



Effect of Processing Method on Some Quality Parameters of Shredded Meat

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Abstract

The experiment was carried out to evaluate the effect of processing method on some quality parameters of shredded meat. The experiment was carried out at the College of Animal Science laboratory, Joseph Sarwan Tarka University of Agriculture, Makurdi, Nigeria. A known amount of beef (thigh muscle) was purchased from the abattoir in North bank Market, Makurdi. The meat was properly washed, cut into sizeable chunks, placed in a clean pot and allowed to cook until soft. The cooked shredded meat was divided into three treatments: Treatment 1-Stir fried shredded meat, Treatment 2- Air fried shredded meat and Treatment 3- Deep fried shredded meat, each consisting of three replicates. Data were collected on proximate composition, lipid profile, consumer acceptability and storage stability. Statistically similar values were observed in most of the parameters studied except total cholesterol which showed higher values in samples that were deep fried probably due to the much oil used, so also, from the sensory evaluation that was conducted, the panelist preferred the deep-fried meat due to its golden brown colour. From the results of this study, it was concluded that the different processing methods did not influence the proximate composition and storage stability but significantly influenced the sensory qualities and total cholesterol of the meat. Stir and air fried shredded meat were recommended due to their low cholesterol levels.

Keywords: shredded, meat, storage stability, frying, Total cholesterol

Introduction

Shredded meat is a popular food product consumed worldwide due to its versatility and convenience. The processing methods used in the production of shredded meat can significantly affect its consumer acceptability and storage stability (Liu *et al.*, 2019). Several processing methods are used in the production of shredded meat, including mechanical shredding, cooking, and marination. Mechanical shredding can be done using various equipment such as grinders, slicers, and choppers. Cooking methods include baking, grilling, and frying, while marination involves the use of seasonings and marinades to enhance flavour and tenderize the meat (Kaur and Kaushik, 2016).

Consumer acceptability of shredded meat is influenced by factors such as taste, texture,

and appearance. The choice of processing method can significantly impact these factors. For instance, mechanical shredding can result in a more uniform texture, which may be preferred by some consumers. Cooking method also play a crucial role in determining the final taste and texture of shredded meat. Marination can enhance the flavour profile and improve the overall acceptability of the product (Lee *et al.*, 2013). The storage stability of shredded meat is essential for maintaining product quality and safety. Processing methods can affect the microbial load, oxidative stability, and moisture content of the product, which in turn influence its storage stability. For example, proper cooking can help reduce the microbial load and improve the shelf life of shredded meat. Marination with antioxidants can help prevent lipid oxidation and maintain the quality of the product during storage

(Mujtaba and Al-Dewik, 2014). This study was designed to determine the effect of processing method on the quality of shredded meat.

Materials and Methods

Experimental Site and Location

The research was conducted at the Multipurpose Laboratory in the College of Animal Science, Joseph Sarwuan Tarka University of Agriculture, Makurdi, Benue State. Makurdi is located on Latitude 7° 43'50"N, and longitude 8° 32'10"E, at an elevation of 98m above sea level (google map 2017). The annual rainfall ranges from 800-1200 mm. The area is warm with the

temperature range of 36.33 ± 3.79 and relative humidity which range from 37.50 ± 2.20 to 64.00 ± 2.47 (TAC, 2009).

Experimental Procedures

A known quantity of beef (thigh muscle) was purchased from the abattoir in North bank market, Makurdi. The meat was properly washed, cut into sizeable chunks, placed into a clean pot and allowed to cook until soft. When the meat was soft, it was drained with a strainer then poured into a clean mortar and pound using a pestle until the shredded texture was achieved. The cooking and pounding recipe of the meat are presented on Tables 1 and 2.

