Exploring Meat Delicacies and Dairy Marvels

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Table of Contents

Physiochemical and Sensorial Properties of Burgers Produced from Nubian Goat Meat and Beef

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Abstract

Purpose: This study was aimed to evaluate sausage processed from different levels of goat meat replacement beef meat.

Methodology: Beef top side cut and goat leg were purchased from local market and used according to A (Beef 50 % ,goat meat 50 %), B(beef 25 %, goat meat 75 %), C (goat meat 100 %) and D (Beef 100 %) as control group, and to compare the goat meat sausages with the most common commercial sausages made with beef.

Findings: The chemically, crude protein percentage was significantly different ($p<0.05$) in sausage treatments where higher in beef sausage, ash, and fat were also different increased with beef meat among sausage treatments, on the other hand moisture content increased with goat meat. Ultimate pH and cooking loss % of sausage treatments were significantly different ($p <0.05$). Total viable bacterial counts of sausage treatments were determined. Sensory attributes, including color, flavor, juiciness, tenderness, and overall acceptability among the different types of sausages prepared were no significantly differences ($p > 0.05$)

Unique Contribution to Theory, Practice and Policy: Goat meat mainly from animals out of quality brands with low commercial value can be valorized when processed, giving the opportunity to increase its consumption and acceptability. In this study goat meat incorporated to the sausage ingredients with beef fat to evaluated the quality and flavor of sausage replacing beef meat. Sudanese Nubian goat meat useful for use in meat processing products with good characteristics and more acceptable for the final products. More researches for use goat meat in other meat products.

Keywords: *Goat Meat, Beef, Sausage, Physiochemical, Sensory*.

INTRODUCTION

Tendencies towards healthier ways of living among the global population have changed and are still changing several aspects of the food industry, leading producers to reformulate their products and offer more healthy alternatives Agregán *et al*., (2019) Consumer perceptions towards healthier meat products are now mainly associated with how meat is produced and processed as well as its physicochemical composition and nutritional and sensory quality Teixeira *et al* (2017), Teixeira and Rodrigues (2021). In recent years, several strategies for producing healthier meat products have been developed. Some of them go through reducing fat content Leite *et al.* (2015) , Teixeira *et al* (2020) using different fat sources Teixeira *et al* (2019) Das (2009).

Statement of the Problem

Meat from goats has been gaining acceptance over the past few years around the world (Devendra, 1990) especially as it is leaner than beef and mutton. Few studies have been carried out to investigate the quality of goat meat but some indicate that it is comparable in quality and nutritive value to beef and chicken (Johnson *et al.,* 1995; Mahgoub *et al.,* 2002).

Objectives of the Study

This study was conducted to evaluate sausage processed from different levels of goat meat replacement beef meat

LITERATURE REVIEW

In Korea, goat production has been mostly for milk production whereas the Korean native black goat (KNBG) has been used for meat production. Also, most of the KNBGs are castrated then slaughtered in the autumn. However, KNBG meat production is limited due to odor and off-flavor of the meat. Typical in Arab and Africa, or Sudan for Sudanese Nubian goat. Consumers in the western world do not favor goat meat (Tech, 1992). Goat meat composition and quality are influenced by genotype (Tshabalala *et al*., 2003), age (Todaro *et al*., 2002), sex (Todaro *et al*., 2004), diet, and production methods (Marinova *et al*., 2001). These factors influence the volatile composition of goat meat, which affects the characteristics that are easily perceived by smell and which consumers associate with goat meat (Webb *et al*., 2005).

Recently, it was reported that hybridization of goat affected its meat nutritive value and quality (Ding *et al*., 2010). Also, sunflower cake feed

supplementation significantly improved goat meat quality (Xazela *et al*., 2012). The overall composition of the carcass was greatly influenced by age, sex, feed, body weight, growth, physiological conditions and physical activity (Owen *et al*., 1978). These factors also influenced the volatile composition of goat meat, hence, the smell associated with it (Webb *et al*., 2005). Branched chain fatty acids in meats of different sheep and goat breeds have been related to flavor (Ha & Lindsay, 1990).

When mutton, goat meat, and spent fowl meat are used with substantial amounts of nonmeat ingredients in certain food processes, the undesirable characteristics of these meats may not be reflected in the final products because of the inherent nature of processes involved, or they may be overcome through ingredient interactions during processing, (Rhee *et al*., 1999). In this study goat meat incorporated to the sausage ingredients with beef fat to evaluated the quality and flavor of sausage replacing beef meat.

METHODOLOGY

Experiment

Carcass of goat purchased from local market and deboning, sausage processing by mixes beef topside to goat meat as flowing: A (Beef 50 % ,goat meat 50 %), B(beef 25 %, goat meat 75 %), C (goat meat 100 %) and D (Beef 100 %) as control group. Fat of formula from beef 10%, sausage products were stuffed in animal intestine.

Chemical Composition

Sausage products samples were ground to a homogenous mass in a grinder, and then used for chemical analyses. Chemical composition of the sausage samples was measured according to standard methods of AOAC (1990).

Crude protein was determined using a Foss Tecator Kjeltec 2300 Nitrogen/Protein Analyzer. Fat was determined by Soxhlet extraction of the dry sample, using petroleum ether. Ash content was determined by ashing samples in a muffle furnace at 500 °C for 24 h.

Meat Quality Attributes

Sausage products were prepared for colour sensing and covered by polythene sheets. The ultimate pH of products samples determined by sing pH meter. The pH meter was calibrated with buffers 4 and 7. Duplicate samples, each of approximately 0.5 gm of two products, were placed on a humidified filter paper (Whatman No. 4 in a desiccator over saturated KCl solution) and pressed

between two plexiglass for 1 min at 25 Kg/cm2. Meat and moisture areas were measured using a compensating planometer. The result was expressed as ratio (Grau and Hamm, 1953). Water Holding Capacity (WHC) = [Loose water area-meat film area] ÷ meat film area. Cooking loss determined as Babiker (1981) by using thermostatically controlled water bath 90^{o}C for 90 min, samples were weighed before and after cooking.

Microbial Analysis

One gram of products (sausage) was homogenized in nine ml of sterile distilled water for 1-5 min. tenfold dilutions of homogenate were prepared in normal saline.

Enumeration of Total Aerobic Mesophilic Bacteria

Plating was performed into plate count agar (PCA, OXOID CM 325) from the prepared dilutions by spread plate method. Colonies formed after 48 h incubation at 30^{o}C of aerobic conditions were counted according to (Swanson *et al*., 1992).

