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Quality Attributes of Breakfast Sausage As Affected by Different Types of Animal Fats

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Abstract- Fat is one of the main components of meat sausages, along with muscle tissue and water, therefore, it has a substantial effect on emulsion stability in meat products. Sausage is a ready to eat meat product usually served as breakfast. It is traditionally produced from pork and lard, but there is insufficient knowledge on the yield and nutritive qualities of breakfast sausage prepared with other animal fats.

Investigations were carried out in a completely randomized design to study the effect of different fats on various physical, chemical and sensory properties of breakfast sausage. Three treatments were evaluated to test the effect of different animal fats on sausage production: sausage produced with lard (LS), sausage produced with tallow (TS) and sausage produced with sheep fat (SFS).

The results obtained showed the yield from the three fat types when used for production of breakfast sausage were 83.85%, 78.52%, and 76.45% for lard, tallow and sheepfat, respectively. The mean pH value of breakfast sausage were ($P<0.05$) 6.46, 6.25 and 6.51 for LS, TS and SFS, respectively. Water Holding Capacity of LS (84.78%) and TS (84.82%) were similar and significantly ($P<0.05$) higher than SFS (82.69%). Crude protein (31.77 %) and ashes (4.83%) of sausages with lard were higher (LS)while the SFS had (25.47%) and (3.39%) for crude protein and ashes, respectively. The panelists evaluated sensory acceptance with respect to flavour, colour, texture, juiciness, tenderness and overall acceptability. LS scored the highest means for colour (5.43), flavour (5.83), juiciness (5.63), tenderness (6.13) and overall acceptability (6.83). On the other hand, SFS scored the lowest means for flavour (4.47) and juiciness (4.83). The aim of this study was to evaluate the influence of different types of animal fats on the physical, chemical composition and sensory evaluation of breakfast sausages.

Keywords: Physical, Chemical, and Sensory evaluation, Breakfast sausages, Animal fats.

I. INTRODUCTION

Sausage is a food that contains an amount of protein with a widespread consumption. Other than protein, it has a high content of fats. Sausage industries need to select a number of various ingredients in the appropriate amount to manufacture and obtain the desired quality and safe product [1]. Fat is one of the main components of meat sausages, along with muscle tissue and water, therefore, it has a substantial effect on emulsion stability in meat products. Hence, it is important to obtain reliable, practical, technological and scientific information about the type of fat used. Fat in the diets serves not only as nutrient in the human body, but also as source of essential fatty acids and essential components of cell membrane [2]. In addition, dietary fat plays an important role in terms of flavour and texture in meat products. It is possible that the technological properties of dietary fat can improve their sensory characteristics [3]. Sausages contain fat which is important in the processing, textural, and sensory characteristics of sausage products. Fat is important in sausage products and can affect the quality of meat products at the processing level. It interacts with other components present within a meat system and helps to develop what can be a more consumer acceptable product. There is limited research available, regarding the effects of fat on processing, textural, and sensory characteristics in sausage products. Thus, the objectives of this study were to evaluate the physico-chemical, textural and sensory properties of cooked sausages as affected by tallow, lard and sheep fat.

II. MATERIALS AND METHODS

Preparation/processing of breakfast sausages

Semitendonisus muscle (6kg) tallow, lard and sheep fat used for this project were purchased from carcass of animals' slaughtered one hour postmortem at Bodija market in Ibadan. The formulation of breakfast sausages and composition of non-meat ingredients are presented in Table 1. The meat was chopped and minced using a 5mm sieve in a tabletop mincer (Breville, Model UTP141, United Kingdom).The minced meat was apportioned into three groups of 2 kg. Group one contained 20% lard as emulsifier (LS) while groups 2 (TS) and 3 (SFS) contained tallow and sheep fat each at 20% inclusion level. Each treatment was replicated four times in a completely randomized design. Slurry of salt (NaCl), sodium nitrite, phosphate and sugar was prepared in the proportion shown in Table 1. All other ingredients were added in equal amounts (g/100g) as shown in Table 1. The minced meat and the other ingredients were mixed thoroughly in a mixer (Oster 8-Speed Blender Model, MG—MB E103TI -Mexico) for 5 minutes. The thoroughly mixed meat samples were stuffed into natural casing (conditioned pig intestine) of about 2 cm diameter. The stuffed casings were twisted at 10cm intervals to obtain shorter linked units.