Table 1: Composition of cooking Recipe Used for shredded meat Production

Ingredients/Seasoning	Scientific/Botanical name	Quantity (g/100g)
Salt	Sodium chloride	10.0
Maggie	Maggie	15.0
Thyme	<i>Thymus vulgaris</i> L.	12.0
Curry	<i>Murrayakoenigii</i> L.	12.0
Onion	<i>Allium cepa</i> L. var. <i>cepa</i>	50.0
Total		100

Table 2: Composition of pounding Recipe Used for shredded meat Production

Ingredients/seasonings	Scientific/Botanical name	Quantity (g/ 100g)
Red Pepper	<i>Piper nigrum</i> L	35.0
Maggie	Maggie	30.0
African Nutmeg	<i>Monodorum myristica</i> (Gaertn.) Dunal	2.50
Ginger	<i>Zingiber officinale</i> Rosc.	4.0
Garlic	<i>Allium sativum</i> L	3.0
Cloves	<i>Syzygium aromaticum</i> (L.)	2.50
Curry powder	<i>Murrayakoenigii</i> L	3.50
Thyme	<i>Thymus vulgaris</i> L	2.50
Salt	Sodium chloride	5.0
Onion	<i>Allium cepa</i> L. var. <i>cepa</i>	12.0
Total		100

Experimental Layout

The shredded meat was divided into three treatments

Treatment 1- Stir fried shredded meat (consisting of three replicates)

Treatment 2- Air fried shredded meat (consisting of three replicates)

Treatment 3- Deep fried shredded meat (consisting of three replicates)

Frying Procedure

i. Stir frying

A cooking pan with small amount of vegetable oil was placed on a medium heat and some quantity of the shredded meat was

added to the already heated oil in the pan. It was continuously stirred to avoid burning until a golden brown color was achieved, after which it was poured into a tray to cool off. This was done in batches until the sample was exhausted

ii. Air frying

A cooking pan was placed on a medium heat, a small quantity of the sample was added to the heated pan and it was continuously stirred until golden brown. No vegetable oil was used

iii. Deep frying

A cooking pan was placed on a medium heat, and 6 cups of vegetable oil was added to an already heated pan. Shredded meat was added to the oil in such a way that the oil covered the shredded meat. This was continuously stirred until golden brown color was achieved

Data Collection

Determination of proximate composition

Shredded meat samples were obtained for each replicate of each treatment and analyzed for its proximate composition. Parameters analyzed were: crude protein, ash, moisture, crude fiber, following the procedure of AOAC (2015).

Determination Lipid Oxidation

Five grams (5g) of each meat sample from the thigh muscle was homogenized in 15ml distilled water. Sample homogenate (5ml) was transferred to a test tube and lipid oxidation was determined as the 2-thiobarbituric acid- reactive substance (TBARS) value by methods of Ahn *et.al.* (1999). Values were expressed as mg malonaldehyde kg of sample (Jang *et al.*, 2007)

Determination of Lipid profile

Composite paste of the shredded meat was prepared with a known amount of chloroform and methanol mixture 1:1(v/v) for each replicate. The resulting paste solvent was

filtered and rinsed with an additional volume of the combined homogenate and allowed to stand for five (5) minutes. The filtered homogenate was equilibrated to remove non lipid material. 2% (0.32M) w/v KLC. Solution was added to the aqueous layer (Folch *et al.*, 1957). The filtrate was centrifuged and lipid extract was decanted. The extract was be made up to a final volume by adding chloroform. The decanted mixture obtained was used for the determination of cholesterol, triglycerol, and high and low density lipoproteins.

Sensory Evaluation

Panelists were convened for a total of three sessions for testing three replications of each treatment. Sensory evaluation was conducted by 6 trained panelists including several parameters e.g texture, taste, flavour, colour and over all acceptability. The panelists were asked to score several sensory parameters of the product using a 9-point hedonic scales. Panelists were asked to indicate how much they liked or disliked each product on a 9-point hedonic scale (9= like extremely, 8= like very much, 7= like moderately, 6= like slightly, 5=dislike extremely, 4=dislike very much, 3=dislike moderately, 2=dislike slightly, 1=indifferent) according to texture, taste, flavor, color, and over all acceptability characteristics. The sensory evaluation was conducted in an appropriately designed and lit room and a mean score was estimated for each product.

Statistical Analysis

Data collected were subjected to analysis (ANOVA) in a complete Randomized Design using Statistical Package for Social Sciences (SPSS, 1999). Significant means were separated using Duncans multiple range tests of the same Software. The Statistical model for the analysis is as follows:

$$Y_{ijk} = \mu + M_i + \varepsilon_{ijk}$$

Where:

Y_{ij} = observed mean value of dependent variable

μ = Population mean
 M_i = Effect of treatment
 ε_{ijk} = The random residual error

Results and Discussions

Table 3 shows the Proximate composition of shredded meat samples processed differently.

