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Full Length Research Paper

Physicochemical and Organoleptic assessment of Patties from Beef and Antelope Meat

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A study was carried out to assess the physicochemical and sensory properties of patties from beef and antelope meat. Fresh 3kg each of beef and antelope meat were purchased and chilled at 4^0C for 24 hours. They were thawed and ground, 2.3kg of each meat type was divided into five portions of 0,25, 50, 75 and 100% after mixing the two meat types into 0g, 115g, 230g, 345g and 460g of antelope meat. The meat patties were broiled and cooled to room temperature. The weight, thickness, diameter, cooked, patties stability, colour change, shear force, pH, water holding capacity, proximate composition and sensory attributes of the patties were determined. The results showed that physical, chemical and sensory attributes were higher (P<0.05) in patties with high level of antelope meat inclusion. Also, patties with low levels of antelope meat inclusion were preferred more (P<0.05) than those with high levels of antelope meat inclusion. The results revealed further that antelope meat inclusion between 25% and 50% was sufficient to provide the varieties the consumers need in meat patties from beef and antelope meat. It is suggested therefore, that antelope meat inclusion in meat patties be limited to those two levels for consumers' maximum consumption of patties from beef and antelope meat.

Keyword: Beef, Antelope meat, Patties, Physicochemical, Organoleptic.

INTRODUCTION

Diet is an important factor in the health of human populace; therefore, there is need for a balanced diet which contains major nutrients. Protein is the major nutrient required in any diet and majority of the population in developing countries are suffering from protein shortage especially from animal and poultry sources (FAO, 1996). This development led to the need for increased production of meat animals and improved processing methods. In order to achieve these goals, meat types other than from domestic animal and poultry sources have been utilized. For instance, meat from game animals have been well consumed for supply of protein to complement protein supply from domestic animals.

In the sub-Saharan Africa and in other continents consumption of meat from wild life has become very high choice irrespective of educational background, religion or sex (FAO, 1989). The demand for wild life meat is in no way limited to rural areas. This is because in recent years, it has been discovered that meat from domestic animal sources contained most of saturated fat which has been linked to high human serum cholesterol and heart diseases (Chizzolini *et al*., 1999). There have been various approaches to minimize the problems associated

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with fat in meat and meat products so that saturated fat should not provide more than 10% of calories and cholesterol should be limited to 300mg per day (Colmenero *et al*., 2001). These approaches include the use of leaner meat materials which the wild life meat possesses (Kingdom, 1997), incorporating non-meat ingredients into human diets (Gregg *et al*., 1995) and physical manipulation of meat by ways of messaging or mining (Keeton, 1994). It has been reported (Claus and Hunt, 1991) that humans have consumed beef and antelope meat in chopped or minced form with spicies, flavouring added and molded into cakes, baked into loaf or stuffed into sausages with little information on their physical, chemical and sensory analysis. This study was therefore, carried out to assess the physicochemical and organoleptic properties of patties from beef and antelope meat.

Materials and Methods

Fresh beef meat 3kg was purchased from Ayetoro market and Antelope meat 3kg was purchased out of a freshly killed antelope from Ago-Iwoye market in Ogun State. The meat samples were chilled at 4^0C for 24 hours. They were removed from the refrigerator and equilibrated to room temperature (25^0C) and were trimmed of connective tissues and fat. They were cut into smaller pieces and ground with a manual grinder. 2.3kg of the ground meat of beef and antelope were weighed out and divided into 5 portions of 0, 25, 50, 75 and 100%.

Mixing of Patties

Mixing of meat patties was done in 500g lots such that 460g, 230g, 115g and 0g of beef was incorporated into 0g, 115g, 230g, 345g and 460g of antelope meat. 5g of salt and 35g f margarine (fat) were added to each sample and pressed as shown in Table 1. The weight, thickness and diameter of patties were determined using scale and a meter rule. Prior to cooking each patties sample was tagged, wrapped in cellophane bags and frozen at -18 to -20^0C for 4hrs. They were thawed overnight a 3^0C in a refrigerator before cooking.

Cooking of patties

Four patties were prepared from each mixed sample. They were broiled in a gas oven for 40 minutes at 180^0C. The patties were allowed to cool to room temperature (25-27^0C) after which the weight, thickness and diameter of parties were measured and expressed as percentages of raw patties weight.