Table 1: Sausage formulation of different animal fats types

Ingredients	LS	TS	SFS
Beef	65.00	65.00	65.00
Fat	20.00	20.00	20.00
Soybean flour	4.00	4.00	4.00
Common salt	2.00	2.00	2.00
Sugar	1.00	1.00	1.00
SodiumNitrate	0.01	0.01	0.01
Phosphate	0.30	0.30	0.30
Icewater	3.00	3.00	3.00
Dry spices	2.00	2.00	2.00
Onion	1.31	1.31	1.31
Garlic	0.69	0.69	0.69
Ginger	0.69	0.69	0.69
Total	**100**	**100**	**100**

Determination of physical properties of the product

Cooking loss:

Samples were taken from the prepared sausage for analysis. Sausages from the different treatments were weighed using an electronic scale (Cuisinart KML-K03BV36246-China) before cooking into an internal temperature of 75^{o}C and after cooking.

$$\text{Cooking loss} = \frac{\text{weight before cooking- weight after cooking X 100}}{\text{Weight before cooking}}$$

Product yield (PY)

The PY of the sausages was determined in each treatment. The cooked and uncooked sausages were weighed, and the process yield was calculated as follows: the weight of the cooked sausage sample divided by the weight of the uncooked sausage sample multiplied by 100 [4].

Water holding capacity: This was determined following a slightly modified method [5]. The amount of water released from the samples was measure indirectly by measuring the area of the filter paper wetted relative to the area of pressed sample.

The water holding capacity (WHC) of the meat was then calculated as follows [5]

$$\text{WHC} = \frac{100 - [(Ar - Am) \times 9.47)] \times 100}{Wm \times Mo}$$

Chemical Analysis:

Moisture content, crude protein, ether extract and ash of sausage using different animal fats were determined using the analytical methods [6]. Total carbohydrates were calculated by differences.

Sensory evaluation

Sensory evaluation was conducted on freshly prepared sausage (day 0). A total of twenty panelists (60% male and 40% female) with age ranging between 22 and 40 years were trained according to the British Standard Institution [7] guidelines to evaluate

the product. The panelist evaluated the products for aroma, texture, taste, juiciness, flavour, tenderness and overall acceptability on a nine-point hedonic scale (1 for extremely dislike and 9 extremely like). The sausages were sliced to approximately 1.5 cm and wrapped in kitchen foil, blind coded with 3-digit random number and oven warmed at 180^{o}C for 5 minutes before serving. The samples were served at a temperature of 10 ± 2°C in the form of 5 mm thick slices of approximately 5 cm in diameter, on disposable white plastic plates coded with 3 digit numbers defined at random, and were accompanied by tooth picks, paper napkins, a cracker and table water. The order of serving samples were randomized and counterbalanced so that all treatments occurred equally. The taste evaluation took place under a well illuminated (white fluorescent) laboratory condition [8] that ensured independence throughout the entire duration.

Statistical Analysis

All data obtained were subjected to analysis of variance and the means were compared using the Duncan's Multiple Range Test (DMRT). The SAS computer soft ware package [9] was used for all statistical analysis.

