and cooking/processing techniques applicable to goat meat that could improve goat meat quality for consumer acceptability as a sustainable solution for human protein dietary requirements. Challenges also exist in terms of,

Quality Control: Despite the potential for value addition through processing, many regions face challenges related to maintaining consistent product quality. Factors, such as transportation

methods and processing facilities, significantly impact the quality of the final product's quality2.

Competition with Imports: Lower-priced imported frozen goat meat poses a challenge for local producers, particularly among lower-income consumers who may prioritize cost over quality12.

However, the value addition and processing of goat meat present numerous opportunities to enhance its market presence. By focusing on improved production practices, effective processing techniques, and understanding market dynamics, stakeholders can position goat meat as a competitive product in both local and international markets.

2.9.1 Value Addition of Goat Meat in Developed Countries

The goat meat processing sector is highly advanced in developed nations. Approximately 60% of total meat is processed into value-added products including sausages, patties, and ready-to-cook meals (Teixeira et al., 2020; Gawat et al., 2023). This high level of processing is facilitated by the following:

a) **Technological Advancements:** This is supported by automated processing equipment that enhances efficiency and product consistency.
b) **Consumer Demand:** There growing preference for convenience foods, leading to increased production of processed meat products.
c) **Regulatory Frameworks*:*** Strict quality control and food safety regulations that ensure high standards for meat processing.

Countries like Australia dominate the global goat meat export market, accounting for approximately 44% of total exports, reflecting their advanced processing capabilities and established supply chains. Value-added products can command higher prices, increase market opportunities, and enhance the overall utilization of goat meat (Gawat et al., 2023). Some examples of value addition in goat meat include sausages and burgers (ground goat meat seasoned, mixed with ingredients such as herbs, spices, and vegetables, and formed into sausages or burgers), marinated or flavoured cuts (marketed as ready-to-cook options), smoked and cured goat meat, ready-to-cook meal solutions, dried and jerky products, deli and cold cuts, speciality ethnic products such as goat meat-based curries, stews, traditional dishes, bone broth, and stocks (Teixeira et al., 2019; Teixeira et al., 2020, Abhijith et al., 2023; Nguyen et al., 2023). The value addition of goat meat not only increases its marketability, but also allows for better utilization of the entire animal, reducing waste, and maximizing profitability.

Therefore, diverse consumption of convenient and appealing goat meat products must be developed, and the industry can expand consumer acceptance and drive increased consumption.

2.9.2 Value Addition in Developing Countries

Conversely, in underdeveloped countries, goat meat processing remains limited, with only approximately 2% of the total meat being processed into value-added products (Skapetas and Bampidis 2016; Abhijith et al., 2023). Key characteristics, according to Nguyen et al. (2023), include the following:

a) **Small-Scale Production:** Most goat farming occurs on small-scale farms with informal marketing channels dominating the market. For instance, in Vietnam, more than 73% of goats are raised by smallholders, who primarily rely on local markets.

b) **Informal Processing Methods:** Many producers use traditional methods for processing goat meat, which often lack the efficiency and hygiene standards seen in developed countries.

c) **Limited Market Research*:*** There scarcity of data on goat production and marketing systems, leading to inconsistent supply and pricing challenges.

Goat meat utilization and acceptability for human dietary needs at the household (H/H) and commercial levels could be improved, irrespective of development or underdevelopment. A positive consumer attitude towards the use of natural and beneficial foods created an opportunity for improved meat-processing techniques that could shape the future of the meat industry and public health. Additionally, knowledge of consumers' perceptions of healthier products requires the inclusion of consumption contexts as well as product quality attributes. Therefore, the way the product is consumed is important as it can lead to different results (DE Andrade et al., 2017).

2.10 Food products development

The success of novel meat products requires coordinated efforts and relationships among numerous factors that could positively or negatively impact the acceptability of the proposed innovative strategy. Hence, without coordination between independent and dependent variables over a certain food product, consumers are less likely to accept innovative products regardless of their beauty. There is a possible place for apparently 'healthier' processed meat products to benefit both the public and the meat business, but only if customers embrace these goods. As a result, consumer experiences, attitudes, sensory evaluation, expectations, and cultures determine product acceptability, irrespective of food quality as a dependent variable.

Moreover, the level and type of information one has about a product could be influenced by product acceptability. Therefore, in terms of consumer acceptability and quality of food products, various factors influence consumer acceptability and food preferences based on consumer food perceptions (Font-i-Furnols and Guerrero, 2014).

The Lexicon Committee of the American Meat Science Association (AMSA) divides meat food product development into two broad categories based on the level of preparation required: minimal processing and additional processing (Seman et al., 2018; Carr, Scheffler, and Johnson 2017). The categorization "raw, nonintact with added ingredients" falls under the 'further processing' category and applies to products such as sausages and burger patties. This category includes meat products that have not been cured or heat-treated (Seman et al., 2018; Carr, Scheffler, and Johnson 2017). According to Purslow (2014), meat quality is a set of intrinsic and extrinsic characteristics related to a consumer's perception or expectation during purchasing, consumption, and processing. According to Abhijith et al. (2023), one of the critical issues facing the goat meat industry is the lack of consistency in meat quality and standardized slaughter weight and age. However, meat quality is a crucial factor because it impacts consumer acceptance and sustained interest in the product.

Many researchers are concerned about the texture, colour, and flavour as major challenging quality determinants in goat meat (Teixeira et al., 2020; Abhijith et al., 2023; Gawat et al., 2023). Meat quality is a complex of numerous factors that interact to affect the ultimate quality of meat, from conception to consumption (Casey & Webb, 2010). In this regard, the Meat Standards of Australia (MSA), in support of the Meat and Livestock Australia (MLA, 2022), considers the production, pre-slaughter, processing, and value-adding aspects of the supply chain, which are conducted through large-scale sensory panel tests using untrained consumers as key elements for maintaining excellent product eating quality.

Consequently, characteristics such as texture, flavour, and aroma are attributes that can be sensed during consumption, while the combination of meat cuts and cooking methods is a critical factor in optimizing goat meat-eating quality. Notwithstanding, tenderness and colour are some factors that determine the quality of meat, although colour usually attracts buyers. Notably, meat has physical and chemical components such as meat colour, sarcomere length, WBSF, MFL, WHC, drip loss, and meat composition (moisture, protein content, and fat content) (Muchenje et al., 2009). However, all these attributes contribute to product quality, which is the main determining factor for consumers' attractiveness and preference, irrespective

of the nutritional composition. Thus, physical product quality is important for the acceptability of the developed goat meat products.

2.10.1 Components of meat quality

2.10.1.1 Tenderness

Tenderness is a crucial component of meat that ensures consumer satisfaction. The primary factors affecting meat tenderness are breed, age, nutrition, muscle type, and cooking methods. A study by Simela et al. (2008) on the sensory acceptability of goat meat products prepared from South African Indigenous goats indicated that goat meat is acceptable to consumers provided products prepared from a two-year-old goat or younger. Physical quality analysis of goat meat products can be performed using instrumental devices, such as texture profile analysis (TPA) and Werner–Bratzler shear force (WBSF), or with trained taste panels or untrained consumer panels. The instrumental measurement of tenderness is expressed in peak shear force (PSF) in N or Kg; the higher the shear force values, the tougher the meat. Although there is a high correlation when using shear force to describe the toughness of meat, direct comparisons between reported values in the literature are difficult due to the differences in the methods used. For example, meat cuts from the forequarter, such as the neck and foreshank, are high in collagen and connective tissue. Therefore, it is partially broken down through casserole (wet) cooking methods, using low heat and moisture over some time. However, for tender cuts, such as loins, grilling is recommended.

Therefore, selecting an appropriate cooking method to optimize the eating quality of known toughness cuts (MLA 2019), also rating the meat-eating quality requires extensive experimentation to identify the ideal combination of conditions (age, sex, weight, fat depth, and intramuscular fat, to name a few) that yield goat meat acceptable quality. Hence, the MSA grading system is a quality assurance system that has proven capability to manage and predict beef and sheep meat palatability, not only in Australia but also in other countries (Bonny et al. 2018). Currently, there is no specific grading system for goat meat, but it is graded using Lamb and Mutton metrics.

2.10.1.2 Meat Colour

Meat Colour is the most important physical characteristic of meat that consumers use to assess the quality of meat at retail stores, determining the consumer's response, purchasing decisions, and perception of meat quality (Mowa, 2018). The characteristic Colour of meat is a function

of its pigment content and light-scattering properties. Colour is determined by the amount of myoglobin, protein pigment present in the muscle, which contributes about 80-90% of the pigment (Aberle et al., 2012). Myoglobin (Mb) is a heme protein (containing iron) that is primarily responsible for the Colour of meat (Khumalo, 2017). The heme ring contains iron (Fe), which can exist in a reduced (ferrous) or oxidized state (ferric). The Colour of meat is defined by the concentration of the iron-based pigment myoglobin and the proportions of its three forms, oxymyoglobin, deoxymyoglobin, and metmyoglobin (Muchenje et al., 2009a), each conferring a different Colour to the meat (Braun, 2010; Borgogno et al., 2015). These three forms of myoglobin are formed by oxygenation, reduction, and oxidation. Decreased myoglobin (deoxymyoglobin (Mb), which is the purple Colour of profound muscle resulting from a combination of ferrous heme iron (Fe^{2+}) and known from meat under vacuum; oxygenated myoglobin (oxymyoglobin (MbO_2)), which is bright cherry red commonly referred as "bloom" and considered to imply new meat by the consumer; and oxidized myoglobin (metmyoglobin), which is grey-brown (Rosenvold & Anderson, 2003; Mancini, 2013). DisColouration results from the oxidation of ferrous myoglobin derivatives to ferric iron ($Fe^{2+} \rightarrow Fe^{3+}$).

According to Borgogno et al. (2015), the great differences in Colour shades, intensity, and stability of meat of different origins are due to the complex synergism of intrinsic factors (species, breed, age, sex, and muscle type) and extrinsic conditions (such as diet, housing system, environmental conditions, and slaughter conditions). The diet of animals can also influence the muscle concentration of myoglobin, which is most readily observed in veal meat (Faustman & Suman, 2017). According to Mancini (2013), animal diets can affect metabolism, glycogen storage, pH chilling rate, and antioxidant accumulation, all of which play a role in meat Colour. Goat meat tends to be darker than other red meats (Teixeira et al., 2020; Paphuwaet al., 2017), which can be explained by the high pH of goat meat and low IMF. The effect of genotype on the Colour properties of goat meat remains debatable.

2.10.1.3 Cooking/ processing quality

The method of cooking meat and end-point temperature play a critical role in the eating quality of goat meat (Xazela et al. 2011; Liu et al. 2013; Oz et al. 2017). Moist and slow cooking methods, such as roasting, braising, and moist cooking, are usually preferred for cubed goat meat from older goats (MLA 2020). Goat meat can be prepared in various ways depending on the country and region where it is consumed. However, there is general agreement that a lower

level of intramuscular fat is responsible for the low juiciness and tenderness of goat meat (Adeyemi et al. 2015). Thus, fast cooking methods, such as grilling or pan-frying, used for sheep or lamb meat are inappropriate for goat meat. Goat meat usually requires long and slow cooking at a lower temperature than fast cooking methods, such as grilling, to prevent it from becoming dry and tough (Jenkinson 2017). Low-temperature, long-term sous-vide cooking is an innovative approach that provides better control of the degree of doneness, tenderness, and Colour than traditional cooking methods (Ismail et al., 2019). Goat meat requires careful seasoning with spices such as onions, garlic, black pepper, chilli powder, paprika, and cumin to balance the flavour of the meat (Putra et al., 2017). According to Abhijith et al. (2023), cooking methods, such as slow and moist cooking, are advocated to promote and enhance the eating experience of goat meat, especially for non-ethnic consumers. In addition, promoting sous-vide cooking provides the opportunity to provide consumers with juicier, tender, and more flavourful meat than dry and tough meat regularly cooked using faster methods.

2.10.1.4 Flavour/aroma of the Meat

Meat flavour is a fundamental sensory characteristic of meat that influences eating quality and, thus, consumer acceptance (Arshad et al. 2018). In goats and sheep, flavour and aroma are complex attributes that can be affected by breed and diet (Ivanovi´c et al. 2020). Goat meat possesses a unique flavour and aroma, and these attributes are influenced by age, subcutaneous fat thickness, sex (Maganga 2015; Ivanovic et al., 2016; Yesufu, 2017), and the method of meat preparation and cooking methods (Liu et al., 2013; Teixeira et al., 2020). Previous studies have shown that goat meat flavour is either rated as acceptable (Teixeira et al., 2020) or less desirable (Teixeira et al., 2021) than lamb or mutton, depending on the familiarity of the consumers and their ethnicity.

Goat meat is commonly consumed from animals less than 9 months of age, as the flavour of meat can be better perceived in young animals, while older animals often represent an undesirable characteristic for consumers (Teixeira et al., 2021). Therefore, it is important to understand the factors that influence goat meat flavour to help producers develop management strategies. Goat meat according to Mandolesi et al. (2020), has strong qualities of ‘gamier,’ metallic, and liver-odor flavours when compared to lamb. A study by Ivanovi´c et al. (2020) on three goat breeds found alpha-linolenic (n-3 fatty acid) and linoleic acids predominantly in Balkan goat meat. Hence, there are limitations to understanding the flavour chemistry of goat

meat, and more research on such components and their influence on goat meat acceptability is required to enhance goat meat marketing for constant household consumption and utilization.

2.10.2 Perceived Quality of Meat

According to Dolojan (2015), perceived quality is defined as the degree to which the product fulfils its functions about the consumer's wants, as there is no "one best quality for all consumers." However, he contends that quality evaluation is relative to consumers' wants, which is why it is referred to as perceived quality. Sensory qualities represent what the product is meant to do or provide to consumers in terms of their wants, and they also serve as the foundation for consumer preferences. Sensory evaluation is a "scientific field that aims to trigger, assess, analyze, and interpret the attributes of both food items and materials as they are experienced through the senses of sight, smell, taste, touch, and sound' (Stone, Bleibaum, and Thomas 2020). Food quality judgment is influenced by how consumers perceive a product in terms of predicted (before consumption) and experienced (after consumption). Teixeira et al. (2020) clearly stated that meat processing currently is no longer exclusively for preservation needs, but mostly to satisfy consumer demand and acceptability for products with traditional palatability and flavour characteristics.

Additionally, product acceptability is based on the perceived quality attributes of the consumer, which determine the acceptability of the product, and product quality attributes influence consumer choices and preferences. Dolojan (2015) affirmed that innovation and technology pave the way for retailing incoming products and serve as an option for current and future marketing systems. A goat meat preference study on the slaughter age of goats in Tamil Nadu indicated that shear force values and tenderness of goat meat are generally acceptable when the meat is from goat kids (Karthik et al., 2017). Flavour enhancements such as garlic, black pepper, chilli powder, paprika, and cumin were found to be pleasant for musking the gamey flavour of goat meat (Putra et al. 2017). Regarding the palatability and acceptability of goat meat, various studies have been undertaken (Anandh, 2018, Mazhangara et al., 2019) and in most of them, goat meat products are evaluated to be of good quality. Thus, attitudes toward goat meat are shifting for various reasons. However, most of these studies used trained taste panels and very few projections on instrumental quality results. However, although goat meats/products are found in European countries and regions such as the Mediterranean, Middle East, North Africa, and Central Asia (Teixeira et al., 2020), there is still evidence that consumers perceive goat meat as rough and stinky (Jacques et al., 2017; Nguyen et al., 2023).

Therefore, better goat meat consumption is required for optimal acceptability, mainly in the control of food processes, physicochemical characterization, food safety, and sensory properties of new goat meat products.

2.11 Conclusion

Goat meat is increasingly recognized as a healthy option in the red meat production industry because of its high biological value (HBV) and associated nutritional and health benefits. Despite its acceptability, the existing numerous challenges in goat meat production, meat classification, processing practices, eating quality, safety issues product diversification and marketing were identified from the literature. However, these limitations are linked to the underdeveloped value chain systems in the South African goat industry, which may vary according to the geographic and socioeconomic contexts. The research on indigenous African goats and their meat value-addition remains underexploited and uncoordinated, highlighting a research gap concerning the practices and the economic value of indigenous goats in South Africa. As a result, the potential of indigenous goats for meat production and innovative product development remained limited, particularly in the South African region.

Goat meat, recognized for its lean quality, faces challenges in acceptability due to its perceived toughness, particularly from culled dairy goats and less-structured production methods that impact quality control in informal markets. Innovative processing technologies and abattoir services can address these issues for improved consumer acceptability. Although goat meat occupies a niche market in developed countries, it is a crucial nutritional and economic resource in developing regions. Goat meat differences underscore the need for new product development and effective marketing to enhance its appeal as a sustainable alternative meat option. Moreover, the South African government and agricultural organizations-initiated programmes limited to improvement of breeding, sustainable production, and market access for goat farmers, further requires agro-food technology practices to promote goat meat consumption through value addition and dietary diversification to bolster its utilization and acceptance. While supporting local food systems, food security, and boost local economies.

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CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This section delineates the methodological framework guiding the study, providing a comprehensive overview of the inquiry approach adopted to address the research objectives. Central to this methodology is the conceptual model framework illustrated in Figure 3.1, which serves as a foundational structure for the investigation. The following subsections detail the research techniques employed, including the research design and procedural steps, as well as a thorough description of the study population and sampling methods. Additionally, the contextual background of the study area is presented along with an elaboration of the overall research methodology, ensuring a robust and systematic exploration of the research questions.

3.2 The Conceptual Model Framework of the Study

The current study investigated the profiles of goat meat products in the market, focusing on the development and analysis of food quality and consumer acceptability of chevon products. To guide this exploration, this study employs the conceptual model of consumer food quality perceptions proposed by Steenkamp (1986) as a foundational framework. This model provides a structured approach to understanding consumer perceptions of food quality, which is essential for assessing the acceptability of chevons in the context of evolving consumer preferences and market dynamics. By applying this conceptual framework, this study aimed to illuminate the factors influencing consumer attitudes toward goat meat.

An overview of the relationships between the variables chosen for the study is provided, along with an outline of the independent and dependent variables. Consequently, the product's acceptance is influenced by and determined by the perceived quality attributes. Furthermore, these elements impact the decisions and inclinations of consumers, while elements such as acceptance are influenced by individual and household attitudes and cultural issues. Food acceptability according to Font-i-Furnols and Guerrero (2014) ‘‘is a complex phenomenon that is usually based on sensorial characteristics and non-sensorial characteristics such as experiences, attitudes, sensory evaluation, and expectations of consumers. Various approaches and philosophies related to the explanation of consumer satisfaction as a discrepancy between expected and experienced quality have been incorporated. Quality is a multidimensional concept that is perceived by combining several product quality characteristics. Therefore, in consumer acceptability and quality of food products, various factors influence consumer acceptability and preferences of food, based on consumer food perceptions’’ (Font-i-Furnols

and Guerrero, 2014). In particular, the focus of this study is to understand whether goat meat is currently available in the market while trying to establish how it is being utilized at the household level and identify whether there is a potential to enhance and stimulate the underutilization of goat meat and reposition it in the commercial market. Hence, Steenkamp's model of consumer perception and food quality is appropriate for investigating the overall aim of the study.

Steenkamp's Consumer Food Quality Perceptions Conceptual Model (Steenkamp, 1986), shows the linkages and role of each component in responding to consumer preferences through food quality that meets consumer requirements. The framework analyzes the issues related to consumer food quality perceptions and preferences, which influence the intention to buy current and new products that might be developed to satisfy consumer demands and expectations. This indicates that consumer characteristics play a critical role in consumer food acceptability and quality perception (Marreiros and Ness, 2009). In this model, consumer characteristics play a critical role in shaping perceptions of product quality, which, in turn, influences acceptability. Steenkamp identified several key factors that affect this dynamic, including the type of information available about products, intrinsic and extrinsic attributes, quality characteristics, sensory evaluation, and perceived product quality. These elements collectively determine consumer acceptance and purchase motivation. Building upon the insights provided by the Steenkamp model, this study sought to integrate indigenous practices of goat meat preparation with contemporary production and processing methods to create value-added goat products. The interplay of these components is visually represented in Figure 3.1, illustrating the framework for understanding how traditional and modern practices can enhance consumer perceptions and the market viability of Chevon products.

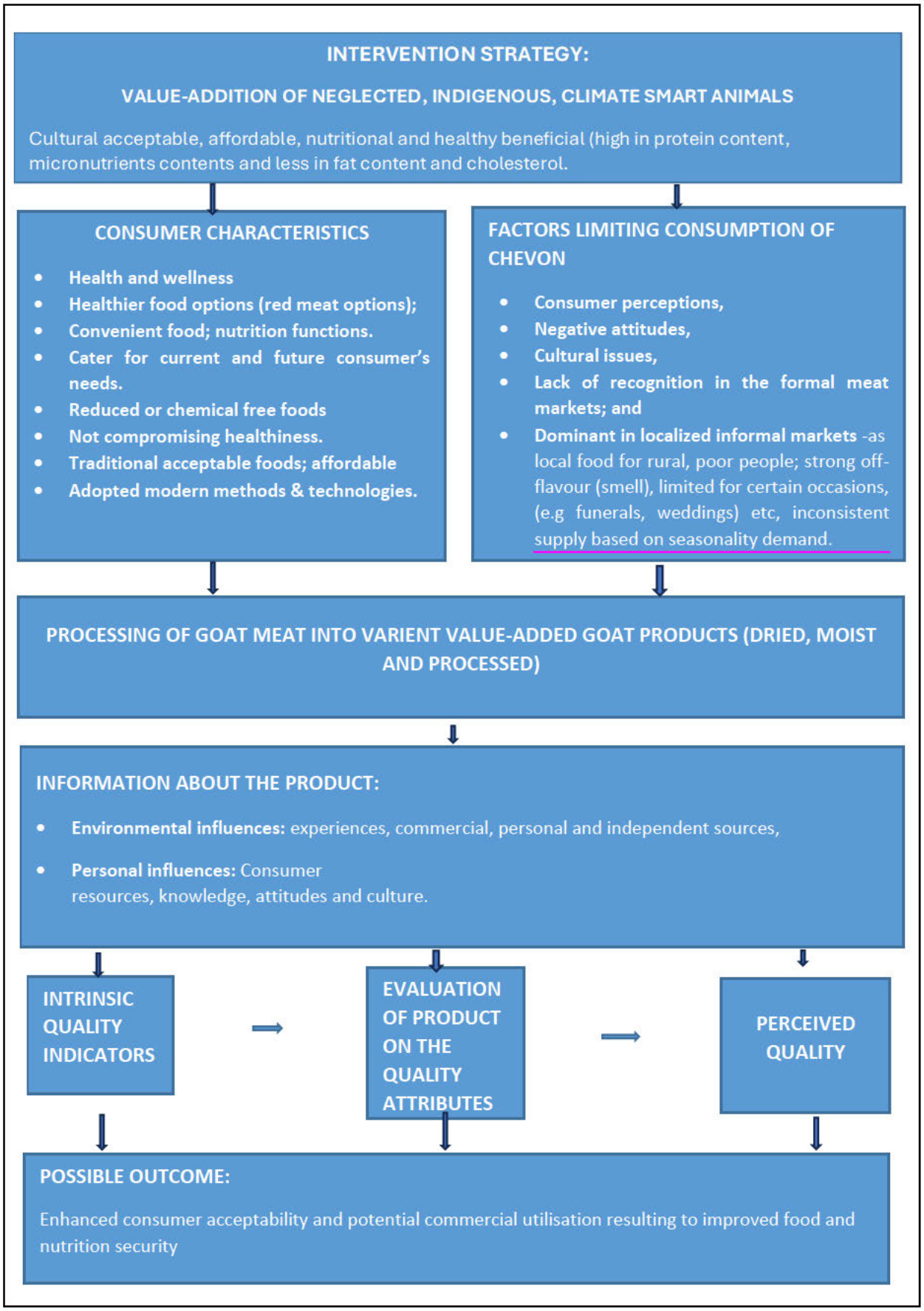

Figure 3. 1: Adapted Conceptual Model on consumer food quality perceptions (Steenkamp et al., 1986)

The value addition of chevon (goat meat) represents a strategic approach aligned with global efforts to address Sustainable Development Goal 2: Zero Hunger**,** particularly through the promotion of nutritionally rich, locally available protein sources. However, the potential impact of such interventions is moderated by the complexities and dynamics of consumer behaviour**,** which can significantly influence the acceptance and, consequently, the nutritional utility of value-added chevon products. In this context, understanding consumer preferences, perceptions, and acceptance becomes critical. The current study draws on Steenkamp's framework, which provides a robust theoretical foundation for examining the intrinsic and extrinsic product attributes that shape consumer decision-making.

Key limitations to consumption are identified, including entrenched consumer perceptions, negative attitudes, and cultural barriers that categorize goat meat primarily as a local food for rural populations, often associated with strong off-flavours, and reserved for specific occasions such as funerals and weddings. Addressing these barriers requires an understanding of the consumer characteristics that prioritize health and wellness, convenience, and nutritional benefits. The current study aimed to capitalize on these insights by proposing an intervention strategy focused on the value addition of neglected Indigenous and climate-smart animals. This strategy emphasizes the development of culturally acceptable, affordable, and nutritionally beneficial goat meat products characterized by high protein content and low levels of fat and cholesterol. By transforming goat meat into a range of value-added products, such as dried, moist, and processed forms, this study seeks to enhance consumer acceptance and integrate traditional practices with modern food processing technologies. This approach not only addresses food security challenges but also aligns with evolving consumer preferences for healthier, convenient food options, thereby fostering a more sustainable and inclusive meat market.

In recognizing the critical role of information about goat meat products, this study identifies both environmental and personal influences as intrinsic quality factors shaping consumer perceptions. Environmental influences encompass a range of experiences, including commercial and independent sources of information, whereas personal influences pertain to consumer resources, knowledge, attitudes, and cultural contexts. These factors significantly contribute to the evaluation of quality attributes, ultimately informing the perceived food quality. By focusing on these dimensions, this study aims to enhance consumer acceptance of Chevon products, which could lead to greater commercial utilization. Such outcomes are

pivotal for improving food and nutrition security, as they align with consumer demands for transparency and quality, fostering an environment conducive to informed purchasing decisions and consumption of value-added goat meat products.

3.3 Research method approach

A mixed-method approach was adopted in this study, mix design is defined as a type of research in which a researcher combines elements of qualitative and quantitative research approaches for the broad purpose of breadth and depth of understanding and corroboration. According to Hastie et al. (2020), the integration of qualitative and quantitative research methodologies creates an enabling environment for researchers to acquire a holistic and comprehensive consumer response**.** Quantitative data on goat product availability and accessibility collected through observations informed qualitative data from key informant interviews (*n=15*) to verify product availability, purchasing frequency, and consumer perceptions towards goat meat/products commercialisation in various meat markets. Again, (*n*=16) key informants with expertise in preparing, cooking and preservation techniques for goat meat at the community level were identified for complementary interviews. While quantitative data on the type of products available in the retail market and consumers of those products, also frequency of goat meat consumption and occasions in which goat meat is consumed at household level, complemented the other. Thereafter, product development through innovation led to sensory evaluation of products, which is quantitative. Christensen et al. (2011) suggested that there is an increase in researchers' recognition of the benefits of using mixed methods to gain deeper insights into various research phenomena. The logic of pragmatic inquiry includes the use of induction, discovery of patterns, and deductions (testing of hypotheses and adaption) to uncover and understand someone's world through knowledge and understanding in a practical and empirical manner (Deen, 2010).

3.4 Description of the study area

The study was conducted in uMhlathuze Local Municipality under King Cetshwayo District Municipality (KCDM), the third-largest district municipality located in the northeast of KwaZulu-Natal, South Africa. Approximately 21% of the South African population resides in KwaZulu-Natal which is about 10 267 300 and covers an area of 94 361km² (Lehohla, 2011). KwaZulu-Natal is one of the most populous cities of eThekwini and attracts many tourists in the province. The Black African population constitutes 87% majority of the population group speaking IsiZulu as their first language and a smaller population group of Asians 7.4%). The

region covers an area of approximately 1,209 km^2. The N2 national road passes through the municipality, which connects it to major towns, such as Richards Bay and Durban. The significance of this road to the municipality is that it serves as a major economic corridor.

The city of uMhlathuze Local Municipality (KZN282) is a Category B Municipality on the northeast coast of KwaZulu-Natal's King Cetshwayo District. The total population size of the district in the year of study was 1008 787 971 the larger population is residing in the city of uMhlathuze local municipality of about 435 449 (Global Insight, 2021). It is the most populous of the district's five local municipalities (uMhlathuze, uMfolozi, uMlalazi, Mthonjaneni, and Nkandla) and comprises the greatest number of wards in the district (n=34). The economic activities of the municipality contribute 9.1% of the gross geographical product (GGP) and 8.5% of the total employment in the province. There is A high population percentage residing in the rural part of the district (80%) and child-headed households (41.8 %) due to either parents working elsewhere, deceased, or migrant labour across the district. This correlates with the 43.1% of the population living within the income bracket of R800 – R3 183.33 monthly, which is an amount of R9 601 – R38 200 per year. Therefore, these living boundaries contribute to the district's poverty line and 26.5% of the provincial unemployment rate. The city of uMhlathuze is sitting at a 24.6% unemployment rate (Integrated Development Plan - KCDM, 2023/2024).

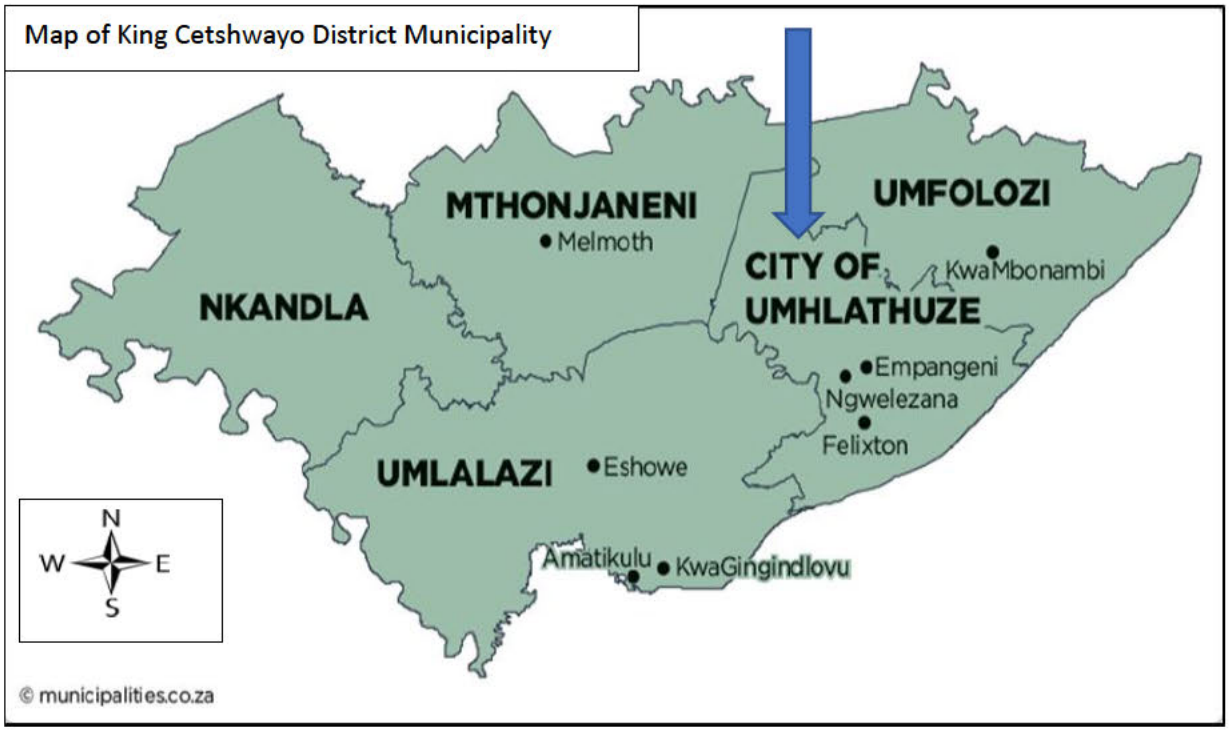

Figure 3. 2: Map of King Cetshawayo District Municipality Source:(Municipality of South Africa, 2012)

Study population and sampling approach

This study employs a focused yet specific methodological design to achieve its objectives, presenting complementary outcomes that enhance the overall understanding of consumer perceptions and behaviours regarding Chevon products. It is important to note that sampling techniques vary concerning the specific context of the study objective versus design. The study population was centred in the KwaZulu-Natal province, specifically within the uMhlathuze Municipality. A purposive sampling approach was used to select retail stores and indigenous knowledge experts, all of whom were consumers of goat meat. This targeted selection ensures that the insights gathered are relevant and meaningful.