The processing method had no significant effect on the Proximate composition of shredded meat. The moisture values for air and deep fried samples were 7.79 and 7.59, respectively.

Table 3: Effects of Processing Method on Proximate Composition of Shredded Meat

Parameters	Df	Af	Sf	SEM	P- values
Moisture content	7.99	7.59	7.78	1.25	0.09
Dry matter	27.01	27.01	27.17	2.05	0.09
Crude protein	19.10	20.95	19.29	1.02	0.08
Crude fat	0.72	0.68	0.72	0.98	0.09
Ash	0.95	0.87	0.90	0.69	0.07

SEM: Standard Error Mean, Df: Deep frying, Af: Air frying, Sf: Stirr frying, P- values: Probability values

The result of Oxidative Stability of shredded Meat is presented in Table 4. The result showed that there was no significant difference ($p > 0.05$) between the parameters across treatment groups 1-3. Superoxide dismutase (SOD) was seen to increase across treatment groups with value ranging from 0.67-1.58 with the lowest value observed in

air fried sample (0.67) and the highest value in deep fried sample (1.58). The values for SOD are lower than the normal range of reference value for meat. Malondialdehyde (MDA) was seen to decrease across treatment groups with value ranging between 0.02- 0.01 with highest value in air fried sample (0.02) and the lowest in deep fried sample (0.01).

Table 4: Storage Stability of Shredded Meat

Parameters (mg/dl)	Stir fry	Air fry	Deep fry	SEM	P-Values
SOD	0.67	1.36	1.58	0.3	0.91
MDA	0.02	0.01	0.01	3.68	0.21

SOD= superoxide dismutase, MDA= malondialdehyde, SEM= Standard Error of Mean, mg/dl = milligrams per deciliter, P-Value= Probability values.

Table 5 shows the Lipid profile of shredded meat samples processed differently. All the meat samples studied showed statistically similar values except for total cholesterol that differed significantly ($p > 0.05$). Total cholesterol had its highest values in the samples that were deep fried (69.1) and its lowest values was observed in samples that were stir fried. The result of sensory evaluation of shredded meat is presented in Table 6. The results showed that there was no significant difference ($p > 0.05$) between the parameters measured across the treatment groups. Colour was observed to decrease in stir fried sample and air fried sample with value range of 7.35 -3.05 but increased

between air fried sample and deep fried sample with value range of 2.95-7.05 with highest value observed in stir fried sample and the lowest in air fried sample. Aroma shows similar trend with decrease in value between stir fried sample and air fried sample ranging between 6.95-7.0 and an increase between air fried sample and deep fried sample with value range of 6.70-6.85. Meaty flavor shows the same trend with decrease in value between stir fried sample and air fried sample with value range of 7.05-4.65 and an increase between air fried sample and deep fried sample with value range of 4.65-7.95. Tenderness shows the same trend with decrease in value between stir fried sample

and air fried sample with value range of 6.05-6.60 and an increase between air fried sample and deep fried sample with value range of 6.60-7.75. Saltiness shows the similar trend with decrease in value between stir fried sample and air fried sample with value range of 5.05-2.30 and an increase between air fried sample and deep fried sample with value range of 2.30-6.05. Overall flavour increases across treatment groups with value ranging

between 5.25-7.75 with highest value in deep fried sample and the lowest in stir fried sample. Overall acceptability was seen to decrease from stir fried sample to air fried sample with value range of 4.15-1.90 but increased between air fried sample to deep fried sample with value range of 1.90-7.65 with highest value observed in stir fried sample and the lowest in air fried sample.

Table 5: Effect of Processing Method on Lipid Profile of Shredded Meat

Parameters	Df	Af	Sf	SEM	P- values
Total cholesterol	69.1 ^{ab}	59.25 ^c	62.45 ^b	4.89	0.03
Triglycerides	202.45	198.45	193.25	10.59	0.89
HDL	11.35	10.5	12.15	0.53	0.42
LDL	17.3	7.15	11.65	2.96	0.71

SEM: Standard Error Mean, Df::Deep frying, Af: Air frying, Sf: Stir frying, P- values: Probability values