III. RESULTS AND DISCUSSION

Cooking Characteristics

Process yield (PY)

Cooking characteristics of breakfast sausage as affected by diffrent animal fats such as product yield, cooking loss, cold shortening and WHC was investigated, and the obtained results are presented in Table 2. The use of different animal fats showed a significant effect (P<0.05) on the PY of the sausages. LS had the highest PY (83.85%) value, while TS and SFS had 78.52% and 76.45%,respectively for PY (Table 2). These results are in agreement with those obtained previous researchers [10]. [11] reported that the yield depends on ingredients, amount of fat in the products, and dietary fiber. Thus, the results obtained in this research indicate that different types of animal fats can improve the yield of the sausages. Cooking Loss corresponds to loss of essential nutrients. The cooking loss (10.00%) of beef sausage prepared from lard in this study was lower than the cooking loss of (19.88%) obtained for comparison of textural properties of low-fat chevon, beef, pork and mixed-meat sausages [12]. Similar results were reported for fermented sausages in which 10 and 20% of the total pork backfat was replaced by olive oil [13]. The inclusion of different types of fat in the processing may change the fatty acids of the meat products [14;15]. Thus, the quality of fat incorporated in the sausages can influence the quantity of fat diluted during the cooking process. Probably, a quantity of the medium fatty acids was released, because it has a lower fusion point, and then fat losses during the cooking process may have been favoured [16]. Cooking loss is an important variable to predict the juiciness and tenderness of the meat and its derivatives, because the dryness of meat affects the sensory characteristics [17]. WHC was influenced (P<0.05) by different animal fats; LS (84.78%) and TS (84.82%) had the highest WHC, and SFS (82.69%) had the lowest; these results showed that different types of fats improve the water holding capacity. WHC of some fibers is related to the type and amount of their polysaccharides; large particles are associated with open structures that improve the properties of hydration and fat absorption capacity. This could explain the fact that addition of different types of animal fats increased the WHC due to their ability to bind water molecules and retain fat. pH value is considered as an important factor in the field of meat quality because of it's influence on many characteristics including shelf life, colour, water holding capacity and texture of meat and meat products. Animal fats used had significant effects (P< 0.05) on the pH of the sausages (Table 2). TS had the lowest (6.25) pH, and SFS had the highest (6.51). [18] stated that the decrease of pH in sausages is affected by the ingredients used in the formulation. In this research, the variation in pH might be due to the sources of the fats. An adequate decrease in pH is directly related to the colour, tenderness and capacity of the sausage to retain water [19].

Lower pH of meat products creates an acidic medium, making it inappropriate for bacterial growth and reproduction [20]. The TS products might therefore have better storability than LS and SFS products. The pH, yield, cooking loss and water holding capacity (WHC) values of breakfast sausages prepared with different fats are listed in Table 2. LS had the highest yield (P<0.05) (83.85%) followed by TS (78.52%) and SS (76.45%).The highest product yield percentage recorded in LS might be due to the fact that Lard sausage had the highest water holding capacity and water holding capacity and yield are directly proportional.

Table 2: PH, Product yield and physical characteristics of sausage produced using three different fats

Parameter (%)	LS	TS	SFS	SEM
Product Yield	83.85^{a}	78.52^{b}	76.45^{c}	2.23
Cooking Loss	10.10^{b}	10.26^{b}	12.20^{a}	3.36
Cold Shortening	17.74^{c}	18.73^{b}	19.63^{a}	0.69
Water Holdig Capacity	84.78^{a}	84.82^{a}	82.69^{b}	3.36
pH	6..46^{b}	6.25^{c}	6.51^{a}	0.07

^{abc}:Means with the same superscript on the same row are not significantly(P> 0.05) different