Additionally, the study incorporated an untrained panel of consumers from the King Cetshwayo community for sensory evaluation. This sampling choice is instrumental in understanding local preferences and perceptions of the chevon. As previously articulated through Steenkamp's conceptual model, we posit that consumer perceptions significantly influence retail market dynamics and the types of products available in formal markets. Moreover, these perceptions play a crucial role in determining the utilization and preparation of chevons within households. By engaging with both retail and consumer segments, this study aims to uncover the intricate relationships between consumer attitudes, market offerings, and traditional practices, thereby providing valuable insights into product development towards enhancing the acceptance and potential commercialization of goat meat products.

3.6 Validity and Reliability

Validity and reliability are fundamental for ensuring that findings accurately represent the phenomena studied and that outcomes can be consistently reproduced. According to Creswell (2014), validity assesses whether a study accurately measures or investigates what it purports to. In this project, validity was carefully structured using complementary research designs to align with each research objective, as each methodology addressed specific aspects of the phenomenon and provided nuanced insights. For example, interviews with retail store representatives and indigenous experts offered rich qualitative insights into cultural perspectives, while observations validated experimental trials. Together, these methods contribute to *construct validity* (Saunders et al., 2016), as they support the alignment of conceptual definitions with the measures used in practice. Further, *triangulatio*n was applied to improve *internal validity* by verifying that the findings from interviews, literature reviews, and product trials were coherent and mutually supportive. Triangulation not only confirmed

the findings but also minimized researcher bias by providing multiple perspectives (Denzin, 2017). Using diverse data sources and methods, we enhance the robustness and trustworthiness of the conclusions (Patton, 2015).

Reliability pertains to the consistency of research instruments and analysis methods, ensuring that other researchers can reproduce findings under similar conditions (Corbin & Strauss, 2015). To achieve reliability, a triangulation of tools and methods was implemented across the data collection stages. For instance, interview questions were crafted to allow comparable responses across participants and were regularly cross-checked with existing literature and observational data. The dependability of these tools supports the reliability of the analysis, as any replication of this research would yield similar results if the same rigorous standards and systematic approach were followed. To strengthen dependability, an iterative approach was employed throughout the data collection and analysis (Babbie & Mouton, 2016). By constantly refining the research tools and clarifying objectives, the study reduced methodological inconsistencies, further securing reliable and valid outcomes that accurately reflected the studied phenomena.

3.7 Research Design/s

The selection of research designs in this study, such as descriptive, phenomenological, and experimental, demonstrates the strategic use of methodological triangulation to comprehensively explore the research problem. Methodological triangulation involves using multiple research methods or approaches that complement each other, offering a richer multi-dimensional understanding of the phenomenon (Denzin, 2017). Each approach uniquely contributes to the depth, reliability, and validity of the study.

3.7.1 Descriptive research design

The descriptive approach presents information on the accessibility and utilization of goat products and meat, documenting baseline conditions and consumer patterns. By providing a snapshot of existing practices and market characteristics, the descriptive design provides a context for understanding how accessibility and utilization influence consumer behaviour (Creswell, 2014).

3.7.2 Phenomenological research design

The phenomenological approach adds qualitative depth by capturing the lived experiences, beliefs, and practices surrounding goat products. Through this lens, the study can gain insights

into the cultural and personal factors that shape consumer preferences and decisions, offering a deeper understanding of the motivations behind consumer choices (Patton, 2015).

3.7.3 Experimental research design

The experimental design complements the approaches (3.7.2) by implementing trials to assess and refine product development, guided by specific research activities such as:

2.7.3.1 Product development: Creating and iterating goat-based products to align with consumer needs and cultural preferences identified in the descriptive and phenomenological findings.

2.7.3.2 Product preference: Evaluating various product versions to identify which best meets consumer preferences, thereby guiding product refinement.

2.7.3.3 Microbial tests: Ensuring the safety and quality of developed products by assessing microbial stability is critical for market acceptance.

2.7.3.4 Physicochemical tests: Testing properties such as texture, flavour, and nutritional content to ensure that the products meet quality standards and consumer expectations.

2.7.3.5 Consumer acceptability: Assessing overall acceptability through consumer trials allows the study to align product attributes with actual consumer preferences, thus enhancing product viability.

Together, these experimental elements test, refine, and validate product characteristics and safety, contributing directly to the study's objectives of consumer acceptance and product suitability (Creswell & Plano Clark, 2018). This layered, triangulated approach not only strengthens the internal validity and reliability of the findings but also ensures that each aspect of the research is cross-verified and aligned with real-world consumer expectations, resulting in a comprehensive understanding of the phenomenon (Tashakkori & Teddlie, 2015).

3.8 Study research procedure

This study followed the various phases discussed below, with the supporting information included in Appendix A:

3.8.1 Profiling the retail markets for goat meat products

In South Africa, retail stores are classified into four categories: lower economic, middle economic, upper class, and specialized shops. Retail segmentation and living standard

measures (LSM) informed the research of which retail store categories were involved. In this regard, these four categories were used to profile goat meat and product accessibility in a ratio of 3:1 (three retail stores + one butchery per LSM) per retail class applied in this study.

Sampling technique

The sample size for this study was determined to detect a medium effect size with statistical power, ensuring a robust representation across different economic segments. Reason being, the retail stores selling the goat products were limited. Retail stores were selected to represent a range of economic classes based on consumers' living standard measures. Retail managers or their representatives (RMs) were invited to participate through a formal request letter that included study details and a consent form.

Inclusion Criteria: Participants included managers of goat meat retailers and farmers actively involved in red meat production and marketing, whether for personal or commercial sale.

Exclusion Criteria: Farmers and retail managers not engaged in goat meat or goat product production or marketing were excluded from the study.

A sample of approximately 16 retail stores was initially selected according to South Africa's retail classification standards, with 15 of them completing the interviews. This group comprised key informants, specifically retail managers, from various meat markets.

A quota purposive sampling approach was used, guided by the following criteria:

1. Retailers must sell goat meat.

2. They must belong to one of the following economic categories: lower-economic-class meat sellers, middle-economic-class meat sellers, upper-economic-class meat sellers, specialized meat markets, or informal meat markets.

Key informant interviews with store managers were conducted to investigate consumer purchasing patterns and the factors influencing the demand for goat meat and products. This approach facilitates qualitative data collection, enabling a deep exploration of the research topic by interpreting participants' experiences and perspectives (Matthews & Ross, 2014).

3.8.2 Documentation of the traditional goat meat preparation and consumption

Various traditional recipes of goat meat were collected from four ethnic groups (Zulu, Indian, Afrikaner and Foreign Nationals) who are goat meat consumers. Through the documentation

processes, a total of at least four key informants from each ethnic group were consulted, and the researcher observed and noted how they prepared their recipes while documenting them (the template used to document the recipes is included in Appendix B). Phenomenological research was adopted, where the researcher spent some time with each key informant to see where they purchased their goat meat, how they prepared it, and how it was consumed (noting other complementary foods eaten with).

Also, the researcher documented the events in which goat meat was usually eaten.

Inclusion criteria: The key informants chosen based on the criterion of being a goat meat consumer, with the age range between 40 and 70 years, were adequate, pertinent encounters, and informative expertise in the preparation, consumption, and marketing of goat meats/products to react to the research questions and objectives of the study.

A purposive sampling strategy was employed to identify key informants who could serve as primary knowledge sharers.

3.8.3 Product development

3.8.3.1 Sourcing of live goats

Indigenous Nguni goats (10) of about 2 years of age at the weight of 36-55kg each were sourced from the reputable Agricultural Academic Institution in KZN, Cedara Agricultural College Farm, situated in the southern region of Pietermaritzburg. Goats were reared on the farm until slaughter. The goats were slaughtered at a reputable and accredited abattoir, Boston Abattoir, in Erf 95 Elandsrivier Farm, Boston 3211, Howick.

3.8.3.2 Recipe collection for standardization

Three variant goat meat products, which first followed the collection's original recipes, and indigenous knowledge holders' recipes, were collected from the four ethnic groups as key informants for goat meat, and all recipes were prepared according to their original ingredients based on their measurements and preparations. The documented goat meat recipes (ingredients, preparation/cooking methods, and complementary food items eaten with them) were classified under the categories of dried, cooked, and processed products prepared in the domestic Consumer Sciences Kitchen at the University of Zululand. Recipes were standardized for the second trial of the IK-holders' recipes.

3.8.3.3 Product preference

The initial sensory evaluation was conducted using the original recipes of goat meat that were prepared and influenced by the preferences of indigenous households. From the various goat meat products prepared, one best-preferred product was selected for each category: moist method, dry method, processed and reformulated. The prepared products were used for acceptability by a trained sensory evaluation panel, which normally consists of 10 – 12 members. Therefore, 15 participants representing a trained sensory unit in each academic institution were ideal for product trial sessions. (five staff members, five female students, and five male students) from each institution (Consumer Sciences Department at the University of Zululand and Owen Sithole College of Agriculture, Agro-processing Unit). This process gauges feedback on the acceptability of the developed original recipes before consumer acceptability of the reformulated products is conducted with the intended sample size (*n=120*).

3.8.3.4 Product formulations and standardization

Each preparation and cooking method was critiqued, and certain ingredients and cooking methods/processing techniques were integrated with modern methods to develop food products with qualities suitable and acceptable to current and future consumers. The products had to be fit for commercialization; hence, this study intended to develop products that could be accepted by consumers while meeting and satisfying their lifestyles. According to Dolojan (2015), current and future consumers demand convenience or "ready-to-eat" food.

3.8.4 Sensory evaluation trials

Sensory evaluation trials were conducted for the best-preferred products, with the original properties of the indigenous knowledge holders' preferences for the three categories chosen. The second evaluation was conducted with new sets of three interfaced goat meat products, reformulated from Indigenous recipes interfaced with modern practices to produce modernized indigenous food products for untrained consumer acceptability test (*n=120*), based on the panel evaluation outcomes.

3.9 Microbiological quality of interfaced goat meat products

The laboratory experiment focused on the physical qualities and microbial contamination of the three interfaced Nguni goat products (curry, burger patty, and dried wors). Especially for the benefit of dried wors since they are raw, all products were taken through the process of microbial testing to ensure the health and safety of consumers. The growth of microorganisms,

such as bacteria, fungi, and yeast, is a major cause of deterioration and reduced shelf life of meat products (Zhu et al., 2022). This is mainly due to poor meat handling practices that affect the quality and shelf life of meat before and after slaughtering (Mohammad et al., 2019; Zhu et al., 2022). Therefore, microbiological testing was conducted for all three products to determine the total plate count using a 10 g sample of each goat product, homogenized in 90 ml sterile 0.1% peptone water, and analyzed using the plate count agar (Mohammad et al., 2019; Zhu et al., 2022).

3.10 Physicochemical qualities of interfaced goat meat products

Physical quality analysis of the three interfaced products was conducted in the form of texture and colour. Product quality test services were sourced from the University of KwaZulu-Natal – Dietetics and Food Science Laboratory in Pietermaritzburg for physicochemical tests, and the Fact Food Laboratory in Durban for microbial quality tests. Below are the different aspects of food quality explored in this study.

3.10.1 Colour analysis

The physical qualities of the goat meat samples were assessed by analyzing colour using a HunterLab ColorFlex Colorimetric Spectrophotometer (Model 45/0, HunterLab, USA). The readings of each sample were recorded, and the mean values were determined.

3.10.2 Tenderness analysis

The study used an instrumental Texture Profile Analyzer (TPA) and Warner Bratzler shear force (WBSF) as the texture analysis method for tenderness. Texture profile analysis (TPA) and Werner–Bratzler shear force (WBSF) are instrumental devices for measuring product tenderness, while the force needed to shear the product is expressed in peak shear force (PSF), either in N or Kg. The higher the shear force, the tougher the meat. The WBS of each goat product was measured as the maximum force required to shear a cylindrical core cooked goat product perpendicular to the grain at a crosshead speed of 400 mm/s. Shear force was measured as the average peak force (kg) per sample. The WBS of each goat product was measured as the maximum force required to shear a cylindrical core cooked goat product perpendicular to the grain at a crosshead speed of 400 mm/s. The physical qualities of the goat meat products are described in Chapter 5.

3.11 Sensory evaluation of the interfaced goat meat products

Consumer acceptability tests were conducted using a five-point hedonic scale for food preference developed to evaluate the three categories of goat meat product formulations using the following sensory parameters: aroma, tenderness, flavour, aftertaste, and overall acceptability. For approximately 120 untrained panellists, each participant tested three samples of goat meat products categorized into goat curry, dry wours, and burgher patties. In this study, a 5-point hedonic rating scale and a ranking preference test were used. Preference tests, according to Garvey et al. (2020), supply information about people's likes and dislikes of products. These are subjective tests that include comparison, hedonic, and scoring rating scales.

Chapter 6 of the study describes the process followed for sensory evaluation.

3.12 Management and Analysis of Data

Before statistical analysis, the quantitative data were cleaned, coded, and computed descriptively in MS Excel and subsequently into SPSS using Statistical Package for Social Sciences (SPSS) version 28.0, from the survey and observations. Frequent data were presented in the form of tables and graphs. Qualitative data from key informant interviews were recorded, fully transcribed, verified with the participants, and coded by developing content, thematic strands, and indicators that had common relationships. Data, particularly from the key informant interviews with retail managers (on purchasing patterns of goat products and influential factors) and Indigenous knowledge holders for traditional goat meat utilization and consumption at the household level, were analyzed within the context of content and concepts acquired from the discussion made through the key informants' interview guide. The experiences and views of the participants were shared with their meanings, and thereafter, a content analysis was conducted.

Moreover, coding was conducted, and themes were created by identifying keywords that were used to present explanations and interpretations of the participants through NVIVO12.x64. For indigenous knowledge holders' interviews. For sensory evaluation, the hedonic scale data for each characteristic (aroma, tenderness, flavour, aftertaste, and overall acceptability) were analyzed separately. The significance level was set at 0.05 for all analyses before the experiment. A literature review was incorporated to consolidate the findings from the primary data. The overall data were analyzed interactively according to emerging themes derived from the research objectives, as described in Appendix A.

3.13 Ethical Consideration

Ethical clearance for the study was obtained from the Humanities and Social Sciences Research Ethics Committee **Protocol reference number:** HSSREC/00003190/2021, see Appendix E. For both the survey and laboratory activities, gatekeeper letters were obtained from the University of Zuland's Deputy Vice-Chancellor: Research and Innovation (see Appendix D1) as well as the Department of Agriculture and Rural Development, Owen Sithole College of Agriculture (see Appendix D2). Data collection tools and consent forms (Appendices C1 and C2, respectively) were used in both the survey and the sensory evaluation of students who volunteered to participate in the study.

APPENDIX A:

Table 3. 1: Study Research Designs and sampling techniques

Objectives	Data collection tool/s	Sampling Technique	Analysis
1. To profile and map out the Chevon products available in the retail market	A key informant interview guide, Observation and Questionnaire	Purposive sampling of key informants from the retail.	Descriptive statistics-frequency, mean and content analysis.
2. To document the traditional methods/ recipes used to preserve and cook chevon at the community level in comparison to the retail. (Chapter 4)	A key informant interview guide,	Quota purposive sampling of key Informants from each of the 4 ethnic groups: Zulus, Indians, Afrikaners & foreign nationals.	Content analysis
3. Product development (Chapter 5)	Instrumentation of three products: *(dried, cooked and processed)*	Food sample evaluation trials by trained food panellists of 15 per institution were recruited	Descriptive statistics
4. To determine the physicochemical characteristics of the value-added Chevon products (Chapter 5)	*Texture- firmness (Cooked, dried, processed Chevon products) Colour- L*a*b*value for processed, Dry & Wet Chevon products*	Food Samples: moist, dried and processed	Descriptive analysis, mean and standard. Deviation
5. To evaluate consumer acceptability of the Chevon value-added products (Chapter 6)	5-point hedonic scale Food Action Rating Scale.	120 untrained panellists recruited	Descriptive statistics analysis

APPENDIX B:

Table 3. 2: Documented recipes for Indigenous knowledge-holders (IK)

IKH-Nigerian		
Dish no.1: Goat Pepper Soup	**Dish no.2: Isi Ewu (Goat head dish)**	**Dish no.3: Goat Asun (Suya- goat) Grilled/braai**
Ingredients -1kg Goat meat -6 cups of water - 1 chopped onion – - 1 tsp Thyme -1 tsp Bouillon -1 tsp Salt -1 tsp pepper soup spice -1 tsp Cayenne pepper - Crayfish (optional)	**Ingredients** -1 Goat head -150ml red palm oil -2 tsp Calabash nutmeg -1 tbsp. powdered potash - 2 beef-flavored stock cubes - 2 medium onions -10 Utazi leaves - 2 tbsp. of habanero peppers (blended fresh pepper) -1 tablespoon crayfish (optional) -1 tsp salt to taste	1,2kg goat meat. (Cut with the skin) -2 habanero peppers -1 medium onion -3 big stock cubes -1 tsp thyme -salt -1 tbsp. of vegetable oil - Black pepper (optional) **To garnish** -1 medium onion -1 small green bell pepper -1 small red bell pepper
Cooking method	**Cooking method**	**Cooking method**
1. Wash the meat well in clean water and cut the meat into desired cube size. 2. Put the meat in the pot and add 6 cups of water. 3. Add the chopped onion, thyme, bouillon and salt. 4. Boil till tender (45min – 1hour). 5. Add pepper soup spice, cayenne pepper and crayfish. 6. Add a cup of water if need be. 7. Taste for salt and add more if needed.	1. In a pot, place the meat with the brain included, 2. Add grated onion, seasoning, a tablespoon of pepper, salt and water. Thereafter, allow to boil until the meat is tender. 3. While the meat boils, slice the other onions into rings, dissolve the potash with a small amount of water and sieve.	1. Cut the goat meat into big chunks with the goat skin. 2. Wash and put the goat meat chunks in a bowl. 3. Add the thyme and black pepper; crush and add the stock cubes. 4. Add other spices (optional) 5. Cover the bowl with a thin film. Put in the fridge and leave to marinate for about 1 hour.

8. Simmer for 20 minutes on medium heat. 9. Serve and enjoy.	4. A while into the meat boiling, take out the brain and place it in a small mortar, add the other spoon of blended pepper and mash. When the meat is ready, separate the stock from the meat. 5. Pour oil into another dry pot. Little by little, pour potash into the oil and stir with a spatula until palm oil turns yellow and thickens. 6. Add the mashed brain, the stock of the meat, Calabash, (crayfish) and continue to stir until blended. 7. Place the meat into the mixture and stir. Turn on the heat, until steaming hot. 8. Garnish with sliced onion rings and utazi leaves. 9. Serve in a small wooden mortar. Once is done, take out the meat from the pan and keep it covered.	6. Pound the habanero peppers and set aside. 7. Cut 1 onion into 4 big chunks. **Making the goat asun** 1. After 1 hour of marinating the meat, put the meat in a pot. 2. Pour water to just half of the level of the goat meat, add the chunks of onion and start cooking at medium heat. (ideally, the water dries up by the time the meat is well done) 3. When the meat is cooked remove the big chunks of onion and add salt to taste. 4. Increase the heat to high and stir constantly until all the remaining liquid in the pot is absorbed. 5. Lay the goat meat flat on an oven rack. 6. Grill in the oven at 180 degrees Celsius till meat is brown all over. (Meat should not be dry) 7. While grilling the meat, wash cut and thread the green bell pepper, red bell pepper and the remaining onion on skewers. 8. When the meat is well grilled, heat the vegetable oil in a dry clean pot. 9. Add the pepper and the thick stock from cooking the meat and fry for a bit.

		10. Add the grilled goat meat. 11. Stir very well till the pepper is evenly distributed on the goat meat. 12. Serve with the threaded vegetables.
IKH-Congolese		
Dish no.1: Goat Pepper Soup	**Dish no.2: Goat Meat Wet Fry**	**Dish no.3: Braai**
Ingredients -1kg goat meat (chopped into chunks) -1 onion -1 celery stick -1 teaspoon curry powder - ½ teaspoon black pepper -1 green pepper (grated) -1 yellow pepper (grated) -1 red pepper (grated) -1 clove of garlic (grated) -2 cubes of Onga spice -1 teaspoon nutmeg -1 ½ tomato (grated) -1 tablespoon coconut oil (optional) -1 cup of water - 1 teaspoon of Onga stew ragout (paprika) -1 chilli pepper (to add flavour)	**Ingredients** -1500g goat shoulder chops -1 onion -1 celery stick -2 Onga spice cubes -1 teaspoon salt -1 teaspoon of salt - 1 teaspoon of curry powder - ½ teaspoon thyme - ½ teaspoon nutmeg spice - ½ teaspoon black pepper -3 medium tomatoes -1 green pepper -1 yellow pepper -1 red pepper -3 cloves of pepper	-Chops/ any other goat braai meat -Steak and chops spice -Marinade (any brand) -Lemon Juice
Cooking method	**Cooking method**	**Cooking method**
1. Chop meat into big chunks and wash it. 2. Put the meat into the pot. 3. Add onion, celery and black pepper, peppers, curry powder, garlic clove, onga spice, nutmeg, tomato and onga stew regout.	1. Wash the meat well. 2. Put the meat in the pot. 3. Add 1 chopped onion and celery. 4. Add onga cube spice, black pepper and salt. 5. Close the pot and let it cook (boil)/ half steam until tender.	1. Spice the meat and soak it in a marinade overnight. 2. Prepare the wood fire. 3. Over coal, grill the meat while sprinkling it with lemon juice. 4. Turn the meat on both sides until done as desired.

4. Without cutting it, add the chilli and 1 cup of water. 5. Add a spoonful of coconut oil (optional.) 6. Let the meat get cooked under slow cooking conditions until tender. 7. Serve 4-5 people with vegetables/pap, cassava/kwanga, or banana plantains. 8. Preparation time is 1 hour and 30 minutes depending on the softness of the meat.	**a. Frying** 6. Heat the frying pan on the stove. 7. Add 3 spoons of coconut oil. 8. Heat the oil in the pan and fry the meat chops on both sides until golden brown. 9. Flavour the meat with thyme and nutmeg spice and close the pot. 10. Once is done, take out the meat from the pan and keep it covered. **a. Soup/Gravy** 11. Fry garlic and add onion until translucent. 12. Add 2 grated tomatoes. 13. Add 2 pockets of onga stew Re gout. (2tsp of paprika/spoons of tomato puree). 14. Add grated peppers to the tomato mixture. 15. Let the tomato get cooked until all the water is finished. (This must be achieved without the lid.) 16. Add fried meat to tomato and cook it further in a slow cooking medium for 10 mins. (For flavour to get into the meat.) 17. Serve with rice/ pap/ cassava/ kwanga.	5. 5. Serve and enjoy with pap.
IKH-Kenya		
Dish no.1: Mbuzi stew	**Dish no. 2: Pilau**	**Dish no.3: Mbuzi Choma (Roast goat)**
Ingredients	**Ingredients**	**Ingredients**

-500g of mbuzi -1 onion -2 tomatoes -Curry powder -4 cloves of garlic - A finger of ginger -Oil -1 cup of water	-2 cups Basmati rice -Pilau masala (cloves, cumin seeds, cardamom, cinnamon) -500g Mbuzi -2 large onions -3 large tomatoes -2 cups of water -Oil	- Goat meat - Black pepper - Salt - Ginger paste
Cooking method	**Cooking method**	**Cooking method**
1. Boil the mbuzi together with the garlic until the water is dry and then out two dessert spoons of oil and finely chopped onion. 2. Stir until the onion is brown and add in the tomato and curry powder. 3. Continue stirring until nice and brown then pour a cup of water to make the stew. Bring it to a boil and it will be ready for serving. Serving: It may be eaten with kachumbari/ rice/ chapatti/ ugali	1. Soak the rice in water until ready to mix. 2. Stir fry the meat in oil with the onions and the tomatoes until they are ready. Mix in two dessert spoons of pilau masala and stir until well mixed then put in the rice. 3. Stir well until the rice is thoroughly soaked in the spices then pour in two cupfuls of water and leave to simmer at low heat. 4. When the rice is cooked, the meal is ready. Serving: It may be eaten with kachumbari.	1. Marinate the meat in black pepper, salt, garlic and ginger paste for an hour. 2. Roasted slowly on the wood fire. 3. This can be eaten with kachumbari and ugali.
Mbuzi Stew side dish: Chapati	**Pilau Side Dish – Kachumbari**	
1. 2 Kg bread wheat flour	1. -1 red onion	
2. 4 pinches of salt	2. -3 tomatoes, cubed	
3. 150 ml of oil and extra oil for cooking	3. -Half a lime juice	
	4. -Salt	
	5. -Black pepper	
	6. Dhania (fresh coriander)	

Cooking method	**Cooking method**	
1. Knead the flour in warm water and add some oil. The dough should not be too sticky, like the consistency of bread. The flour can be added in bits until it is just right. 2. Sprinkle some flour and continue to knead until the lump is smooth then cover with a cloth and leave to rest for about 20 minutes. 3. Tear pieces off the dough and make balls of about 4cm in diameter. Flour the board and roll the balls out into thin circles put oil on them and then fold. 4. Roll out the folded ball again and prepare to cook it.	1. Mix all the ingredients in a bowl drizzle with the juice and serve.	
IKH-Zambia		
Dish no.1: Soup yambuzi (goat meat soup)	**Dish no.2: Goat Meat Wet Fry**	**Dish no.3: Braai**
Ingredients -1kg goat meat -1 onion -2 tomatoes -Curry powder -4 cloves of garlic - A finger of ginger -Oil -1 cup of water	**Ingredients** -2 cups Basmati rice -Pilau masala (cloves, cumin seeds, cardamom, cinnamon) -500g Mbuzi -2 large onions -3 large tomatoes -2 cups of water -Oil	**Ingredients** -1 red onion -3 tomatoes, cubed, -Half a lime juice -Salt -Black pepper -Dhania (fresh coriander)
Cooking method	**Cooking method**	**Cooking method**

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CHAPTER 4: GOAT MEAT AND GOAT PRODUCTS CONSUMER MARKET ACCESSIBILITY AND HOUSEHOLDS' UTILISATION IN UMHLATHUZE MUNICIPALITY, KZN

Abstract

In recent years, there has been a global increase in interest in goat meat (*chevon)* which was previously exclusively perceived as meat acceptable for ceremonial purposes such as appeasing ancestors, religious beliefs, and cultural customs. As a result, goat meat is rarely used regularly for household consumption as a source of animal protein, and consumer behaviour, preferences, and perceptions regarding goat meat and meat products have been reported to be less favourable than other sources of meat. As such, consumer acceptance and commercial use of goat meat products may still lag compared to other meats, such as beef, pork, and chicken, in South Africa, particularly in Northern KwaZulu-Natal. Therefore, the main objective of this investigation was to assess and document the utilization and consumption of goat meat and its products available in markets, as well as its utilization and preferences at the household level.

A mixed-method approach was employed to incorporate quantitative and qualitative data. Fifteen retail managers provided insights into the goat products that customers are likely to purchase. Retail managers/representatives were drawn from various classifications of meat markets: upper, middle, lower, specialized, and informal markets. Additionally, 16 indigenous knowledge holders from four distinct ethnic groups were interviewed on the accessibility and household utilization of goat meat. About 15-16 key informants were used for qualitative/quantitative research, depending on several factors, quality of data, theoretical framework employed, and the cross-case analysis strategy utilized. A consumer instrument was used to determine the frequency of consumption of goat meat.

About 26,7% of retail stores selling goat meats/products targeted the upper-class, 26,7% middle-class, 20% lower-class customers and 26,6% informal markets. Upper- and middle-class retail stores were primary suppliers of goat meats/products in commercial markets, indicating interest in goat milk, cheese, yoghurt, infant formula, and goat meat. In addition, it was observed that goat meat had a higher price than other meats in retail stores. The fact that the majority of products were limited to higher-class markets further revealed the existence of issues with consumer accessibility and affordability. However, a variety of goat products were available in some stores, such as milk, cheese, yoghurt, and infant formula. It is noteworthy

that a greater selection of these products was found in retail establishments with high living Standard Measures (HLSM) retail establishments. Informal markets were discovered to be the main suppliers of goat meat at the community level. Most participants indicated goat meat consumption annually at 31.35%, followed by quarterly at 19.75%, and daily consumption reported at 17.65% of participants. While 12.5% indicated a weekly consumption of goat meat (once or twice a week). The least frequent consumers (6.25%) eat goat meat only once every three years. The findings revealed that household utilization of goat meat has not changed significantly, and the same behavioural pattern has persisted for goat meat primarily utilized for customary purposes, such as rituals and celebrations. Therefore, the development of goat products integrated with consumer education programs could potentially re-engineer. Therefore, the development of value-added food products could re-engineer consumer behaviour, thereby improving acceptability and optimizing the utilization of goat meat for human dietary requirements, especially in Northern KwaZulu-Natal.

Keywords: *chevon, goat products, accessibility, utilisation, consumer preference, consumption patterns.*

4.1 Introduction

This chapter presents goat products available in commercial markets, with an emphasis on highlighting accessibility as a factor that influences utilization. The array of food options available to customers shapes their purchasing decisions; thus, it is imperative to acknowledge the lack of a universally applicable approach to maintaining a uniform set of consumer preferences because every consumer has perspectives and preferences regarding particular products. Consumers' demands and motivations are complex, and they are likely to seek satisfaction at economic and social levels. Personal level satisfaction involves emotions, personality, lifestyle, and so on (Madhavan & Kaliyaperumal, 2015). Therefore, the same could be investigated for the acceptability and utilization of goat meat or goat products, particularly in this study.

Goats are species of animals that are widely distributed worldwide and are estimated to have a total of one billion heads (FAO, 2017). Nevertheless, they are underutilized for meat production, which can meet the daily dietary requirements of humans. The highest number of goat breeds have been found in Asia and Africa (Ivanovic et al., 2016). Research by the South African Department of Agriculture, Forestry, and Fisheries revealed that less than 1% of the world's goat population is produced in South Africa (Mogala, 2018). However, South African indigenous goats account for 63% of the overall goat population (Mogala, 2012). Three commercial goat breeds in South Africa have been primarly raised for meat production: Boer, Savanna, and Kalahari Red. According to Mazhangara et al. (2019), goats raised in natural veld circumstances without the use of pharmaceutical substances to enhance their output or health are referred to as "organic" or "green produce." Therefore, the "natural" or "organic" aspect gives them an advantage over competitors, since it directly addresses consumer demands for healthier food options. Thus, organically grown food and meat in this case are important to consumers; hence, developers need to be mindful of this when developing new products to maintain the ‘‘health’’ aspect that is trending. This consumer transition, from the researcher's perspective, has stimulated trial and error, passion, innovation, and many more ideas for new product development, especially in small and medium enterprises (SMEs).

De Andrade et al. (2017) indicated that consumer transition has prompted the meat industry to use advanced meat-processing techniques to fulfil consumer demand for healthy products. Teixeira et al. (2019) clearly stated that although healthier novel products are less frequent,

they can be obtained from small ruminant meat, including goat meat. Various campaigns advocate the consumption of plant-based proteins over animal protein, but these initiatives have been met with much opposition (Apostolidis and Mcleay, 2016; Banovic and Sveinsd´ottir, 2021). Instead, efforts to encourage the consumption of natural, healthier, and environmentally friendly animals are trending (Lalhriatpuii and Singh, 2021). The demand for red meat is projected to rise significantly by 2029, with per capita protein availability expected to increase from 65 to 85 g daily. This trend is supported by several factors that influence global meat consumption and production (OECD-FAO 2020). The global middle-class upturn has led to an increase in global meat demand, which has further increased the supply of meat (OECD-FAO, 2020).

Studies on current consumer trends indicate an increased demand for lean meat products with low fat and sodium content (Gadekar et al., 2014), natural and healthier novel product options with convenient attributes, while not compromising palatability (Goddard, 2019). Therefore, the use of goat meat as a healthier red meat alternative is increasing (Mazhangara et al., 2019; Lalhriatpuii and Singh, 2021). Goat meat (*chevon*) is a red meat type with high nutritional quality, but limited accessibility poses a challenge. Research has shown that social stigma surrounding meat, unreliable supply, poor quality, and a lack of established market systems are additional obstacles to its universal distribution and worldwide acceptability (Cawthorn & Hoffman, 2014; Maganga et al., 2015; Yesufu et al., 2017). As a result of localized trade and promotion, goat meat is still not considered a standard food item in many parts of the world despite its potential health benefits. A large amount of goat meat is not traded like other prominent meat varieties but is consumed locally in the areas where it is produced, both in developed and developing countries (Maganga et al., 2015; Yesufu et al., 2017). These demerits in the goat meat industry contribute to reduced goat meat product diversity. Hence, modernizing goat meat consumption could improve its acceptability for household (H/H) daily food requirements.