Statistical Analysis

The data collected from the different treatments was subjected to analysis of variance and whenever appropriate the mean separation procedure of Duncan was employed (Steel and Torrie, 1980). The SAS program (SAS, 2002), was used to perform the general linear model (GLM) analysis.

FINDINGS

The chemical composition for sausage of goat meat were significantly ($p<0.05$), presented in table (1) A higher protein percent mean for beef sausage the control, and the second mean value for sausage which processing by 50% of beef, and then group B 25% of beef, and a lower one in protein group C processed from 100% goat meat, that indicates the protein percentage relative to amount of beef meat in sausage, on the other hand, fat content % for sausage increased by increasing beef meat proportion in processing formula also ash content %.

Hogg *et al.,* (1992) reported that goat meat contained little fat and therefore relatively higher proportions of protein and minerals. The relatively high protein content and the low percentage fat found in goats compared to sheep lead to a favourable ratio of protein and fat which conforms to contemporary nutrient requirements of humans (Riedel according to Raljic *et al*., 1995) and consumer preferences (Hadjipanayiotou and Koumas, 1994) agreement with

(Rhee *et al*, 1999) in percentages level for protein and fat. Moisture content increasing by goat meat increased in formula, a higher one for group C (100% goat meat), B (75% goat meat), A (50% goat meat), and D (control 0 goat meat), moisture content means value 60%, 58%, 55.3%, and 53% respectively. Rhee *et al*, 1999 also reported that chicken and goat meat had more moisture than other meats Moreover, chicken and goat meat were much lower in fat content others.

Table 1: Chemical Composition of Sausage Treatments

Items	A	B	C	D
Protein	19.8 ± 0.28^{b}	19.6 ± 0.05^{b}	19.2 ± 0.14^{c}	21.2 ± 0.14^{a}
Fat	7.4 ± 0.05^{a}	6.7 ± 0.11^{b}	6.3 ± 0.05^{b}	7.9 ± 0.03^{a}
Moisture	55.3 ± 0.3^{b}	58 ± 0.6^{b}	60 ± 0.3^{a}	53 ± 0.3^{c}
Ash	1.53 ± 0.03^{a}	1.26 ± 0.03^{b}	1.16 ± 0.03^{b}	1.86 ± 0.03^{a}

^{ab}Means ± SD with different superscripts in the same row are significantly different ($P \leq 0.05$).

A (Beef 50 % ,goat meat 50 %) , B(beef 25 % , goat meat 75 %) , C (goat meat 100 %) and D (Beef 100 %)

Table 2: Ultimate pH, Cooking Loss% And Total Bacterial Count of Sausage Treatments

Item	A	B	C	D
PH	5.9 ± 0.01^{b}	6.0 ± 0.03^{b}	6.1 ± 0.05^{ab}	5.7 ± 0.03^{bc}
Cooking loss	18 ± 0.6^{b}	22 ± 0.6^{a}	22 ± 0.3^{a}	17 ± 0.6^{b}
T Count	5.6 ±	6.2 ±	6 ±	6.3±

^{ab}Means ± SD with different superscripts in the same row are significantly different ($P \leq 0.05$).

A (Beef 50 % ,goat meat 50 %) , B(beef 25 % , goat meat 75 %) , C (goat meat 100 %) and D (Beef 100 %)

Sausage pH values were significantly different among sausage treatments which indicate that the pH value decrease in sausage by increased beef meat, whereas sausage made from goat meat 100% a higher one (6.1) in pH and a lower one in control group which processed from beef (5.7).

Although, the pH effect in other meat quality attributes, but it's not clear in cooking loss%, which obtained 22% as a higher values for sausage made of goat meat (100 and 75 %) whereas sausage beef had low cooking loss%, that

it may be refer to protein type and proportion in beef beside moisture% in goat meat Gamaleldin *et al*., 2019 Nagaraj *et al*. 2005 suggested that the changes in the rates of myofibrillar protein fragmentation may clarify the changes in the rate of postmortem tenderization of meat.

The total bacterial count cfu/gm were significantly ($p<0.05$). The bacterial growth higher number in beef and lower in sausage which made from 50% incorporation. The bacterial growth effect by various factors, ultimate pH, equipment, skinning, cutting, and all things may be in touch to meat and meat products. Contamination could happen during production, processing or distribution. The excellent microbiological quality of Mortadella and meat products were due to the quality of raw materials used, in combination with good production practices in preparing the products. Guerra. *et al*, 2011, Rawaa *et al*., 2020

Sensory attributes of sausage groups there were no significantly different in coulor, falvour, juiciness, tenderness, and overall acceptability. The panelist prefer coulor of sausage made from beef and even tenderness, on other hand prefer flavor of sausage made 100% from goat meat. Sausage juiciness in all groups 5.5 except sausage made from goat meat 100% lower in juicy. The panelist grade sausage in overall acceptability the control firstly, sausage made by goat meat 100% and 50% second, finally sausage made 75% goat meat and 25% beef.

Tshabalala *et al.*, 2003 mentioned Acceptability of ground beef patties has been correlated with fat content showed that for ground beef patties, flavor intensity was affected by the fat content. Differences in fat content were minor at high levels of fat but more pronounced at lower levels. The differences in flavor intensity between goat and beef patties can be explained by the differences in fat content between beef and goat meat. Meat composition is considered a significant indicator of meat functionality; protein and fats are essential constituents reflecting the quality value of meat, whereas moisture content plays a central role in eating and keeping qualities of camel meat

Table 3: Means and Standard Error of Sensory Evaluation of Sausage Treatment

Sample code	Colour	Flavour	Juiciness	Tenderness	Overall acceptability
A	5.7± 0.14 [ab]	5.8± 0.14 [ab]	5.5± 0.28 [ab]	6.03 ± 0.26 [ab]	6.03 ± 0.26 [ab]
B	5.8 ± 0.49 [ab]	5.5± 0.28 [ab]	5.5± 0.28 [ab]	5.8 ± 0.11 [ab]	5.8 ± 0.11 [ab]
C	5.7 ± 0.14 [ab]	6.1± 0.05 [ab]	5.2± 0.20 [ab]	6.03± 0.03 [ab]	6.03 ± 0.03 [ab]
D	6 ± 0.01 [ab]	5.8± 0.11 [ab]	5.5 ± 0.28 [ab]	6.16 ± 0.60 [ab]	6.16 ± 0.16 [ab]

[ab]Means ± SD with similar superscripts in the same row are not significantly different (P> 0.05).