Table 6: The sensory evaluation of shredded meat

Parameters	Stir fry	Air fry	Deep fry	SEM	P-Values
Colour	7.35 ^a	2.95 ^b	7.05 ^a	0.14	0.00
Aroma	6.95	6.70	6.85	0.16	0.92
Meaty Flavour	7.05	4.65	7.95	0.15	0.89
Tenderness	6.05	6.60	7.75	0.16	0.86
Saltiness	5.05 ^b	2.30 ^c	6.05 ^a	0.14	0.00
Overall Flavour	5.25 ^c	6.65 ^b	7.75 ^a	0.12	0.00
Overall Acceptability	4.15 ^b	1.90 ^c	7.65 ^a	0.15	0.00

SEM= Standard Error of Mean, P- Values= Probability values

Discussion

The observed increase in SOD (superoxide dismutase) levels across treatment groups suggests that the cooking methods may lead to elevated oxidative stress in the meat. SOD helps to neutralize superoxide radicals, which can be generated during lipid oxidation and thermal processing (Wang *et al.*, 2018). The lowest SOD value in air-fried samples compared to the highest in deep-fried samples could be attributed to varying temperatures and cooking times involved in these methods. Air frying typically uses hot air circulation, inducing less oxidation due to

reduced exposure of the meat to direct heat and potentially harmful lipid oxidation products, thus leading to lower SOD activation. In contrast, deep frying involves higher temperatures and greater exposure to detrimental oxidative conditions, prompting a greater increase in SOD levels as a protective response to oxidative stress. Although the SOD values were still lower than the normal reference range for meat, this indicates that the cooking processes might not have optimally preserved the meat, which remains a concern for oxidative stability. The decrease in MDA levels is an intriguing

outcome. MDA is a well-established biomarker of lipid peroxidation, and lower MDA values suggest reduced lipid oxidation in the deep-fried samples compared to the air-fried samples, despite the initial hypothesis that higher temperatures might promote increased lipid oxidative damage (García *et al.*, 2018). This discrepancy might be attributed to the fact that the deep frying process could create a protective barrier of frying oil around the meat, which may reduce the direct interaction of oxygen with the lipids in the meat (Madan *et al.*, 2020). Furthermore, the nature of the frying oil used could also impact the oxidation status, as certain oils possess properties that can inhibit lipid peroxidation (Kumar *et al.*, 2019). This is in line with findings of a number of researchers including García *et al.* (2018) who observed that sous-vide cooking led to lower levels of MDA compared to conventional cooking methods, emphasizing how sous-vide's lower temperature can preserve meat quality and reduce oxidative stress.

Crude protein is one of the most significant nutritional components of beef. Protein is crucial for building and repairing tissues in the human body and is made up of essential amino acids. In beef, the crude protein content typically ranges between 18% and 23% of the fresh meat weight, which translates to about 60–80% of the dry matter (Cross *et al.*, 1986). This range can fluctuate based on the animal's breed, diet, and muscle development. Lean cuts of beef tend to have higher protein content, while fatty cuts may have relatively less protein. Beef is considered a complete protein source, meaning it provides all the essential amino acids required by the body. The crude protein obtained in this study is within the normal of 18% and 23% as stated by Cross *et al.*, (1986).

Crude fat, or the total fat content in beef, is another key component. It provides energy and essential fatty acids but is also the primary contributor to the meat's caloric density. On average, the crude fat content in beef can range from 2% to 15% of the fresh weight, though highly marbled cuts, such as ribeye, can exceed 20% fat content (Wood *et al.*, 2008). Beef fat, or tallow, contains both saturated and unsaturated fats, with saturated fats being more predominant. The amount of fat in beef not only influences its nutritional profile but also affects flavor and tenderness. The crude fat obtained in this study falls below the normal range of 2% to 15% according to Wood *et al.* (2008). The differences observed could be attributed to the cut and fat trimming of beef used.

Ash in beef represents the total mineral content left after the complete burning of the organic matter. It includes essential minerals such as calcium, phosphorus, potassium, magnesium, and trace elements like zinc and iron. The ash content in beef is typically around 1% to 1.5% of the fresh meat weight, reflecting the mineral richness of the meat (Lawrie and Ledward, 2006). These minerals play various roles in bodily functions, such as bone health and oxygen transport. The Ash obtained from this study falls below the normal range of 1% to 1.5% recorded by Lawrie and Ledward, (2006). The slight variations observed can be attributed to factors such as the animal's diet or the specific cut of meat.