Less acceptability of goat meat has been associated with monotony in preparation and sensory attributes such as stringiness, toughness, and distinct smell leading to a lower acceptability of goat meat (Xazela et al., 2011; Mazhangara et al., 2019). Additionally, the lack of formalized marketing standard measures for goat meat further exacerbates the unavailability and inaccessibility of goat meat at the commercial level as well (Cawthorn and Hoffman, 2014; Maganga et al., 2015; Yesufu et al., 2017). Thus, the range of value-added goat products may

serve as a means of overcoming market barriers and enhancing goat meat acceptance among consumers. Therefore, it may be possible to improve the availability, accessibility, utilization, and acceptability of goat meat and its products by meticulous organization of food value chain components, with an emphasis on safety standards during production, processing, marketing, and distribution. In particular, we consider all the mentioned dimensions of food security towards achieving sustainability.

Therefore, in keeping with the study aim (to investigate the consumer acceptability of goat meat through the processing of value-added convenient products for household and commercial utilization), the objective of this investigation was to assess and document the original preferences and utilization patterns of goat meat/products available and accessible in the markets. Specific objectives included determining product availability and accessibility in the markets and establishing utilization patterns and preferences for goat meats/products, both at commercial and community levels.

4.2 Methodology

4.2.1 Research population

The study population consisted of retail managers or retail representatives from both formal and informal markets situated in Empangeni and Richards Bay, KwaZulu-Natal, South Africa, under the city of uMhlathuze Municipality. Study samples were drawn from various classifications of meat markets available under these two locations, including upper class, middle class, lower class, and specialized markets (butcheries and informal markets, referred to as the goat farmer group including individual or communal goat farmers), determined and informed by the following criteria:

i. Selling of goat meat in their retail stores.
ii. This belongs to one of the economic clusters named above.

The sample size was determined to be 3:1 (three retail stores and one butchery per LSM) per retail class. Due to the limiting factor of retails, the sample size was determined to observe a medium effect size with power, allowing 15 key informants in the ratio of 2:1 applied in this study. While documenting data on indigenous goat meat utilization and consumption, the sample size comprised 16 indigenous knowledge holders of goat meat located at Esikhawini and Madlankala for the Zulus and Foreign nationals and Empangeni for other ethnic groups

such as the Indians, Afrikaners and Foreign nationals. The sample size comprised four (4) participants representing each ethnic group.

4.2.2 Research technique

A quantitative approach was followed when profiling retail stores selling goat meat and goat meat products, their availability, and accessibility through a descriptive design. Moreover, an observational study was conducted using an observational checklist to document the types of products available and their forms of consumption through identified areas of access as per the living standard measure (LSM). The living standard measure according to the University of Cape Town (UCT) Liberty Institute of Strategic Marketing (2019) is an indicative system whereby the profile of shoppers is segmented according to the National Income Dynamics Survey data (NIDS). Therefore, a cohort of key informant interviewees comprising retail managers and supervisors from various classified meat markets (n=15) was conducted in the form of key informant interviews.

To collect qualitative data on indigenous utilization patterns and preferences of goats at the community level, 16 interviews with key informants were conducted with representatives from four ethnic groups (Zulu, Indian, Afrikaner, and Foreign Nationals) who are consumers of goat meat. Key informants were consulted and visited in their respective places, and an integrated study approach (mixed methods) was adopted to gain deeper insights into indigenous knowledge holders' preferences for goats and their utilization patterns at the household level. The documentary process on their original utilization and goat meat preferences was conducted through observational study, direct experiences, and discussion on types of goat meat dishes prepared at the household level, as well as consumption patterns.

4.2.3 Study research procedure and the sampling technique

4.2.3.1 Profiling the retail markets for goat meat products

The strategy of nonprobability sampling, known as the purpose-examining strategy, was used to outline the retailers selling goat meats/products in KwaZulu-Natal, uMhlathuze Municipality. In this regard, retail segmentation and LSMs informed the researcher that retail store categories should be included in the study. For retail representatives (RRs), a purposive quota sample of these participants was adopted, determined, and informed by the following criteria:

1. Selling of goat meat in their retail stores.

2. They should belong to one of the following economic clusters:

   a. *lower economic class meat seller*
   b. *middle economic class meat seller*
   c. *upper economic class meat seller*
   d. *specialized meat markets*
   e. *informal meat markets*

4.2.3.2 Documentation of the traditional goat meat utilisation patterns and preferences

A non-probability sampling technique, snowballing, was used to identify key informants who were knowledgeable about goat meat/product utilization and preferences. A purposive quota sampling of key informants who are goat meat consumers between the ages of 40-70 years from the four dominant ethnic groups of KwaZulu-Natal (*Zulus, Indians, Afrikaners, and Foreign Nationals*) were intentionally selected to participate in the study. These groups were targeted and invited to participate in the study as knowledge holders of indigenous communal utilization and preferences for goat meats/products. Therefore, goat meat utilization patterns and preferences of goats were specifically gathered based on their knowledge and settings to develop a holistic view of the original perspectives across various ethnic groups.

4.3 Ethical considerations

The study was conducted after the researcher received permission to proceed through an ethical clearance certificate issued as an authority to pursue a research project with the protocol reference number HSSREC/00003190/2021 (Appendix C). Furthermore, the study followed the necessary ethical protocols by requesting key informants (retail managers/representatives) and indigenous knowledge holders to sign a consent letter, which confirmed the participation of the respondent in the study and allowed the researcher to give a brief introduction to the study's aim and objectives. This process allowed the researcher to emphasize the important role of the participants in the study while assuring confidentiality, as stated in the ethical statement, and the protection of the participants as per privacy and anonymity assurance. Before commencing each session, the interviewees were reminded that their participation in the study was voluntary and anonymous, with the full right to withdraw at any time without incurring any recourse.

4.4 Management and Data Analysis

The descriptive results outlining retail stores as per the LSM categories that sell goat products and types of goat products available in the market were captured and coded into Microsoft® Office 365, a word presented in the form of a table according to food security parameters (availability, accessibility, utilization, and stability). Demographic data on retail managers/representatives were coded onto a Microsoft® Office Excel spreadsheet and reported in the form of descriptive statistics and frequencies. The indigenous knowledge holders' demographic data were captured using the Statistical Package for Social Sciences (SPP) Software version 28.0 and reported in the form of descriptive statistics. Qualitative data from the key informants were analyzed by explaining the content and concepts acquired from the discussions made through the interview guide (Appendix F). Key informant interviews were recorded, transcribed, and verified by participants. Moreover, coding was conducted, themes were created by identifying keywords, and they were used to present explanations and interpretations of the participants using NVIVO-12. Thereafter, a content analysis was conducted.

4.5 Results and Discussions

4.5.1 Participants demographics

Table 4.1 presents retail managers' demographics, who played an important role in the management positions of both commercial and informal markets of goat meats/products surveyed . The demographic data provide a general overview of the people who mostly manage formal and informal markets. Notably, the demographic features of retail managers are vital in the business sector, as this may influence many elements of business management, including marketing strategies, product development, customer service, and staff management (Oduro-Ofori, Aboagye and Acquaye, 2014). The study population was predominantly males, with the majority having secondary education in Table 4.1. Most participants were married and geographically, 60% were from Empangeni, and 40% from Richards Bay. The retail classification is fairly evenly distributed across the informal, lower, middle, and upper categories, with each representing approximately 26-27% of the population.

Table 4. 1: The Retail Managers/Representatives' Demographics (N=15)

Characteristics	Categories	Frequency (%)
Gender	Male	73,3
	Female	26,7
Age	35-40	31,3
	41-45	25
	46-50	6,3
	Above 51years	37,4
Level of education	Primary	7,3
	Secondary	53,7
	Tertiary	39
City	Richard's bay	40
	Empangeni	60
Retail classification	Informal	26,6
	Lower	20
	Middle	26,7
	Upper	26,7

As presented in Table 4.2, Indigenous Knowledge Holders (IKH) participated in the study as locals/key informants in the aspect of communal utilization and consumption preferences of goats, most of whom were above 40 years of age, thereby indicating a level of maturity and experience in indigenous knowledge of their areas of interest. Indigenous knowledge holders on goat meat consumption patterns, utilization, and preferences are represented in each of the following ethnic groups (Zulus, Indians, Afrikaners, and Foreign Nationals). The demographic characteristics of IKH are described below.

Table 4. 2: Indigenous Knowledge Holders (IKHs) at household level (N=16)

Characteristics	Categories	Frequency (%)
Gender	Male	31,3
	Female	68,7
Age	40 - 50	20
	51 - 60	53,8
	61 - 70	26,2
Ethnic group	Zulus	25
	Indians	25
	Afrikaners	25
	Foreign nationals	25
Religion	African traditional religion	12,5
	Christian	12,5
	Islam	31,25
	Hindu	43,75
Performed household Practices	Religious practices	26,6
	Cultural practices	20
	Both religious and cultural	26,7
	None	26,7

4.5.1.1 Gender

The majority of IKHs at the household level (Table 4.2) was predominantly females, represented as active participants in household goat meat preparation and cooking. Contrary, the minimum indigenous knowledge holders in retail marketing of goat products (RR) were females, versus the majority who were males. The findings on RRs confirmed the stereotype denoting male positions in the formal sector. Table 4.1 shows that most of the individuals involved in commercial retail markets were males, compared to females.

4.5.1.2 Age

The average age of both IKHs (retail managers of formal and informal goat product markets and goat meat consumers of different ethnic groups at the household level) was 45 years. As a result, maturity and experience in the fraternity were indicated. The majority of the study participants were over 50 years, followed by the participants ranging from 35-40 years, and the least group of participants were 45-50 years. These results conformed to the requirements of the study that targeted key informants aged 40 to 70 years for the documentation of traditional

goat meat utilization and consumption at the household level. According to Miralles (2016), older workers are generally viewed as more reliable and committed, often bringing a wealth of expertise and knowledge into their roles. Their extensive experience can result in younger workers.

4.5.1.3 Educational level

The majority of total participants completed secondary education, whilst the minimum group had attended the tertiary education, and least had lower levels of primary education. In this regard, Lubambo (2011) confirmed that educational level influences decision-making capacity and is strongly tied to business success. Oduro-Ofori et al. (2014) emphasized that returns on business productivity improve as the educational level increases. It was further established that educational level also matters in the management of retail stores, as 53.7% of the respondents had formal/secondary education, 39% had attended tertiary education and only 7,3% had levels of education lower than matric, but this was coupled with onsite training and workshops, as per the findings.

4.5.1.4 Religion

Religious traditions have a significant impact on what is being bought and consumed in the household (Khumalo, 2017). There are religious traditions that prohibit the use of certain meat, such as beef, pork, or other meat types, which is acceptable and not prohibited for others (Teixeira et al., 2020). Specific consumption patterns and preferences for goat meat are dictated by the cultural and traditional backgrounds and socioeconomic status of the community. Virtually, there are no religious or cultural taboos on the consumption of goat meat (Casey, 2005).

4.5.1.5 The geographical location of Retail Meat Markets

The study found that the majority of retail managers, spanning both formal and informal markets, were based in Empangeni, and the remaining 40% operated in Richards Bay. Results show that 26.7% of retail stores sold goat meat and related products catered to the upper-class market, with an equal percentage (26.7%) catering to the middle-class market. In contrast, 20% of these retail stores served the lower-class market and 26.6% represented the informal market. These findings indicate that upper- and middle-class retail stores are the primary suppliers of

goat meat and its products at the commercial level, whereas the informal market serves as the main source of goat meat at the community level.

4.5.2 Goat meat/product availability and accessibility in retail markets

This section presents the findings on the availability, accessibility, utilization, and stability of goat products in both formal (commercial) and informal markets. The analysis focuses on the commercial landscape, as goat products, though commonly available within the KwaZulu-Natal Province and across South Africa, are only selectively offered in certain retail environments at the commercial level.

As indicated in Table 4.3, goat meat and related products are available in both the commercial and informal markets. However, accessibility remains limited by affordability and physical availability as these products predominantly appear in higher-end retail spaces. The price of a litre goat's milk significantly exceeds that of a cow by 2.99%, according to the Woolworths online catalogue, March 29, 2024. Comparatively, in 2017, the cost of raw cow milk was around R11.99 per litre (Tomić, Milić, & Janković, 2020), underscoring the considerable price disparity between goat and cow milk products over time. The current cost of goat milk, at R29.99 per litre, suggests that certain goat milk products may only be accessible to particular socioeconomic groups, likely targeting specific consumer demographics.

Market segmentation in retail plays a significant role in this accessibility gap, as goat products are predominantly distributed across upper, middle, and specialized retail settings, including butcheries and informal markets. This segmentation, which is aligned with Living Standards Measure (LSM) categories, reflects classifications such as upper-class, middle-class, and lower-class markets, shaping both availability and customer targeting within the goat product market.

Table 4. 3: Goat products profiling for utilisation using Food Security Parameters

Availability *In what food item form is it available?*	**Accessibility** *In which retail class versus price?*		**Utilisation** *How is it utilized and by who?*	**Stability** *Seasonality versus availability and frequency consumption of purchase*
Milk	Upper and middle-class	1L = R25.99	• There is a perception that milk boosts sexual drive, especially among men. • It is purchased by health-conscious consumers to boost their immune systems.	• Available based on the economic formulae used by the respective retail store based on the supply and demand.
Cheese	Upper class only	R45.99/ 100g	• Replacement of other cheese types as it is preferred for immune boosting and less fat for healthiness. • Literature also revealed that people with mild cases of lactose intolerance can tolerate goat milk better than cow's milk.	
Yoghurt	Upper class only	R39.99/ 500g		
Infant's milk	Upper class only	R259.99/ 850g	• Frequently bought for infants mainly with eczema.	
Meat	Middle-class and specialized market	Ranges around R143.03/ kg	• It is used for stews, curries and grilling by foreign, white and Indian ethnic groups.	• Frequency differs as per the need and ceremonies to be performed. Most purchases that occur weekly are for funeral rituals. • Seasonal purchases are around June/July and also around September -October, • Hindus and Muslims mostly make purchases around July and October. • Each ethnic group has their preferred method of slaughter according to their religious beliefs.
Live goat	Informal markets	Small –ranges from R1000-R1500	• Utilized for ceremonies and rituals. Mainly the consumers include Zulus, Indians and Hinduism and Islam religion believers.	
		Big - ranges from R1500-R3000.		
Slaughtered and dressed by request	Informal market	From R1800 – R2300	• It is consumed as a delicacy and a treat to remind individuals about their identity. Especially amongst the modern Zulu ethnic group. For foreign and other groups, it is for regular consumption as another type of meat in their cupboards.	

Table 4.4: Exhibits the stability trends of goat meat

Product	Company name	Volume/ Weight	Price	Price/kg	Frequency of purchase
Sells goat meat products online: Half goat meat box (Goat chops, goat leg, goat stew/mince, goat shoulder chops)	Incoso Goat meat	10kg	R1780.00	R178.00	Highly in demand. They deliver 50kg per week (10 boxes).
a) Pre-marinated goat meat (in a bag)		2kg	R350	R175.00	
b) Assorted processed goat meat box		5kg	R890	R178.00	
c) Fresh goat chops		2kg	R346	R173.00	
d) Two-course meat platters		2kg	R300	R150.00	
Product		**V/Wgt**	**Price**		**Frequency of purchase**
Selling *live goats* and *goat meat* on customer request: a) *Live goats*	uMzamo Goat Farming	Small Big	R1000 – R1500 R1500 – R3000		Frequency differs as per the need and ceremonies to be performed. Most purchases that occur weekly are for funeral rituals. Seasonal purchases are around June/July and September-October, Indians use goats to perform ceremonies too. Frequency differs as per the religion and type of ceremony to be performed. Muslims purchase goats around July. Hindus make purchases from July to mid-September. For Hindus, no prayers from mid-September to mid-October, which is the fasting month, and no meat is consumed during that period.
b) *Goat meat* (stock for slaughter price is between R1800-R2300)	Maqhude Butchery	Small - Big	R1800 R2300		
Goat meat chops (No other product except meat and not consistently available)	Five Ways Mall - Spar	0.98kg	R118		Every afternoon observation checks at 14h00 for two weeks - no goat meat found on refrigerator shelves. Customers even put in requests to be called once the goat meat was in stock. The witnessed customer who placed the request was a male. It was observed that goat meat chops were expensive compared to the same kilogram of mutton chops.

Table 4.4 presents the stability trends of goat meat and purchase frequency at various marketing levels. The data revealed a consistent and high demand for goat meat, with suppliers delivering approximately 50 kg weekly (10 boxes), although frequency and quantity vary depending on the cultural or ceremonial needs at hand. Weekly purchases are primarily driven by funeral rituals, underscoring the significance of goat meat in specific cultural practices. Demand surges seasonally, particularly in June-July and September-October, coinciding with periods of traditional and religious observation that intensify purchasing needs.

In the Indian community, the ceremonial use of goat meat is shaped by religious and cultural practices. For instance, Muslim customers significantly increase their purchases in July, while Hindus predominantly purchase from July to mid-September. During the Hindu fasting period (mid-September to mid-October), demand drops because meat consumption is typically avoided. This variation in demand illustrates the important role of goat meat across religious groups as well as the impact of religious observances on purchasing patterns.

Furthermore, observations conducted every afternoon at 14:00 over two weeks showed a recurring shortage of goat meat on refrigerator shelves, indicating unmet demand at the retail level. Customers have adapted to request notifications when the goat meat is restocked. One observed instance involved a male customer specifically asking to be informed about restocking, which reflects a proactive consumer approach due to frequent supply issues. Notably, goat meat chops are priced significantly higher than mutton chops of the same weight, suggesting a market premium that may be influenced by the cultural and ceremonial value of goat meat. This pricing may also restrict accessibility to lower-income consumers, highlighting an economic barrier to consumption for certain groups.

As reported in the literature, one challenge in consuming goat meat is that it is not recognized as a valuable food item in terms of its nutritional value and health properties (Teixeira et al., 2019; Teixeira et al., 2020). In this study, the segmentation of the goat meat market, structured by cultural, religious, and seasonal demands, suggests the need for responsive supply strategies to align with consumption peaks. Additionally, the observed price disparity raises questions about the accessibility of goat meat to economically diverse groups, particularly given its elevated status in cultural and ceremonial contexts. This intersection of high demand, cultural significance, and economic accessibility highlights a unique market dynamic, warranting

further exploration to better understand supplier responsiveness, consumer accessibility, and cultural embeddedness of goat meat within these communities.

According to Visser and Van Marle-Kooster (2017), South Africa has a thriving goat business that comprises fibre, meat, and dairy-producing goat varieties and "KwaZulu-Natal has a goat population of one million, almost all of which are in communal areas" (Stewart, 2000). Hence, literature shows that KwaZulu-Natal produces such large numbers of goats annually, and there is a significant market for the manufacture of goat meat and products. Nevertheless, the findings reported that the stability of goat meat is usually not consistent during certain seasons due to the limited consumption of goat meat. There are peak periods for its demand; however, goats are regarded as climate-smart livestock and are abundantly reared and available throughout the year in the province, even in rural areas.

4.5.3 Stability in Goat Meat Supply and Availability Across Market Levels

The stability of goat meat supply and availability, as depicted in Table 4.3, reveals that access to goat meat products is contingent upon specific needs and events, limiting consistent availability across various economic and social strata. This selective accessibility indicates that goat meat products remain largely restricted to individuals at particular economic levels, thereby excluding a significant portion of the population from regular access. Observations from this study showed that the most stable form of access to goat meat is through the purchase of live goats. However, the use of live goats is predominantly seasonal, aligning with cultural and traditional ceremonies, which restricts year-round availability in formal retail settings.

These findings are supported by Ntuli and Fourie (2022), who found that abattoirs are among the least-utilized marketing channels for goat meat (4%), with most goat sales occurring through auctions (14%), butchers (10%), and informal traders (12%). These marketing channels, particularly in the informal sector, play a crucial role in supplying goat meat for cultural and traditional purposes. However, the choice of these channels is often influenced by factors such as market availability, prices offered, and geographic proximity to the market, as noted by Sehar (2018:9). This variability in channel preference reflects the underlying challenges in maintaining a stable and accessible goat meat supply, as market structures favour intermittent rather than consistent distribution.

Ultimately, the findings underscore a stability gap in the goat meat market, where regular retail-based supply channels are underdeveloped, and seasonal need-based demand leads to an

uneven supply chain. These dynamics reveal the socio-economic disparities that influence accessibility, whereby goat meat, due to its cultural significance and limited supply infrastructure, remains a niche product largely accessible to higher-income consumers or those directly involved in cultural and religious practices. This highlights the need for more inclusive marketing strategies and infrastructure improvements to ensure broader access to goat meat across socioeconomic groups.

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4.5.4 Consumption and frequency of goat meat

Figure 4.2 shows the frequency of goat meat consumption while illustrating varied consumption patterns and underlying motivations across demographic groups. Although the reasons for and frequency of goat meat consumption differ, they are interrelated, with cultural and racial influences playing significant roles. The data indicated that the highest consumption frequency is on an annual basis, followed by quarterly consumption. A small proportion of

participants reported consuming goat meat as part of their daily diet, going further down to weekly, and twice weekly. A minimal percentage reported the lowest frequency of consumption, limited to once every three years, likely corresponding to specific cultural or ceremonial events that dictate these intervals.

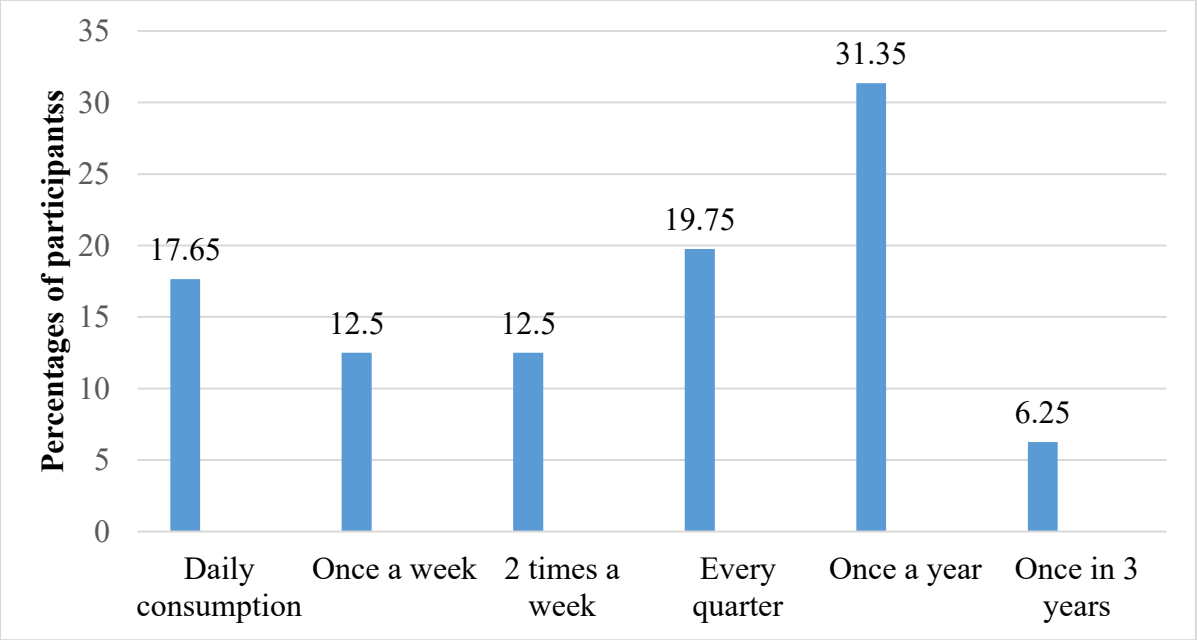

Figure 4. 1: Consumption frequency of goat meat

These findings align with those of Borgogno et al. (2015), who noted that variations in consumption frequency within a single community are common, particularly when the food in question has cultural significance and is not part of the regular diet. Such diverse consumption frequencies within the same community suggest that goat meat fulfils both regular dietary needs and specific ceremonial roles, highlighting its dual function as a staple for some and a culturally reserved food for others.

4.6 Occasions in which goat meat dishes are consumed

Goat meat is traditionally consumed during various events and cultural gatherings. These occasions include religious and cultural ceremonies, family gatherings and celebrations, festive holidays, community and social events, special occasions, and feasts. On various occasions, this influenced participants' consumption of goat meat, as shown in Figure 4.3. Thirty-seven percent of participants who consumed goat meat indicated that the main contributory factors for goat meat consumption were celebrations and were meant to be honoured. About 34.3% of the knowledge-holders reported traditional ceremonies as part of the important occasions influencing goat meat consumption. However, 11.4% of goat meat was consumed as a special

treatment and respectively (11.4%) was another significant contributor occasions in the consumption of goat meat. However, (5.7%) was for dietary diversity purposes.

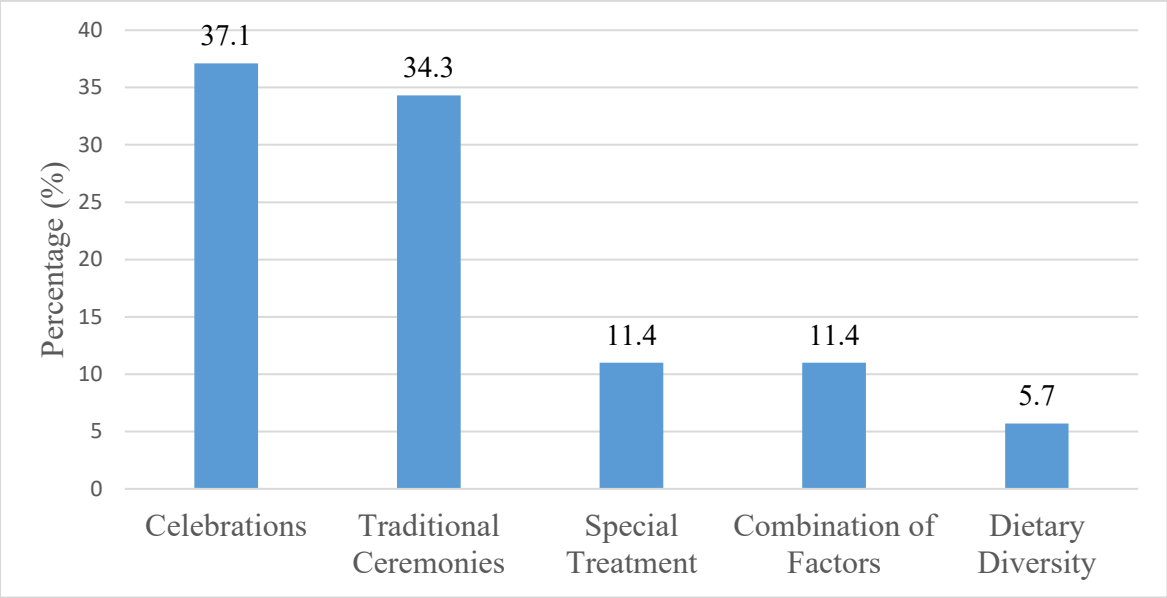

Figure 4. 2: Various occasions in which goat meat is consumed

Although the dietary diversity factor was not dominant, recent studies have reported an increase in healthy food demand for human dietary requirements among health-conscious groups (Right Choice, 2014). In a study by Teixeira et al. (2020), natural goat meat qualities (gamey meat type, nutritional profile, and flavour) were identified as one of the major drivers of goat meat consumption among consumers in Mediterranean countries. However, Soji and Muchenje (2017) revealed that the strong aroma had an impact on marketing initiatives aimed at boosting goat meat consumption in South Africa, as well as its commercial availability. Thus, consumer intake is important, as some consumers have grown loyalty and preferences for original food attributes.

4.7 Qualitative results emerged from the semi-structured interviews with indigenous knowledge holders.

Themes were identified through interview-guided discussions to establish indigenous utilization patterns and chevon preferences. Relevant quotes from the data generated from the key informant interviews were used to support the discussion on the themes. The data from the key informant interview guide were transcribed verbatim and used during the discussion; the names of interviewees were not required to ensure anonymity. The analysis of the data gathered from the guided key informant interviews resulted in the identification of themes and subthemes highlighted in Table 4.4.

Table 4. 5: Themes and subthemes identified based on goat meat utilisation and preferences (N=16)

Themes	Subthemes	Summary
Sources of goat/goat meat versus specification dynamics	• Sources and forms of goat products • Frequency of accessing goat meat • Utilisation and consumer preferences for goat meat	*Sources and forms in which chevon is sourced vary as per consumer preferences, as consumption frequency is found to differ based on consumer needs. However, similarities and differences were observed among the participants.*
Pre-preparation techniques – common and different practices	• Goat meat treatment: purchased for stew, curry, or grilling • Live goat meat (slaughtered at home) • Meat portions used for different dishes • Goat dishes and complementary foods	*Goat meat either from the commercial market readily packed or through live goat meat slaughtered at home undergoes a certain treatment before and post-slaughtering process for various expected meat qualities.*
Driving factors for goat meat demand	• Healthy lifestyle preference • Health properties • Medicinal properties • Cultural and traditional important • Consumer preference	*Various factors influence consumers' drive for goat meat/products liking and purchases. Besides cultural and traditional importance, lifestyle, health and medicinal properties, familiarity, and product knowledge are the most important drivers of goat meat and product acceptance.*
Attitude toward Goat Meat and its commercialisation	• Mixed attitude • Negative attitude • Positive attitude	*Consumers' prior exposure, knowledge, experiences, and sensory diversity are important contributory factors in consumer attitudes toward meat and product consumption.*
Future of goat meat	• Main consumers and expectations	*Effective utilisation of Chevon considers supply and demand to be relevant and efficient for well-oriented consumers.*

4.7.1 Theme 1: Source of goats/goat meat versus specification dynamics

Depending on the purpose, goats were obtained through domestication in households, farms, local markets, retail establishments, and speciality shops, such as butcheries. The key informants, who were referred to as indigenous knowledge holders, provided a guide on the specification for goats, although there were certain agreements and disagreements on the perspectives that informed the ethnic group's beliefs. Therefore, dynamics regarding the preferences of goats cannot be ignored, as these play a vital role in influencing their utilization.

Various knowledge holders interviewed accentuated that:
"The selection of goats in terms of gender and colour is also based on the type of ceremony to be performed. For example, the bad luck cleansing ceremony strictly makes use of the black goat to wash away the spirit of darkness" (IKH#*16).* However, an Indigenous knowledge holder (IKH #14) indicated the following.
"Whenever we are performing ceremonies like funerals, unveilings, weddings, welcoming of a newborn baby and many more, there are no specifications in terms of goat gender or colour".

The frequency differs according to religion and the type of ceremony to be performed. Muslims bought goats in July, while Hindus bought goats from July to mid-September each year. Hindus observed a month-long fast from the middle of September to mid-October, during which they do not pray or eat meat. From the perspective of Hinduism, animal sacrifice is part of their cultural rituals, in which goats are offered to the Hindu deity Kali in order to appease her wrath and seek her blessing. The belief system for Hindus is mostly about the pouring of blood for purification and to pacify bad spirits (Singh, 2020). For Muslims, goats are slaughtered following halal slaughter methods to commemorate Eid al-Aidha (Aghwan and Regenstein 2019). Islam provides a basis for slaughter, and the Arabic word *halal* is permissible. One cut of the jugular vein during *halal* slaughtering and a windpipe with a single swipe is practical (Zainalabidin et al, 2019). *The halal* slaughtering process enables rapid bleeding, which reduces product (goat meat) deterioration and extends the product shelf life (Farouk et al. 2014).

4.7.1.1. Goat age and sex

The effects of age and sex on the quality of meat were highly irradiated in the statements made by the knowledge holders as follows:

"Very young goat, especially legs for roast and chops for braai" (IKH #11).
"Young animal of 24 months, especially the ribs and chops" (IKH #12).
"Not the too-old one as it is too tough and the too-young one is said to be immature and very lubricant with a lack of taste" (KH #15).
As with most livestock species, the age and sex of goats influence their meat properties and relative values. Young goats generally produce more tender meat than older goats (McMillin and Brock, 2005), according to Smith et al. (1978), conformation and breed may influence the effect of age on meat properties. As for age and gender specification, agreements in the study indicated that the acceptable slaughtering age for goats is between 2 years and 2 ½ years for meat consumption. Therefore, these findings concur with the reported age recommended in other studies (Simela and Webb, 2011; Teixeira et al., 2020; Lalhriatpuii & Singh, 2021).

On the other hand, there was a contradiction regarding whether meat sourced from male goats was acceptable or not, as other IKHs preferred female goats because it omitted less odour and reduced cooking time when compared to its counterpart. Again, differences came up in the type of male goat used to perform the ceremony or the ritual. Indian groups again preferred to utilize the male goat that is not castrated, while the other ethnic group (foreign nationals and Zulus) preferred that male goats should be castrated to eliminate their strong smell. The Indian ethnic group believed that female goats were not an option for consumption and worse for their rituals. One of the Indian knowledge holders declared that *"goats should not be castrated especially for the cultural sacrifices" (IKH #7)* and the other confirmed that "*we only slaughter male goats, not female goats because they are regarded as a mother and you may never know whether a female goat is pregnant or not" (IKH #5).* This is another sense of respect given to animals of Indian ethnicity.