Cooking loss

This was determined using the equation thus:

$$\%\ \text{Cooking loss} = \frac{\text{Wt before broiling} - \text{Wt after broiling}}{\text{Wt before broiling}} \times 100$$

Cooking yield was determined as the different between 100% and values of cooking loss of each treatment thus; Cooking yield = (100 – cooking loss %)

Cooked patties stability

This was carried out by heating 10g of each cooked patties sample in 30mls of boiling 1.5% brine solution for 6mins. The weight of each sample was taken after removal from boiling brine, cooled and mopped dry. Cooked patties stability was determined using the equation;

$$\text{Cooked patties stability} = \frac{\text{Wt before boiling} - \text{Wt after boiling}}{\text{Wt before boiling}} \times 100$$

Determination of Shear Force of Patties

This was carried out by using the Warner Bratzler shearing apparatus with the capacity of 25kgx50gm. This was done by taking the centre slice of cooked patties with 2cm x 2cm cross section and was sheared thrice across the long side. The mean of the shear values was taken as the objective tenderness score of the meat patties.

Water Holding Capacity (WHC) of parties

1g of each of the raw meat parties was weighed out and placed in between two filter papers and were put between two plexi-glasses and pressed between the jaws of a vice for 1 minute. The area of irregular surface of the meat patties film and the expressed juice was determined by grid method as the WHC of meat parties thus;

$$1 - \frac{\text{Meat patties film area}}{\text{Area of expressed juices}} \times 100$$

Proximate composition and pH of patties

This was carried out following the procedures of AOAC (2000). Moisture content, ether extract (fat) crude protein and ash contents were determined for each raw and cooked meat patties, while nitrogen free extract was obtained by difference between 100% and sum of the analyzed variables. Moisture content of meat patties was determined by weighing out 2g of each sample of meat patties into a silica dish and oven dried for 20 hours at 100 – 105^0C until a constant weight was obtained. Each meat patties sample was allowed to cool for 10 min in a desiccator before reweighing to determine the percentage moisture thus;

$$\%\ \text{Moisture} = \frac{\text{Initial wt} - \text{Final wt}}{\text{Initial wt}} \times 100$$

Crude protein of meat patties

This was carried out by digesting 2g of each sample of ground meat patties in a kjedahl flask and distilled over the Markham apparatus and titrating the distillate with 0.01N HCL. The crude protein value was derived by converting nitrogen (N %) content of patties samples obtained through titration with a constant (6.25), thus crude protein was obtained as (6.25xN%).

Ash content

Ash content was determined by weighing 2g of patties from each treatment into a crucible and transferred into muffle furnace set at 550^0C and left for 4hrs. The crucible and its content was cooled in a desiccator (25^0C) and then reweighed.
The percentage ash was calculated as:

$$\%\ \text{Ash content} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100$$

Ether Extract (fat) of patties

Table 1. Ingredients Composition of Patties

Treatments **Variable**	**0%**	**25%**	**50%**	**75%**	**100%**
Beef (g)	460	345	230	115	0
Margarine (g)	35	35	35	35	35
Salt (g)	05	05	05	05	05
Antelope meat (g)	0	115	230	345	460

Table 2. Physical Properties of Patties from Beef and Antelope meat

Treatments **Variable**	**1** **0%**	**2** **25%**	**3** **50%**	**4** **75%**	**5** **100%**
Cooking Loss (%)	28.03±291[c]	29.55±0.89[b]	29.65±0.07[b]	32.43±2.11[a]	31.48±2.14[a]
Patties Yield (%)	71.97±0.00[a]	70.45±0.01[b]	70.35.001[b]	68.57±0.02[c]	68.52±0.02[c]
Patties Stability (%)	26.00±1.83[a]	25.50±3.42[a]	18.50±4.80[b]	17.75±2.36[b]	15.00±2.58[c]
Water holding capacity (%)	62.00±0.01[b]	67.00±0.01[a]	66.20±0.01[a]	57.00±0.08[c]	56.20±0.09[c]
Thickness (cm)	15.00±5.77[a]	15.00±5.77[a]	15.00±5.77[a]	12.50±5.00[b]	12.50±5.00[b]
Diameter (cm)	17.50±5.00[a]	17.50±5.00[a]	15.50±5.10[b]	15.00±5.77[b]	12.00±5.77[c]
Shear force (kg/cm^3)	2.40±0.38[a]	1.38±0.36[b]	1.06±0.55[b]	0.69±0.10[c]	0.58±0.09[c]

abc: means in the same row with different superscripts are statistically significant (P<0.05)