A (Beef 50 % ,goat meat 50 %) , B(beef 25 % , goat meat 75 %) , C (goat meat 100 %) and D (Beef 100 %)

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study it was concluded the Sudanese Nubian goat meat obtained good results in processing sausage products by mixing with beef and developed characteristic especially in microbial growth, and giving the opportunity to increase its consumption and acceptability. However, goat meat had good characteristics where used in processing products like fresh sausage especially whereas, incorporated and mixes with beef meat.

Recommendation:

Sudanese Nubian goat meat useful for use in meat processing products with good characteristics and more acceptable for the final products. More researches for use goat meat in another meat products.

Emerging Issues and Controversies

Consumer acceptance and perception: The use of Nubian goat meat in burger production raises questions about consumer acceptance and perception. Goat meat is not as commonly consumed as beef in many regions, and consumers may have preconceived notions about its taste, texture, and overall desirability. Controversies may arise regarding the marketability and acceptance of goat meat burgers compared to beef burgers.

Nutritional composition and health considerations: Comparing the nutritional composition of Nubian goat meat and beef is essential, as it influences the dietary value and health implications of consuming the respective burgers. Controversies may arise regarding the relative amounts of fat, protein, vitamins, minerals, and cholesterol in the two types of burgers. Discussions on the potential health benefits or risks associated with consuming each type of meat may also emerge.

Quality and sensory attributes: The physiochemical and sensory properties of the burgers, including color, texture, juiciness, flavor, and aroma, are important factors for consumer acceptance and preference. Controversies may arise if there are significant differences in these attributes between Nubian goat meat burgers and beef burgers, leading to debates about which product provides a better eating experience.

Sustainability and environmental impact: The environmental impact of meat production is a growing concern. Comparing the sustainability aspects of goat meat and beef production, such as land use, water consumption, greenhouse gas emissions, and feed efficiency, can generate controversies. Stakeholders may have differing opinions on the environmental implications of promoting one type of meat over the other.

Animal welfare considerations: Discussions may emerge concerning the welfare of Nubian goats and cattle in meat production systems. Controversies may arise if there are concerns about the living conditions, handling practices, or ethical considerations specific to either species. Stakeholders may debate the ethical implications of using one type of meat in burgers over the other.

Cultural and regional preferences: Food preferences and cultural traditions can vary across regions and communities. Controversies may arise if the study findings challenge cultural norms or regional preferences regarding the consumption of goat meat or beef. Balancing cultural heritage and traditional

preferences with scientific findings and changing dietary patterns can spark debates among stakeholders.

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Effect of Production System on Chemical Composition and Macro-Minerals of Sudanese Camels Milk

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Abstract

Purpose: This study was conducted to determine the production system effect on camel milk composition and macro-elements content in Sudan.

Methodology: Sample purchased from camel milk production markets (Albutana- Tumbool, Kordfan-Elobied, and Khartoum-Alsalam market) in 6 replicates.

Findings: There were no difference in moisture, and protein % among camel milk from different area, on the other hand there were significantly different in fat and ash content % with highest values for Khartoum camel milk and lowest values for Kordofan camel milk. Macro-minerals (Na, K, Mg, Ca, and P) content in camel milk were determined and there was different content. Ca, Na, K, Mg and P higher in Khartoum camel milk and lowest content values for Kordofan camel milk. The study was extended to determine soil macro-elements contents in Albutana and Kordofan areas which were fed by grazing system, and ignored soil in Khartoum whereas camels lives in a farm.

Unique Contribution to Theory, Practice and Policy: Camels produce more milk of high nutritional quality and for a longer period of time than other species in an environment that might be rightly termed as hostile in terms of extreme temperature, drought and lack of pasture, in Sudan camel's milk constitutes the sole diet of camel herders for considerable periods and they rely completely on camel's milk for more than month without having drinking

water especially during the migratory routes. Camel milk from different areas and production system had different chemical content in fat and ash % and similar in moisture and protein %, within the same season. However, macro-minerals in camel milk increasing by soil macro minerals contents specially on grazing system.

Keywords: *Camel, Milk, Composition, Macro-Elements*

INTRODUCTION

Sudan has a livestock wealth of more than 165 million heads of livestock, including livestock, poultry and equines, as well as 76000 tons of fish stocks (livestock estimates for 2017) MARF (2017). Camels have been a trend of growing numbers of camels in the world between 2001 and 2011 (FAO, 2013). This increase might be attributed to their adaptation to various environments, development in camel farming, and the improvement of ecological image of camel farming and products. The total large camels' population in the world in 2013 was estimated at around 25 million animals. This number is probably underestimated because camels are migrant animals.

It is difficult to conduct a census for camels such as the wild Australian camel population. The general estimate of the camel world population may probably be around 30 million head (Faye, 2013). About 88% of the camels are found in Africa, while Asia has 12%. The main concentration of dromedary camels in Africa is in the East African countries with 80% of the total camel population raised under various production systems. The most important countries with a camel population of more than 1 million are Somalia, Sudan, Ethiopia, Niger, Mauritania, Chad, and Kenya.

A significant proportion of the world camel population is found in countries defined by FAO as Net Food Importing Developing Countries (71% of total world camels), Low Income Food Deficit Countries (68% of total world camels), and Least Developed Countries (59% of total world). Furthermore, in Sudan camel's milk constitutes the sole diet of camel herders for considerable periods and they rely completely on camel's milk for more than month without having drinking water especially during the migratory routes (Al-Khori and Majid, 2000).

Statement of the Problem

Variations in the composition of camel milk may be attributed to several factors such as analytical methods, geographical area, nutritive conditions, breed, stage of lactation, age and number of callings (Khaskheli *et al*., 2005). Geographical origin and seasonal variations are factors which influence most changes in composition of camel milk. Konuspayeva *et al*., (2009) studied the effect of geographical origin on the composition of camel milk and the study showed that camel milk from camels located in east Africa has more fat than milk from camels in Africa and western Asia.

Seasonal variations also play a significant role in the composition of camel milk, even with camels of the same breed and from the same region (Bakheit *et al.,* 2008). Camel milk production in Sudan estimated in 2017 about 61000 tons (MARF, 2017).

Objectives of the Study

This study was conducted to determine the production system effect on camel milk composition and macro-elements content in Sudan.

LITERATURE REVIEW

In many arid areas, camels play a central role as milk suppliers. The comparative advantage of the camel as a dairy animal over the other species in the same environment is difficult to quantify; however, it is widely recognized that in absolute terms, the camel produces environment is difficult to quantify; however, it is widely kg/day (Al-Khori, and Majid, 2000), less than these, reported in three herds of recognized that in absolute terms, the camel produces recognized that in absolute terms, the camel produces more milk and for a longer period of time than any other milk animal held under the same condition (Farah, 1996.).