Concerning animal gender, the following was highlighted by the key informants concerning gender preferences:
"The female goat is preferred over the male goat because the female goat doesn't have a strong odour (IKH # 1; IKH # 13). He-goat is known for its strong odour. If it's a he-goat, it must be castrated at a young age to eliminate that nature of the he-goat. That again helps the he-goat to grow in the form of a normal she-goat" (IKH #1). McMillin and Brock (2005) in agreement with the findings, stated that the increased age of goats was reported to increase drip loss, with the meat from seven to eight permanent incisors. Goats of this age are judged to have lower initial and sustained juiciness than goat meat for younger animals with no permanent incisors.

4.7.2 Theme 2: Pre-preparation techniques – common and different practices

Across the four ethnic groups interviewed, there were common practices regarding the preparation and cooking of goat meat for purchased or home-slaughtered goats.

4.7.2.1 Treatment for goat meat purchased for stew, curry, or grilling

All preparations began by washing the meat in water with vinegar (2 L water: ½ a cup of vinegar) as a means to reduce the smell. This also influences aroma and tenderness. The combination of tomatoes and onions was used in the cooking process to counteract the strong odour while enhancing the flavour. In addition, tomatoes are acidic and contribute towards the tenderization of meat. Complimentary, ginger, garlic, and masala are common spices used to reduce smell and enhance flavour. Generally, two cooking methods are utilized: the meat is first boiled (moist heat preparation) to tenderize the meat and then treated with another cooking method: dry/moist or a combination of flavour enhancers (pot roast, frying, stew, or curry dishes) to improve palatability. Preparing the meat by applying the steaming method with flavour and tenderizing enhancement conditions was also common, either curry or roast. For grilling and roasting, marination was recommended to allow the meat to absorb the flavours and for tenderness.

4.7.2.2 Live goat meat slaughtered at-home treatment.

Among the Indian and African ethnic groups, specific practices are performed to clean, tenderize, and reduce the smell of goat meat. These included slaughtering the goat a day before and allowing the carcass to rest overnight, followed by washing with water and vinegar. Indian groups also use maize-mealie to rub off fine hairs before washing them with water and vinegar. The meat is then chopped into pieces and prepared according to the traditional methods for grilling, stewing, or making curries, often for ceremonial purposes.

For ceremonies, the respective prayers were conducted before any other process. However, this is just a practice for ancestors and has nothing to do with the enhancement of meat. There is a unique practice reported by the Nigerian knowledge holder, who mentioned that a goat is just not skinned off but is burnt over the wood fire to remove hair. Thereafter, a knife was used to scrape off the burnt hair and the meat was thoroughly washed with clean water. It is believed that smoke reduces the smell and enhances flavour. It is quite interesting that the ethnic groups have accepted that goat meat has a strong smell; however, they have found a means to mask

and reduce the smell by using certain techniques acceptable to their respective groups. The combination of tomatoes and onions and the use of masala and ginger spices are common ingredients in all recipes for cooking goat meat across all ethnic groups.

The indigenous knowledge holder from Zulus mentioned that "*the younger the animal, the more tender the meat, especially female goats. However, gender does not matter to us, because of the special technique that is applied in male goats and in that way, any part of goat meat is nice in its way with no smell" (IKH #13).* The knowledge holder stated that there are glands located in the hind legs, which are the primary source of the strong odour of goat meat. Once these glands were removed, there was no goat odour. Once cooked, it can be identified as a lamb or mutton. Goat meat is unique but certainly not inferior to lamb (Webb et al., 2005), but the key influential factors to be considered in terms of goat meat quality include breed, gender, age, and weight of slaughter (Toplu, 2014).

4.7.2.3 *Meat portions used for different dishes*

As per the IKHs interviews, all parts of the goat can be eaten, including the head, blood, trots/hooves, intestines, and other internal organs, such as the liver, heart, lungs, and kidneys. Others ate the skin. Xazeka et al. (2011) further indicated that most of these parts are usually accompanied by indigenous vegetables and pap or stiff porridges. According to Webb (2014), countries differ in terms of goat cut utilization based on the muscle type and cooking method. Equally, most counties use sheep grading and classification systems for goat carcasses because of the lack of specific systems for goats (Webb et al., 2011). Figure 4.1 indicates lamb meat cuts, which are also used for goat meat cuts in commercial markets. However, it is different when slaughtered in the household or for rituals.

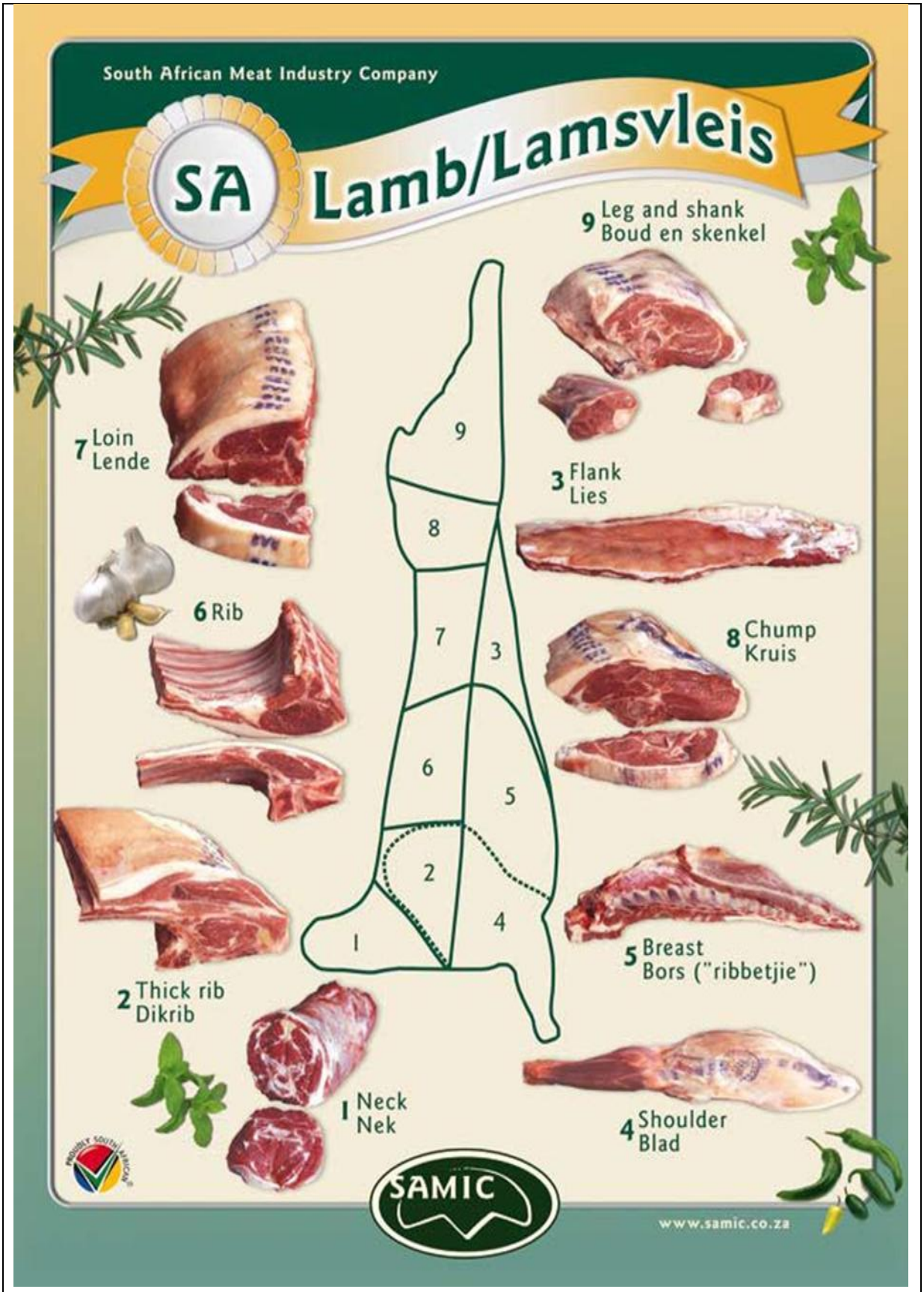

Figure 4. 3: Cuts of a goat carcass are done as shown for Lamb, Source: South African Meat Industry Company (2022)

Table 4. 6: Goat meat favourite dishes and complementary foods particularly for surveyed Ethnic Groups (N=16)

	Favourite dishes	**Meat portion**	**Cooking style: Moist/ dry/wet fry/ Processed**		**Complementary foods served with**
Foreign nationals: *(a) Nigerians*	Pepper soup	• Tripe, intestines, liver, kidneys	Boiled		Served with rice/yam/bread
	Nsala soup	• Any flesh meat parts and hooves	Boiled		Semolina or pap
	Isi-Ewu (special dish)	• Goat head alone,	Stew		Served as a dessert after the main food / anytime.
(b) Congolese	Pepper soup (special dish)	• Head and hooves	Boiled		Vegetables/ pap/ cassava/ kwanga or banana plantains.
	Goat fried meat	• Shoulder chops		Wet fry	Serve hot with pap/ rice/ kwanga/ cassava.
	Braai meat *is called "abri"* and ribs are called "cote" in French	• Ribs, chops, lions		Braai	Serve and enjoy with pap/ kwanga
kenyans	Goat meat stew *called "mbuzi stew"*	• Legs, shoulder and any borne-meat parts	Stew		Served hot with ugali (Kenyan pap), rice, chapatti
	Mbuzi choma (Roaste goat)	• Shoulder chops, lions		Braai	Serve with pap, kachumbari
	Pilau,	• Flesh meat from legs and shoulders	Biryani dish		Goat meat biryani dish served with kachumbari
(c) Zambians	Offals dish *called "nkhulungila"*	• *Stomach (tripe), intestines*	Boiled		Served hot with "papua" (pap)
	Fried goat meat	• Ribs, leg chops, loin chops		Wet fry	Rice/ pap/ cassava
	Goat meat soup called *"Soup yambzi"*	• Legs, chunks of meat and bone-meat parts	Stew		Served with brown rice, cassava/ pap

Afrikaners	Braai	• Leg chops, loin chops, heart, liver		Braai	Pap/ phuthu, tomato salad
	Roast leg	• Leg and shoulder		Roast	Roasted potatoes, green beans, sweet pumpkins,
	Pasta dish and spaghetti with meatballs	• Flank, neck, shoulder, ribs		Minced meat	Served with any vegetable as a side dish.
Indians	Goat meat curry	• Flesh meat- flank, ribs, neck and tail,	Curry		Served hot with rice, bread, roti
	Roast leg/shoulder/chops (Oven/pot roast)	Leg shank and shoulder		Roast	Served hot with rice and any vegetable side dish
		• Heart, kidneys and liver		Fried	Served with bread,
		• Stomach towel, bible tripe and intestines	Boiled	→ Wet fry	Served as a starter with roti
Zulus	Insides	• Heart, liver, kidneys, lungs, tripe, intestines	Boiled with salt		Served hot as stater or supper with pap
	Boiled meat	• Breast, legs, shoulders, head and hooves	Boiled with salt		Can be served hot or cold with doublings

4.7.2.4 Common home-based cooking methods applicable across the ethnic groups

All groups confirmed the use of different cooking methods for goat meat. However, the Zulu nation is the only ethnic group that has confirmed boiling as the only cooking method for goat meat without the need for additional cooking treatments. Other groups have used boiling as the first cooking method, followed by roasting or frying as the second cooking method to add flavour to the meat. However, ethnic groups have accepted that the slow cooking technique is key to perfect oven-roasted, pot-roasted, curried, or stewed goat meat, irrespective of the animal's age. Thus, the taste, flavour, and nutritional content of the meat are maintained. Wood fires have been praised over charcoal for braai, pot roasting, and curries or stews. The Indian knowledge holders interviewed stated the following:
"We like to use the tougher meat for curries and slowly cook on fire using a long thick-based pot because wood fire gives a different awesome taste and flavour as well" (IKH #5).

"Smoked goat meat is highly preferred when it is done over a wood fire. Then it can be cooked in whatever way or boiled with tomatoes", said the Zambian knowledge holder (*IKH #4)***.** This is believed to give a pleasant aroma when the meat is roasted, grilled, or cooked over a wood fire. In preparation for grilling and roasting, ethnic groups have accepted that goat meat is tough; therefore, the following ingredients are commonly used to tenderize meat (lemon, vinegar/yoghurt, and normal commercial tenderizing spices by all ethnic groups to soak meat for about an hour before any dry cooking method.

4.7.3 Theme 3: Perceived medicinal benefits driving demand

The choices and preferences of consumers are influenced by their lifestyle; choosing to live a healthy lifestyle is another identified driver of the availability of goat products in markets. Healthy lifestyle preferences, medicinal properties, exposure, and product awareness were the most influential factors in the study of goat meat demand. The study findings further concur with previous literature reports by Casey (2005) that consumption patterns and preferences for goat meat are further dictated by personal lifestyle and socio-economic status, in addition to cultural and traditional backgrounds. *"For health reasons, goat meat is good for silent diseases like the heart because it is lean" (IKH #6).* Complimentary refers to the belief that these products have medicinal properties. The medicinal practice reported by the Nigerian and

Zambian knowledge-holders who mentioned that *"for medicinal use of goat meat – when man starts to fail sexually or grow older and have a problem with libido or no desire for sex for whatever reason, the older people advised the wife to buy the goat's sex organs (goat's penis, scrotum and testicles) from where goats are slaughtered and roast them nicely until are well done for the man, and give the men to eat to gain the healthy libido. The man would then gain the sexual interest and bounce on the women like a he-goat" (IKH #1; IKH #4).* King (2004) said, "Goats are used as experimental animals for medicinal purposes," while Alvites et al. (2021) in agreement with King said, numerous scientific disciplines, including nutrition, parasitology, immunology, infectious illnesses, chemotherapy, psychology, physiology and reproductive medicine, use goats as animal models in their research. Goat milk soap is a prominent goat product that repurifies skin conditions, such as eczema, acne, and dry and itchy skin.

However, some still use goat meat only for cultural or traditional purposes.
The study findings revealed that other ethnic groups, Indians - Hindus and Muslims in particular–strictly utilize goats only for ceremonies and ancestral appeasing events, which is the only time they consume goat meat. In other ways, Hindus, in particular, use mutton and lamb for household red meat consumption because they do not consume beef, as per the findings of this study. Goat meat products have reached almost all other market types as opposed to other red meat products. Therefore, it can be argued that goat meat is less acceptable and thus less available as a commercial food item owing to a myriad of factors that could include beliefs, preferences, and consumer acceptability attributes, as these have been reported as barriers to the promotion of its utilization (Mazahangara et al., 2019 and Teixeira et al., 2020).

This argument is validated by the dearth of availability of goat meat and its products in retail, targeting the lower class. However, markets targeting lower classes also respond to the demands and preferences of consumers, for example, by selling live goats. These findings indicate that the stability of goat meat is usually not constant during certain seasons because of the limited consumption of goat meat based on peak periods for demand. The demand for goat meat and its form of utilization varies according to the needs and specifications of the consumers. The highest price in the United States was found not to be stable, but to coincide with religious and ethnic holiday dates, the price per live-weight goat is higher in winter and the beginning of spring (McMillin and Brock, 2005) in agreement with the study findings.

4.7.4 Theme 4: Driving factors for lack of demand

The findings revealed a complex interplay of factors influencing the consumption of goat meat and related products, primarily revolving around issues of exposure, familiarity, awareness, and product variety. One of the central barriers to goat meat consumption is the lack of exposure and familiarity with the product. Consumers often lack awareness and product knowledge of goat products, which is a significant impediment to purchasing and consumption. This limited awareness, particularly in higher-end retail environments categorized as high living standard measure (HLSM) stores, constrains consumer choice due to a narrow product range. Consequently, the availability of diverse goat products in these stores appears to be a critical factor in shaping consumer decisions.

Prior research by Borgogno et al. (2015) highlighted that goat meat consumption remains low on a familiarity scale. Only 44% of participants reported occasional consumption, while a mere 6% identified themselves as regular consumers of goat meat. This trend is not consistent globally; however, familiarity with goat meat products is higher among Spanish and UK consumers than in Germany. Furthermore, the South African Meat Industry Company (2022) underscores the vital role of consumer education in shifting consumer perspectives and enhancing demand within the retail sector. Sensorial attributes such as the distinctive odour and texture of goat meat were also found to be influential, with many consumers perceiving these qualities negatively, which affects demand. However, Teixeira et al. (2020) and Mazhangara et al. (2019) suggest that these traits, particularly the characteristic smell, are appreciated by some consumers and contribute to the meat's unique identity. Efforts to alter or remove these attributes may thus undermine their authenticity, potentially alienating certain consumer segments.

Mazhangara et al. (2019) further argued that the prevalent negative perceptions surrounding goat meat are largely due to insufficient consumer education on the diverse culinary applications of meat offers. Therefore, increasing awareness and culinary education may serve as a pathway for enhancing consumer acceptance and demand.

4.8 Attitude toward goat meat commercialization

Previous studies on consumer perceptions towards goat meat have discussed and reported consumers' positive, negative, and mixed perceptions of goat meat value in South Africa and other countries around the world (DAFF, 2019). Although the type of information, experience, personal, social, economic, and cultural influences the consumer holds, they can positively or negatively affect consumer interest towards the product. Consistent with this view, we found that goat meat consumption and utilization are affected by various types of consumer attitudes. The thematic data generated from the interviews resulted in the identification of the three sub-themes depicted in Figure 4.4.

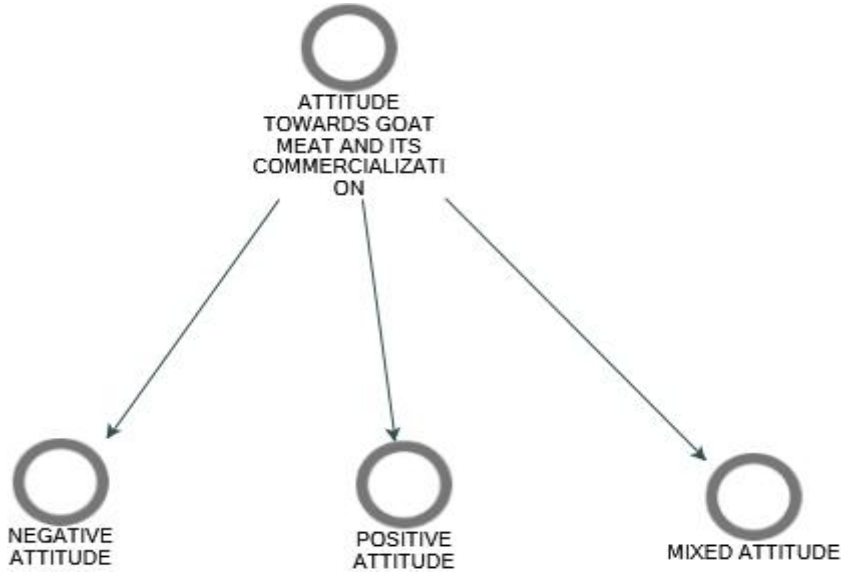

Figure 4. 4: Illustrating attitude towards goat meat commercialization

The majority of the knowledge holders interviewed offered insights into the negative, positive, and mixed attitudes impacting goat meat and product consumption.

4.8.1 Mixed attitude

Goat meat consumption and commercialization are negatively affected by mixed consumer perceptions. Interviews conducted with the key informants revealed the following:

"Generally, we do not like the smell. If one can eliminate the smell, it is like sheep/ lamb meat" (IKH#10).

"There is no negative perception. It is just meat as any other, except that is occasionally consumed. However, it is nice and healthy" (IKH #15).

4.8.2 Negative attitude

"I do not like the smell of goat meat; therefore, I use it once in a time for rituals".

According to Maganga et al. (2019) and Yesufu et al. (2017), compromise in the formal markets for goats and chevons, lack of product grading systems, poor product quality, and inconsistent supply also contribute to negative consumer attitudes towards goat meat consumption. In African culture, a goat slaughtering is considered an animal that communicates with ancestors. Therefore, goat meat is not used anyhow but is highly respected and valued for African rituals and ceremonies. This was witnessed in the case study of the Msinga abattoir, which remained a white elephant and was not being used because people did not want to sell their goats to be slaughtered at the abattoir and not in their cultural norms. Indigenous Slaughter methods are mostly practised in rural areas within the South African context, particularly by the Zulu and Xhosa tribes when performing rituals (Khumalo, 2017).

4.8.3 Positive attitude

Looking at positive consumer attitudes, the following accentuates were highlighted through IK-holders' interviews from the commercial retail perspective and community level:

"I find it nice with a gamey meat taste" (IKH #13)

"Goat meat is Congolese food. It is just a popular meat, and it is well welcomed, no attitude that prevents people from consuming goats".

"Customers are happy and getting used to purchasing goat meat in retail stores. Slowly the mindset and attitude are changing from previous comments" (RRAc1).

4.9 Future of goat meat

Goats have significant cultural esteem among many African communities, symbolizing respect and tradition. Given this, the proper alignment of marketing standards could position goat meat as a leading red meat option within the market, especially in light of growing consumer interest. Despite the evident demand, the goat meat market currently faces issues of stability in both supply and demand. A key challenge lies in transforming and educating consumers on innovative and diverse dietary options. Notably, goat meat is still primarily associated with cultural and ceremonial contexts, which limit its consumption on specific occasions rather than as an everyday dietary choice. Cultural and traditional beliefs, as highlighted by Traoré et al. (2018), continue to heavily influence food choices and preparation methods, especially in rural

and lower-socioeconomic areas. The other key informants during the interview session accentuate that: *"The fact that there is lamb and mutton from the sheep, which is in the same category as goat, all are small stock animals, I think there was no fairness in retail marketing and correct branding of goat meat for acceptable publicity" (RR #13).* Therefore, if supply and demand components are well established and marketed to a well-educated clientele, goat meat has the potential to stand in the marketplace.

4.10 Conclusion

In conclusion, the most widely purchased and consumed meat types remain chicken, pork, beef, mutton, and lamb, with animal-sourced products in the marketplace predominantly derived from these sources. Goat meat and goat-related products, when available in both formal and informal markets, show restricted accessibility within commercial retail spaces. This is partly due to the higher affordability threshold and physical access barriers, as these products are frequently positioned in upper-market sectors, limiting their reach to a broader consumer base.

Beyond issues of accessibility, goat meat preferences vary significantly across ethnic groups, where consumption is often rooted in specific cultural or traditional practices. Seasonal fluctuations further influence goat meat market stability, with peak periods of consumption typically aligned with cultural events, rather than regular dietary inclusion. Nonetheless, there is a growing potential for goat meat consumption to expand in light of the current trends toward health-conscious living. As consumers increasingly prioritize healthier food options, the nutritional benefits of goat meat may drive a greater demand.

However, to support this potential growth of goat meat processing and value-addition, strategic efforts must be made to educate consumers about the health advantages of goat meat and diversify its culinary applications. Producers and marketers should try to align their product offerings with consumer expectations to enhance product acceptance and usage across diverse market segments. By addressing these aspects, goat meat could secure a more prominent place in the broader meat market, thereby promoting its viability as a sustainable dietary choice.

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CHAPTER 5: PRODUCT DEVELOPMENT AND FOOD QUALITY ANALYSIS OF VARIANT INNOVATIVE GOAT MEAT PRODUCTS

Abstract

Goat meat serves as a valuable foundation for developing alternative modern food products that merge traditional culinary knowledge with contemporary tastes, enhancing authenticity, cultural relevance, and consumer appeal. The study investigated three products that were created from traditional recipes of various ethnic groups (n=16), to inform the innovative goat products. Therefore, the study mained to examine the potential of innovative goat products in terms of textural and colour qualities, and microbiological status of variant-developed goat products to shape the consumer acceptance and preferences. Recipes were categorized by cooking method (*moist cooking, dry cooking/dehydration*, and *processing)*, and were developed through iterative product development trials conducted until optimal qualities were achieved, as evaluated by a trained sensory panel (n=30). Goat curry, burger patty and dried wors recipes were therefore standardized, and their quality characteristics were evaluated. Textural qualities were determined using an instrumental TA-XT Plus texture analyzer, and colour qualities were measured using a HunterLab ColourFlex Colourimetric Spectrophotometer (model 45/0, HunterLab Reston, USA). Microbial analyses was conducted to determine the contamination status of the three products. Hence, consumer safety and product reliability is important in product development Goat curry, burger patty and dried wors were all acceptable for the larger acceptability study. However, the panel recommended reducing fat content in dried wors to enhance their health profile, although the literature suggests that lower fat content may impact sensory attributes such as texture, flavour, and shelf life. The texture profile indicated that goat curry was the tenderest product, followed by burger patties and dried wors. Notably, colour changes were observed in more processed products (burger patties and dried wors), likely due to several contributing factors linked to processing. Microbial testing confirmed that the three products exhibited low levels of 'Listeria monocytogenes' and 'Staphylococcus aureus' (< 100 CFU/g), ensuring their safety for consumption. Therefore, it can be concluded that highly acceptable value-added products can be prepared from the indigenous goats' meat had better physicochemical, microbial qualities, and sensory acceptability. While promoting these products as nutritious and accessible, may enhance food and nutrition security and revenue opportunities in the meat industry.

Keywords: Goat meat, Indigenous Knowledge, consumer acceptance, value-added products, texture, colour, microbial safety

5.1 Introduction

This chapter presents the effects of processing methods and practices applied in goat meat processing and the quality of developed productsin terms of texture, colour and microbial quality. Thus, every products available to consumer, has a potential to display its qualities to influence the consumer decision whether to purchase a particular product or not. to influence consumer satisfaction. It is therefore important to acknowledge range of practices applicable in food processing in order to meet the consumer demands and preferences. Therefore, goat meat value-added products and their quality analysis (goat curry, burger patty and dried wors) was investigated to determine consumer preferences.

5.2 Background

The global consumption of goat meat has increased largely due to its unique flavour, lean characteristics, and universal socio-religious acceptability (Umaraw et al., 2015), as well as the world's need for low-cost animal-source food (ASF) options (Ntwenya *et al*., 2015). Thus, changes in peoples' lifestyles could be the reasons that brought a new look towards previously downgraded indigenous foods with high nutritional content. Furthermore, various studies have been conducted to test the nutritive properties and status of goat meat as a healthy product poised to make a significant contribution to animal-derived foods for human consumption (Boada et al., 2016; Stephens et al., 2018). Nevertheless, goat meat consumption has certain reasons for various ethnic groups, irrespective of the beneficial effects of its nutritional profile and health properties.

Goat meat, or chevon, is globally recognized for its nutritional benefits, including low fat and high protein content, making it an attractive option for health-conscious consumers (Joy et al., 2021). However, despite its potential, goat meat remains underrepresented in commercial markets, particularly in South Africa, where its availability is limited compared to other red meats, such as lamb and beef. The lack of diverse processed products, along with consumer knowledge gaps and negative perceptions, constrains consumption among both low-income and high-income groups (Mazhangara et al., 2019). Addressing these gaps requires strategic product development that aligns with consumer preferences and lifestyle shifts toward convenience foods. Processed forms of goat meat, such as ready-to-eat (RTE) meals and home meal replacements (HMRs), offer viable avenues for increasing marketability while preserving

traditional flavours and nutritional benefits (Teixeira et al., 2019). This study explored sensory and nutritional quality considerations for the development of processed goat meat products.

5.2.1 Sensory Quality Attributes in Processed Meat Products

Sensory quality attributes, including texture, flavour, colour, and aroma, are critical for consumer acceptance of processed meat products. Texture is vital in products such as sausages and jerky, where consumers often prefer tenderness and consistency (Almela et al., 2020). Processing techniques such as grinding, emulsification, and curing can enhance goat tenderness and juiciness, making them more appealing to consumers seeking consistency in commercial products. However, in the context of indigenous South African goat breeds, such as the Nguni goat or "Imbuzi," additional research on textural optimization for local preferences could further enhance consumer satisfaction.

Flavour is another important sensory attribute, as the distinct taste of goat meat may not appeal to all consumers. Techniques such as marination, smoking, and seasoning with spices can help mitigate gamey flavour and broaden the appeal of goat meat products to diverse consumer segments (Madruga et al., 2021). In South Africa, utilizing traditional spices and seasonings associated with local cuisine may enhance consumer connection to these products, while simultaneously addressing the preference for indigenous flavours.

Colour stability remains essential, especially as consumers associate bright fresh-looking meat with quality. Goat meat, particularly in processed forms like jerky, can suffer from discolouration due to oxidative reactions, which may deter consumers (Mendiratta, Sharma, & Majhi, 2020). Integrating natural antioxidants, such as vitamin E, and employing low-oxygen packaging techniques helps to maintain colour stability and improves visual appeal (Pophiwa et al., 2020). Given the emphasis on natural, clean-label ingredients in the current market, these methods align with consumer expectations for minimally processed, visually attractive products.

5.2.2 Nutritional Quality and Health Attributes in Processed Goat Meat Products

Processed goat meat is valued not only for its unique taste but also for its nutritional profile, which includes lower fat and favourable fatty acid composition compared to other red meats (Joy et al., 2021). Health-conscious consumers are increasingly drawn to goat meat's naturally

lean profile and high protein content, as well as its mineral composition, which includes essential nutrients, such as iron and zinc (Madruga et al., 2021). Product development strategies that retain these nutritional benefits while enhancing flavour and texture can appeal to health-focused markets.

For example, value-added products that incorporate functional ingredients such as dietary fibre, omega-3 fatty acids, or antioxidant-rich spices offer additional health benefits (Bunge et al., 2020). However, reducing the fat content can sometimes affect texture and flavour, potentially compromising product appeal. Strategies such as adding plant-based oils or utilizing fat replacers can help retain moisture and improve mouthfeel without sacrificing nutritional quality (Bunge et al., 2020; Troy & Kerry, 2010). Such innovations make goat meat an appealing choice for consumers who prioritize healthy, convenient foods without saturated fats.

5.2.3 Shelf Life and Microbial Stability in Processed Goat Meat Products

Shelf life is a critical consideration in processed goat meat products, particularly given the high spoilage rate of lean meat. Traditional methods such as curing, drying, and smoking effectively extend shelf life while aligning with consumer preferences for naturally preserved foods. Additionally, modified atmosphere packaging (MAP) and natural preservatives, such as rosemary extract, can further enhance product stability (Almela et al., 2020). In South Africa, where convenient, long-lasting products are increasingly in demand, preservation techniques are essential for product development. Moreover, these methods are advantageous for rural consumers who may have limited access to refrigeration.

For dried products, such as jerky, microbial stability is essential to prevent contamination and ensure food safety. While consumer preference leans toward natural preservation techniques over synthetic additives, effective natural preservatives are crucial for ensuring safety and extending product shelf life. Research continues to explore effective natural preservation methods that do not compromise taste or texture, thereby contributing to sustainable product development that meets consumer safety and quality expectations (Teixeira et al., 2019).

5.2.4 Consumer Acceptability in Product Development and the Need for Diversification

Consumer acceptance of processed goat meat products depends on cultural norms, sensory quality, and perceptions of health benefits. Studies indicate that South Africa's goat meat market is limited by knowledge constraints and negative perceptions, which are often

associated with the distinct flavour profile of goat meat (Mazhangara et al., 2019). These factors point to a significant need for product diversification to introduce goat meat in more consumer-friendly formats, such as sausages, spreads, and RTE meals, to cater to diverse preferences and lifestyle demands.

The growth of South Africa's convenience food industry presents an opportunity for goat meat to reach new consumer segments through RTE meals and HMRs. The shift toward ready-made meals reflects changing lifestyles, with increased female workforce participation and time constraints impacting home-meal preparation (Mazhangara et al., 2019). Value-added goat meat products, particularly those that incorporate familiar flavours or ready-to-eat options, could fill a gap in the market, aligning with consumer demand for nutritious and convenient foods (Troy & Kerry, 2010).

Developing products that use South African Nguni goats offers a way to bridge this gap by creating appealing products that integrate indigenous ingredients and flavours. For example, value-added chevon products can be developed in various forms, such as sausages or seasoned jerky, to appeal to both household and commercial consumers (Bunge et al., 2020). Product diversification, which includes health-conscious labelling, clean ingredients, and minimal processing, would enhance consumer acceptability, particularly among health-aware consumers seeking alternatives to conventional red meat. Moreover, value-added goat meat products offer a sustainable protein source with potential for household food security, particularly in rural communities where goat farming has already been established (Mazhangara et al., 2019; Bunge et al., 2020)."

5.3 Methodology

5.3.1 Study site and ethical aspects of the study

The study population and area were categorized based on the study phases conducted for the study as aimed to enhance the acceptability and commercialization of goat meat products under uMhlathuze Local Municipality in Northern KwaZulu-Natal, South Africa.