Proximate composition

Table 3 showed the chemical composition values obtained from the three treatments. Results showed that at P<0.05, there was a significant difference for moisture content, crude protein, ether extract and ash. The moisture of TS (76.10%) was higher than that of LS (71.47%), and TS (76.33%) had the highest value. Lipids are highly efficient sources of energy and they contain more than twice the energy of carbohydrate and protein [21]. In the present study mean lipid content varies from 5.20% to 7.27% and shows a significance difference between the three treatments (P<0.05). Highest lipid content was found in LS (7.27%) and the lowest was found in TL (5.20%). High lipid LS have less water and more protein than TL and SFS. There is also concern that low levels of fat will lead to products that is perceived as dry and less tasty. The minimum requirement for an acceptable level of consumer satisfaction for meat products is 3–4% ether–extract on a fresh uncooked basis [22]. The mean level of protein determined from the sausage was high. However our determinations showed that SFS had a remarkably lowest protein content than LS (31.77%) and TS (28.35%), respectively. The highest crude protein contents of the LS products (Table 3) can be explained by the differences in fat content from the carcasses of different species of farm animals and therefore, its addition to meat products has the advantage of increasing the crude protein contents of the final product. [23] indicated that the most valuable component of meat, from the nutritional and processing points of view is protein. The protein content of meat and meat products also indicates their biological value, thus meat with higher protein levels are graded higher in terms of quality, than those with lower crude protein levels [24]. The ash content was higher in LS (4.83%) due to the addition lard fat. These differences could be attributed to the fat content and the dietary ingredients due to their high binding ability and water holding capacity [25]. In this study, the ether extract in the sausages made with lard (7.27%) and sheep (6.83%) fats were statistically different from that in the tallow fat (5.60%); this could be attributed to the ability of unsaturated fat with decreased melting point to mimic the function of fat in the sausages.

Table 3: Proximate composition of sausage prepared using three different animal fats

Parameters	LS	TS	SFS	SEM
Moisture Content	71.47^{c}	76.10^{b}	76.33^{a}	1.78
Crude Protein	31.77^{a}	28.35^{b}	25.47^{c}	1.59
Ether Extract	7.27^{a}	5.60^{c}	6.83^{b}	0.58
Ash	4.83^{a}	4.40^{b}	3.39^{c}	0.33

^{abc}:Means with the same superscript on the same row are not significantly(P > 0.05) different

Sensory Evaluation

Mean scores that the panelists gave for the three treatmens of products are shown in Table 4. Colour, flavour, juiciness, tenderness and overall acceptability were significantly different with respect to different sources of fats, whereas no significant differences in aroma were found among the three treatments. In meat products, fat contributes to the flavour, texture, mouthfeel, juiciness, and overall acceptability of lubricity of the product [26]. Juiciness also has an important role in overall quality of meat products [27]. Juiciness is related to the degree of lubrication of the food during chewing and subsequent swallowing. At any rate, the juiciness of meat products is considered to arise from the moisture that is released by the product during chewing and the moisture that comes from saliva. Because of the dehydration that takes place during the processing of meat products, the direct contribution of fat itself plays a very important role in the juiciness of this type of product. Data in this study confirmed the above findings because we observed a stronger significant relationship between fat content and juiciness in breakfast sausages. LS sausages obtained the highest score for colour (5.43), flavour (5.83), juiciness (5.63), tenderness (6.13) and overall acceptability (6.38). These results indicate that the higher acceptability of LS sausages may be related only to appearance traits and fat content because differences in fat content improved texture attributes. This outcome is in agreement with the sensory evaluation of Greek sausages with 20% fat [28].

Table 4: Sensory evaluation of sausage prepared using three different fats

Parameter (%)	LS	TS	SFS	SEM
Aroma	5.50	5.57	5.71	0.28
Colour	5.43^{a}	4.50^{c}	4.77^{b}	0.22
Flavour	5.83^{a}	4.90^{b}	4.47^{c}	0.29
Juiciness	5.63^{a}	5.37^{b}	4.83^{c}	0.20
Tenderness	6.13^{a}	5.10^{ab}	4.87^{b}	0.25
Overall Aceeptability	6.83^{a}	5.03^{b}	5.73^{ab}	0.31

^{abc}:Means with the same superscript on the same row are not significantly(P>0.05) different

IV. CONCLUSION

This study was conducted to evaluate the effect of various types of animal fats on the physico-chemical and sensory characteristics of the final products. The moisture and fat contents of breakfast sausages varied from 71.47%-76.33% and 5.60-

7.26%, respectively, whereas, the protein content ranged from 25.47 to 31.77%. Sensory evaluation results indicated that the most appropriate fat content (%) to have better sensory properties was lard fat. Further research should be performed to analyze the proportion of lard fat require for the production of breakfast sausages.

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