METHODOLOGY

Samples Collection

Soil Samples

Soil samples were taken from different surfaces up to 30cm using a stainless-steel sampling auger. A total number of 6 soil samples within each growth from the study area were taken and stored in plastic bags.

Soil Analysis

The laboratory method outlined by Richards (1954) was followed. They are briefly described below:

Exchangeable (Na):

Sodium was extracted with 1N ammonium acetate (pH 7.0) and determined by Exchangeable Sodium Percentage **(ESP):**

Was calculated by: ESP= $\frac{EX}{\quad}\cdot Na$*100 CEC

Soluble Cat ion and anions: water soluble (Na) was determined by flame photometer, (Ca) and (Mg), carbonates by titration, Sulphates estimated by subtraction of anions from cations.

Milk Samples

One liter from a round camel from three area at north kordofan elbowed market, Botana Tumbol market, and Khartoum Alsalam market.

Camel Milk Chemical Composition

Moisture, crude protein, fat, and Ash content were determined according to (AOAC, 2008). Moisture content was based on weight loss from a definite quantity of meat, dried overnight in drying oven at 102 °c. The dried sample was cooled in desiccator and weighed. The moisture content was calculated as percentage of fresh sample weight as follows:

$$\text{Moisture \%} = \frac{\text{Weight of fresh sample - Weight of dried sample}}{\text{Weight of fresh sample}}$$

Crude protein content was determined by using Kjeldahl method and calculated by multiplying the amount of nitrogen by 6.25. One ml of dried sample was weighted in kjeldahl flask. Half a tablet of catalyst mixture (10 parts k_2so_4 to part of cuso4). And 25 ml concentrated H_2so_4 concentration were added. The content of the flask was digested under boiling atmaximum heat for 2 hours. And then the flask was cooled and transferred to distillation unit. The sample was distilled by using NaOH solution 40% the content was titrated against HCL acid 0.1N and crude protein percentage was calculated.

Fat content of milk was determined as given by (AOAC1990) in clean dry Gerber tube, 10ml of sulfuric acid (densty 1.85gm\ml at 20C) were poured, and then 110..94 ml of milk were added .amyl (1-2ml) was added to the mixture, followed by the addition to distilled water .the gerber tubes were centrifuged at 1100 revolution per minutes (rpm) for 4-5 minutes and the tube were then transferred to a water bath adjusted at 65Cfor three minutes. The fat percent was then read out directly

Ash content was determined by weighing 2 ml of dried free sample into dried crucible of known weight. The crucible were placed inside muffle furnace at 550 c° for 4hours, After complete ashing, the crucible with ash were transferred directly to a desiccators, cooled , weighed and calculated as percent of original weight sample.

Camel Milk Macro-Minerals

Macro elements in milk camel of calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) were analyzed using atomic absorption (Sin et *al*., 2005), phosphorus (P) analyzed using atomic absorption spectrophotometer.

To a 5 ml aliquot of milk in a 100 ml volumetric flask add 50 ml of 24% (w/v) TCA and dilute to volume with deionized water Shake the samples at 5-min intervals for 30 min and filter transfer a5ml aliquot of the filter to a 5 ml ml volumetric flask add 1 ml of 5% (w/v) lanthanum solution and make to volume with deionized water

A mixed standard should be prepared containing 50 mg /L Ca 06 mg/L Mg 16 mg/L Na 50 mg/L k 500 mg/L La and 12 % (w/v) TCA All determination should be made versus a reagent blank containing 500 mg/L La and 12% TCA follow the direction on the "Standard Condition" pages for preparation of standards for each element and standard condition

Statistical Analysis

The data collected from the different treatments was subjected to analysis of variance and whenever appropriate the mean separation procedure of Duncan was employed (Steel and Torrie, 1980). The SAS program (SAS, 2002), was used to perform the general linear model (GLM) analysis.

FINDINGS

Chemical Composition of Camel Milk

The chemical composition of camel milk was presented in table (1). Protein and moisture, % had no significantly different among camel milk, on the other hand, fat content (%) significantly different with means value (3.37, 3.60, 4.00) for kourdofan, Butana and Khartoum camel milk respectively. Fat content in camel milk was higher than ELhag *et al*, (2003) ELbadawi (2004) whereas found (3.01). The Ahs with means value (0.87, 0.94, 0, 96) for Khartoum, Butana and kourdofan camel milk respectively. Ahs content in camel milk was higher than ELhag *et al*, (2003) content 0.80 %

The moisture content of fresh camel milk (%) had ranged between (88.83-87.25). moisture content in camel milk was agrees of the results of Jardali and Ramet, (1991) as (87.73), Ahmad (1990) who reported a value ranging between (84-88) in this study the crude protein had no significantly different ($p \geq 0.05$) with means

Table 1: Chemical Composition of Camel Milk from Three Different Areas in Sudan

Treatments				
Parameter, %	**Kourdofan**	**Butana**	**Khartoum**	**± SEM**
Fat	3.37^{b}±0.15	3.60^{b}±0.1	4.0^{a}±0.14	0.08
Moisture	88.53^{a}±1.29	88.83^{a}±1.13	87.25^{a}±0.25	0.58
Crud protein	$3,05^{a}$ ±0.05	$2,93^{a}$ ±0.8	$2,95^{a}$ ±0.0.5	0.58
Ash	0.96^{a} ±0.05	0.94^{a} ±0.02	0.87^{b} ±0.03	0.02

^{ab}Means ± SD with different superscripts in the same row are significantly different ($P \leq 0.05$).