Figure 5. 1: City of uMhlathuze Local Municipality, Source (Municipalities South Africa, 2012)

5.3.1.1 Ethical aspects

The study was conducted with the approval of the Humanities & Social Sciences Research Ethics Committee through the issuing of ethical clearance by the University of KwaZulu-Natal. Furthermore, the researcher requested ethical permission from different bodies, such as the National Director of Animal Health in South Africa, under Section 20 of the Animal Diseases Act (Act No. 35 of 1984), goat sourcing approval as per the directive of the State Veterinary Public Health as goats were sourced from Cedara Agricultural College Farm, in KZN Province, North Region, as well as the Boston Abattoir approval for their slaughter services. To run the product development aspects of the study, permission for the use of facilities had to be sourced from the University of Zululand, a domestic Consumer Sciences Kitchen where the products were developed. For product quality analysis, the services were sourced from the University of

KwaZulu-Natal – Dietetics and Food Science Laboratory in Pietermaritzburg for physicochemical tests and the Fact Food Laboratory in Durban for microbial quality tests.

5.3.2 Research approach

An experimental research design was adopted at various stages of product development. First, the original recipes of the IK-holders surveyed in Section 4 were used according to their original ingredients, measurements, and preparations. Thereafter, an experimental research design that involved laboratory work for innovative goat meat products inspired by the IK holders' recipes was followed by microbiological and physicochemical (texture and colour) quality analysis.

5.4 Materials and Procedures

5.4.1 Documentation of Indigenous Knowledge Holders' Recipes

Based on Objective 2 of the study: To document the traditional methods/recipes used to preserve and cook goat meat at the community level, Chapter 4 of the study focused on the assessment and documentation of the original favourite recipes of different ethnic groups, preferences, and utilization patterns of goat meat in the African continent (Nigeria, Congo, Kenya Mozambique, and Southern Africa perspective) to be informed, see Appendix B. However, relating to the study title (Enhancing consumer acceptability and commercial utilization of goat meat through the processing of value-added products in Northern KwaZulu-Natal, South Africa), the study aimed to improve goat meat acceptability and utilization through modern consumption patterns suitable in the South African context.

5.4.2 Sourcing of live goats for goat meat production

Because of the Foot-and-Mouth-Disease (FMD) outbreak, which struck the northern part of Kwazulu-Natal (KZN) around the year 2021 February, up to the middle of the year 2022, goats were sourced from a reputable Agricultural Institution, Cedara Agricultural College. Cedara Farm is located at the headquarters of the KwaZulu-Natal Department of Agriculture and Rural Development in Pietermaritzburg, South Region. Goats were reared from the farm until they were humanely harvested at the age of 1½–3 years. Thereafter, 10 male goats of different body weights were randomly selected for the study. At intervals, goats were transported to the

nearest accredited abattoir, Boston Abattoir, in Erf 95 Elandsrivier Farm, Boston, 3211, Howick, before the day of slaughter.

The slaughtering of goats at Boston Abattoir was conducted with strict adherence to established humane protocols, ensuring compliance with standard animal welfare guidelines. Goats were provided with water ad libitum and slaughtered in the morning after a fasting period of 16-18 hours, a standard practice that aligns with humane handling protocols for red meat abattoirs (American Veterinary Medical Association, 2016; Mench, 2019). In South Africa, the classification and marking of meat fall under the purview of the South African Meat Industry Company (SAMIC), as stipulated by the Department of Agriculture, Forestry, and Fisheries (DAFF). This oversight is mandated by the Agricultural Product Standards Act, which governs voluntary participation in the classification and marking of red meat abattoirs.

An indigenous knowledge-based protocol was adopted for the treatment of goat meat products, involving a standardized procedure for washing the meat with water and vinegar. This method, commonly utilized by indigenous knowledge holders, serves the dual purpose of removing residual hair and reducing the characteristic goat odor, thereby enhancing the acceptability of meat for further processing and consumption.

Dressed carcasses were weighed within 1 h (hot carcass weight) and slaughter by-products were collected and weighed within 30 min. Thereafter, carcasses underwent ripening for 24 h at 4°C, followed by cutting into prime cuts based on age and through the quarter segmentation procedure. The forequarter portions (neck, thick ribs, eye ribs, loin, shoulder, and breast) were differentiated from the hindquarter portions (flank, chump, leg, and shank). All meat portions were immediately vacuum packed into polyethene film pouches (size 200 × 300) of 250 gauge, transported in a refrigerated vehicle to the Consumer Sciences domestic laboratory, and stored in a freezer at -18°C for subsequent investigation. Below is the slaughtering guide that was followed at the Boston abattoir concerning goat meat production (slaughtering, portioning, and packaging of meat) for subsequent investigation (Figure 5.2).

Goat meat production procedure

The animal brain must not be damaged during the slaughtering process for the heart and lungs to continue functioning to ensure rapid bleeding which promotes the attractive appearance of the meat.

- **Weighed- live goats received from Cedara farm to the abattoir.**
- **Goats to rest overnight:** Treatment before slaughtering animals to be kept as calm as possible before slaughtering it.
- **Goats to be slaughtered the next day using the stunning procedure.**
- **Bleeding**
- **Skinning**
- **Evisceration**
- **Grading**
- **Weighing (warm body mass) after dressing being taken down with and without offal**
- **Rigor mortis process (post-mortem phenomenon):** This process is vital to be completed as rapid cooling of warm carcasses causes cold shrinkage. This leads to rapid and drastic muscle contraction, which makes the meat tough.
- **Ripening process (24 HR):** All goat carcasses undergo the process of 24-hour ripening at temperatures between 0– 4 °C.

Figure 5. 2: Goat meat processing

5.5 Product development and Quality Analysis of Value-added Goat meat Products

5.5.1 Development of Indigenous Recipes

Sixteen traditional goat meat recipes were compiled from four ethnic groups (Chapter 3, appendix B), which are discussed in detail. From the total of 16, only four were selected, fitting into the specifically selected categories under study (see table 5.1).

Table 5.1: Indigenous Knowledge Holders' Recipes for Reformulation

Goat meat dishes	Ingredients	Method of preparation	Dish images
Indian goat curry	1 kg goat meat	1. Steam the meat with garlic and ginger (1 teaspoon) for 20-30 minutes.	 Steaming phase
	3 tablespoons of sunflower oil	2. Heat oil and add onion, star-anise, cinnamon sticks, bay leaves, curry leaves and jeera seeds.	
	1 large onion,	3. Fry all this together, then add ginger and garlic paste (4 teaspoons).	
	2 star-anise		
	2 cinnamon sticks	4. Add, turmeric, masala curry powder and garam masala.	
	2 bay leaves		
	2 stems curry leaves	5. Add meat and salt, then allow to cook for at least 20 minutes.	
	1teaspoon jeera seeds whole		
	1 tablespoon of garlic and ginger paste	6. Before the water dries up, add tomatoes, and allow to cook till all gravy dries out.	
	2 tablespoons masala curry powder	7. Once the liquid from the meat dries out, add water, and cook for a further 1 hour or until the meat is almost soft	
	1 teaspoon of turmeric	8. Add potatoes and cook over low heat.	
	1 teaspoon of garam masala	9. Cook until potatoes are soft, and not too much gravy but a thick curry.	
	2 tomatoes (grated) peeled and finely chopped	10. Once ready, serve with hot rice or roti.	
	1 teaspoon of salt		
	3 cups of boiling water		
	3 potatoes cubed		

Goat meat dishes	Ingredients	Method of preparation	Dish images
			
Roasted leg Afrikaners' dish	1 kg leg	1. Prepare a brine with salt, garlic powder, and water, and inject it into the meat.	
	1 tsp salt	2. With the extra salt, sprinkle the outer part of the meat with salt.	
	½ tsp garlic powder	3. Keep the meat covered in a marinade for an hour in a refrigerator.	
	15ml water	4. Coat the meat with flour.	
	1tsp extra salt	5. Bake for 1½ hours/kg at 72°C inner temperature.	
		6. Allow the meat to rest for 10 minutes after cooking.	
		7. Serve with vegetables and gravy.	

Goat meat dishes	Ingredients	Method of preparation	Dish images
			
Goat-meatballs Afrikaners' dish	1kg minced goat meat	1. Mix all ingredients (minced goat meat, salt, herbs, black pepper, Worcestershire sauce, onion, eggs, and breadcrumbs.	
	2 tsp salt	2. Take 40g minced mixture and form it into balls.	
		a. Frying	
	½ tsp fresh herbs	3. Heat the frying pan/ pot on the stove	
	1 tsp black pepper	4. Heat 2 tablespoons of oil and add meatballs to fry all over until brown on the sides but not done.	
	4 tsp Worcestershire sauce	5. Once done, take the meatballs out of the pan and keep them covered.	
	½ onion (finely chopped)	**b. Tomato based sauce**	
	2 eggs	6. Fry onion and garlic until translucent.	
	2 crust slices of white bread (crumbed)	7. Add paprika, black pepper, two grated tomatoes, and salt for taste.	
	2 tablespoons of sunflower oil	8. Let tomatoes get cooked until all the water is finished (without the lid on).	

	Tomato based sauce 3 tablespoons of sunflower oil	9. Add meatballs to tomato and cook it further on low heat for 10 minutes.	
	1 large onion	10. Serve with spaghetti /pap.	
	1teaspoon of ginger and garlic paste		
	1teaspoon of paprika		
	A pitch of black pepper		
	2 tomatoes peeled and finely chopped		
	1 teaspoon of salt		

5.5.2 Product formulations and standardisation

Of the 16 traditional goat meat recipes documented, three were selected as samples: goat curry, leg roast, and meatballs. The selection process involved rigorous evaluation by a trained panel, followed by methodical interfacing of modern food science techniques with traditional cooking practices. This integration aimed to optimize the sensory qualities and consumer appeal of each product. The interface of modern and traditional recipes followed these key stages.

5.5.2.1 Recipe Documentation and Classification

Traditional recipes from the four ethnic groups were initially documented in detail, capturing ingredient proportions, cooking techniques, and flavour profiles. These recipes were classified into three categories: moist-cooked (e.g., curry), dry-cooked (e.g., leg roast), and processed (e.g., meatballs). This classification provided a structured foundation for interfacing modern techniques with traditional methods, facilitating adjustments while retaining cultural authenticity.

5.5.2.2 Recipe Formulation for Goat Meat Products

The recipe formulation process for goat meat, dried, and burger patties followed distinct phases, aligned with the classifications of dry, moist-cooked, and processed products. For each product type, ingredients were selected and proportioned based on their functional roles such as flavour enhancement, moisture retention, and textural modification. For instance, goat meat curry required a balance of spices, tenderizers, and moisture-regulating ingredients to achieve an appealing consistency and flavour profile that would remain stable over time. The dried wors were formulated to have a stable water activity level, ensuring product safety and shelf stability, while maintaining desirable flavour and texture characteristics. Meat portions for variant product development were selected from various parts of the carcass. These cuts were specifically selected for the three products in question based on portion suitability for the cooking method (see table 5.2).

Table 5.2: Reported goat meat cuts and appropriate cooking methods for consumer-acceptable products suitable for commercialisation

Meat Primal cut	Specific cuts	Age and sex	Cooking Method	Product	Justification
Forequarter	Neck, shoulder, shoulder shank and breast	Intact male goats of 2½ - 3 years old for three products.	Dry and Moist (Braising and the simmering) method	**Goat meat curry**	Braising was the critical stage in goat meat curry formulations to critically seal in the meat juices to enhance moisture retention for improved tenderness of goat meat. Hance, tenderness is one of the influential qualities in goat meat (Brown, 2018; Mazhangara et al., 2019). The slow moist heat preparation method allows the tenderising of the meat (Teixeira et al., 2011; Vincent, 2018). Aso, due to the controlled cooking process, the flavour, taste and juiciness come from the long slow simmering methods of preparation (McWilliams, 2017; Browm, 2018).
Hindquarter	Leg, flank, and ramp,	Intact male goats of 2½ - 3 years old for three products.	Dry (shallow fat frying)	**Burger patties**	Mincing which is a tenderising method was used and appropriate for the product (Vincent, 2018; Palmer et al., 2022).
Hindquarter	Leg, flank, and ramp	Intact male goats of 2½ - 3 years old for three products.	Dried salted product through dehydration preparation method.	**Dried wors**	Marinading and keeping meat at rest in the refrigerator before further processes tenderises the meat (Brown, 2018; and the process of mincing the meat further tenderises the meat (Cluff et al., 2017; Jones et al., 2017; Vincent, 2018; Palmer et al., 2022).

5.5.2.3 Standardization Process

Standardization in food product development is a scientific process that involves adjusting and controlling variables to ensure that each batch of products meets specific quality parameters including taste, texture, appearance, and nutritional content (Ragaert et al., 2017). In this study, each recipe underwent adjustments in ingredient proportions, cooking times, and temperatures to achieve repeatable results across all trials. This step is crucial for developing products that would reliably exhibit a uniform flavour and texture, regardless of the production scale. The integration of these methods, combined with carefully controlled ingredient ratios and cooking parameters, resulted in products that were not only scientifically standardized, but also aligned with contemporary consumer preferences for flavour, convenience, and nutrition. After standardization, the interfaced products (goat curry, burger patty, and dried wors) were prepared and subjected to sensory evaluation by a trained panel.

5.5.2.4 Sensory Evaluation using Discrimination Tests in Sensory Evaluation Acceptability Testing

Following recipe preparation, each dish was evaluated by a trained sensory panel consisting of individuals selected based on their familiarity with sensory evaluation procedures and their ability to discern nuanced flavour and texture differences in meat products. The panel assessed the acceptability of each dish in terms of taste, texture, aroma, and overall appeal. To streamline the analysis and focus on the most preferred options, the trained panel selected three recipes from the original set, based on their highest acceptability scores. Utilizing trained sensory panels is a widely recognized methodology in food product development, facilitating systematic evaluations of consumer acceptability to inform product refinement and market alignment (Muhoozi et al., 2021). This approach provided reliable, structured insights into the acceptability of traditional goat meat recipes across distinct cooking methods, thereby guiding the development of culturally resonant, consumer-friendly goat meat products. The chosen recipes were Goat curry (representing the moist heat category), roasted leg (representing the dry heat category), and goat meatballs (representing the processed category). This selection enabled a focused examination of representative cooking methods for goat meat while providing insights into consumer preferences for each type (Muhoozi et al., 2021).

5.5.2.5 Sensory Evaluation using Consumer Acceptability Testing

Consumer acceptability testing follows, and this section is further discussed in Chapter 6.

5.5.2.6 Preparation of Goat Curry

The meat curry is a widely appreciated local dish that accommodates diverse cultural preferences. In this study (Chapter 4), it was noted that the traditional boiling cooking methods employed by indigenous African communities presented certain limitations, as identified by a trained sensory panel. These include insufficient flavour development and the inability to adequately mask the distinct taste and odour of goat meat. Additionally, the colour of boiled meat, when compared to preparations from other ethnic groups, was perceived as less visually appealing, further affecting its acceptability.

To address these challenges, the Indian curry recipe has been reformulated. The inclusion of a diverse range of spices in this preparation effectively mitigated the characteristic goat odour and masked its taste, resulting in an improved sensory profile and increased overall acceptability among the evaluators. Moreover, as discussed in Chapter (4), the retail market currently offers a variety of meat-based curries, including beef, chicken, and mutton, but lacks goat or chevon curry options. This presents a significant opportunity for innovation and market diversification by introducing goat curry as a product that caters to consumers seeking unique, culturally relevant, and flavouring options in the retail space.

Goat meat was prepared using a moist heat cooking method, which involves transferring heat through a water-based medium or steam. Moist-heat cooking alters the molecular structure, texture, taste, aroma, and appearance of food, which is typical of other cooking methods (Brown, 2018). For this study, the goat meat was specifically prepared as a curry to address distinct goat meat attributes that were moderated through various cooking techniques. The first technique applied was braising, where goat meat was seared in a preheated pan with 10 ml of sunflower oil. Braising was selected for its benefits in sealing meat juices and enhancing the texture. Following this, strongly flavoured spices were fried in oil along with onions in a thick-bottomed pot. Goat meat was then added and subjected to shallow frying in a covered pot to ensure optimal flavour absorption from curry leaves, Masala curry powder, garam Masala, star anise, and other ingredients. This method helps infuse meat with rich flavours while achieving the desired texture and tenderness.

The ingredients primarily known for distinct flavours/aromas in food preparation were used in recipe formulations to enhance the goat meat smell. This first included the cleaning of goat meat in potable water with vinegar as a technique for the eradication of the goat meat smell. However, goat meat curry uses fresh onions, garlic, ginger paste, tomatoes, curry leaves, and

condiments such as garam masala, masala curry powder, star-aniseed, coriander, and cumin in powder form to enhance the aroma. This is similar to Indian curries, but the powder version "ground" version of condiments and finely chopped curry leaves were chosen for easy indulgence and palatability purposes. Therefore, the second formulation yielded acceptable results during the pilot sensory evaluation. Thus, no further formulations were developed (see Table 5.3 for goat curry formulations).

Figure 5. 3: Depicts dried and ground form of ingredients/species for enhanced palatability and mouthfeel

5.5.2.7 Preparation of Goat Mince

Burger patties were deemed a better option because of their higher demand, established market presence, and widespread utilization in households. Furthermore, the selection of burger patties over meatballs was informed by observations in retail stores where patties derived from various types of meat were significantly more prominent (see Chapter 4). On the other hand, meatballs are primarily prepared at home using minced meat, highlighting the reliance on home preparation rather than ready-to-cook options. This distinction underscores the convenience offered by burger patties, which are widely embraced by diverse South African households.

Moreover, the popularity of burger patties is closely tied to the substantial growth of the fast food industry, which has become a key driver of burger consumption. The South African fast-food market, valued at $2.7 billion in 2018, projected to reach $4.9 billion by 2026, growing at a compound annual growth rate (CAGR) of 7.9% (Allied Market Research, 2019). While Mordor Intelligence (2023), indicated market growth at $8.91 billion in 2024 and further $17.22 billion by 2029, reflecting a CAGR of 14.09%. This substantial growth highlights the fast-food sector's increasing role in the South African economy and its significant influence on consumers' food choices.

In contrast, meatballs remain less ubiquitous, rarely featuring as a staple in daily meal preparation, and are absent from lists of commonly consumed grocery items. This disparity stems from several factors, including cultural preferences, with burgers gaining widespread integration into South African cuisine through fast-food chains, whereas meatballs retain associations with specific cultural or traditional dishes. Additionally, the convenience and accessibility of burgers, coupled with aggressive marketing strategies, have made them a staple for all segments of the population. Meatballs, which require more preparation effort and lack visibility and accessibility.

The burger patty-making process, as shown in Images 1-4, begins with the initial step of mincing goat meat. The full preparation process involved debonding goat meat, cutting it into cubes, seasoning, mincing, and shaping. The meat emulsion was pressed through the mincer using an 8 mm plate, followed by a 6 mm plate, and subsequently shaped into the desired patty size, as shown in the images below:

Goat meat mincing

Image 5.1: Electrical mincer

Image 5.2: 8mm mincing plate

Mage 5.3: 6mm mincing plate

Image 5.4: Mincing the goat meat

The burger patty formulations are depicted in Table 5.4

Table 5.3: Goat meat curry formation

Name of product: Goat meat curry			**Cooking time:** 1h45 Minutes	
Preparation time: 40 Minutes **Braising:** 10 Minuets			**Total recipe yield:** 4 209kg	
Ingredients	**Quantity:**	***Formulation 1***	***Formulation 2***	***Final product upscaled***
Goat meat: neck, shoulder, shoulder shank and breast	1 kg		1 kg	3 kg
Sunflower oil	45 ml		**90 ml**	270 ml
Star-anis	2 - whole		5 ml - **powdered**	15 ml
Cinnamon sticks	2 – whole		-	-
Bay leaves	2 -4		5 ml - **Curry leaves**	15 ml
Jeera seeds	5 ml - whole		-	-
Onion	1 large		1 large **-red onion**	3 large
Ginger and garlic paste	4 5ml		45 ml	90 ml
Masala curry powder	45 ml		45 ml	90 ml
Turmeric powder	5 ml		5 ml	15 ml
Garam masala	5 ml		5 ml	15 ml
Coriander and cumin	-		**5 ml**	15 ml
Tomatoes peeled and finely chopped	2 medium tomatoes		2 medium tomatoes	6 medium tomatoes
Iodised salt	5 ml		**10 ml**	30 ml

Hot water	750 ml	750 ml	2 250 ml
Potatoes cubed	3 medium potatoes	3 medium potatoes	9 medium potatoes
Preparation method			
Step 1	Wash meat in water with vinegar until its clean.	Wash meat in water with vinegar until its clean.	Wash meat in water with vinegar until its clean.
Step 2	Cut the meat into small cubes.	Cut the meat into small pieces of 25x25mm, removing all bones.	Cut the meat into small pieces of 25x25mm, removing all bones.
Step 3	-	Place meat in a bowl, and rub in 30ml of oil and Worcestershire sauce. Cling wrap and allow to rest for 15 minutes.	Place meat in a bowl, and rub in 30ml of oil and Worcestershire sauce. Cling wrap and allow to rest for 15 minutes.
Cooking method			
Step 1	Steam the meat with garlic and ginger for 20-30 minutes.	Heat 15ml of oil in a non-stick pan and braise the meat for 10 minutes.	Heat 15ml of oil in a non-stick pan and braise the meat for 10 minutes.
Step 2	Heat oil and add the star-anis and bay leaves.	Take out the meat into a bowl cover it and add curry leaves to fry.	Take out the meat into a bowl cover it and add curry leaves to fry.
Step 3	When starts spluttering add onions.	When starts spluttering add onions.	When starts spluttering add onions.
Step 4	Fry onions until translucent, then add ginger and garlic paste.	Fry onions until translucent, then add ginger and garlic paste.	Fry onions until translucent, then add ginger and garlic paste.
Step 5	Add masala curry powder, turmeric, and garam masala.	Add masala curry, turmeric, garam masala, cumin, and star-anis.	Add masala curry, turmeric, garam masala, cumin, and star-anis.

Step 6	Add goat meat to fry and add tomatoes as well as salt.	Add goat meat to fry and add tomatoes as well as salt.	Add goat meat to fry and add tomatoes as well as salt.
Step 7	Close the pot and let it simmer.	Allow to simmer until tomato juice dries out.	Allow to simmer until tomato juice dries out.
Step 8	Once the liquid from the meat dries out, add water, and cook for a further 40 minutes or until the meat is almost tender.	Add water and cook for a further 40 minutes or until meat is almost tender.	Add water and cook for a further 40 minutes or until meat is almost tender.
Step 9	Add potatoes and let it cook slowly.	Add potatoes and let it cook slowly.	Add potatoes and let it cook slowly.
Step 10	Add chillies and let it steam in the sauce.	-	-
Step 11	Cook until potatoes are soft, and the sauce has thickened.	Cook until potatoes are soft, and the sauce has thickened.	Cook until potatoes are soft, and the sauce has thickened.
Step 12	Once ready, serve with hot rice or roti.	Once ready, allow **the 10 minutes to rest** and serve it.	Once ready, allow **the 10 minutes to rest** and serve it.
			Raw meat weight: 3 kg **Cooked weight:2 496 kg** **Cooking loss: 504 g**

Table 5.4: Goat meat burger patty formulations

Name of product: Goat Meat burger patties			**Cooking time:** 10 Minutes per patty		
Preparation time: 30 Minutes **Mincing and shaping:** 25 Minuets			**Total Recipe Yield:** 24 patties (120g x 24)		
Ingredients	**Quantity:**	***Formulation 1***	***Formulation 2***	***Formulation 3 - Final***	***Final product upscaled***
Goat meat: leg, flank and shoulder	1 kg		1 kg	1 kg	3 kg
Fine salt	10 ml		**10 ml**	**10 ml**	30 ml
Black pepper	2 ml		2 ml	**2,5 ml fresh cracked pepper**	7,5 ml fresh cracked pepper
Ground coriander and cumin	2 ml		2 ml	**2.5ml**	7.5ml
Freshly grated garlic glove	2 ml		2 ml **garlic powder**	**2.5 garlic powder**	7.5 garlic powder
Freshly grated ginger	-		**2 ml ginger powder**	**2.5 ginger powder**	7.5 ginger powder
Paprika	-		-	**7.5 ml**	22.5 ml
Onion finely grated powder	1		**5ml onion flakes**	**10 ml onion flakes**	30 ml onion flakes
Worcestershire sauce	20 ml		**10 ml**	10 ml	30 ml
Egg beaten	1		**2 eggs**	1	3

Breadcrumbs	2 slices	-	-	-
Granulated sugar	-	-	2.5 ml	7.5 ml
Butter	-	-	5 ml	15 ml
Sunflower oil	-	-	5 ml	15 ml
Preparation method:				
Step 1	Cut the meat into small pieces of 3x3cm and remove bones.	Cut the meat into small pieces of 3x3cm and remove bones.	Cut the meat into small pieces of 3x3cm and remove bones.	Cut the meat into small pieces of 3x3cm and remove bones.
Step 2	Place pieces in a bowl, add all the ingredients and mix thoroughly.	Place pieces in a bowl, add seasonings, and onion, and mix thoroughly.	Place pieces of meat in a bowl, add seasonings, sugar, and egg and mix thoroughly.	Place pieces of meat in a bowl, add seasonings, sugar, and egg and mix thoroughly.
Step 3	Cling wrap the bowl and allow it to chill for 10 minutes in the refrigerator.	Add the remaining ingredients and mix well.	Rub the meat with Worcestershire sauce, butter, and oil.	Rub the meat with Worcestershire sauce, butter, and oil.
Step 4		Cling wrap the bowl and allow it to chill for 10 minutes in the refrigerator.	Cling wrap the bowl and allow it to chill overnight in the refrigerator.	Cling wrap the bowl and allow it to chill overnight in the refrigerator.

Step 5	Using the 8mm grinding plate, mince the formulation through the mincing funnel.	Using the 8mm grinding plate, mince the formulation through the mincing funnel.	Using the 8mm grinding plate, mince the formulation through the mincing funnel.	Using the 8mm grinding plate, mince the formulation through the mincing funnel.
Step 6	Shape the mincemeat into a 100 g burger patty using the manual patty machine (100mm).	Shape the mincemeat into a 120 g burger patty using the manual patty machine (100mm).	Shape the mincemeat into a 120 g burger patty using the manual patty machine (100mm).	Shape the mincemeat into a 120 g burger patty using the manual patty machine (100mm).
Cooking method				
Step 1	Preheat the frying pan and add the sunflower oil.	Preheat the frying pan and add the sunflower oil.	Preheat the frying pan and add the sunflower oil.	Preheat the frying pan and add the sunflower oil.
Step 2	Fry the burger patty for 5 minutes on each side and the internal temperature must be 75°C.	Fry the burger patty for 5 minutes on each side and the internal temperature must be 75°C.	Fry the burger patty for 5 minutes on each side and the internal temperature must be 75°C.	Fry the burger patty for 5 minutes on each side and the internal temperature must be 75°C.
				Raw weight: 120 g **Cooked weight: 110 g** **Cooking loss: 10 g**

5.5.2.4 Preparation of Goat meat Dry wors

Another reported utilization of goat meat is its preparation in the form of roasts. Unfortunately, this cooking method and preparation style appear to be culturally specific and appreciated primarily by certain cultural groups. Observations from retail stores have highlighted that one of the most consumed dry-cooked meat products is dried wors (a type of traditional South African sausage). This product, made from other types of meat, is enjoyed by various cultural groups that favour meat-based dishes. Based on these observations, this study incorporated chevon dried wors as a culturally versatile product with potential appeal across diverse demographics, leveraging their popularity as a convenient, dry-cooked meat option. The production of dry wors involves several key steps, including debonding, cubing, spicing of the meat, mincing, shaping, and drying. For the drying process, a custom-designed plastic homemade dry box was used. Through the development and testing of various dry waste formulations, an acceptable quality standard was achieved and validated by a panel of trained evaluators. However, specific adjustments and ingredient modifications employed to enhance the texture and odour attributes of dry wors will only be disclosed upon request, as they constitute proprietary intellectual property. The dried wors processing flowchart is shown in Figure. 5.4.

The baseline homemade wors (formulation 1) were used as a starting point for the development of dry wors, as shown in Table 5.5. The dried versions of the same ingredients were used. Through various formulations, it was determined that fresh ingredients such as onion and garlic were not an option for such products. However, for these products, no premix seasonings or commercial batch-packed spices were used. Only accessible ingredients and seasonings from the retail stores were chosen to ensure ease of preparation and allow the reproduction of developed products even at the community level. Furthermore, according to the Department of Agriculture, Land Reform, and Rural Development (2022), all products of this kind must maintain 75% of the total meat content to comply with South African regulations, governing the composition and labelling of raw processed meat products. The costs of the three product formulations are presented in Table 5.6.

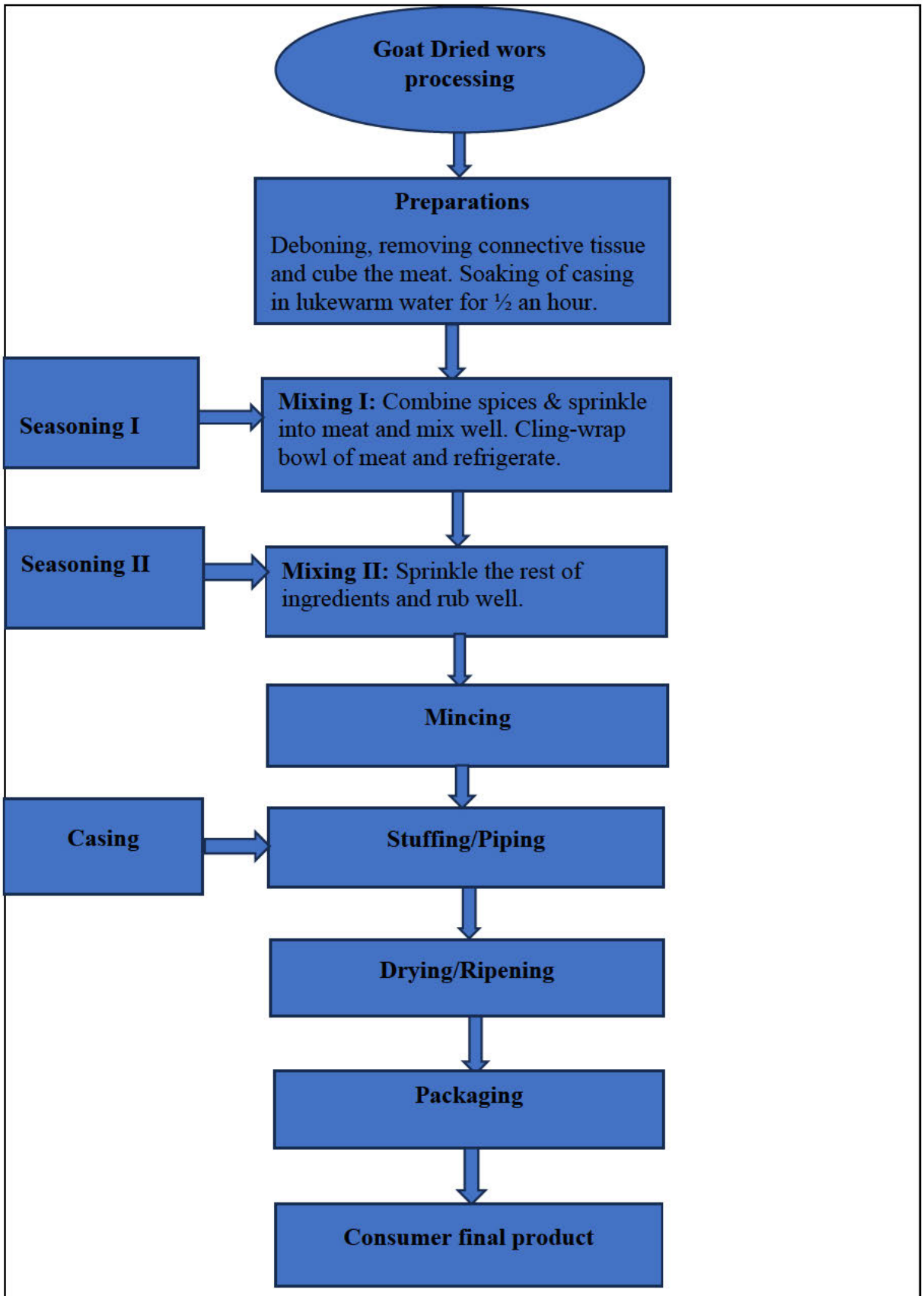

Figure 5. 4: Flowchart diagram illustrating processing of goat meat dried wors

Table 5.5: Goat meat dry wors formulations

Name of product: Goat-Dried wors		**Dehydration:** 7 Days		
Preparation time: 30 Minutes **Mincing and shaping:** 25 Minutes		**Total Recipe Yield:** 24 patties (120g x 24)		
Ingredients	***Baseline Homemade* worse**	***Formulations 1:***	***Formulation 2:***	***Formulation 3: Upscaled recipe***
Goat meat: leg, flank, rib and ramp	1 kg	1.5 kg	1.5 kg	3 kg
Spek	175 g	**200 g**	**150 g**	300 g
Ground coriander	7 g	**12.5 g ground coriander**	**15 g ground coriander and cumin**	30 g ground coriander and cumin
Salt - iodised	20 g	**30 g salt**	**36 g salt**	72 g salt
Ground black pepper	4 g	**3 ml**	**3.6 ml** ground black pepper	7.2 g ground black pepper
Ground garlic cloves	1.75 g	**5 ml garlic powder**	**6 ml garlic powder**	12 ml
Brown spirit vinegar	75 ml	75 ml	75 ml brown spirit vinegar	150 ml
Sheep casing (18-22 mm)	30 g	30 g casing (18-22 sheep casing)	30 g casing (18-22 sheep casing)	30 g casing (18-22 sheep casing)
Preparation method:				
Step 1	Cut the meat into small pieces of 3x3cm, and remove bones.		Cut the meat into small pieces of 3x3cm and remove bones.	Cut the meat into small pieces of 3x3cm and remove bones.
Step 2	Add the rest of the ingredients except the speck and vinegar.		Place the meat pieces in a bowl, cling wrap, and allow to chill for 10 minutes in the freezer until film but not frozen.	Place the pieces in a bowl, cling wrap, and allow to chill for 10 minutes in the freezer until film but not frozen.
Step 3	Diced the speck and kept it separate.		Diced the speck and kept it separate to chill.	Diced the speck and kept it separate to chill.

