IMPACT OF PACKAGING MATERIALS ON SENSORY QUALITY OF GOAT MEAT PRODUCT (MEAT FLOSS)

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ABSTRACT
The study aimed to identify eco-friendly packaging materials and evaluate their effectiveness on the sensory quality of meat floss over a period of nine days storage duration using a 3×4 factorial arrangement in a Completely Randomized Design (CRD). The packaging materials used were sterile containers (SC), Banana leaves (BL) and Plastic containers (PC). The storage durations were (0, 3, 6, and 9 days). Sensory attributes were colour, flavour, taste, texture and overall acceptability, evaluated every three days. Result showed that Packaging material used had no significant (P<0.05) effect on the sensory parameters measured. Flavour score differed significantly (P<0.05) with PC having the best score 3.33±0.09 compared to other packaging materials used. Plastic containers initially preserved the sensory qualities (taste, texture, flavour, colour, and overall acceptability) of meat better than banana leaves and control (SC), but all sensory qualities deteriorated over time. For optimal sensory quality, meat should be stored in plastic containers for short duration (1-3 days) to retain taste, texture, and flavor. For longer storage, banana leaves are recommended due to their antimicrobial properties, which help to control bacterial growth.
Keywords: Sensory, Quality, Packaging materials, Meat floss, Eco-friendly.

INTRODUCTION

One of the oldest domesticated animals in the world is goat. The Fertile Crescent is where goats were initially domesticated, and from there they spread over the world (Gibson, 2016). Goats are found to be among the big five livestock species (chicken, sheep, cattle, pigs and goats) (Saleh *et al.,* 2021). Goat is normally referred to the poor man's cow. Worldwide, domesticated goats are primarily used to provide meat, milk, fat, skin, fiber, and cashmere (Bomba *et al.,* 2015). History has it that there are over 600 breeds of goat worldwide. Different breeds of goats are adapted to different livestock systems - from small herds of 3-5 heads on meager grazing to large intensive livestock farms, from year-round grazing to fully stable housing, with many intermediate variations between them. Among the goat breeds there are highly productive specialized, dual-triple-use and universal breeds. External differences between breeds are represented by many major and minor traits that vary in a very wide range. Goat breeds (especially dairy goats) are some of the oldest defined animal breeds for which breed standards and production records have been kept. Breeds are generally classified based on their primary use, though there are several breeds which are considered dual- or multi-purpose. These variations are categorized based on how well they serve certain functions (Bertolini *et al.,* 2018). After domestication, goat species got scattered quickly over the world through human migrations and commercial traders (Rezaei *et al.,* 2008). One of the main factors supporting farmers' livelihoods in arid and semi-arid areas is goat production (Mohammadi *et al.,* 2009).

Meat is the fleshy or edible part of an animal usually domesticated livestock used for food, which includes not only the muscles and fat but also the tendons and ligaments *(*Britannica*,* 2024). The quality of meat products is established in food science and technology. Packaging plays important role in preserving the safety, quality and shelf-life of meat products thereby protecting them from physical, chemical, and microbiological damage and danger and equally making them qualitative and safe for consumption by humans. Meat packaging is not only streamlined to wrapping or enclosing a meat product but it also protects the meat from spoilage. Packaging must ensure safe delivery of the meat products at a minimum cost. (Choi, 2014). The cost of packaging has to be affordable to its consumers. Packaging does not improve the existing quality of a product but it helps in maintaining its keeping quality (shelf life) during storage and transportation (Choi, 2014). In order to ensure safety and meet consumer satisfaction, the current packaging materials (zip-top plastic bag, wax paper, aluminum foil, and many more) used for meat floss (a Nigerian traditional meat product) contributes to environmental degradation. This results in harm to the environment, depletion of natural resources and negative impact on public health. To mitigate these impacts, the use of innovations and technological preservation methods can be adopted in the packaging of meat products (Marsh *et al.,* 2007*).* Packaging is vital in keeping the quality of meat products from being contaminated, which is critical for the general public's health (Vanderroost *et al.,* 2014). Therefore, investigating and identifying eco-friendly packaging materials for meat floss is crucial for ensuring the product's quality while promoting environmental stewardship (Robertson, 2013).

Materials and Methods

Description of the study area

This research was being carried out at the Animal Product Processing Laboratory, Department of Animal Science, College of Agriculture and Environmental Science, Kaduna State University, Kafanchan, Kaduna Nigeria.

Kafanchan is located at latitude 9o 59'N, longitude 8o 29'E and it is situated at an elevation of 733m above sea level (World Atlas, 2018). The town has zero rainfall at the beginning and end of the year with a yearly precipitation of about 28.1mm (1.11) on average and an average of 53.7% (Ovimaps, 2022).

Experimental design and sample preparation

The meat samples were purchased from an open market within Kafanchan metropolis. Meat sample were evaluated for qualities of meat floss (dambun nama) under different packaging materials (banana leaves and plastic containers), with 4 storage durations (0, 3, 6, and 9 days, respectively). Four treatments were used for the study using a factorial arrangement consisting of 3×4 factors, that is 3 packaging materials and 4 storage periods in a completely randomized design (CRD).