This was determined with soxhlet extractor with a reflux condenser. 2g of each ground meat patties was transferred into a thimble and placed in the extractor using petroleum ether in a flask. This was heated and the solution was allowed to siphon to the flask for at least 10-12 times. The flask containing the oil was weighed and dried in an oven to a constant weight and ether extract (fat) calculated thus;

$$\% \text{ Ether Extract (fat)} = \frac{\text{Weight of oil}}{\text{Weight of patties sample}} \times 100$$

This was determined using Weston pH meter. 10g of each meat parties was ground and dissolved in 90ml of distilled water and the pH electrode inserted into the solution to read off the pH value at room temperature (25^{0}C).

Sensory evaluation of patties

This was conducted following the procedures of AMSA (1995) A 10-members taste panel was used. They were semi-trained to adjudge test for meaty flavour, juiciness, colour cohesiveness, aroma, hardness and overall acceptability of patties sample from each treatment independently on a 9-point hedonic scale on which 1-corresponds to dislike extremely and 9-like extremely.

Experimental design and statistical analysis

Completely randomized design (CRD) was used for this study with four replicates. Data collected were subjected to analysis of variance (ANOVA) using (SAS, 2002) and the means were separated with Duncan multiple range teat of the same system.

RESULTS AND DISCUSSION

The composition of patties from beef and antelope meat is shown on Table 1. The results of physical properties of meat patties from beef and antelope meat are presented on Table 2. The results showed that treatments 4 and 5, that is, meat patties with 75% and 100% antelope meat inclusion had higher (P<0.05) cooking losses of 31.43±2.11% and 31.48+2.14% followed by treatments 2 and 3; meat patties with 25% and 50% antelope meat inclusion with 29.55±0.89 and 29.15±0.07 and least (P<0.05) in treatment 1 meat patties with 0% antelope meat inclusion with 28.03±2.91%. The cooking loss of meat patties in treatments 4 and 5. The results of patties cooking loss revealed that it increased as the level of antelope meat inclusion in the patties increased indicating that higher levels of antelope meat inclusion in the patties induced loss of juices from the patties perhaps due to high moisture in the patties since the moisture content of both meat types was very high, therefore, there was tendency for the patties to loose most of the moisture content during cooking (Gunter, 2007).

The results of patties shear force showed that patties with 0% and 25% antelope meat inclusion had the highest (P<0.05) shear force values of 2.40±0.38kg/cm^3 and 1.38±0.36kg/cm^3, while that with 100% antelope meat inclusion had lowest (P<0.05) shear force value of 0.58±0.09kg/cm^3. The results also showed that the higher the level of antelope meat inclusion in the patties the lower the shear force value treatment 2 compared well with 1 (control). Patties cooked stability was higher (P<0.05) in treatment 1 and 2, than in treatments 3 and 4 while it was least (P<0.05) in treatment 5. The results indicated that patties with lower antelope meat inclusion were more stable when cooked. The results also revealed that the higher the level of antelope meat inclusion in the patties the lower the patties cooked stability. This could be due to reduced moisture and fat contents of the patties which could have acted in binding the patties together during cooking. The results of patties

Table 3. Proximate Composition and pH of Patties from beef and antelope meat

Treatments Variable	1 0%	2 25%	3 50%	4 75%	5 100%
Moisture					
Raw Patties (%)	61.70±0.00[a]	60.30±0.0[b]	60.25±0.07[b]	59.20±0.28[c]	59.10±0.10[c]
Cooked Patties (%)	58.90±0.42[a]	59.15±0.78[a]	57.70±2.26[b]	57.20±3.25[b]	56.75±0.35[b]
Crude Protein					
Raw Patties (%)	20.20±0.21[b]	20.90±0.07[ab]	21.20±0.21[ab]	21.60±0.07[ab]	22.20±0.28[a]
Cooked Patties (%)	22.45±0.21[c]	24.80±0.07[b]	24.72±0.14	24.60±0.14[b]	26.35±0.07[a]
Fat					
Raw Patties (%)	4.20±0.00	3.95±0.35	3.90±0.14	3.75±0.35	3.50±0.00
Cooked Patties (%)	10.25±0.21[a]	10.20±0.00[a]	10.20±0.42[a]	8.25±0.07[b]	8.20±0.14[b]
Ash					
Raw Patties (%)	1.01±0.14	1.31±0.14	1.51±0.12	1.76±0.12	2.10±0.10
Cooked Patties (%)	2.05±0.11	2.12±0.11	2.15±0.10	2.21±0.09	2.25±0.07
NFE					
Raw Patties (%)	12.74±0.40	13.34±0.28	13.42±0.20	13.69±0.17	13.10±0.21
Cooked Patties (%)	6.35±0.05[b]	3.73±0.08[d]	5.23±0.05[c]	7.74±0.02[a]	6.45±0.05[b]
Ph					
Raw Patties (%)	5.17±1.12	5.21±1.02	5.23±1.10	5.25±0.09	5.27±1.14
Cooked Patties (%)	5.26±0.07	5.32±0.05	5.35±0.05	5.37±0.05	5.37±0.05