Step 4	-	Using the 8mm grinding plate place the meat formulation into the mincing funnel to mince.	Using the 8mm grinding plate place the meat formulation into the mincing funnel to mince.
Step 5	Add speck and vinegar to minced meat and mix lightly but thoroughly.	Add seasoning ingredients, speck and vinegar to minced meat and mix lightly but thoroughly.	Add seasoning ingredients, speck and vinegar to minced meat and mix lightly but thoroughly.
Step 6	Using the 8mm grinding plate, mince the formulation through the mincing funnel.	Using the 8mm grinding plate, mince the formulation through the mincing funnel again.	Using the 8mm grinding plate, mince the formulation through the mincing funnel again.
Step 7	To prepare the casing, soak in lukewarm water to remove salt coated as a preservation agent for about half an hour or until soft.	To prepare the casing, soak in lukewarm water to remove salt coated as a preservation agent for about half an hour or until soft.	To prepare the casing, soak in lukewarm water to remove salt coated as a preservation agent for about half an hour or until soft.
Step 8	Rinse with cold running water and pull casing over sausage filler with nozzle size 22mm.	Rinse with cold running water and pull casing over sausage filler with nozzle size 22mm.	Rinse with cold running water and pull casing over sausage filler with nozzle size 22mm.
Step 9	Stuff meat into the casing and twist the wors into 60cm portions.	Fill the goat meat mince into the casing. Once the casing is filled, twist the wors into 60cm portions.	Fill the goat meat mince into the casing. Once the casing is filled, twist the wors into 60cm portions.
Step 10	-	Place wors in a dryer box at a temperature of 25°C, at a relative humidity of 30%, and air velocity of 2 m/s, for 5 days.	Place wors in a dryer box at a temperature of 25°C, at a relative humidity of 30%, and air velocity of 2 m/s, for 5 days.
			Raw weight: 3 136 kg **Dried weight: 1 468 kg** **Weight loss: 1 668 kg**

The weight of both uncooked and cooked products (goatmeat curry and burger patty), as well as the fresh raw and dried raw formulations of goat wors were recorded. The yield of each product was calculated using the following formula:

Product yield = weight before cooking/weight after cooking x 100 (Gadekart, 2013).
Thus, the formula determined the cooking yield, while the product yield was calculated to calculate the amount of weight lost during the processing of cooked and dried products. Thus, the weight loss was calculated as follows:

$$Total\ cooking\ loss\% = \frac{calculated\ mass\ of\ raw\ patty - Mass\ of\ cooked\ patty}{calculated\ mass\ of\ raw\ patty}\ X\ 10$$

5.6 Microbiological Quality Assessment

Further developments were conducted to investigate the quality of developed products. Therefore, microbiological testing was conducted on three products: goat curry, dried wors, and burger patties. The samples were prepared on the same day and sent for microbiological testing. However, goat-dried wors were prepared in advance to allow adequate time for the drying process. Goat curry (100 g) was packed in a pre-sterilized bottle with a lid, while (110 g) burger patties and (100 g) dried wors were packed separately in a sterile bag and placed in a cooler box with ice packs to maintain the old chain temperature of 4°C. Product samples were sent to the Fact Food Laboratory in Durban to be analyzed for total plate count, Presumptive *E. coli, Salmonella spp,* and Enumeration of S. aureus. Microbiological analyses were conducted to ensure the safety of the consumers and the reliability of the results.

5.6.1 Total Microbial Plate Count

The total microbial play count was determined using a 10 g sample of each goat product, homogenized in 90 ml sterile 0.1% peptone water, and analyzed using plate count agar. The samples were analyzed using plate count agar at 30°C for 72 h (ISO 4833:2003[E]). Each sample was measured in Colony Forming Unit (CFU/g), and mean values for microbial total count were established for goat curry, burger patties, and dried wors.

5.6.2 Detection of Presumptive E. coli

A detection method using broth and peptone water at 37°C and 44ºC for 2-6 days as guided by the South African National Standard (SANS) 7251:2005 ed.2 was conducted for all three goat samples. The mean values were determined from the readings recorded for each sample.

5.6.3 Detection of Salmonella spp.

Salmonella was detected using South African National Standards (SANS) ISO6579 in 25 g of goat meat curry and burger patties, samples were homogenized in 225 mL of Buffered Peptone Water (Oxoid), and incubated for 24 h at 37 °C. After incubation, 1 mL was transferred to 10 mL of Tetrathionate broth with iodine (Oxoid) and incubated at 37 °C for 24 h.

5.6.4 Enumeration of Listeria monocytogenes

The collections that developed following a 48-hour incubation period at 37°C under the guidelines provided by SANS 5763:2006 and ISO 11290-2:1998 (E)-modified were recorded. Each sample was measured in Colony Forming Unit (CFU/g), and the mean values for Listeria monocytogenes were determined for all three goat meat samples.

5.6.5 Enumeration of *Staphylococcus aureus (S. aureus*)

Staphylococcus aureus was enumerated on Baird-Parker medium supplemented with Tellurite Yolk Egg (Merk) after incubation of 48 h at 37 °C. The bacterial load was measured using Baird Parker agar at 37°C for 48 h, guided by the South African National Standard (SANS) 5763:2006.

5.7 Physicochemical Quality Assessments

5.7.1 Texture Profile Analysis (TPA)

The physical quality of the resulting goat products was determined using an instrumental TA-XT Plus texture analyzer. Three goat products (goat curry, burger patty, and dried wors) were rotated at an angle of 90°C for triplicate readings in each product to determine how much force would the consumer need to bite the product. Therefore, product firmness levels were measured. The three-point Warmer-Bratzler blade attachment, which mimics the consumer's teeth and the amount of pressure to cut the food in the mount, was connected to a 30 kg load

cell of a universal TA-XT texture analyzer. The maximum peak force (Newton) for triplicate samples per product from the force deformation curve was recorded. Hence, this action determines the amount of force required to experience the texture of a product. Again, this is based on the tenderness (firmness) of the product.

5.7.2 Instrumental colour measurement

The colour was measured using a HunterLab ColourFlex Colourimetric Spectrophotometer (model 45/0, HunterLab Reston, USA). The readings of each sample were taken in triplicate, with the mean values for L*, a*, and b* determined (L*= lightness, ranging from 0 [black] to 100 [white]; a*= redness and ranges from green [–] up to red [+]; b*= yellowness and ranges from blue [–] to yellow [+]). Three colour readings were taken from moist and dry cooked products, as well as from the dried product. However, the trained panel results from this study indicated that the preparation technique for the three goat meat products could enhance consumer acceptance of products with the potential to meet consumer demands for convenient and healthier animal products of natural origin. These product-quality services were sourced from the University of KwaZulu-Natal – Dietetics and Food Science Laboratory in Pietermaritzburg.

5.8 Data analysis

The qualitative data collected from the product qualities through product development trials reported in the form of winning recipes for final end-products. While quantitative data was collected from the trained panel sensory evaluations, microbial and physicochemical analyses of value-added products in the form of texture and colour qualities. Results were analyzed utilizing variance (ANOVA) using Statistical Package for Social Sciences (SPSS) Software version 28.0. Significant F-tests at the level of probability ($p<0.05$) were reported. Each sample was analyzed in triplicate, and the mean values were established for each product (goat meat curry, burger patty, and dried wors). In addition, microbial analysis and physicochemical statistical analyses of texture and colour parameters were performed using a one-way ANOVA of XLSTAT statistical software. Descriptive results determining the tenderness/firmness and colour spectrum of each developed product were used to analyze the data collected, and significant differences at the level of probability ($p<0.05$) were reported.

5.9 Considerations for food safety

The following procedure was followed during the development of the food product in accordance with the R638 legislation (South African Department of Health 2018), which specifies food safety regulations and best practices for food preparation.

- Every meat product was kept chilled to inhibit the growth of germs.
- The food handlers who participated in the product development process were fully kitted out with the chef's uniform, closed shoes, coat, apron, and hairnet. They were made sure to wash their hands correctly during pre- and post-handling of raw and cooked meat, as well as every 30 min.
- A food-grade disinfectant was used to clean the surfaces before and after the product was developed.
- Before and after usage, each piece of equipment was cleaned in hot, soapy water, and the utensils were sterilized, especially those for meat processing.
- The recommended temperatures were determined to ensure that the food was safe to eat by following the prescribed cooking temperatures.
- The sensory evaluation panel advised that the products were made from goat meat, and those who had allergy problems were not allowed to participate in the tasting sessions.

Given the significance of consumer safety in the food production process, the researcher went beyond the parameters of the study in addition to considering food safety. Therefore, there may be a compelling basis for increasing consumer risk, particularly for uncooked products, such as dried goat meat wors in particular. Thus, microbiological analysis was carried out for this reason, and all three products were microbiologically tested. Microorganism testing was performed to ensure customer safety even though goat meat curry and burger patties were cooked, although the heating was minimal to inactivate microorganisms (McWilliams, 2017).

5.10 Results and Discussion

5.10.1 Development of innovative goat meat products

5.10.1.1 Chevon curry

Chevon curry was successfully modified to yield a much better product. Below is the goat curry represented in Figure 5.5. with the critical steps employed in processing of the final product.

Figure 5.5 Flowchart for goat curry

In this study, it was evident that not only did the use of spices influence taste and odour masking, but the cooking techniques employed also played a significant role. Various cooking methods have been shown to positively affect meat quality and sensory attributes. For instance, Mowa (2018) and Ngomane, Tsvakirai, and Mlambo (2022) reported that certain cooking techniques effectively mitigated factors traditionally reducing meat acceptability, such as the characteristic gamey odour (attributed to the fatty acid composition) and the often-tough, chewy texture.

One such method, simmering, a slow cooking technique particularly suitable for tougher cuts of meat, was employed in this study to enhance the sensory qualities of goat meat. Simmering provides sufficient time for muscle proteins to coagulate, which improves tenderness and reduces toughness (McWilliams, 2017). Additionally, this method involves precise temperature control, which not only enhances tenderness but also amplifies key sensory properties such as taste, flavour intensity, and juiciness. Consequently, simmering produces a more palatable and visually appealing final product that addresses the traditional challenges associated with goat meat preparation.

5.10.1.2 Burger Patty

Burger patties can be prepared in diverse ways, such as pan-frying or grilling on a griddle pan. Because shallow frying is a quick cooking method that is frequently employed in both homes and commercial settings, it was chosen for this study's patties. Preheating a non-stick frying pan at medium heat was the first step in the dry heat cooking method (Brown 2018), as shown in Figure 5.3. For frying, 10 mL of sunflower oil was poured into the prepared pan, and no further water was used for cooking (Brown 2018). Because sunflower oil has a high smoke point temperature of 210°C, the temperature required for frying can endure high heat (Bastida and Sánchez-Muniz 2015: 226). Fried foods require a temperature range of 150–200°C. (Gertz 2014). After carefully placing the patties on the pan, they were cooked for 10 min and 5 min on each side. During the frying process, the Maillard reaction causes patties to caramelize and brown on all sides (Bastida and Sánchez-Muniz 2015). The internal temperature of the burger patties was measured to be 75°C to avoid overcooking/undercooking of the products. However, Jones et al. (2017) agreed that 75°C in cooked products is the ideal temperature outside the danger zone. The fried patties were then placed on a paper towel to drain any excess oil accumulated during cooking.

1. **Weighing in preparation for shaping**

2. **Shaping using the manual patty press**

4. **Packed burger patty for chilling**

3. **Frying the goat meat burger patty**

5. **Weighing the cooked burger patty**

6. **Feedback process on sensory evaluation test**

Figure 5.6: Flow diagram for goat meat burger patty

5.10.1.3 Preparation of Goat meat Dry wors

Goat meat undergoes a curing process that involves deboning, cubing, and spicing of the meat, followed by drying conditions (parameters) that focus on the specific temperature and airflow. No other animal fats were added to the recipe, except for the goats' kidneys and pelvic fats. These types of fats were used purposefully for the benefit of acceptability, as stated by (Umaraw et al., 2015). This was done to maintain a clean product identity and certification of product originality, particularly for consumer information benefits. For this study, the drying kinetics technique of dried wors was determined at a temperature of 25°C, relative humidity of 30%, and air velocity of 2 m/s for 5 days. Thereafter, dried wors were cut into individual samples 8 cm long for sensory evaluation using a food slicer (OMAS, Type H 300, Italy).

Image 5.5: Fresh goat wors

Image 5.6: Goat-dried wors

Image 5.7: Portioned goat dried wors for sensory evaluation test

As shown in Table 5.4, the use of fresh ingredients, such as onion, garlic, and ginger, contributed to the discolouration of the product with a soft mixture and a bitter taste. Therefore, the use of dried and ground ingredients did not only enhance the flavour/aroma of the product.

However, the product taste and structure were improved through sensory pilot study feedback from the semi-trained sensory panel. Dried and grounded versions of these ingredients were selected based on their long shelf-life capacity, intense flavour/aroma, and limitations to discolouration and moisture development during food production, particularly for burger party production.

5.11 Microbiological and Physicochemical Quality

5.11.1 Microbiological Quality

Microbiological results for three developed products: Total plate count (TPC), yeast, mould, *Clostridium perfringens*, *Escherichia* coli (*E. coli*), *Salmonella* spp., *Listeria monocytogenes* (*L. monocytogenes*), and *Staphylococcus. aureus* (*S. aureus*) is listed in Table 5.6.

Table 5.6: Microbiological results for goat meat curry, burger patties and dry wors

Microbial Test Analysis	**Goat meat curry (cfu/g)**	**Goat burger patty (cfu/g)**	**Goat dried wors (cfu/g)**	**Acceptable limits cru/g**
Total plate count	3.7×10^2	1.6×10^6	1.6×10^2	$<10^6$
Escherichia (*E. coli*) /0.1g	Absence	Absence	Absence	<10
Salmonella spp. / 25g	Absence	Absence	Absence	0/25g
Listeria monocytogenes (CFU/g)	Absence	Absence	Absence	0/25g
S. aureus (CFU/g)	<100	<100	<100	$<10^3$
Yeast	-	-	<100	$<10^4$
Mould	-	-	<100	$<10^4$
Clostridium perfringens	-	-	<10	$<10^2$

Three product developed were further compared in terms of number of microorganism count between two replicate using Comparison Pairwise Welch's t-test, as illustrated in Table 5.7.

Products / Samples	**Total plate (cfu/g)**	**Mean**	**SD**	**P-value**	**Significance**
Goat curry vs burger patty	382.77 354.07	368.42	20.29	0.0260	$P < 0.05$
Goat curry vs dried wors	1750000 1612500	1,681,250.00	97,227.18	0.0182	$P < 0.05$
Burger patty dried wors	180 149	160.00	28.28	0.0260	$P < 0.05$

The total plate count (TPC) indicated that the number of viable microorganisms per gram in the goat burger patties was $P < 0.05$, goat meat curry $P < 0.05$ and goat dried wors $P < 0.05$. Thus, all three products had acceptable limits for the total plate count. This suggests that the goat burger patties had a moderate level of microbial contamination, which is an acceptable level, while goat meat curry and dried wors plate count was significantly lower than that of goat burger patties. The levels of microbial contamination in the goat burger patties were relatively high among the three products. Therefore, the smaller the count, the better the quality of the microbiological products. The absence of *Escherichia coli*, *Salmonella* and *Listeria monocytogenes* in all three products, was a good sign that reassured the safety of the products for consumption as *Escherichia coli* is a common indicator of faecal contamination and can cause foodborne illness. *Salmonella* and *Listeria monocytogenes* are pathogenic bacteria, and *Salmonella* can cause severe food poisoning. *Listeria monocytogenes* has the potential to cause food poisoning, known as listeriosis, leading to serious foodborne illnesses.

Staphylococcus aureus was found to be $P < 0.05$, which was relatively low, indicating a low level of contamination by this bacterium. Overall, the results indicated that all three goat meat products were safe for consumption, although yeast, mould, and Clostridium perfringens bacteria were present in dried wors at relatively low levels. The dried wors yeast and mold hold were within acceptable micro-level limits (Jones, 2017; Petit et al., 2014). Despite admitting other research findings, it also met government legislation standards, which are based on the International Commission on Microbiological Specifications for Foods and the International Standards in the Field of Food Safety and Quality (GSO 1016/2015). Dried wors, in particular for this study, are one of the dried-cured products that are uncooked, but a completely raw dried meat snack type of food, produced by drying salted/spiced meat in a tube/casing. Salt and vinegar serve as preservatives for product shelf life. The reduction in water content for dried wors led to limited conditions for food spoilage microorganisms, as shown in Table 5.6.

The minimal presence of yeast and mould was due to the use of vinegar, which lowered the pH (4.9) values (Jone, 2017). This probably acts in combination with moisture and salt to inhibit the growth of yeast, mould, and Clostridium perfringens. Furthermore, this could be because the product is uncooked and dried under controlled conditions, which could also lack ventilation. Similarly to these findings, Bader et al. (2021) experienced similar results with the dried/salted meat samples of different animal species. Yeast and mould count in goat and camel meat samples were below the detection threshold (<10 CFU/g).

5.12 Physicochemical quality results

5.12.1 Texture

The instrumental texture results for the determination of tenderness presented in Table 5.7, revealed that the maximum shear force and workforce demonstrated on goat dried wors was the highest ($P<0.05$), while minimum values were observed in goat curry, followed by the burger patty with a better toughness than the dried wors. Textural values of fresh meat were evaluated by the number of muscle fibres and thickness of connective tissue, as measured by texture profile analysis (TPA). The shear force value of goat curry and burger patty was within the range reported by Umaraw et al. (2015), which is 32.6 – 56.34 N. Though the burger shear force was higher ($P<0.05$) than that of goat curry. The mean shear force and work of shear area values of dried wors were significantly higher ($P<0.05$) than those of goat curry and a burger patty, which could be attributed to the structural conformation, the direction of the muscle fibres, fat deposition, and uniformity of the sample size. Again, the significantly higher values of dried wors shear force and work of shear in the area could be attributed to the drying technique applied, which preserved the meat with up to 50% water loss for 118 h.

Surprisingly, goat meat curry had a lower shear fore ($P<0.05$) compared to the minced product/burger patty. The shear force value of goat curry likely decreased because of the presence of water between the muscle fibres owing to the cooking process applied (moist cooking method). The cooking process considered first braising the meat cubes to seal in the moisture content and then simmering at a low temperature. Thus, the cooking time of the goat curry product increased, and the shear force value decreased. As a result, the cooking time for goat curry increased and the shear force value decreased. Vasanti et al. (2007) reported similar findings of decreasing shear force values with increasing cooking time. Again, it was noted that as the meat cooled down (goat curry and burger patty), weight loss gradually increased. However, dry processing can easily form charred skin on the meat surface, while wet processing methods make the meat surface moist, which is another reason for the differences in meat quality among the different thermal processing methods (Lui & Lanier, 2016).

Table 5.7: Results for Texture and Colour analysis of developed goat meat products

Product	a	b	L	Firmness (N)	Toughness (mm)
Goat curry	5.95±1.29[ab]	20.62±4.08[b]	28.68±2,21[b]	46.4±5.29[a]	27094±2352[a]
Dried wors	2.760±0.06[a]	4.37±0.61[a]	21.10±0.73[a]	273.0±48.62[b]	39666±13450[a]
Burger patty	8.093±0.71[b]	14.59±0.92[ab]	35.48±1.40[b]	53.0±2,18[a]	80587±1541[b]
P-value	0.047	0.030	0.015	0.006	0.026

[ab]Least square means (LSM) with different superscripts within a row are significantly different at P<0.05.
L*reflects the lightness of meat colour, a* reflects redness, and b* reflects yellowness.

5.10.2 Colour

The colour results are presented in Table 5.7, indicating differences in the colour values of Nguni goat meat samples processed using different methods. The results indicated a declining trend in the colour of the three interfaced products (goat curry, dried wors, and burger patties). The decline in the colour score of burger patties could be related to lipid and pigment oxidation as the patties' formulation was frequently handled during the mincing phase, which involves two distinct plate sizes and during the massaging stage, as well as in and out of the refrigerator after each phase of mincing. These colour changes were observed during meat processing of burger patties and dried wors. As a result, enzymatic browning and surface dehydration can both contribute to colour reduction. Several studies have confirmed that salt content has a pro-oxidant effect on lipids owing to its inhibitory action on antioxidant enzymes, leading to discolouration in meat products (Mariutti & Bragagnolo, 2017; Huang & Ahn, 2019).

Based on the study conducted by Giriprasad et al. (2015) reported a similar decline in colour and appearance scores in restructured buffalo meat steaks. According to Ivanović and Pavlovi (2015), meat colour may be affected by many factors, including type/breed, structure, and the ratio of intramuscular fat. In line with this study, Ivanović (2020) found that a statistically significant difference ($P < 0.05$) occurred between the colour of meat originating from Balkan and Saanen goats, meaning there was a difference in meat colour from these two species. But

not between Balkan and Alpine goats ($P > 0.05$) for all colour parameters. On the other hand, Madruga et al. (2008) showed significant differences ($P < 0.05$) in the a* parameter of meat colour between breeds but not for the L* and b* parameters. Therefore, in this study, it was discovered that meat handling, the amount of time handling, and processing of meat, as well as the type of processing methods used, contribute to the colour reduction as meat is exposed to surface dehydration. However, despite the findings from the study of value-added goat meat products, it has been discovered that good management practices during food production are important. As a result, this work is an outcome of good management practices, hygiene practices, and product processing analysis, with a focus on each product phase.

5.13 Conclusion

In conclusion, successful optimization of chevon utilization relied on a nuanced understanding of market trends, consumer dynamics, and cultural preferences. While interfacing of chevon-based products was guided by the need to emulate consumer palatability, preferences, and family dynamics while incorporating local and traditional elements. The presence of competing meat products in the market provided critical cues on the development of the new products. Thus, three products: goat curry, burger patty and dried wors were successfully developed. The consumer preference indicated goat curry as the tenderest, followed by the burger patty, and dried wors thereafter. This was backed by the colour, texture shear force, lower microbial contamination and good products texture qualities. Additionally, the value placed by consumers on indigenous and traditional foods, often because of their perceived naturalness and cultural authenticity, highlighted the desire of aligning chevon-based products in a modern consumption patterns, while promoting goat meat products into commercial marketing.

The positive outcomes on product development stages, sensory evaluations, microbial and physicochemical qualities on goat meat curry, burger patty and dried wors, proved the potential market for goat meat products in KwaZulu-Natal Province. Provided, these qualities are maintained or improved for better acceptability and utilization , while improving revenue opportunities in the meat industry through goat meat processing and marketing, for food and nutritionally secured population/ communities. Moreover, provided a valuable reference in the academia for future studies on goat meat product development and consumption. Therefore, further research on range of value-added goat meat products and physicochemical quality analyses, especially colour as the most challenging factor, are recommended.

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CHAPTER 6: CONSUMER ACCEPTABILITY AND THE WILLINGNESS TO PAY FOR INNOVATIVE GOAT MEAT PRODUCTS

Abstract

The use of modern technologies, such as cooking and processing techniques, in food product sensory qualities can influence consumer acceptability or rejection of food products. Owing to the lack of innovation in goat meat consumption worldwide could be a major contributory factor to the lack of goat meat acceptability. Despite the commercial availability of goat meat compared to lamb, mutton, and other red meat varieties, that of South Africa is still low. The limited retail availability of goat meat is further attributed to consumer knowledge constraints and negative perceptions regarding the attributes of goat meat. Therefore, processing goat meat into value-added goat meat products (VAGMPs) may enhance the sensory quality and acceptability of goat meat. Consequently, sensory diversity is an important factor to be considered in the development of new products to influence consumer attitudes towards goat meat and diversify goat meat offerings and consumption. The purpose of this study was to evaluate the sensory characteristics and consumer acceptability of value-added goat meat products, while also determining the consumer willingness of purchasing these products in rural KwaZulu-Natal. A 120-consumer panel recruited voluntarily from two academic institutions in northern KZN determined sensory characteristics using a five-point hedonic scale. In addition, a ranking preference test was conducted to determine the level of product preference. The Food Action Rating Scale (FACT) was used to determine the extent to which the preferred products would be consumed if they were available in the market. The consumer characteristics of VAGMPs were highly appreciated ($P<0.05$) for goat meat curry, followed by burger patties, and finally dried wors. This was observed in both product preference and FACT testing. Likewise, more consumers were willing to pay for goat curry; thereafter, burger patties and dried wors less than conventional goat meat. The willingness to purchase and consume goat meat VAGMPs is greatly influenced by sensory quality. However, sensory evaluation needs to be replicated in other provinces to verify and draw conclusions on the specific product variety that has favourable consumer characteristics.

Keywords: *Goat meat, consumer acceptance, value-added products, sensory evaluation and consumer willingness to purchase.*

6.1 Introduction

This chapter focuses on the fifth objective of the study – consumer sensory evaluation and consumer willingness to purchase value-added goat meat products. This approach focuses on food-based product development by integrating culinary processing practices and current consumer trends into contemporary food systems, which can influence consumer acceptance or rejection of various foods. Therefore, this chapter presents the significant role of preparations and cooking techniques applied in shaping the consumer acceptability of goat meat products derived from the South African Indigenous Nguni Goats. Second, there are experimental insights on potential customers for value-added goat meat products, as well as the extent to which they are willing to purchase these products. Goat meat, also known as *chevon,* is a high protein-quality-rated animal food, perceived as leaner than other red meat types, with less saturated fats. However, goat meat is generally not as acceptable as other meat types, such as beef, lamb, mutton, pork, and chicken (Maganga et al., 2015; DARD, 2017). Goat meat is not available even in retail markets, and its low consumption may be due to multiple factors, including problems related to marketing classification and regulations (Soji & Muchenje, 2017; Yesufu et al., 2017), supply, and consumers' unfamiliarity with or dislike of goat meat (Borgogno et al., 2015).

Again, the lack of innovation in goat meat consumption in this study could have contributed to the lack of acceptability. As a result, sensory diversity is an important factor to be considered in the development of new products that influence consumer attitudes towards goat meat and diversify goat meat consumption. According to Xazela (2011) and Mdladla et al. (2017), the major demand for goat meat on the African continent seems to come from various ethnic groups, as influenced by their cultural traditions or religious beliefs. Therefore, a lack of prior experience with certain foods or with their flavour principles may result in poor consumer acceptance (Borgogno et al., 2015). However, product familiarity with similar sensory profiles, such as texture, taste, and flavour, can provide a context for new product development. This signals their palatability and safety while increasing product preference and purchasing effort. According to Borgogno et al. (2015) and Teixeira et al. (2020), is one of the most important drivers of food product preference. This is because it reduces product uncertainty and leads to a more likely match between the expectations and product characteristics. However, recent global reports on goat meat consumption trends indicate an increased consumption of goat meat due to the global need for low-cost animal-source food (ASF) options (Ntwenya et al., 2015).

Thus, changes in peoples' lifestyles could be the reasons that brought a new look towards previously downgraded indigenous foods of high nutritional content that are mostly underutilized and less acceptable.

Apart from their health significance, convenience foods are also a recent trend in the food market (Jong-Youn et al., 2024). Due to the demand for these foods, there is therefore a need for innovation in goat product development, including convenient yet healthy and sustainable animal-source foods to make food appealing to consumers. Changing consumer trends in food preferences have attracted the attention of food producers and entrepreneurs to take advantage of the benefits of goat meat and the rising goat meat innovation trend in the healthy food segment. Owing to several factors, including convenience, ready-to-cook (RTC) and ready-to-heat (RTH) products are increasingly gaining acceptance in most countries in the sub-Saharan African region and gradually replacing most non-convenient/traditional meat (Xazeka et al., 2011). These services enhance cooking convenience by providing precise ingredient measurements and preparations, reducing housework, and providing a healthy alternative (Jong-Youn et al., 2024). The processing of value-added goat products from goat meat involves preparation techniques such as ripening, meat treatment, cubing, deboning, processing, and cooking or dehydration treatment (i.e., moist cooking, drying, and processing). Goat meat may also need to be seasoned and processed into various products to bridge the need gap, based on the availability of resources, habits, and preferences.

Although chevons have more nutritional and health benefits than other meat types, consumer studies conducted in several countries have found a lower acceptance of GM compared to beef, lamb, and mutton globally (Borgogno et al., 2015; Boada et al., 2016; Stephens et al., 2018) and South Africa (Mazhangara et al., 2019; Ngomane et al., 2022). However, the application of advanced techniques in developing modernized convenient food has been found to improve consumer acceptability of goat meat consumption in many countries, especially Asia, Africa, and South America (Dubeuf et al., 2004). Therefore, processing goat meat into value-added goat meat products (VAGMPs) may enhance the sensory quality and acceptability of goat meat. Hence, there is limited information on the exposure to value-added goat meat products and consumer acceptability of these products for sustainable utilization. As a result, this study aimed to determine the effects of processing and cooking techniques on the sensory quality and consumer acceptability of VAGMPs, as well as the consumer intent to purchase goat meat products for household and commercial utilization.

6.2 Methodology

6.2.1 Study site and ethical aspects of the study

The study population considered academic institutions under the uMhlathuze Local Municipality in northern KwaZulu-Natal, South Africa. The two academic institutions where product sensory evaluation, consumer acceptability, and product intent to purchase were conducted are in the rural setting of KwaZulu-Natal at Empangeni. University of Zululand (UniZulu), located in KwaDlangezwa under the Tribal Authority of KwaMkhwanazi and Owen Sithole College of Agriculture (OSCA), located in the KwaMthethwa area, under the Tribal Authority of KwaMthethwa. The designated area has many farmers with Nguni goats; however, there is limited access to food outlets around the institutions. The nearest formal food outlets are situated 16 km from the academic institutions. The academic institutions are situated in the hilly countryside of the uThungulu area, where the days are hot, sticky, and sluggish. Sugarcane, cotton, and lumber plantations are the main crops of Empangeni.

The consumer evaluation aspect of the study required permission from the academic institutions where students and staff from the University of Zululand and Owen Sithole College of Agriculture were involved in sampling goat meat products. Participants were recruited from the Consumer Sciences Department at UniZulu and the Agro-processing Unit at OSCA. This is because they are specialists in food product development and analysis and are experienced in the field of study. The inclusion criterion considered all participants to be goat meat consumers as a prerequisite for participation in the study. The survey only included consumers who expressed their willingness to take part and consumer panellists who participated in the sensory evaluation of the reformulated recipes for the product acceptability test. Participants were free to exercise the right to participate in the study.

6.2.2 Research approach

The experimental research design was adopted for consumer acceptability of value-added goat meat products and consumer willingness to purchase developed products.

6.3 Material and Procedures

6.3.1 Sensory evaluation of goat meat value-added products: Pilot Study

A pilot study of the sensory evaluation was conducted before the main evaluation with 30 participants, including both the University of Zululand and Owen Sithole Agricultural College (15 panellists per institution). This is an ideal panel size, as per Pedersen et al. (2018); thus, a 15 –panel of experts is sufficient in applied research on several factors, including quality and cross-case analysis over a particular subject (Patton, 2014; Pedersen et al., 2018). This was done to determine whether the approach utilized was feasible for use on a larger scale and to detect and correct methodological problems (Leon et al., 2011). Pilot study participants were recruited from the Consumer Science Department, University of Zululand, and the Agro-processing Unit from Owen Sithole College of Agriculture in KwaZulu-Natal, South Africa. Participation was voluntary, and participants were not permitted to participate in the main study. To ensure this, the researcher selected different days and weeks to conduct the main study. The following changes were made after the pilot study. The 8 cm dried wors individual sample size, and the four-quarter samples per burger patty were selected so that consumers could take two-tree bites of tasting in case it is necessary. Close polystyrene clear containers were used so that the samples did not dry out and became cold, especially the cooked ones. This allowed goat curry and burger patties to remain warm when tasted by the participants.