SEM: Standard error of the means from ANOVA d.f 6· Value 2.93, 2.95, 3.05 for Butana, Khartoum and kourdofan respectively camel milk proteins were higher than), ELhag *et al*,(2003) where reported (3.4%) and Ahmad.,(1990) also (3.0%). Physiological stage, feeding conditions, season, physiological variations, genetic make-up and health status of the camel were reported to influence the composition of camel milk (Konuspayeva *et al*. 2009). In general, the average amount of components of camel milk is protein 3.4%; fat 3.5%; ash 0.79%, while water covers 87% (Al-Haj and Al-Kanhal 2010). Camel milk is still the most important nutritional source for pastoralists in many

African and Asian countries (Valérie 2007). Camels produce more milk of high nutritional quality and for a longer period of time than other species in an environment that may be rightly termed as hostile in terms of extreme temperature, drought and lack of pasture (Yagil and Etzion 1980; Valérie 2007). The milk has many properties that make it a very useful choice, as camel's milk is used in some parts of the world to cure certain diseases Attia *et al.* 2001, Askale and Samson 2018

Table 2: Camel Milk Macro-Minerals in Kordofan, Albutana and Khartoum State

Treatments					
Parameter,%	**Kourdofan**	**Butana**	**Khartoum**	**± SEM**	**Sig**
K++	148^{b}±4.37	154.46^{a}±1.07	155.37^{a}±2.12	1.66	*
P	96.80^{b}±4.31	105.17^{a}±4.25	102.03^{ab}±2.68	2.21	*
Ca	129.33^{c} ±5.05	137.90^{a} ±1.36	145.17^{b} ±1.05	1.45	*
Mg	14.15^{b} ±94	16.23^{a} ±0.60	17.30^{a} ±1.56	0.52	*
Na	43.13^{b}±3.15	49^{a}±1	52.58^{a}±2.56	1.39	*

^{ab}Means ± SD with different superscripts in the same row are significantly different (P≤ 0.05).

SEM: Standard error of the means from ANOVA d.f 6.

The results of camel milk macro minerals presented in table 2. And there were significantly different among camel milk from different areas in Sudanese camel milk markets. Calcium Ca, magnesium Mg, and sodium Na were highest content values in Khartoum camel milk and lowest content means value for Kordufan camel milk, except Phosphorus P, which higher content value in Albutana camel milk than Khartoum camel milk. Various minerals such as Na, K, Ca, P, Mg are present in camel milk (Khasmi *et al*. 2001; Onjoro *et al*. 2003). The values of trace minerals were significantly higher in camel milk as compared to cow's milk (Agrawal *et al*. 2004).

Table 3: Kordofan and Albutana Macro Minerals in Soil (ppm)

Treatments			
Parameter,%	**Kourdofan**	**Butana**	**± SEM**
K	0.27^{a}±0.03	0.41^{b}±0.03	0.02
P	1.1±0.11	1.5±	0.07
Ca	14.17 ±0.11	8.83 ±0.44	1.92
Mg	19.33 ±7.57	13.33 ±2.07	3.18
Na	$0.34^{a\pm}$0.10	0.18^{b}±0.06	0.05

^{ab}Means ± SD with different superscripts in the same row are significantly different (P≤ 0.05).

SEM: Standard error of the means from ANOVA df 6.

Macro Minerals in Soil

Potassium K, phosphorus P, calcium Ca magnesium Mg, and sodium Na for kordufan and Butana soil contents shows in table (3). The results in this study

had significantly different in potassium content in Butana soil higher than Kordufan soil with mean value 0.4 and 0.27 respectively. On the other hand, sodium content higher in Butana soil with mean value 0.34 and 0.18 for Kordufan soil. Phosphorus, Calcium and Magnesium had no different. The effect of production system was clearly appear on meat content of macro-element especially Ca, Na, and K which provided from soil and plant El-rasheed, and Adam (2018).

Camels can be adapted to various climatic conditions. They are utilized in transport, sport, wellspring of meat and milk; therefore, they contribute to raising the economy and food security for people (Suliman *et al.*, 2019; Swelum *et al.*, 2020). The decrease in crude protein and ash during winter might be due to nutritional factors as winter feed requirements are higher than that of the other seasons.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Camel milk from different areas and production system had different chemical content in fat and ash % and similar in moisture, and protein %, within the same season. However, macro-minerals in camel milk increasing by soil macro minerals contents specially on grazing system. Whereas, camels milk of Khartoum state which live in a farm didn't effect by soil contents of macro-elements.

Recommendation

Camels' production system especially in the rural areas must be to completely there feed by the elements which it's poor in soil of the grazing area.

More researches to determine and compare elements content in soil and the grazing animals' products in the same areas.

Acknowledgment

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Emerging Issues and Controversies

Grazing and feeding practices: The production system and feeding practices employed in camel husbandry can impact the chemical composition and macro-mineral content of camel milk. Controversies may arise if different production systems, such as traditional extensive grazing versus modern intensive feeding, result in significant variations in milk composition. Stakeholders may debate the relative nutritional value and quality of milk produced under different systems.

Nutritional composition and health implications: Understanding the nutritional composition of camel milk and its health implications is important for consumer awareness and decision-making. Controversies may emerge if there are significant differences in the levels of proteins, fats, vitamins, minerals, and other bioactive compounds in camel milk from different production systems. Stakeholders may debate the potential health benefits or risks associated with consuming milk from specific production systems.

Quality and safety considerations: The quality and safety of camel milk are paramount for consumer protection. Controversies may arise if certain production systems are associated with higher risks of milk contamination, such as microbial pathogens or environmental pollutants. Discussions on the implementation of quality control measures, hygiene practices, and regulatory frameworks may be necessary to address these concerns.

Environmental sustainability: The environmental impact of camel milk production systems is an emerging concern. Controversies may arise if certain production systems are found to have adverse effects on natural resources, including water usage, land degradation, or greenhouse gas emissions. Stakeholders may debate the sustainability of different production systems and explore practices that minimize environmental footprints.

Cultural and traditional values: Camel milk holds cultural and traditional significance in many societies. Controversies may arise if the adoption of modern production systems alters the traditional ways of camel husbandry and milk production. Stakeholders may debate the preservation of cultural heritage and the importance of maintaining traditional production practices while addressing modern challenges.

Marketing and consumer preferences: Consumer preferences play a significant role in shaping the market for camel milk. Controversies may emerge if different production systems lead to variations in milk characteristics that

affect consumer acceptance and preferences. Stakeholders may debate the marketing strategies, labeling requirements, and consumer education efforts needed to inform consumers about the impact of production systems on milk composition.

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The Characteristics of Cracker Fish and Beef Products Processed Under Sudanese Condition

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Abstract

Purpose: The study was designed to evaluate the processing of fish and beef crackers under Sudanese conditions.

Methodology: 2kg *Tetraodon fahaka* fish meat, 2kg beef top side cut, corn flour, and spices were purchased from local market, and then prepared for processed cracker. The processing formula consist of 50% Meat or fish with 50% corn flour.