abcd: means in the same row with different superscripts are statistically significant (P<0.05)

NFE: Nitrogen Free Extract

water holding capacity showed that treatments 2 had the highest (P<0.05) water holding capacity of 67.00±0.01% followed by treatment 1 with 62.00±0.01% and treatment 3 with 60.00±0.08% while it was least (P<0.05) in treatments 4 and 5 with 57.00±0.08% and 56.20±0.09% respectively. It has been reported (Aduku and Olukosi, 2000) that the majority of the physical and sensory characteristics of raw and cooked meat and meat products depend on the water holding capacity. This trend was observed in this study all other physical attributes of patties either increase or decrease depending on the degree of water holding capacity. The results of patties thickness and diameter followed the same trend. The thickness of the patties in this study were higher (P<0.05) in treatments 1,2 and 3 than those of treatments 4 and 5 while patties diameter was higher (P<0.05) in treatments 1 and 2 followed by those of treatments 3 and 4 and least (P<0.05) in treatment 5. The results of patties thickness and diameter showed that they decreased along with the decrease in water holding capacity as the level of antelope inclusion in the patties increased. This result could be due to higher cooking losses as well as WHC observed in treatments 4 and 5 which tend to reduce the thickness and diameter of the patties. There was no significant (P>0.05) difference in the pH of raw and cooked patties in all the treatments. This could be due to the fact that beef, antelope and meat from other species of animal posses almost the same pH which could have been maintained even after cooking the patties from the two meat types (Van Lack *et al*., 2001).

The results of proximate composition meat patties are shown on Table 3. Moisture contents of raw patties in treatments 1,2 and 3 were higher (P<0.05) than those of raw patties in treatments 4 and 5 and cooked patties in treatments 1 and 2 had higher (P<0.05) moisture contents than those in treatments 3,4 and 5. Moisture content of patties followed the trend of water holding capacity obtained in this study. But protein content was highest (P<0.05) in raw patties in treatment 5 followed by protein of raw patties in treatment 3 and 4 while raw patties in treatment 2 and 1 had lower (P<0.05) protein contents. The same trend of protein content was observed in cooked patties. Treatment 5 had higher (P<0.05) protein, than treatments 4, 3 and 2 while treatment 1 had the least (P<0.05) protein. These results could be that protein from beef and antelope meat got accumulated as the level of antelope meat inclusion increased which was concentrated the more during cooking (FAO 2006). The results of fat content of patties showed that there was significant (P<0.05) difference in fat content of the patties with patties in treatment 4 having higher (P<0.05) fat than patties in treatments 1,2,3 and 5 respectively. But fat content was higher (P<0.05) in treatments 5, 3 and 1 in cooked patties than in treatments 2 and 4.

It was observed that there was increase in the concentration and coagulation of fat in patties in this study perhaps due to shrinkage as a result of cooking and loss of water in the process (FAO, 2006). However, lower percentages of fat were obtained in this study especially in treatments 2 and 4 which makes the patties

Table 4. Sensory Scores of Patties from beef and antelope meat

Treatments					
	1	**2**	**3**	**4**	**5**
Variable	**0%**	**25%**	**50%**	**75%**	**100%**
Colour	7.25±0.93[a]	6.03±0.51[b]	5.61±0.93[b]	5.29±0.61[b]	4.50±0.92[c]
Aroma	5.86±1.07	5.18±0.55	5.79±0.38	5.36±0.30	5.14±0.12
Flavour	6.30±0.61[a]	6.54±0.74[a]	6.25±1.07[a]	5.14±1.07[b]	4.72±0.58[b]
Tenderness	4.25±0.68[c]	5.34±0.91[b]	6.58±1.15[a]	6.62±0.66[a]	6.79±0.30[a]
Juiciness	4.18±1.09[c]	5.57±0.61[b]	6.60±0.62[a]	6.63±0.49[a]	6.89±0.57[a]
Cohesiveness	3.89±0.65[d]	5.25±0.84[c]	6.75±1.16[b]	6.80±0.61[b]	7.93±0.25[a]
Overall Acceptability	6.50±0.56[a]	6.82±0.43[a]	6.62±0.58[a]	5.57±0.32[b]	5.55±0.48[b]

abcd: means in the same row with different superscripts are statistically significant (P<0.05)