6.3.2 Sensory evaluation of goat meat value-added products: Main Study

6.3.2.1 Recruitment of Panelists

The main study participants were recruited earlier to ensure that a minimum number of participants was recruited. The hundred and twenty staff and students working or studying at OSCA and UniZulu, KwaZulu-Natal, and Empangeni were recruited (n=120) at a ratio of 60:60 to participate in the main study. This was an acceptable sample size, as 50 or more subjects representing each population are recommended for consumer acceptance studies (Stone & Sidel, 2004). This was a cross-sectional study conducted at different sites and on different dates. The sensory evaluation of goat meat samples (goat meat curry, goat burger patty, and goat-dried wors) was conducted using the following volunteers:

- Students and staff members from the Consumer Science Department at the University of Zululand, and the Agro-processing Unit from Owen Sithole Agricultural College.

- Students and staff members, who were regular goat meat consumers, were willing to consume goat meat products.
- Students and staff members without food-related allergies/ intolerances, and
- Students from the consumer science department from UniZulu, Agro-processing students from OSCA, and from the second to fourth-year level of study.

Thus, the inclusion criterion for the study was the suitability of the sensory panel.

Participants were recruited verbally and by invitation posters on the notice boards in the Consumer Science building at UniZulu and the Agro-processing Center for Owen Sithole College of Agriculture. Subjects who had participated in the pilot study a week before were not allowed to participate in the main study. Potential study participants were informed that participation in the study was voluntary and that there was no payment for participation. Participants were also required to abstain from eating food for 15 minutes before the evaluation. Participants who had smoked 30 minutes before the study and had flu, mouth sores, or other taste or smell abnormalities were told not to participate in the study.

6.3.2.2 Sample Coding, Serving Order and Sensory Evaluation Set-Up

The UniZulu sensory evaluation session was conducted in two separate rooms: lecture venues (SC 8E and 8F), and at OSCA, NLT and the main hall were used for sensory evaluation. These venues were specifically targeted to ensure reasonable proximity to preparation areas in both institutions. Thirty panellists from each room participated in the sensory evaluation session. All panellists were allocated a number to assist with identification. Before the participants could start the study, they signed a consent form. The research assistants explained the contents of the consent form to them. Participants were asked if they understood everything in the consent form before signing it. If anything was unclear, it was explained before the participants signed. The consent form is available in English. The panellists were seated in cubicles with sufficient spacing between them. The participants were asked not to communicate with each other to prevent them from influencing each other during the sensory evaluation of the samples.

Each panellist was given a sensory tray with three samples served in warm conditions, especially the cooked samples, and the containers were individually coded. A table of random numbers was disseminated, and each sample received a unique three-digit code based on a table of nine random variations. The samples were evaluated randomly and moved from the left to the right. The serving order was determined randomly from a table of nine possibilities to

prevent bias, as the samples were not served sequentially. Samples were served in small clear plastic containers with lids for individual analysis, with containers closed after portioned samples to maintain warmth in the cooked samples until serving. The samples were placed on a serving tray alongside a clear plastic cup of water, a plain unsalted cracker to serve as a cleanser between the tasting, a scorecard, a pencil, an eraser, and a small plastic bag to spit out the samples if the panellists did not want to swallow them (Image 6.2). The instructions were given verbally to the participants and included on scorecards. The panellists completed their demographic information and proceeded to complete a five-point hedonic test for three products (goat curry, burger patty, and dried wors), followed by the ranking preference test and food action rating scale.

Image 6.1: Sensory evaluation setup

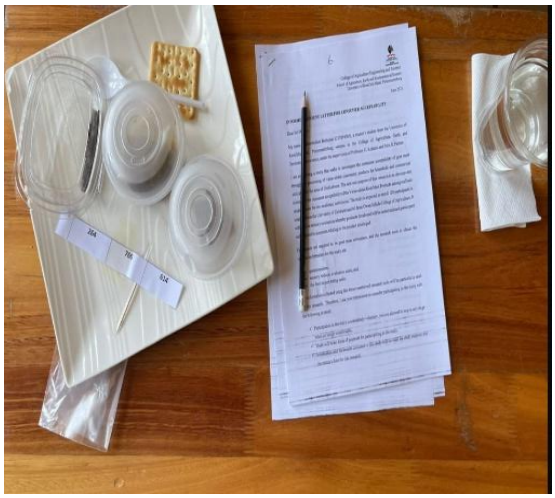

Image 6.2: The **s**ensory evaluation tray for the consumer acceptability test

6.3.3 Consumer acceptance testing

Consumer acceptance sensory testing is a crucial step in product development. Various sensory evaluation tests can be used to assess consumer attitudes, perceptions of a product's qualities, and willingness to buy. In this study, three tests were used to measure consumer attitudes and purchase intent: five-point hedonic scale, ranking preference test, and food action rating scale (FACT). These are described below.

6.3.3.1 A 5-point hedonic scale test

For consumer acceptance tests, consumers were asked to "rate" how they liked the products to test their acceptance using scores on an ordered but arbitrary scale. A 5-level hedonic scale was used, where 1= very bad. 2= bad, 3= neither good nor bad, 4= good, and 5= very good. Overall evaluation rating of value-added goat products (curry, burger patties, and dried wors) by consumers used a score ranging from 1 (extremely pleasant) to 5 (extremely unpleasant). Other factors that can influence the score are individual characteristics such as gender, age, and education.

6.3.3.2 Ranking reference test

The study is also interested in knowing whether innovative practices applied in product development are more appreciated by consumers to influence their preference for ranking potential. In addition, the extent to which these products are liked was determined based on a scale of 1= highly preferred, 2= moderately preferred, and 3= least preferred.

6.3.4 Food action rating scale (FACT)

The participants were then given a food action rating scale (FACT) to determine consumers' willingness to purchase (WTP) the goat meat value-added products. A food action rating scale test was used to determine the consumers' intent to consume the goat meat curry, burger patty, and dried wors in a real-life situation, and their attitude towards consumption of these products. If they liked the products, they liked it enough to buy it? and how often they would like to eat these products? This would give direction as to whether the products had the potential to be economically viable in the marketplace and would serve the target populations' demands. This category scale test has seven options: positive, undecided, and negative.

The reason why the Food Action Rating Scale was given to the participants in addition to the hedonic rating scale and preference tests was to cross-check the validity of the chosen products in consumer preference tests were still be the same intended to be purchased should available in the marketplace.

6.4 Data analysis

The collected data from the sensory evaluation panellists for the three interfaced goat meat products were analyzed using variance (ANOVA) using Statistical Package for Social Sciences

(SPSS) Software version 28.0. Significant F tests at the level of probability ($p<0.05$) are reported. The ranking data from the consumer attitude and willingness to purchase the products (goat curry, burger patty, and dried-wors), using consumer acceptance test, preference ranking test, and food action rating scale were determined using a one-way ANOVA with XLSTAT statistical software. Descriptive results determining the aroma tenderness, juiciness, flavour, and aftertaste of each interfaced product were used to analyze the data collected, and significant differences at levels of probability ($p<0.05$) are reported. The frequencies are presented in tables and graphs.

6.5 Results and Discussions

6.5.1 Sensory Evaluation test results of Goat meat curry, burger patty and dried wors

Three products were successfully evaluated, and this testing technique required a sensory panel composed of people who may use the products, as presented in Table 6.1.

6.5.1.1 Demographics results of sensory evaluation panellists

Table 6.1: Demographics information for consumer acceptance participants (n=120)

Variables	Frequency	Percentage (%)
Gender		
Male	45	37,5
Female	75	62,5
Age		
Less than 20 years	12	10,0
20 - 25 years	63	52,2
26 - 30 years	14	11,6
Above 30 years	31	26,2
Ethnic group		
African	120	100
Educational level		
1sy year	11	9,2
2nd year	41	34,2
3rd year	42	35,0
4th year	16	13,3
Postgraduate	10	8,3

Table 6.1 presents the demographic information of the participants involved in the acceptability evaluation of the product samples. Representing the population gender pattern, there were more females than males. As mentioned in Chapter Three, higher learning students who were young were selected as evaluators of the acceptability of the products. All participants were ethnically diverse according to their demographic profile. As reported in the literature, goat meat is commonly consumed during festivities among African groups, and goat meat is underutilized and less consumed than other red meat types owing to certain unacceptable attributes (Webb, 2014; Ngomane et al., 2022). Therefore, graphic features such as gender, ethnicity, and age, targeting the youth population group were of fundamental importance in this study, as influencial factors that may support or reject the prospects of goat meat markerting in this case.

6.5.1.2 Five-point hedonic scale test

The results in Table 6.2 represent the sensory attribute scores of the participants.

Table 6.2: Sensory attributes of the three goat meat products (N=120)

Treatment	**Mean ± SD**
Aroma curry	4.6 ± 0.57
Tenderness curry	4.8 ± 0.45
Juiciness curry	4.7 ± 0.50
Flavour curry	4.7 ± 0.53
Aftertaste curry	4.6 ± 0.62
Overall acceptability curry	**1.3 ± 0.57**
Aroma burger	4.4 ± 0.62
Tenderness burger	4.5 ± 0.59
Juiciness burger	4.0 ± 0.71
Flavour burger	4.6 ± 0.61
Aftertaste burger	4.5 ± 0.74
Overall acceptability burger	**1.5 ± 0.56**
Aroma wors	4.1 ± 0.71
Dryness wors	4.4 ± 0.61
Mouthfeel wors	4.3 ± 0.64
Flavour wors	4.3 ± 0.69
Aftertaste wors	4.2 ± 0.76
Overall acceptability wors	**1.8 ± 0.60**

The sensory attributes of the products indicated higher tenderness scores for goat curry, followed by curry juiciness and flavour. The aroma was also good, with the curry overall acceptability indicating that it was extremely pleasant. This means that most of the respondents

in this study were interested in and enjoyed goat curry. These results are consistent with those of Alexandre et al. (2008) and Teixeira et al. (2020), who reported that the acceptability of goat curry is highly influenced by local customs. Regarding the sensory attributes of goat meat, the results showed that the flavour of the goat burger was very good, followed by tenderness. The juiciness and aroma of the goat burger were good respectively. The overall acceptability of the goat burger indicated that it was pleasant. This implies that most of the participants found the burger enjoyable. In contrast, Teixeira et al. (2021) found that goat burgers were sensorially harder and presented more difficult chewiness than beef burgers. The results of the sensory analysis showed that almost all sensory attributes of goat wors received a good response from the participants.

Table 6.3: Sensory attributes of goat meat products by percentage (N=120)

	Very bad	**Bad**	**Average**	**Good**	**Very good**
Tenderness curry	0.00%	0.00	1.67	18.33	80.00%
Juiciness curry	0.00	0.00	2.50	21.67	75.83 %
Flavour curry	0.00	0.00	3.33	24.17	72.50 %
Aftertaste curry	0.00	0.00	6.67	28.33	65.00 %
Aroma burger	0.00	0.83	4.17	45.00	50.00
Tenderness burger	0.00	0.83	2.50	46.67	50.00
Juiciness burger	0.83	0.00	18.33	55.83	25.00
Flavour burger	0.00	0.83	3.33	35.00	60.83
Aftertaste burger	0.83	1.67	5.00	35.83	56.67
Aroma wors	0.00	3.33	9.17	57.50	30.00
Dryness wors	0.00	0.00	6.67	47.50	45.83
Mouthfeel wors	0.00	0.83	7.50	52.50	39.17
Flavour wors	0.00	2.50	5.83	53.33	38.33
Aftertaste wors	0.00	2.50	12.50	45.83	39.17

6.5.1.3 Overall acceptability of goat meat curry, burger patty and dried wors

The overall acceptability of the goat products was analyzed based on a variance of Figure 6.1 shows the overall acceptability of goat meat products in percentage, variance indicated 1= extremely pleasant, 3 = average, and 5 = extremely unpleasant. None of the three products were rated extremely unpleasant. The results showed that more participants considered goat curry extremely pleasant, followed by burger patty, and thirdly, least percentage of participants considered dried wors extremely pleasant. The results also indicated the least percentage of participants considered dried wors, goat curry and burger patty having an average e taste. A small percentage of participants regarded all three goat products as unpleasant. Therefore, none

of the products was extremely unpleasant. However, most participants found all three products pleasant and extremely pleasant.

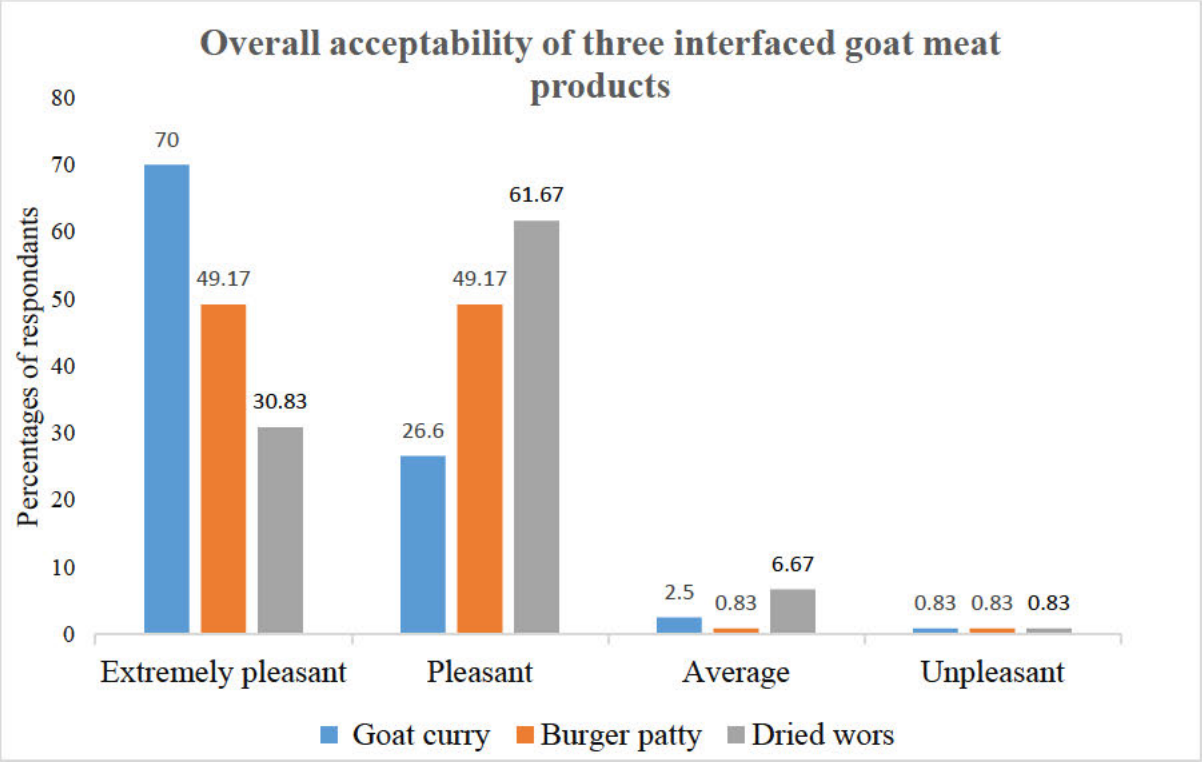

Figure 6. 1: Percentage of responses in goat meat product acceptability

6.5.1.4 Overall acceptability of three interfaced goat products by age

The results in Table 6.4 represent the overall acceptability of the three interfaced goat products according to age. The results showed that age had a positive and significant impact on goat curry at the 1% level. This means that, as age increased, more goat curry was accepted. These results were substantiated by Liu et al. (2013), who reported that a substantial demand for goat meat with great growth potential was driven by demographic factors such as age. Again, this could probably be because young people are so determined to try new products for future potential consumers and markets. Though, the age of participants did not have any significant impact on goat burgers. This means that goat burger consumption was not influenced by age. However, the study conducted by Ngomane et al. (2022) also found youths' perceptions to be key factors in determining the future trends of goat meat marketing and consumption in South Africa. Ngomane further claimed that very little information available from youth segments could be used to inform product offerings in South African markets.

Table 6.4: Overall acceptability of reformulated goat meat products by age (N=120)

Treatments	Age category	Mean	SD	P-value
Curry	Less than 20	1.53	0.68	
	20 to 25	1.39	0.59	0.005
	26 to 30	1.00	0.00	
	Over 30	1.06	0.24	
Burger	Less than 20	1.53	0.51	
	20 to 25	1.61	0.61	0.354
	26 to 30	1.42	0.51	
	Over 30	1.35	0.49	
Wors	Less than 20	1.90	0.55	
	20 to 25	1.84	0.61	0.034
	26 to 30	1.67	0.65	
	Over 30	1.41	0.51	

The results showed that the age of the participants had a positive and significant ($p<0.05$) impact on the goat flour product. This implies that as the age of the participants increased, more goat wors were accepted. This was in line with the results of Zenebe et al. (2014), who reported that older people tend to demand more goat products, such as wors, because they understand the nutritional value of goat meat.

Table 6.5: Overall acceptability of reformulated goat meat products by gender (N=120)

Treatments	Gender	Mean	SD	P-value
Curry	Male	1.3	0.6	
	Female	1.3	0.6	0.902
	Total	1.3	0.6	
Burger	Male	1.6	0.5	
	Female	1.5	0.6	0.506
	Total	1.5	0.6	
Wors	Female	1.8	0.5	
	Male	1.8	0.6	0.969
	Total	1.8	0.6	

6.5.1.5 Preference Ranking Test

The preference ranking scale test is a category scale designed to measure participants' liking for products.

Table 6.6: Goat meat product preference test results in percentage

Treatments	Highly preferred (%)	Moderately preferred (%)	Least preferred (%)
Curry	61.7	26.7	11.7
Burger	30.8	57.5	11.7
Dry-worse	7.5	15.8	76.7

The results in Table 6.6 showed that more participants highly preferred goat curry, followed burgers, and only least participants highly preferred wors. The moderately preferred product by half of the total participants was goat burgers, followed by the goat curry, and lastly, dried wors. As per the results, most of the participants did not like dried wors, but very low participants preferred burgers and curry the least. This means that dried wors was not as popular as curry and burger patties, as revealed in the study results. Dried wors was the least preferred product, probably because of a lack of familiarity and characteristics. A study conducted by Palmer (2022) concerning the consumption of processed meat also found that biltong (salted dried meat) was not a popular option for young African students. Nevertheless, the nutritional content (protein quality) of biltong was higher, resulting in a more concentrated form. However, curries and burgers were preferable for students due to familiarity and convenience in the perspective of the students. Concerning this study, Mazhangara et al. (2019) and Web (2014) highlighted product popularity as one of the key factors that prompt consumers towards a certain product, as it centred on healthful attributes such as its low content of fat, cholesterol, and saturated fatty acids.

6.5.2 Consumer Willingness to Purchase Goat meat Products

It must be noted that not everyone completed the food action rating scale for all three products. They only rated the product that was rated highest on the hedonic rating scale. For validity, the study further checked if the hedonic rating of the product was high enough to prompt the participants to buy it should it be available in the market. Hence, the participants might like the product but not willing to buy it. The FACT results are depicted in Figure 6.2, representing the two highly rated products for consumer acceptability.

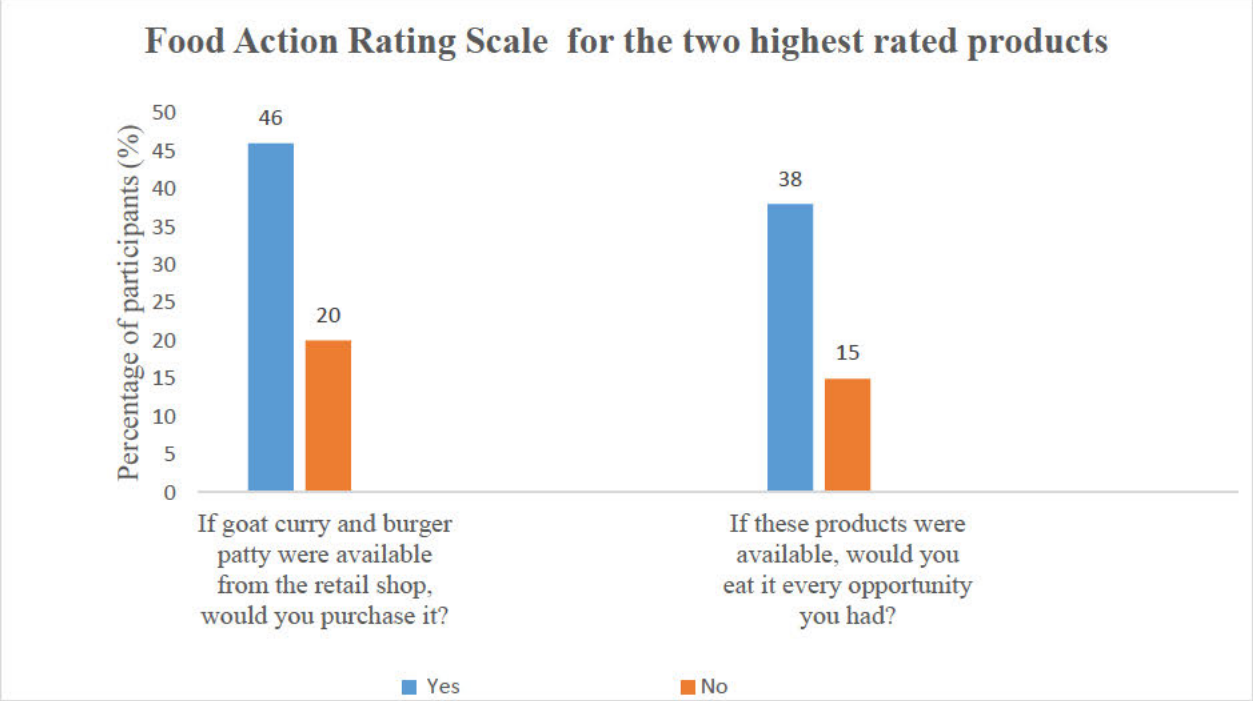

Figure 6.2: Willingness to purchase goat meat curry and burger patty (N=120)

6.5.2.1 Sensory characteristics of goat meat curry and burger patties as experienced by customers

Consumers evaluated the goat meat curry and burger and described its sensory attributes as 'tender' for texture, 'juiciness' for mouthfeel, and 'aroma' for fragrance. Aroma was a key factor in sensory acceptance as it is often the first thing consumers notice, even unintentionally. Teixeira et al. (2020), concluded that while trained panels are essential for product improvement, consumer panels are equally effective in telling product designers about their perceptions and preferences. In a systematic assessment of 25 countries using the Food Choice Questionnaire (FCQ), sensory appeal was identified as a key factor influencing food choices (Cunha et al. 2018). According to Mazangara et al. (2019), uncooked/raw meat has a minor flavour, whereas heated meat with fat generates a flavour that is more distinctive to the species from which it is sourced. The meaty flavour is composed of thousands of volatile compounds, yet only a few contribute to its characteristic odour and flavour (Shahidi 1998).

6.5.2.2 Willingness to purchase developed goat meat products.

On the food action rating scorecard, participants rated the goat curry and burger patty as the highest products intended to be bought. Few participants were undecided or had unfavourable

responses regarding their intention to purchase goat meat curry or burger patties, respectively. The highest percentage of participants chose positive comments indicating their propensity to purchase goat curry as the first choice, followed by the burger patty. Marketers aim to determine a consumer's willingness to purchase or attitude towards a product rather than just its sensory features (Ngomane et al., 2022).

6.6 Conclusion

The study successfully assessed the sensory characteristics of goat meat curry, burger patty and dried wors, as well as the purchasing intentions of these products. The study showed that these products will be bought in the market. This was evident when goat curry and burger patty were highly rated. The positive results from sensory attributes of goat curry and burger patty as 'tender' for texture, 'juiciness' for mouthfeel, and 'aroma' for fragrance, together with positive attitude on the product preference and the willingness to purchase the products, gave an indication that these products has a potential to withstand market competition in the retail space. Therefore, this study experimental findings indicated that consumer willingness to purchase goat meat in value-added products is meaningful, as this was backed by the agreement in terms of from sensory attributes, consumer preference and willingness to pay for the products (WTP). The highly rated products for attributes and preference, were the same rated for the consumer intent to pay. Therefore, these findings confirmed the potential of value-added goat meat products as positioned and relevant for commercial marketing. Product attributes, consumer preference and intent to pay for the product are determinants for future product developments and products expansion in goat meat industry. While, convenience and modern consumption of goat meat had set a trend in KwaZulu-Natal province through goat curry, burger patty and dried wors production. Therefore, as results can never be generalised, it is recommended that the study is replicated to other provinces or regions to verify the results.

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CHAPTER 7: CONCLUSION AND RECOMMENDATION

7.1 Introduction

Goat meat industry has become an economically important sector in the South African meat industry. However, in particular seasons of the year. Yet, has the potential for further growth. With increasing understanding of goat meat health benefits, both particular regions and worldwide, demand for goat meat is slightly noticeably even locally, However to retail category, and for certain group of consumers. The specific objectives included assessing the utilization and consumption preferences at the household level by various consumers of goat meat, developing prototyped (modern and convenient) goat meat products, with determined quality of microbial, colour, and texture analysis, and investigating the sensory acceptability of value-added products: goat meat curry, burger patty, and goat dried wors. The research study contributed to the body of knowledge in the following phases:

Objective 1: To conduct market profiling of *Chevon* products available in the retail market. Although goat meat is occasionally consumed and mostly utilized during cultural and religious ceremonies, this study has revealed that a considerable proportion of commercial retailers under uMhlathuze Local Municipality in KwaZulu-Natal sell goat meat as a nonconventional product. However, goat products such as yoghurt, cheese, and milk are available and accessible to a certain group of consumers, who are knowledgeable about the value proposition of goat meat and goat product consumption and have buying power. Thus, such products have demonstrated the economic principle that processing adds value to raw agricultural produce and increases its monetary returns.

Objective 2: Document the traditional methods and recipes used to preserve and cook chevon at the community level. The study confirmed that consumption patterns and utilization preferences of goat meat vary according to ethnicity. However, there were similarities worth noting among indigenous knowledge (IK) holders in future research. A total of 16 traditional recipes were documented from four ethnic groups of goat meat indigenous consumers. These recipes as per the three most preferred ones for acceptability, further served as the original foundation for objective No. 3. While objective 1 (product market profiling) and objective 2 (documentation of traditional recipes) of the study, contributed to Chapter 4: Consumer market accessibility and households' utilization of goat meat and goat product in uMhlathuze Municipality, KwaZulu-Natal. Goat meat/ product availability and accessibility in retail market

indicated that goat meat and related products are available in both the commercial and informal markets. However, accessibility remained with the certain group of people due to affordability and physical availability of these products predominantly appear in higher-end retail stores. These are limiting factors to product accessibility and utilization amongst consumers.

Objective 3: To develop three variant chevon value-added products (dried, cooked, and processed) integrating traditional and modern processing technologies. It was recognized that processing techniques could be applied for a good course but pose certain disadvantages. Therefore, it is imperative to check and understand the impact of the processing techniques applied to the end product.

Product quality in response to Objective 4: To assess the food quality characteristics (tenderness and colour) of value-added *chevon* products, revealed that burger patty shear force was higher than that of goat curry. The mean shear force and work of shear area values of dried wors were significantly higher ($P<0.05$) than those of goat curry and burger patties. With the increased cooking time of goat curry in the slow cooking method, the shear force value decreased. The colour attributes of both the cooked and dry-processed meat products were low in this study. This is due to the over-handling of meat during processing, as well as the processing methods used, which contributes to the colour reduction of meat products. These two objectives added value on chapter 5 of the study: Product development and food quality analysis of variant innovative goat meat products. Interfacing of chevon-based products to emulate consumer palatability, preferences, and family dynamics while incorporating local and traditional elements gave the positive results on product formulations and sensory attributes. The presence of competing meat products in the market provided critical cues on the development of the new products, with acceptable microbial count and physical quality in all three products.

Objective 5 of the study: sensory evaluation of goat products overall acceptability results showed that more than more participants considered goat curry extremely pleasant, followed burgers patties, and lastly, dried wors. All three products were found acceptable based on the fact that none of the products were found extremely unpleasant. However, these findings did not support the fact that goat meat remained an underutilized option in the South African population, and its low consumption. The products are therefore in line with current and future trends, where it was reported that there will be a need for products that will be locally produced using local ingredients, be passed and future-oriented, demonstrate a sense of globalization of

flavors, be healthy, and convenient. This innovation strategy significantly contributed to acceptable goat meat products. Objective 5 contributed to chapter 6 of the study (Consumer acceptability and the willingness to pay for innovative goat meat products). Successfully assessed the sensory characteristics of goat meat curry, burger patty and dried wors, as well as the purchasing intentions of these products. Sensory attributes of goat curry and burger patty as 'tender' for texture, 'juiciness' for mouthfeel, and 'aroma' for fragrance, together with positive attitude on the product preference and the willingness to purchase the products, gave an indication that these products has a potential to withstand market competition in the retail space. However, a range of further developments in goat meat products is recommended for sustainable acceptance and consumption.

7.2 Recommendations

7.2.1 Future Studies

A practical approach concerning the sustainable acceptance and consumption of goat meat requires strategic means of supply and demand, with a strong political commitment to help disseminate information about foods of high nutritional value; however, it is neglected and underutilized. Thus, it is important to alleviate the negative effects of goat meat consumption by providing a more sustainable means of convenience for meat and product production.

- Therefore, there is a need to create awareness and popularize the diversified forms of goat meat consumption among the consumers of goat meat, the literate, or the illiterate increase the acceptability. This may occur through various platforms, such as media programs, electronic and print media, food festivals, seminars, and workshops.
- Textural and color improvements should be considered for further development. In particular, during preparation and processing periods.
- The nutritional quality of the developed prototypes should be investigated to determine their effectiveness in combating food and nutrition insecurity.
- The study also recommends that a HACCP model be adopted and investigated in parallel with the identification of the microbes present in the samples. This will help to determine the microbial safety and stability of the products.

7.2.2 Government and Policymaker's recommendations

The processing of agricultural raw materials is central to the National Department of Agriculture, Forest, and Fisheries (DAFF). However, agro-processing industries, particularly at the small-medium enterprise (SME) level, have failed because of a lack of integration between the upstream supply of raw materials and downstream components responsible for the processing and marketing of raw or value-added agricultural products. Consequently, based on the understanding of consumer preferences and responses to innovative strategies for value-added goat meat products, this study proposes the following policy recommendations. It is important to recognize that activities such as agro-processing, storage and handling, marketing, and distribution in local and international markets are integral to postharvest agricultural management. Furthermore, the insufficient information provided to consumers has led many to compromise their dietary requirements through suboptimal food decision-making. This situation necessitates agricultural awareness campaigns by various stakeholders to disseminate information about new and emerging trends in the agricultural sector, particularly within the goat meat industry.

Horizontal integration in the goat industry, with the support of government stakeholders and the private sector, could provide a fundamental approach for optimizing the utilization of underexploited agricultural commodities (indigenous goats), whereby the effects of chevon value-addition and processing practices on the production of natural healthy foods for healthy consumption will be beneficial in numerous ways. Thus, food and nutrition security needs can be enhanced through the provision of an alternative source of red meat (goat meat products) in a convenient form. This strategy aims to promote a culture of production for self-consumption in rural households while promoting economic benefits. However, strict marketing standards for goat meat are necessary for the profitability and sustainability of goat meat/product enterprises. Improving the value-chain system of goats from poor supply, processing, and marketing through organized farming can make goat consumption commercially viable. Therefore, goat farmers, processors, and policymakers should focus on transforming the consumption of goat meat. Strong backward and forward linkages are recommended throughout the activities of the value chain systems for sustainable production and an accessible range of convenient goat meat products that are culturally acceptable and affordable for constant utilization and consumption, both at the household and commercial levels.

7.3 Areas of Further Studies

Through the production of value-added goat meat products for improved taste, cooking qualities, and convenience, while suiting the lifestyle of consumers, other trends such as increased demand for localization, health, cultural experiences, and sustainability in the range of value-added goat products for improved acceptability and consumption have to be considered for future studies.