Findings: The products were significantly different chemically in lipid content 19% for fish and 14 % for beef cracker and similar in moisture, protein, and ash%. (WAI) water absorption index, (WSI) water Solubility index determined without different between products. Linear expansion and oil absorption were differently 15.6, 10.7, 19.7, and 2.1for fish and beef cracker respectively. Sensory characteristics were determined included colour, falavor, Crispness, overall acceptability. The panelists prefer cracker fish in overall acceptability.

Unique Contribution to Theory, Practice and Policy: Cracker fish products are traditional food in Asia; it's made of fish and sea food which increases the nutritional value, and is taken between meals. Most of the snacks available in the market are mainly based on cereals, which are high in calorie and low in protein content. For this reason, snacks like fish or beef crackers with high protein content was thought to be developed for nutritional enrichment. Cracker fish and beef were processed in Sudan had acceptable chance to increases the nutritional value for children which like crispness. Cracker it can be useful in IDP camp for displaced human in Darfur province.

Keywords: *Cracker, Characteristics, Processing, Fish, Beef*

INTRODUCTION

Fish crackers is one of the popular snack food in Southeast Asian countries including Malaysia. Crackers are a popular snack among young and old people, can be consumed at any time and any place. In fact, crackers are frequently served as a side dish with rice or other delicacies such as wonton noodles, rice cake, and *batagor* (Sufiat *et al*., 2022). They are made of fish flesh together with starch flour, water and seasoning which then shaped into round, oblique, Stick or longitudinal forms and gelatinized by boiling or steaming (Huda *et al*., 2009; Taewee, 2011).

The cool dough is sliced and dried for certain times before being fried to be eaten as fresh and puffed Crackers. In Malaysia, there are many producers from the cottage industry especially in these three major States, Terengganu, Kelantan and Pahang. There are more than 100 small scale producers along the streets in Terengganu that each of them producing different taste and look of the crackers. Other characteristics that differ among the fish cracker producers are an uneven expansion and shapes, different sizes and color. This is happen due to the different ratio of ingredients used by the producers.

Therefore, it is important to ensure that the crackers suits the best characteristics of good quality crackers in terms of their sufficient expansion from puffing, crispiness, low moisture content and less oil absorption (Taewee, 2011). Fish at large are divided into two main groups which are marine and freshwater fishes. In the fish introduction of new types of fish based products in tune with the changing market trends is need of the day. Present market trends demand for healthy ready-to-cook and ready-to-eat convenient products for present day time starved consumer (Paradkar, 2007, Esmat *et al.*, 2020, Broto *et al*., 2020)

Statement of the Problem

Starch based snack foods that are popular among all age groups, do not normally contain adequate quality protein and minerals. Fish crackers can now replace these unhealthy snack foods available in the market by providing utilizable protein and minerals. Starch serves as a functional ingredient that contributes to the expansion of the product. The expansion is directly related to the crispiness, which determines the acceptability of fish cracker (Yu SY, 1991b, and Yu SY, 1991a).

Objectives of the Study

The general objective of the study to evaluate processing cracker from beef and fish under Sudanese conditions and determine the characteristics or acceptability of beef cracker compare with fish.

LITERATURE REVIEW

One such important traditional fish-based snack food is the crackers known by different names in many countries of Asia. In India they are called wafers or crackers and in Malaysia they are called 'Keropok'. Ingredients for making fish crackers are starch or flour, seasoning (pepper, garlic, salt, sugar and monosodium glutamate); and the protein ingredient that gives its distinction to the name of the cracker. Starch or flour is a principal ingredient for making fish cracker (Huda, 2009 and Taewee, 2011)

Amylose-amylopectin ratio in starch has a strong effect on the expansion of starch-based snack Matz (1984) &Wang (1997). Fish cracker made from various flours, which had a different amylose-amylopectin ratio, were compared in their expansion (Mohamed *et al*., 1989). It was found that linear expansion of cracker correlated positively to the amylopectin content in flour. Types of starch have different compositions and functional properties (Subarica *et al*., 2012). Starch composition was shown to influence cracker expansion. Protein in flour seems to inhibit cracker expansion (Kyaw *et al*., 1999).

METHODOLOGY

Experiment

The experiment was conducted at the food processing hall, Faculty of Agricultural Technology and Fish Sciences, Al-Neelain University. ingredients for processing cracker *Tetraodon fahaka* fish, Beef meat, Corn Flour, Nutmeg, piper cubeba, Salt, Sugar, Black pepper, garlic, dry onions, fenugreek, Sesame, Cinnamon were purchased from local market.

Processing Fish and Beef Crackers

The fish was washed with chilled chlorinated water of 2 ppm and flesh was separated from the bones manually after heading, gutting, scaling and cleaning. 1kg beef top side cut prepared for processing. Fish and beef cracker was prepared as per flow chart shown in Fig. 1. The mince obtained was mixed with Corn Flower starch the meat or fish-to-starch ratio of 50:50 (%) including

1% sodium bicarbonate, 2% salt, 2% seasoning and 200 ml water added to the mixture.

The ingredients were mixed mechanically using blender until a smooth paste was obtained. The semi-solid paste was then molded into a sausage casing having a diameter of 3 to 5 cm and 25 to 30 cm length. The sausage was steamed for 60 minutes. The steamed pastes were cooled in cold water to minimize shrinkage and chilled for 24 hrs in a refrigerator at 4±1 °C. The cooked and chilled sausage was cut manually into slices about 3 to 4 mm thick and dried in an oven at 60° for 12 hours until a moisture content was around 10 ± 2%. The dry slice of beef and fish cracker was fried in cooking oil approximately at 180° for 10 sec. The fried crackers were evaluated for different quality analysis.

Table 1: Ingredients Used for Preparation of Fish and Beef Cracker

Combination-1 C-1	**Combination-1 C-2**
50%Corn Flour (including 2% salt and other Ingredients like sodium Bicarbonate 1% and 2% seasoning) 50% fish Meat	50%Corn Flour (including 2% salt and other Ingredients like sodium Bicarbonate 1% and 2% seasoning) 50% Beef Meat