Total cholesterol in beef varies based on the cut and fat content, typically ranging from 60 to 90 mg per 100 grams of cooked lean beef (Daley *et al.*, 2010). Cholesterol is essential for cell membrane structure and hormone production, but excessive consumption can elevate blood cholesterol levels, increasing the risk of cardiovascular diseases. Leaner cuts of beef tend to have lower cholesterol content, making them a healthier option for

managing cholesterol intake. The total cholesterol obtained in this study falls within the normal range of 60 to 90 mg as recorded by Daley *et al.*, (2010).

Triglycerides, the primary form of fat stored in the body, are also found in beef. Their content in beef depends largely on the fat content of the specific cut. Marbled cuts, such as ribeye and brisket, have higher triglyceride levels compared to lean cuts like sirloin. Triglyceride levels in beef can range from 2 to 30 grams per 100 grams depending on fat content (Wood *et al.*, 2008). While triglycerides are a necessary energy source, high intake from fatty beef can lead to elevated blood triglyceride levels, contributing to obesity and cardiovascular issues.

HDL, known as the "good" cholesterol, helps remove cholesterol from the arteries and transport it to the liver for processing. Beef contains both saturated and unsaturated fats, which can influence HDL levels in the body. Consuming lean beef, which has a lower saturated fat content, is less likely to negatively impact HDL levels. Studies suggest that grass-fed beef, which contains more omega-3 fatty acids, can help improve the ratio of HDL to LDL, thus promoting cardiovascular health (McAfee *et al.*, 2010). Maintaining healthy HDL levels is crucial in protecting against atherosclerosis and other heart diseases.

LDL, often referred to as the "bad" cholesterol, is responsible for transporting cholesterol to cells, but high levels can lead to plaque buildup in the arteries, increasing the risk of heart attacks and strokes. Beef, especially fatty cuts, contains saturated fats that can raise LDL cholesterol levels (Krauss *et al.*, 2000). For individuals looking to manage their LDL levels, choosing lean cuts of beef and limiting intake of processed beef

products, which are typically higher in saturated fat, is recommended. Reducing saturated fat intake from beef is one of the dietary strategies used to lower LDL cholesterol levels.

The decrease in color score from stir-fried to air-fried samples suggests that air frying may not achieve the same level of browning or attractive coloration due to lower cooking temperatures and the absence of direct oil contact (Mansour *et al.*, 2017). This impact on color can significantly influence consumer perceptions, as appealing coloration is often associated with flavor and quality. Conversely, the increase in color score from air-fried to deep-fried samples highlights the effect of higher temperatures and oil immersion during deep frying, which enhances the Maillard reaction, resulting in a more appealing golden-brown appearance. Similar trends are evident in aroma scores, with a decline observed from stir-fried to air-fried samples and an increase between air-fried and deep-fried samples. The trend in saltiness is somewhat less intuitive, with a decrease from stir-fried to air-fried samples and an increase in deep-fried samples. This variance could be due to differences in how salt is perceived based on moisture content and flavor profiles created through fat interactions. Air frying may mask some of the saltiness perceived due to drier and less flavorful meat, while deep frying can amplify flavors, including saltiness, due to the enhanced Maillard reaction and oil usage. Overall acceptability was highest in the stir-fried samples and showed a decrease when moving to air-fried samples before increasing again in deep-fried samples. This trend aligns with consumer preferences, which generally favor flavours that are richer and more complex, as produced by deep frying, compared to the more health-oriented approach of air frying, which may sacrifice some of the sensory attributes (Wang *et al.*,

2020). This study aligns with other findings such as Mills *et al.*, (2018) who found that grilled or fried meat tends to have higher sensory ratings for flavour and tenderness due to enhanced fat content and the development of desirable aromatic compounds, confirming the trends seen in your study; Surai *et al.* (2018) who demonstrated that frying improves sensory attributes, such as flavour and tenderness, while air frying resulted in lower ratings, particularly in flavour and overall acceptability, aligning with your findings. Warren *et al.* (2019) also noted that cooking method significantly affected sensory attributes, with deep frying enhancing both flavour and overall acceptability due to the rich chemistry associated with fat interactions.

Conclusion

From this study, the following conclusions were drawn

- i. The different processing methods of shredded meat used did not influence storage stability
- ii. The different processing methods significantly influenced sensory qualities of meat.
- iii. The different processing methods of meat floss had no effect on the proximate composition but had a significant effect on the total cholesterol.

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