The scores were obtained on a 9-point hedonic scale where 1=dislike extremely and 9 = like extremely.

safe for consumption (Colmenero *et al*., 2001) and (NIH, 2005). The results of sensory characteristics of patties from beef and antelope meat are shown in Table 4. The colour of cooked patties decreased as the level of antelope meat inclusion in the patties increased with treatment 1, having the highest (P<0.05) colour score of 7.25±0.73 followed by those of treatments 2, 3 and 4, while treatment 5 has the least (P<0.05) colour score of 4.50±0.92. This showed that high inclusion of antelope meat in the patties induced dark colour of the patties. Probably because antelope meat colour is darker than that of beef which tends to dominate. There was no significant (P>0.05) difference in aroma of patties in all the treatments.

The results of patties flavour showed that treatments 1 and 2 had higher (P<0.05) flavour scores closely followed by treatments 3 and 4 while treatment 5 had the lowest (P<0.05) flavour score of 4.72±0.58. The trend in the flavour of patties in this study was such that flavour intensity decreased in the patties. This result could be due to increasing cooking loss in the patties which could have drained most of the flavour components of the patties during cooking as a result of losses of juice (Paika and Daun, 1999). The results of patties tenderness showed that treatments 3, 4 and 5 had higher (P<0.05) tenderness scores followed by treatment 2 and least (P<0.05) in treatment with 4.25±0.68 score. Also, the patties juiciness result has almost the same pattern as patties tenderness results. Treatments 3, 4 and 5 had higher (P<0.05) juiciness scores than in treatments 4 and 5 with 4.57±0.61 and 4.18±1.09 scores respectively. The results of tenderness and juiciness of patties also followed the trends of moisture content, water holding capacity as well as cooking loss results of the patties. They decrease and increase in line with the patties attributes mentioned, above which showed that tenderness and juiciness were highly dependent on moisture and water holding capacity (Aduku and Olukosi, 2000).

The results of patties cohesiveness showed that of score was higher (P<0.05) in treatment 5 while it was lower (P<0.05) in treatment 1. This could be as a result of high cohesive force that might have developed between beef and antelope meat due to high moisture and fat contents of the raw patties which increased as the inclusion level of antelope meat increased in the patties as against the lower cohesiveness observed in treatment 1 which contained beef only. The results of patties overall acceptability revealed that patties in treatments 2 and 3 had higher (P<0.05) acceptability scores of 6.82±0.43 and 6.62±0.58 respectively while treatments 1, 4 and 5 had the same (P>0.05) acceptability scores. This result could be due to comparatively high colour, flavour, tenderness and juiciness of the patties. Most meat and meat products consumers are attracted by the colour of meat or meat products, (Cornforth, 1994) then its flavour as well as its tenderness and juiciness. Although, most meat consumers in developing countries preferred relatively tougher meat (Okubanjo, 1990), but this study showed that they preferred tender meat patties from beef and antelope meat more probably for them to be able to consume more of the product as the higher inclusion level of antelope meat in the patties might have made the patties more tenderer and juicier.

CONCLUSION

Meat and meat product consumers prefer varieties that is derivable from varying the composition of meat through various cooking methods or meat products by combining different types of meat and additives in the preparation of products like meat patties. The results of this study showed that physicochemical and organoleptic characteristics of patties from beef and antelope meat were better in patties with low level of antelope meat inclusion except tenderness juiciness and cohesiveness. This is because higher inclusion levels almost marred the meaty flavour of the patties, reduced the yield and colour of the patties, lowered moisture content, water holding capacity, as a result of higher cooking losses, which lowered shear force values, hence low acceptability. It is therefore, suggested that antelope meat inclusion in meat patties should be limited to 25% and 50% inclusion levels, treatments 2 and 3. This is because at these levels most of the physicochemical and sensory attributes were favourable since patties in these treatments were preferred and accepted more.

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