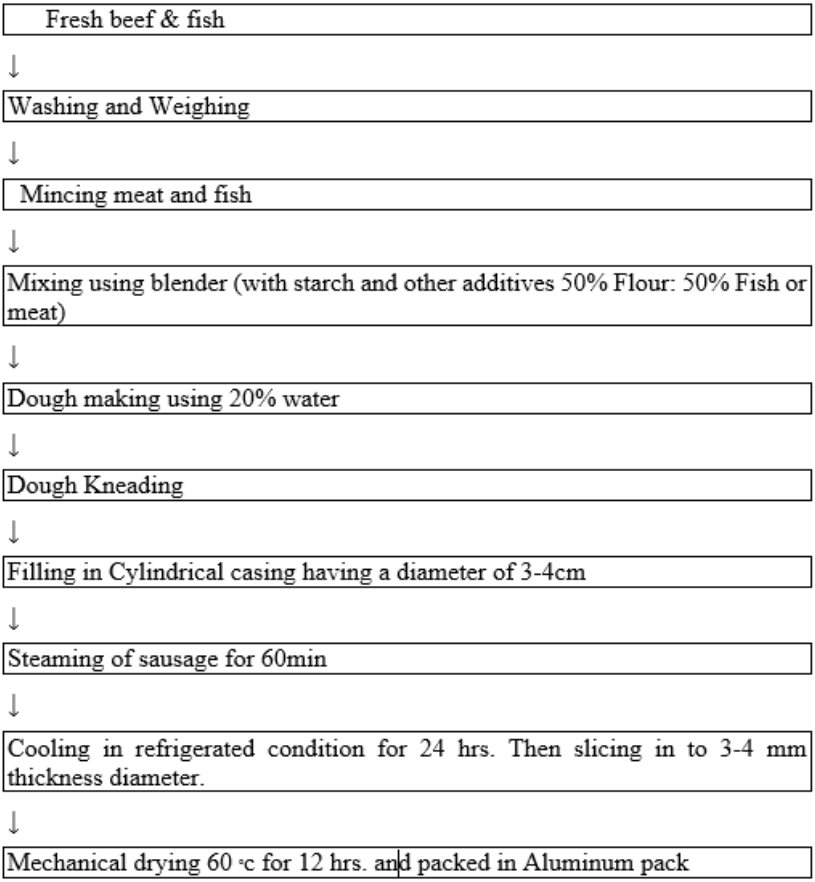

Figure 1: Flow Chart for Processing Beef and Fish Cracker

Fish and Beef Cracker Chemical Composition

Moisture, crude protein, and Ash content were determined according to (AOAC, 2005). Water content was determined by drying samples at 105±2 ^{o}C until a constant weight was obtained. Wet samples were used for determination of crude fat, protein and mineral contents. Crude fat was measured by solvent extraction method in a soxhlet system where n-hexane was used as solvent. Crude protein content was calculated by using nitrogen

content obtained by Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content. Total mineral content was determined by incinerating samples at 550±10 ºC for 5 hours. The weight of the residual ash, expressed as a percentage of the wet sample weight, was taken as the total inorganic residue.

Determination of Linear Expansion (LE %)

The percentage linear expansion was obtained after deep frying the dried crackers in oil at 180º. The un-puffed cracker was ruled with three lines across using a marker pen. Each line was measured before and after puffing.

According to the method (Chudasama *et al.,* 2019) used as follows:

Linear Expansion (%) =Length after puffing − Length before puffing ÷ Length before puffing×100

Determination of Oil Absorption (%)

The percentage oil absorption was calculated according to the standard method (Yu SY 1991a) below:

Oil Absorption (%) = Weight of cracker after frying − Weight of cracker before frying ÷Weight of cracker before frying × 100.

Water Absorption Index (WAI) and Water Solubility Index (WSI)

WAI and WSI were determined in triplicate following the method described by Yagci and Gogus (2009). Each ground cracker (3g) was dispersed in 30 ml of distilled water and stirred using a vortex mixer. This dispersion was allowed to stand for 30 min in a water bath at 30º C. Subsequently, the dispersion was centrifuged at 3000 rpm for 15 min using the centrifuge (Remi Instruments, Bombay, India). The supernatants were poured into a petridish and dried at 110 ºC and weigh. WAI and WSI were calculated using following equations:

Dispersion was centrifuged at 3000 rpm for 15 min using the centrifuge the supernatants were poured into a petridish and dried at 110 º and weigh. WAI and WSI were calculated using following equations:

WAI (g/g) = Weight of hydrated residue ÷dry weight of the sample

WSI (%) = Weight of dissolved solids in supernatant ÷Dry weight of the sample × 100

Sensory Analysis

Sensory evaluations were conducted using an eleven-member semi trained panel. Panelists were trained to evaluate the fish cracker for crispiness, texture, taste/flavor, odor and overall acceptability on a using 5-point hedonic scale according to standard procedure Cross and Overby 1988 as Like very much (5), Like moderately (4), Neither like nor dislike (3), Dislike moderately (2), Dislike very much (1). The limit of acceptability was 3 for all the samples.

Statistical Analyses

Data obtained from all the tests were analyzed by using one-way analysis of variance (Anova) and followed by Duncan multiple range test of the Statistical Package for Social Science version 22.0 (SPSS inc., 2018 Chicago, Illinois, U.S.A). Statistical significance was indicated at the 95% confidence level. Values expressed are means of three determinations ± standard deviation.

FINDINGS

Chemical composition of cracker fish and beef products were processed under Sudanese condition presented in table (2). There were not different in crude protein 17.5 and 19.2 for cracker fish and beef respectively beside moisture content with average 5% for each one, 5-4 % ash of cracker fish or beef without significantly different. On the other hand lipid % had differ means value between cracker of fish and beef 19% for cracker fish and 14% for beef, although beef meat had high percent of fat than fish meat, whereas lean meat were used in processing the products. The lipid % in cracker fish it might be refer to the frying processing step which its clear in the measured of oil absorption. Protein of cracker fish recorded 8-16.5% after processed mentioned by Modupe 2002) . The same author reported fat 19.8-21.4 ash 1.5-3 and moisture % 3-4.1. In this study the results nearly to Chudasama *et al.,* (2019) were recorded 19.9 of protein 14.7 for lipid 5.13 for ash% and 3.19 % for moisture content.

Water absorption index WAI in dried fish and beef cracker was recorded as 5.2±0.05, and 5.2±0.15. However, water solubility index (WSI) showed no significant difference for these products. Analysis of WSI observed was 13.3 for all products. WAI and WSI are considered as indicators of the degree of starch gelatinization and its degradation. The higher content of soluble polysaccharides released from the starch polymer chains after gelatinization can effect on the increase of WSI and the decrease of WAI values Chudasama *et al*., 2019.