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APPENDIX A: STUDY RESEARCH DESIGNS AND SAMPLING TECHNIQUES

Table 3.1: Study Research Designs and sampling techniques

Objectives	Data collection tool/s	Sampling Technique	Analysis
1. To profile and map out the chevon products available in the retail market	A key informant interview guide, Observation and Questionnaire	Purposive sampling of key informants from the retail.	Descriptive statistics-frequency, mean and content analysis
2. To document the traditional methods/ recipes used to preserve and cook chevon at the community level in comparison to the retail. (Chapter 4)	A key informant interview guide,	Quota purposive sampling of key Informants from each of the 4 ethnic groups: Zulus, Indians, Afrikaners & foreign nationals.	Content analysis
3. Product development (Chapter 5)	Instrumentation of three products: *(dried, cooked and processed)*	Food sample evaluation trials by trained food panelists of 15 per institution were recruited	Descriptive statistics
4. To determine the physicochemical characteristics of the value-added chevon products (Chapter 5)	*Texture- firmness (Cooked, dried, processed chevon products) Colour- L*a*b*value For processed, Dry & Wet chevon products*	Food Samples: moist, dried and processed	Descriptive analysis, mean and standard. Deviation
5. To evaluate consumer acceptability of the chevon value-added products (Chapter 6)	5-point hedonic scale Food Action Rating Scale.	120 untrained panelists recruited	Descriptive statistics analysis

APPENDIX B: DOCUMENTED RECIPES FOR INDIGENOUS KNOWLEDGE-HOLDERS (IK)

Table 3.2: Documented recipes for indigenous knowledge-holders (IK)

IKH-Nigerian		
Dish no.1: Goat Pepper Soup	**Dish no.2: Isi Ewu (Goat head dish)**	**Dish no.3: Goat Asun (Suya- goat) Grilled/braai**
Ingredients -1kg Goat meat -6 cups of water - 1 chopped onion – - 1 tsp Thyme -1 tsp Bouillon -1 tsp Salt -1 tsp pepper soup spice -1 tsp Cayenne pepper - Crayfish (optional)	**Ingredients** -1 Goat head -150ml red palm oil -2 tsp Calabash nutmeg -1 tbsp. powdered potash - 2 beef-flavored stock cubes - 2 medium onions -10 Utazi leaves - 2 tbsp. of habanero peppers (blended fresh pepper) -1 tablespoon crayfish (optional) -1 tsp salt to taste	1,2kg goat meat. (Cut with the skin) -2 habanero peppers -1 medium onion -3 big stock cubes -1 tsp thyme -salt -1 tbsp. of vegetable oil - Black pepper (optional) **To garnish** -1 medium onion -1 small green bell pepper -1 small red bell pepper
Cooking method	**Cooking method**	**Cooking method**
1. Wash the meat well in clean water and cut the meat into desired cube sizes. 2. Put the meat in the pot and add 6 cups of water. 3. Add the chopped onion, thyme, bouillon and salt. 4. Boil till tender (45min – 1hour). 5. Add pepper soup spice, cayenne pepper and crayfish. 6. Add a cup of water if need be.	1. In a pot, place the meat with the brain included, 2. Add grated onion, seasoning, a tablespoon of pepper, salt and water. Thereafter, allow it to boil until the meat is tender. 3. While the meat boils, slice the other onions into rings, dissolve the potash with a small amount of water and sieve.	1. Cut the goat meat into big chunks with the goat skin. 2. Wash and put the goat meat chunks in a bowl. 3. Add the thyme and black pepper; crush and add the stock cubes. 4. Add other spices (optional) 5. Cover the bowl with a thin film. Put in the fridge and leave to marinate for about 1 hour.

7. Taste for salt and add more if needed. 8. Simmer for 20 minutes on medium heat. 9. Serve and enjoy.	4. A while into the meat boiling, take out the brain and place it in a small mortar, add the other spoon of blended pepper and mash. When the meat is ready, separate the stock from the meat. 5. Pour oil into another dry pot. Little by little, pour potash into the oil and stir with a spatula until palm oil turns yellow and thickens. 6. Add the mashed brain, the stock of the meat, Calabash, (crayfish) and continue to stir until blended. 7. Place the meat into the mixture and stir. Turn on the heat, until steaming hot. 8. Garnish with sliced onion rings and utazi leaves 9. Serve in a small wooden mortar. Once is done, take out the meat from the pan and keep it covered.	6. Pound the habanero peppers and set aside. 7. Cut 1 onion into 4 big chunks. **a. Making the goat asun** 8. After 1 hour of marinating the meat, put the meat in a pot. 9. Pour water to just half of the level of the goat meat, add the chunks of onion and start cooking at medium heat. (ideally, the water dries up by the time the meat is well done) 10. When the meat is cooked remove the big chunks of onion and add salt to taste. 11. Increase the heat to high and stir constantly until all the remaining liquid in the pot is absorbed. 12. Lay the goat meat flat on an oven rack. 13. Grill in the oven at 180 degrees Celsius till meat is brown all over. (Meat should not be dry) 14. While grilling the meat, wash cut and thread the green bell pepper, red bell pepper and the remaining onion on skewers. 15. When the meat is well grilled, heat the vegetable oil in a dry clean pot. 16. Add the pepper and the thick stock from cooking the meat and fry for a bit.

		17. Add the grilled goat meat. 18. Stir very well till the pepper is evenly distributed on the goat meat. **19.** Serve with the threaded vegetables.
IKH-Congolese		
Dish no.1: Goat Pepper Soup	**Dish no.2: Goat Meat Wet Fry**	**Dish no.3: Braai**
Ingredients -1kg goat meat (chopped into chunks) -1 onion -1 celery stick -1 teaspoon curry powder - ½ teaspoon black pepper -1 green pepper (grated) -1 yellow pepper (grated) -1 red pepper (grated) -1 clove of garlic (grated) -2 cubes of Onga spice -1 teaspoon nutmeg -1 ½ tomato (grated) -1 tablespoon coconut oil (optional) -1 cup of water - 1 teaspoon of Onga stew ragout (paprika) -1 chili pepper (to add flavor)	**Ingredients** -1500g goat shoulder chops -1 onion -1 celery stick -2 Onga spice cubes -1 teaspoon salt -1 teaspoon of salt - 1 teaspoon of curry powder - ½ teaspoon thyme - ½ teaspoon nutmeg spice - ½ teaspoon black pepper -3 medium tomatoes -1 green pepper -1 yellow pepper -1 red pepper -3 cloves of pepper	-Chops/ any other goat braai meat -Steak and chops spice -Marinade (any brand) -Lemon Juice
Cooking method	**Cooking method**	**Cooking method**
1. Chop meat into big chunks and wash it. 2. Put the meat into the pot. 3. Add onion, celery and black pepper, peppers, curry powder, garlic clove, onga spice, nutmeg, tomato and onga stew regout.	1. Wash the meat well. 2. Put the meat in the pot. 3. Add 1 chopped onion and celery. 4. Add onga cube spice, black pepper and salt. 5. Close the pot and let it cook (boil)/ half steam until tender. **a. Frying**	1. Spice the meat and soak it in a marinade overnight. 2. Prepare the wood fire. 3. Over coal, grill the meat while sprinkling it with lemon juice. 4. Turn the meat on both sides until done as desired. 5. 5. Serve and enjoy with pap.

4. Without cutting it, add the chili and 1 cup of water. 5. Add a spoonful of coconut oil (optional.) 6. Let the meat get cooked under slow cooking conditions until tender. 7. Serve 4-5 people with vegetables/pap, cassava/kwanga, or banana plantains. 8. Preparation time is 1 hour and 30 minutes depending on the softness of the meat.	6. Heat the frying pan on the stove. 7. Add 3 spoons of coconut oil. 8. Heat the oil in the pan and fry the meat chops on both sides until golden brown. 9. Flavor the meat with thyme and nutmeg spice and close the pot. 10. Once is done, take out the meat from the pan and keep it covered. **a. Soup/Gravy** 11. Fry garlic and add onion until translucent. 12. Add 2 grated tomatoes. 13. Add 2 pockets of onga stew Re gout. (2tsp of paprika/spoons of tomato puree). 14. Add grated peppers to the tomato mixture. 15. Let the tomato get cooked until all the water is finished. (This must be achieved without the lid.) 16. Add fried meat to tomato and cook it further in a slow cooking medium for 10 mins. (For flavor to get into the meat.) 17. Serve with rice/ pap/ cassava/ kwanga.	
IKH-Kenya		
Dish no.1: Mbuzi stew	**Dish no. 2: Pilau**	**Dish no.3: Mbuzi Choma (Roast goat)**
Ingredients -500g of mbuzi -1 onion	**Ingredients** -2 cups Basmati rice	**Ingredients** - Goat meat - Black pepper

-2 tomatoes -Curry powder -4 cloves of garlic - A finger of ginger -Oil -1 cup of water	-Pilau masala (cloves, cumin seeds, cardamom, cinnamon) -500g Mbuzi -2 large onions -3 large tomatoes -2 cups of water -Oil	- Salt - Ginger paste
Cooking method	**Cooking method**	**Cooking method**
1. Boil the mbuzi together with the garlic until the water is dry and then out two dessert spoons of oil and finely chopped onion. 2. Stir until the onion is brown and add in the tomato and curry powder. 3. Continue stirring until nice and brown then pour a cup of water to make the stew. Bring it to a boil and it will be ready for serving. a. Serving: It may be eaten with kachumbari/ rice/ chapatti/ ugali	1. Soak the rice in water until ready to mix. 2. Stir fry the meat in oil with the onions and the tomatoes until they are ready. Mix in two dessert spoons of pilau masala and stir until well mixed then put in the rice. 3. Stir well until the rice is thoroughly soaked in the spices then pour in two cupfuls of water and leave to simmer at low heat. 4. When the rice is cooked, the meal is ready. a. Serving: It may be eaten with kachumbari	1. Marinate the meat in black pepper, salt, garlic and ginger paste for an hour. 2. Roasted slowly on the wood fire. 3. This can be eaten with kachumbari and ugali.
Mbuzi Stew side dish: Chapati	**Pilau Side Dish – Kachumbari**	
2 Kg bread wheat flour	-1 red onion	
4 pinches of salt	-3 tomatoes, cubed	
150 ml of oil and extra oil for cooking	-Half a lime juice	
	-Salt	
	-Black pepper	
	Dhania (fresh coriander)	
Cooking method	**Cooking method**	

1. Knead the flour in warm water and add some oil. The dough should not be too sticky, like the consistency of bread. The flour can be added in bits until it is just right. 2. Sprinkle some flour and continue to knead until the lump is smooth then cover with a cloth and leave to rest for about 20 minutes. 3. Tear pieces off the dough and make balls of about 4cm in diameter. Flour the board and roll the balls out into thin circles put oil on them and then fold. 4. Roll out the folded ball again and prepare to cook it.	1. Mix all the ingredients in a bowl drizzle with the juice and serve.	
IKH-Zambia		
Dish no.1: Soup yambuzi (goat meat soup)	**Dish no.2: Goat Meat Wet Fry**	**Dish no.3: Braai**
Ingredients -1kg goat meat -1 onion -2 tomatoes -Curry powder -4 cloves of garlic - A finger of ginger -Oil -1 cup of water	**Ingredients** -2 cups Basmati rice -Pilau masala (cloves, cumin seeds, cardamom, cinnamon) -500g Mbuzi -2 large onions -3 large tomatoes -2 cups of water -Oil	**Ingredients** -1 red onion -3 tomatoes, cubed, -Half a lime juice -Salt -Black pepper -Dhania (fresh coriander)

APPENDIX C1: DATA COLLECTION TOOLS

OBSERVATIONAL STUDY: CHECKLIST (ENGLISH)

Consumption and Marketing of goats' products (meat and meat products, etc.)

Items	Observations		
Consumption and sale of goat meat	**Product Name**	**Weight per product (g, kg, L, ml)**	**Price per unit sold**
Fresh meat			
Dry			
Processed			
Any other type of goat product			

Other observations:

KEY INFORMANTS INTERVIEW GUIDE FOR THE RETAIL MANAGERS/ REPRESENTATIVE (ENGLISH)

Municipality:	**City:**	**Retail Classification:**
Number of participants in the interview _____	**Men _____**	**Women _____**
Interviewers:		**Date:**

A. PRODUCT AVAILABILITY AND MARKETING:

1. Are there goat products available in the retail store? **Yes** or **No**

   If Yes, what goat products are available?

_____

2. Compare the goat meat products' availability in the market as opposed to other meat types.

_____

3. What could be the driving factors for demand or lack of demand thereof?

_____

4. Who are the main consumers of the products?

_____

5. How frequent is the purchasing of the products?

_____

6. What is the perceived attitude towards goat meat commercialization?

_____

2A. If No, what could be the contributory factors of not selling goat products?

_____

What are your thoughts towards goat meat commercialization?

_____

Did you ever thought of goat meat as one of the prime product for the future consumers?

B. ONSITE GOAT MEAT PROCESSING:

1. What requirements do you follow with regards to the processing of goat meat/products?

   _____

2. What products do you make on-site?

   _____

3. Are there any specifications with regards to the type of animal used for each product targeted?

   3.1 Yes Or No

   3.2 If yes, what are those specifications and why? E.G:

   - Type of animal:
   - Maturity (age):
   - Slaughtering process:
   - Processing techniques, etc.

   _____

   3.2 Other comments on the consumption and marketing of goat meat/products**.**

   _____

We came to the end of our interview, and I like to thank you for your participation in the study.

THANK YOU!!!

KEY INFORMANTS INTERVIEW GUIDE FOR ETHNIC GROUPS (ENGLISH)

Documentation of traditional methods/recipes used for goat meat preparation, cooking, and consumption at the household level.

Ethic group:	**City / Village**	**Gender: _____** **Age: _____**
Number of household members:	**Religion**	

DISCUSSIONS

A. Goat meat accessibility

1. Do you consume goat meat? **1. Yes or 2. No**

   If yes, how do you access goat meat?

_____

2. How often do you access chevon (goat meat)?

_____

3. In what form do you access the goat meat?

_____

4. Any preferences or specifications with regards to age, gender, and part of the meat you consume?

_____

B. Traditional preparations and consumption of Goat meat

1. What pre-preparations do you conduct before cooking, and why?

_____

2. Which type of meat is used and used for what type of dishes?

_____

3. What are the most three special/favourite dishes for your ethnic group?

_____

4. How are dishes prepared? Step by step, together with ingredients and measurements (Recipe).

_____

On what occasions do you consume these dishes?

_____

C. Traditional consumption of goat meat

1. How often do you consume goat meat?

_____

2. When was the last time you ate goat meat?

_____

What was the reason for eating goat meat?

_____

3. Are there any factors that influence the consumption of goat meat?

_____

4. What is the perceived attitude towards goat meat consumption?

_____

We came to the end of our interview, and I like to thank you for your participation in the study.

THANK YOU!!

For office use only

SENSORY EVALUATION QUESTIONNAIRE: INDIGENOUS GOAT MEAT PRODUCTS

Trained panellist no: _____ Date: _____

Thank you for participating in the sensory evaluation of goat meat products. Please complete the following information by crossing or ticking the appropriate boxes.

1. Panellists' status

1	Student	
2	Staff member	

2. Gender

1	Male	
2	Female	

3. Age (Please provide the exact age)

4. Ethnic group

1	African (specify tribe), (for Foreign nationals (specify the country	
2	White (Afrikaans/English speaking)	
3	Indian	
4	Coloured	
5	Other	

5. Education

5.1 Level of education

1	First Year	
2	Second Year	
3	Third Year	
4	Fourth Year	
5	Postgraduate	

5.2 Faculty

1	Arts	
2	Commerce, Admin, and Law	
3	Education	
4	Science & Agriculture	

SENSORY EVALUATION OF TRADITIONALLY PREPARED GOAT MEAT

Preference Test Ranking

Goat meat

Name: _____ Date: _____

Panel Number: _____

1. Please rinse your mouth with water before and in-between tasting.
2. You may take a sip again at any time during the test if you need to.
3. Please taste the samples in the order given, from left to right.
4. Rank the samples from most preferred to least preferred

Using the following numbers:

1= first choice, 2 = second choice, 3 = least preferred

(If you have any questions, please ask the server now)

Sample Rank (1 to 3)

861 ____

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SENSORY EVALUATION QUESTIONNAIRE: REFORMULATED GOAT MEAT PRODUCTS (ENGLISH)

Participant no: _____ Date: _____

Thank you for participating in the sensory evaluation of goat meat products. Please complete the following information by crossing or ticking the appropriate boxes.

1. Panellists' status

1	Student	
2	Staff member	

2. Gender

1	Male	
2	Female	

3. Age (Please provide the exact age)

4. Ethnic group

1	African (specify tribe), (for Foreign nationals (specify the country	
2	White (Afrikaans/English speaking)	
3	Indian	
4	Coloured	
5	Other	

5. Education

5.1 Level of education

1	First Year	
2	Second Year	
3	Third Year	
4	Fourth Year	
5	Postgraduate	

5.2 Faculty

1	Arts	
2	Commerce, Admin, and Law	
3	Education	
4	Science & Agriculture	

SENSORY EVALUATION: HEDONIC RATING SCALE

Participant number: _____ Date: _____

Instructions to Panellists

1. Please rinse your mouth with water before and in between tasting.
2. You may take a sip again at any time during the test if you need to.
3. In case you are not comfortable to taste and swallow the products, you may taste and spit. Disposables are provided for your help.
4. Please taste the samples in the order given, from left to right.
5. Please make a cross (**X)** against the word that best describes how you feel about the product for each of the following attributes.

SAMPLE NUMBER: _____

Sensory Attributes	**Five-Point Hedonic Scale 1-5**				
	Very bad 1	**Bad 2**	**Average 3**	**Good 4**	**Very good 5**
1. Aroma					
2. Tenderness					
3. Juiciness					
4. Flavor					
5. After taste					

6. **Overall acceptability**

	Five-Point Hedonic Scale 1-5				
Overall acceptability	**Extremely pleasant 1**	**Pleasant 2**	**Average 3**	**Unpleasant 4**	**Extremely unpleasant 5**

What have you liked about this product?

_____
_____

What have you not liked about this product?

_____
_____

APPENDIX C2: CONCENT FORM

INFORMED CONSENT FOR THE RETAIL MANAGERS

TITLE: ENHANCING CONSUMER ACCEPTABILITY AND COMMERCIAL UTILISATION OF GOAT MEAT THROUGH PROCESSING VALUE-ADDED PRODUCTS IN NORTHERN KWAZULU-NATAL, SOUTH AFRICA

My name is Buthelezi Thembelihle (217034765), a master's student from the University of KwaZulu-Natal, Pietermaritzburg campus in the College of Agriculture, Earth and Environmental science, under the supervision of Professor U. Kolanisi and Mrs. K Palmer.

I am conducting a study that seeks to profile and map out the chevon products available in the retail market for commercial utilization and consumption. Therefore, you are cordially invited to participate in a research project that is named above. The aim is to determine the types of chevon products (goat) available in the retail, acceptability and marketing of the products. The research could provide an insight into the potential of chevon products at the commercial level. However, your confidentiality is guaranteed, as your input will not be attributed to you as a person but will instead be reported only as a retail member's opinion and will not be used against you.

Your participation in this study is absolutely voluntary and there is no penalty if you do not participate. If you do choose to participate, you are at liberty to stop at any stage when no longer comfortable. Your involvement will be purely used for academic reasons. The questionnaire will take approximately 30 -45 minutes to complete. The record as well as other items associated with the interview will be held in a password-protected file accessible only to myself and my supervisors. After a period of 5 years, in line with the rules of the university, it will be disposed by shredding and burning. Please kindly sign on the dotted line below, to indicate that you have read and understood the contents of this consent and also to show your interest in the study.

DECLARATION OF CONSENT

I…….. (full name and surname) hereby confirm that I understand the content of the research study and my role has been clearly explained prior to participation in the study. I understand that:

- ✓ The information received will be used for study purposes, and privacy and anonymity will be ensured.
- ✓ There will be no form of payment for participating in the study.
- ✓ Participation in this study is entirely voluntary, and I may withdraw at any time should I desire to do so.
- ✓ I am expected to answer questions about the study to my satisfaction, and I will not be exposed to any risks during the study.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at [redacted] / call [redacted]. Supervisors' details are: kolanisi@ukzn.ac.za./ KolanisiU@unizulu.ac.za and PalmerK@unizulu.ac.za.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may quote the reference number HSSREC/00003190/2021 to contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Ms. Phumelele Ximba

University of KwaZulu-Natal

Research Office

Pietermaritzburg

Email: ximbap@ukzn.ac.za

Tel: 27 31 2603587

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview YES / NO

Use of my photographs for research purposes YES / NO

_____ _____

Signature of Participant **Date**

INFORMED CONSENT FOR ETHNIC GROUPS (ENGLISH)

TITLE: ENHANCING CONSUMER ACCEPTABILITY AND COMMERCIAL UTILISATION OF GOAT MEAT THROUGH PROCESSING VALUE-ADDED PRODUCTS IN NORTHERN KWAZULU-NATAL, SOUTH AFRICA

My name is Buthelezi Thembelihle (217034765), a master's student from the University of KwaZulu-Natal, Pietermaritzburg campus in the College of Agriculture, Earth and Environmental science, under the supervision of Professor U. Kolanisi and Mrs. K Palmer.

I am conducting a study that seek to profile and map-out the chevon products available in the retail market for household/ commercial utilization and consumption. Therefore, you are requested to participate in an interview regarding indigenous preparation, cooking, consumption methods, and the events in which the goat meat/products are consumed.

I_____ (full name and surname) have been informed about the study entitled: Enhancing consumer acceptability and commercial utilisation of goat meat through processing value-added products in northern KwaZulu-Natal, South Africa and by Thembelihle Buthelezi (217034765).

I understand the purpose and procedures of the study is to document the original preparation, cooking methods and/or recipes, and consumption methods of goat meat followed at the community level by various indigenous groupings.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I have been informed that the information received will be used for study purpose, and privacy and anonymity will be ensured.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at [redacted] / call [redacted]. Supervisors details are: kolanisi@ukzn.ac.za./ KolanisiU@unizulu.ac.za and PalmerK@unizulu.ac.za. If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609 Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview / focus group discussion YES / NO

Use of my photographs for research purposes YES / NO

_____ _____

Signature of Participant **Date**

_____ _____

Signature of Translator **Date**

INFORMED CONSENT LETTER FOR CONSUMER ACCEPTABILITY

Dear Sir/Madam

My name is Thembelihle Buthelezi (217034765), a master's student from the University of KwaZulu-Natal, Pietermaritzburg campus in the College of Agriculture, Earth and Environmental science, under the supervision of Professor U. Kolanisi and Mrs. K Palmer.

I am conducting a study that seeks to investigate the consumer acceptability of goat meat through the processing of value-added convenient products for household and commercial utilization in the area of Umhlathuze. The aim and purpose of this research is to develop and investigate the consumer acceptability of the Value-added Goat Meat Products among staff and students from the two academic institutions. The study is expected to enrol 120 participants in total, 60 from the University of Zululand and 60 from Owen Sithole College of Agriculture. It will involve sensory evaluation whereby products developed will be tested and each participant will respond to questions relating to the product developed.

Participants are required to be goat meat consumers, and the research tools to obtain the required information for the study are:

- questionnaires,
- sensory hedonic evaluation scale, and
- the food action rating scale.

The information collected using the above-mentioned research tools will be particularly used for this research. Therefore, I ask your permission to consider participating in the study with the following in mind:

- ✓ Participation in the study is completely voluntary, you are allowed to stop at any stage when no longer comfortable.
- ✓ There will be no form of payment for participating in the study.
- ✓ Information and the results collected in this study will be used for study purpose and the primary data for this research.
- ✓ Over time, the information provided will be destroyed when necessary
- ✓ Your views in this interview will be presented anonymously. Neither your name nor identity will be disclosed in any form in the study.

- ✓ The duration of participation, if you choose to be part of the taste panel, is estimated to be an hour per session. Though will be depending on the pace at which the evaluation is completed.
- ✓ This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee Approval number: HSSREC/00003190/2021.

In the event of any problems or concerns/questions you may contact the researcher or the supervisors on the following details:

Thembelihle Buthelezi (student): Email: [redacted] or Phone: [redacted]

Professor U. Kolanisi: Email: kolanisi@ukzn.ac.za./ KolanisiU@unizulu.ac.za

Mrs. K. Palmer: Email: PalmerK@unizulu.ac.za, or the UKZN Humanities & Social Sciences Research Ethics Committee. Contact details are as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Ms. Phumelele Ximba

University of KwaZulu-Natal

Research Office
Pietermaritzburg
4000

Email: ximbap@ukzn.ac.za

Tel: 27 31 2603587

APPENDIX D: GATE KEEPER PERMISSION LETTERS

KWAZULU-NATAL PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: ANIMAL HEALTH

DrDr Minkie S Masimege
KZN Department of Agriculture & Rural Development
Addes1 Nelson Mandela Drive, Port Shepstone
Tel: 03o396822045
Email:minkie.masimege@kzndard.gov.za

RE: APPLICATION TO PERFORM RESEARCH UNDER SECTION 20 OF THE ANIMAL DISEASES ACT (ACT35 OF 1984)

Dear Dr Maja (Director: Animal Health, DALRRD)

This letter concerns Thembelihle Buthelezi's request for permission to perform research under Section 20 of the Animal Diseases Act 35 of 1984. Thembelihle Buthelezi is a Masters student for the Food Security Programme, which is part of the School of Agriculture, Earth and Environmental Sciences at the University of KwaZulu-Natal, Pietermaritzburg. Her research will be focused on the consumer acceptability and commercial utilisation of value-added goat meat products.

She will be accessing live goats from:

- Cedara Agricultural College Farm situated in UMgungundlovu District.
- The goats will be slaughtered at Boston Abattoir, Erf 95 Elandsrivier Farm, Boston, 3211, Howick.
- Goat meat will be transported to the university laboratory through refrigerated vehicle.

This letter confirms that UMgungundlovu District area is not under official quarantine of the suspicion or incidence of any controlled or notifiable disease for these species, and that I, the Acting Director South Region, am aware of the research processes undertaken within uMgungundlovu District, and no objection thereto.

Kind Regard

DEPARTMENT OF AGRICULTURE AND RURAL DEV.
DR M.S. MASIMEGE
STATE VET UGU
2022 -01- 24
BVMCh
REG NO: D02/4888
P/BAG X885 PORT SHEPSTONE 4240

[redacted]

Date: 24/01/22

Dr Minkie S. Masimege
Ugu State Vet/ Acting Director South Region
Veterinary Services
KZN Department of Agriculture and Rural Development

GROWING KWAZULU-NATAL TOGETHER
#PHEZ'KOMKHONO

KWAZULU-NATAL PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

2021 -10- 15
Department of Agriculture and Rural Development
CHIEF DIRECTORATE: ARD&TI

01 Cedara Road, Pietermaritzburg, 3200
KZN Department of Agriculture & Rural Development, Private Bag X9059, Pietermaritzburg, 3200
Tel: 033 355 3906

SUBMISSION
CHIEF DIRECTORATE: ARD&TI

To:	Enquiries:	Siyabonga Vilakazi
Mr. SD Sibande ***Head of Department***	Tel:	[redacted]
	Ref:	11/3/19/OSCA2021
	Date:	22 September 2021

RE: REQUEST FOR NGUNI GOATS FOR VALUE ADDING RESEARCH STUDY

1. PURPOSE

1.1. The purpose of this submission is to request approval from the Head of Department for the use of ten (10) goats for a Masters Research study to investigate consumer perceptions of chevon value-added products derived from locally produced Nguni goats.

2. BACKGROUND

2.1. Mrs. T.N.B. Buthelezi (Lecturer: OSCA – Home Economics/Value Adding) is embarking on a Masters Research study through the University of KwaZulu Natal.

2.2. The research project is titled "Nguni Goat Meat Value Addition, interfacing goat meat processing towards enhanced goat meat consumption as a healthy meat option in the 21st century in KwaZulu Natal Province".

2.3. In past years, Owen Sithole has participated in numerous food exhibitions, including but not limited to the Royal Agricultural Show and Food and Wine Show.

6. COMMUNICATION IMPLICATIONS

6.1. There are no communication implications.

7. FINANCIAL IMPLICATIONS

7.1. The request is for the use of ten goats that are already on the Department's biological asset register. Pending approval, the value of these goats will be determined by Asset Management and removed from the asset register.

7.2. Should the College have to purchase the animals outright, the following costs are anticipated:

10 goats	: 5 goats (under age of 2 years)	* **R 1500**	= **R 7 500**
	: 5 goats (over age of 2 years)	* **R 2000**	= **R 10 000**
	: TOTAL		**R 17 500**

8. RECOMMENDATIONS

8.1. It is recommended that the Head of Department grants approval for the use of ten (10) goats for a Masters Research study to investigate consumer perceptions of chevon value-added products derived from locally produced Nguni goats.

AUTHORED BY

[redacted]

DR FN MKHIZE
CHIEF DIRECTOR: AGRICULTURAL RESEARCH DEVELOPMENT & TRAINING INSTITUTES

Recommended / ~~Not Recommended~~ / as amended [redacted] **MRS S DIEDERICKS** **DIRECTOR: ASSET MANAGEMENT**	Comments: All cow tag numbers to be reported on monthly Stock return. - document to be Scanned to the cow application. **Date:** 11/10/2021

BOSTON ABATTOIR

MEATING ALL YOUR REQUIREMENTS

Date: 3rd January 2022

Mrs. Buthelezi T.N.B (UKZN Masters student: 2170347650)
School of Agriculture, Earth and Environmental Sciences
University of KwaZulu-Natal
Pietermaritzburg
3209

RE: REQUEST TO USE OUR ABATTOIR SERVICES FOR THE RESEARCH STUDY ON ENHANCING CONSUMER ACCEPTABILITY AND COMMERCIAL UTILISATION OF GOAT MEAT THROUGH PROCESSING VALUE-ADDED PRODUCTS IN NORTHERN KWAZULU-NATAL, SOUTH AFRICA.

Dear Madam:

Please be advised that you are granted the permission to use our services to carry through with your research based on goat slaughtering process, skinning, and portioning of meat into prime cuts.

I understand that ethically reviewed studies under UKZN Humanities and Social Sciences Research Ethics Committee, need not to proceed until ethics approval letter has been issued for the concerned student. Therefore. I request that in order to proceed with your request, you provide us with the ethics approval letter permitting you to conduct the study.

I trust that the concern is clear, and we are looking forward to work with you.

Yours sincerely,

[redacted]

John Troisi

UNIVERSITY OF ZULULAND

University of Zululand, Private Bag X1001, KwaDlangezwa, 3886
W: www.unizulu.ac.za

T: +27 35 902 6434
E: [redacted]
Office of the Registrar

Our ref: Permit: 19/2022
Your ref:

PERMIT TO COLLECT DATA

The University of Zululand hereby permits Thembelihle Natacia Brenda Buthelezi to conduct research and collect data in accordance with his Ethics Clearance Certificate HSSREC00003190/2021 issued by UKZN dated 7 September 2021, and UNIZULU's POPI Declaration and Indemnity form dated 25 March 2022.

The Researcher may commence with data collection from the date of this Permit. This permit is valid for 12 months from date of issue.

UNIZULU retains the right to withdraw or amend this permit if:

- Any unethical conduct is revealed or suspected;
- Relevant information has been withheld or misrepresented;
- Regulatory changes of whatsoever nature so require;
- The conditions contained in the Declaration has not been adhered to.

[redacted]

D MOTHILALL
REGISTRAR

agriculture
& rural development
Department
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

OWEN SITOLE COLLEGE OF AGRICULTURE

Private Bag X20013, EMPANGENI 3880
Tel: 035 795 1345 | Fax: 035 795 1379

13 December 2021

ATT: Mrs. T. Buthelezi
Lecturer OSCA: Value Adding/Home Economics

RE: Permission to conduct research at Owen Sithole College of Agriculture

The request to conduct research study with college staff and students, was received and acknowledged. The Chief Director of the Training Directorate (**Dr. Mkhize**), has granted permission for you to carry out your research as duly requested. Authority to carry the research out at the college has been granted by the chief director.

I am certain that the research will be successful and the findings will certainly be well received within this niche market. The College wishes you of the very best in this path finding activity.

We look forward to participating in this research study.

[redacted]

S. Vilakazi
Owen Sithole College Principal

APPENDIX E: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

17 June 2022

Thembelihle Natacia Brenda Buthelezi (217034765)
School of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear TNB Buthelezi,

Protocol reference number: HSSREC/00003190/2021
Project title: Enhancing consumer acceptability and commercial utilization of goat meat through processing Value-added products in Northern KwaZulu-Natal, South Africa
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 16 August 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 17 June 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

DZEMWA PROOFREADING & EDITING SERVICES

EDITING EXCELLENCE

04th February 2025

Declaration of a professional edit

Enhancing Consumer Acceptability and Commercial Utilisation of Goat Meat Through Processing Value-Added Goat Meat Products in Northern Kwazulu-Natal, South Africa

I certify that I edited and proofread this manuscript. My editing focused on organization, clarity, correctness, coherence, conciseness, consistency, grammar, punctuation and, spelling. The content has remained unchanged structurally.

I am qualified to perform such editing as I hold a copy-editing and proofreading certificate from the South African Writers College.

As a copy editor, I am not responsible for identifying or removing passages in the manuscript that are exactly equivalent to previously published text and thus constitute plagiarism. I am not responsible for any changes made to this document by the author or any other party after the date of this declaration. The academic content is entirely the responsibility of the researcher.

Sincerely,

Kuda

Dzemwa

24 Stoney House
Hayfields
Pietermaritzburg
3201

PHONE 0684937332

EMAIL kudadzemwa@live.com

SAWRITERS COLLEGE
ONLINE COURSES FOR A CAREER IN WRITING

THIS CERTIFIES THAT

Kudakwashe Brandon Dzemwa

HAS SUCCESSFULLY PASSED

The Copy-editing and Proofreading Course

COURSE UTOR:

Di Smith

CERTIFICATE NUMBER: SAWC D7666

[redacted]
PRINCIPAL: Nichola Meyer

15/07/2021

DATE

[redacted]