Four (4kg) chevon meat was used to prepare the meat product (Meat floss). The meat samples were washed, seasoned with fresh ginger (60g), thyme (10g), garlic (40g), pepper (120g), onions (220g), salt (20g), curry (20g) and seasoning cubes (80g). The meat was allowed to marinate for 30 minutes after mixing the meat together with the ingredients thereafter, cooked at a cooking temperature of 160°C for 1:30 minutes to enable the meat get softer for easy pounding. The meat was fried into meat floss with 100g of cooking oil under normal frying temperature for 20 minutes; it was then allowed to cool down for 30 minutes before packaging.

The Meat floss samples were packaged using the already sourced packaging materials (sterile container, plastic container and banana leaf) during the experiment with four samples randomly assign to each treatment inside the already purchased packaging materials. At the end of the packing, four (4) replicates of each treatment was realized making twelve (12) samples available with their codes on each of the packaging materials.

Packaging materials

Three different packaging materials were selected for the study. The materials were sourced from an open market within Kafanchan metropolis. The materials include sterile container, banana leaf and plastic containers. After purchasing the banana leaf, it was cut into a square shape of equal sides then folded into a box with one side completely open in order to have a cavity. Another one was made in such a way that it can fit into the first one that is, one box serves as the container and the other lid. Then a strand was removed from the banana leaf and was used to tie the two boxes together. This process was repeated until four boxes were achieved.

Storage conditions

All packaged meat samples were stored under controlled environmental conditions (e.g., refrigeration temperature of -18°C) for a period of 9 days.

Sensory evaluation

A team of semi trained sensory panelist (n=20) were used to evaluate the product for taste, tenderness, texture, color, and general acceptability respectively, using a 5-point hedonic scale (Excellent: 5, very good: 4, moderately good: 3, poor: 2, very poor: 1). They were offered blind samples of the meat product. Each panelist was served with three (3) samples to score the above mentioned parameter. They were provided with water for rinsing their mouth, and biscuit in order to avoid contamination from taste of the previous product. Sensory evaluation was done after every three days (i.e., 0, 3. 6 and 9 days, respectively).

RESULTS AND DISCUSSION

Table 1: Effect of packaging materials on sensory quality of meat product (Danbun nama)

The result obtained in this study indicate that the type of packaging material used had no significant ($P<0.05$) effect on the sensory parameters measured. The attributes measured include taste, texture, flavour, colour and overall acceptability. They were all similar across the packaging materials tested. The taste scores for Sterile containers (SC), Plastic containers (PC) and Banana leaves (BL) did not differ significantly ($P>0/05$) with scores ranging from 3.56±0.09, 3.55±0.08 and 3.50±0.08, respectively. Texture scores also had no effect on the packaging materials used. The scores include SC 3.41±0.24, PC 3.82±0.23 and BL 3.14±0.23, respectively. Flavour score differ significantly ($P<0.05$) with PC having the best score 3.33±0.09 compared to other packaging materials use. This could be due the fact that modified atmosphere packaging (MAP) prolongs shelf life by reducing lipid oxidation (Chandra *et al.,* 2020).

Table 1: Effect of storage material on the sensory evaluation

Parameters	Storage material			P-value
	Sterile container	Plastic container	Banana leaf	
Taste	3.56±0.09	3.55±0.08	3.50±0.08	0.8707^{NS}
Texture	3.41±0.24	3.82±0.23	3.14±0.23	0.1251^{NS}
Flavour	$3.00±0.08^{b}$	$3.33±0.09^{a}$	$2.96±0.08^{b}$	0.0065^{*}
Color	3.25±0.09	3.09±0.09	2.99±0.08	0.1265^{NS}
Overall acceptability	3.18±0.09	2.99±-0.09	2.90±0.08	0.0973^{NS}

^{ab}Means with different superscripts within the same row are significantly different, NS= Not significant, *= Significant at 5 %

Packaging slows down the deterioration of meat quality, including microbial growth, discolorations, off-flavor, and vitamin loss *(*Fang *et al.,* 2015). According to (Kauffman, 2017), the intramuscular fat level of meat, or marbling, is one of the main variables influencing its quality. Marbling is a critical factor in determining meat quality, as it affects tenderness, juiciness, and flavor. Colour and Overall acceptability also do not differ significantly (P>0.05) across all the packaging materials tested. The scores include colour: SC; 3.25±0.08, PC; 3.09±0.09 and BL; 2.99±0.08, respectively. Overall acceptability scores incudes: SC; 3.18±0.09, PC; 2.99±0.09 and BL; 2.90±0.08, respectively. (Kauffman, 2017), report tha intramuscular fat level of meat, or marbling, is one of the main variables influencing its quality. Marbling is a critical factor in determining meat quality, as it affects tenderness, juiciness, and flavor.

Meat under preservation may be rather sensitive to the kind of substance or procedure used to preserve it, and the sensitivity of the meat and the packaging material determines how hygienic the food is. Meats will constantly keep changing, either chemically or physically, depending on the kind of storage environment. Packaging materials affect the texture, color, and appearance of chevon (Kumar *et al.,* 2020). Packaging materials affect how quickly chevon oxidizes and spoils (Patel *et al.,* 2019*).* It can be concluded that:

CONCLUSION

Plastic containers initially preserved the sensory qualities (taste, texture, flavour, colour, and overall acceptability) of meat better than banana leaves and control (SC), but all sensory qualities deteriorated over time and recommend that, for optimal sensory quality, meat should be stored in plastic containers for short durations (1-3 days) to retain taste, texture, and flavor, for longer storage, banana leaves are recommended due to their antimicrobial properties, which help to control bacterial growth.

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