Table 2: Characteristics and Chemical Composition of Cracker Fish and Beef

Item	Fish cracker	Beef cracker
Protein	17.5±1.7	19.2±1.7
Moisture	5.o±1.0	5.0±3.0
Ash	5.0±1.0	4.o±0.0
Fat	19.0±1.0[a]	14.0±1.0[b]
WAI	5.2±.05	5.2±.15
WSI	13.3±0.0	13.3±0.0
Linear expansion	15.5±1.4[bc]	10.7±.25[bc]
Oil Absorption	19.7±12.6[bb]	2.1±.6[bb]

[ab]Means ±std. deviation in the same row bearing different superscripts are significantly different (P<0.05)

WAI: water Absorption index

WSI: water Solubility index

Linear expansion and oil Absorption were recorded 15.6, 10.7 19.7, and 2.1 for cracker fish and beef respectively nearly to Chudasama *et al*., 2019 were recorded linear expansion and oil absorption of cracker fish with rice starch 18.7 and 6.2

Crispness, the most important sensory attribute of crackers, is directly related to linear expansion. A linear expansion greater than 77% is required for an acceptable level of crispness.

The linear expansion ratings of the fried crackers increased with an increase in the amount of fish (Table 2). In previous work on expansion using soybean/cassava, wheat flour/wheat starch, and tapioca/rice starch, an increase in the protein content of the blends caused a decrease in the linear expansion of the extrudates.

However, in a study of soy, wheat, milk, and egg proteins, milk protein tended to increase expansion volume, whereas the other proteins decreased expansion Chinnaswamy and Hanna1993. This was related to the viscoelastic nature and the cross-linking ability of different proteins. As the degree of cross-linking increases, the amount of expansion during frying decreases. The increase in linear expansion with an increased proportion of fish may be associated with myofibrillar protein (particularly myosin) present in minced fish, which has the ability to form a gel (Modupe 2002).

Table 3: Sensory Evaluation Characteristics of Cracker Fish and Beef

Item	Fish cracker	Beef cracker
Color	4.2±1.4 [a]	3.1±1.7 [b]
Flavor	4.4±1.2 [b]	3.9±1.8 [b]
Crispness	4.3±1.6 [b]	3.4±2.0 [c]
Textures	4.0±2.0 [b]	3.8±1.6 [b]
Overall acceptability	5.±1.5 [a]	3.6±1.4 [b]

[ab]Means ±std. deviation in the same row bearing different superscripts are significantly different (P<0.05).

The taste panelists found no significant difference in flavor and texture between cracker fish and beef, on the other hand there were prefer colour, crispness, and overall acceptability of cracker fish fig (1), whereas the same formula of processing cracker that indicated for beef meat which had connective tissues, and become tough with frying.

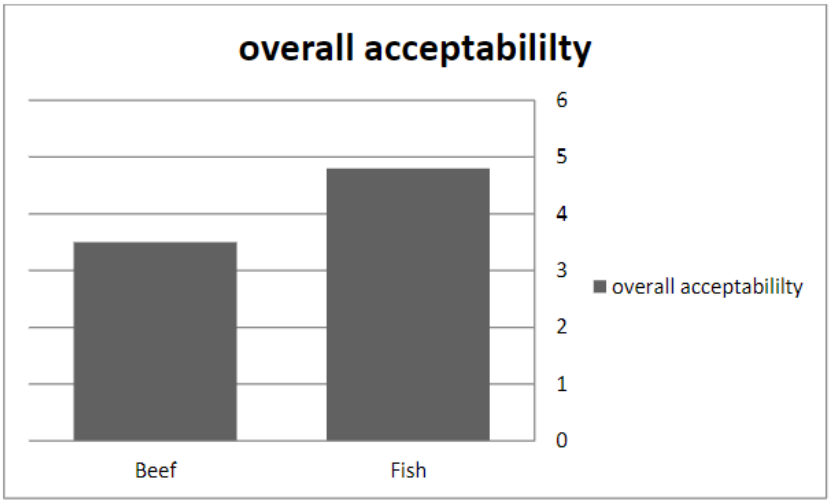

Figure 2: The Overall Acceptability of Panelist

CONCLUSION AND RECOMMENDATIONS

Conclusion

Cracker fish and beef products were processed under Sudanese condition had good chance to successful as food industry in Sudan and other African

countries, from the results of the study the characteristics of cracker fish and beef processed under Sudanese condition nearly to same with an Asian crackers. Nevertheless, cracker products which increased the nutritional value by using meat and fish in the products will become useful and improvement junk or snack food. However the sensory attributes of cracker were acceptable and favored especially cracker fish.

Recommendation

More research to investigate crispness of beef cracker and developed all characteristics of cracker fish and beef. Development and entry this industry in Sudan which increased the nutritional value for children. Cracker it can be useful in IDP camp for displaced human in Darfur province and other place in the world.

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Emerging Issues and Controversies

Quality and sensory attributes: The quality and sensory attributes of cracker fish and beef products are important factors for consumer acceptance and preference. Controversies may arise if there are significant variations in the texture, flavor, juiciness, tenderness, and overall eating experience between the two products. Stakeholders may debate the relative quality and sensory appeal of cracker fish and beef products, especially if there are notable differences in consumer perception and market demand.

Nutritional composition and health considerations: Understanding the nutritional composition of cracker fish and beef products is essential for consumer awareness and health implications. Controversies may emerge if there are significant differences in the levels of proteins, fats, vitamins, minerals, and other bioactive compounds between the two products. Stakeholders may debate the relative nutritional value and health benefits or risks associated with consuming cracker fish and beef products.

Processing techniques and food safety: The processing techniques employed in producing cracker fish and beef products can impact their safety and quality. Controversies may arise if certain processing methods are associated with higher risks of microbial contamination, chemical additives, or improper handling practices. Discussions on food safety regulations, adherence to hygiene standards, and the use of additives may be necessary to address these concerns.

Environmental sustainability: The environmental impact of processing cracker fish and beef products is an emerging concern. Controversies may arise if certain processing practices are found to have adverse effects on natural resources, such as water usage, waste generation, or energy consumption. Stakeholders may debate the adoption of sustainable processing technologies and practices to minimize the environmental footprint of the production processes.

Market competitiveness and consumer preferences: Consumer preferences and market demand play a crucial role in shaping the market for cracker fish and beef products. Controversies may emerge if one product is perceived to be more popular or preferred by consumers over the other. Stakeholders may debate marketing strategies, pricing, product positioning, and consumer education efforts to inform and influence consumer choices.

Cultural and regional preferences: Cultural and regional preferences can influence the acceptability and marketability of cracker fish and beef products. Controversies may arise if there are conflicts between traditional culinary practices, dietary customs, or religious considerations associated with consuming certain types of meat or fish products. Balancing cultural heritage with evolving dietary patterns and consumer demands may require stakeholder engagement and dialogue.

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