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EFFECTS OF SUBSTITUTION OF FAT WITH MELON SEED MEAL ON QUALITY CHARACTERISTICS OF PORK SAUSAGES

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ABSTRACT

A study was conducted in which melon seed meal (MSM) replaced fat at 0, 33, 66, and 100% levels in four batches of pork sausages. The chemical and storage properties, cooking weight losses, and sensory properties, of the sausages were determined in the meat processing laboratory. The results showed that MSM increased both ash and crude protein contents. The highest ether extract (36%) was obtained for batch 1 (control) while the lowest value (25.50%) was recorded for batch 4. The values obtained for refrigeration weight losses increased with increase in MSM while the results for dry matter were statistically insignificant. Batch 3 had the highest cooking weight loss of 0.83% while batch one had the lowest value of 0.30%. The values obtained for sensory properties increased with increase in the level of MSM up to 66%. It was concluded that pork back fat can be replaced with MSM in pork sausage without adverse effect on processing yield.

Keywords: Melon seed meal, low fat, pork sausage

INTRODUCTION

In spite of the importance of meat as source of protein with high biological value, preferential consumption is obviously noticed among the Nigerian populace. This may be due to a combination of a number of factors bordering on religious beliefs, culture, adaptability, food habit, age, sex, socio-economic factor and individual variation in Nigeria (Onwuka and Ojewola, 2000). Consumers are becoming increasingly prepared to pay for improved and better quality products from the meat industry (FAO, 2010).

The origin of food processing is lost in antiquity but probably began when mankind learned that salt is an effective preservative. Sausage making evolved as an effort to economize and preserve meat that could not be consumed fresh at slaughter. In sausage making, quality standards are maintained while using most parts of the animal carcass (Martin *et al*., 1998). Meat and meat products

have continued to remain a valuable food material because of their general acceptability and sensory characteristics. Their palatability and acceptability depend on factors such as colour, texture, juices, flavor, tenderness and general acceptability.

Meat processing is a vital issue that cuts across various ways such as refrigerating, curing, freezing, smoking and changing to different end products of meat, ensuring its preservation and palatability improvement (Wiley, 1992). Sausage is a food made from comminuted meat and seasoning that is formed into a symmetrical shape. It originated during pre-historic times when our ancestors discovered that addition of salt and drying would delay spoilage and stuffing of sausage into intestine would enhance conveniences (Wiley, 1992). The process therefore preserves meat by inhibiting spoilage and improving flavor (Pearson and Tauber, 1984).

Fat is an important constituent of processed meat products because it affects tenderness and juiciness. It is usually added to reduce cost of production and to boost energy density of meat product. However, in a tropical environment like Nigeria, low fat meat products are needed. A high content is traditionally associated with succulence and flavor, however, the composition of fat in the human diet is becoming increasingly important because of apparent relationship between the amount and type of fat consumed and the incidence of coronary heart disease (Abiola and Adegbaju, 2001). There is therefore a need to replace this ingredient in sausages preparation and find an alternative for the replacement of the hazardous saturated fat from animal sources.

A decrease in the amount of fat and the production of new item with reduced calories has been a scientific goal leading to the use of low fat meat in the production of meat product. Melon (Egusi) seed is a common tropical oil seed, valued for its good quality oil and high protein content. Abiola *et al*. (2004) reported that egusi kernels are good sources of essential amino acid. Akobundu and Eluchie (1992) reported that vegetables have been used in sausage production with success and they possess unique functional properties relating to increased emulsion capacity, cooking yield, flavor and slicing characteristics. The authors reported that vegetables supply plant protein and that the use of vegetables, especially melon seed meal is now profound, prompting it to be incorporated into processed meat products to reduce cost and generate end products with specific characteristics. There is however a paucity information on the use of melon seed meal in sausage production. This study therefore investigated the effect of substituting pork back fat with melon seed meal on chemical composition and yield of pork sausage.

MATERIALS AND METHODS

Processing of Melon Seed Meal

Melon seeds were purchased from a reputable source in Abeokuta, Nigeria. The processing included shelling, toasting for about ten minutes, and grinding to obtain a smooth textured meal.

Preparation of Pork Sausages

Lean pork was purchased from a slaughter slab in Abeokuta, Nigeria and cut into pieces. The meat was later run through a 5mm plate in a Kenwood sausage making machine, fat obtained from the back of boar (subcutaneous fat) was also chopped in the machine. The ratio of fat to meat used was 3:7. Both ingredients were mixed together in

the mixer. Flour, seasonings and water were added to the chopped pork and fat in the mixer. Four batches of pork sausages were prepared in which melon seed meal replaced pork back fat at 0, 33, 66 and 100% levels. Each batch of the sausage was replicated three times. Cellulose casing was used as sausage container. The ingredient composition of the sausage is presented in Table 1.

Table 1: Composition (%) of pork sausages formulated with graded levels of melon

	Replacement levels of Melon Seed Meal			
Ingredients	0%	33%	66%	100%
Pork (lean)	57.89	57.89	57.89	57.89
Fat	10.00	6.70	3.40	-
Melon Seed Meal	-	3.30	6.60	10.00
Wheat flour	15.12	15.12	15.12	15.12
Water	15.10	15.10	15.10	15.10
Ascorbic acid	0.05	0.05	0.05	0.05
*Seasoning	1.84	1.84	1.84	1.84
Total	100.00	100.00	100.00	100.00

*Contains: Salt: 200g; pepper: 115g; mace: 80g; coriander: 70g; monosodium glutamate: 50g

Cooking of Pork Sausages

Three replicates from each batch were weighed separately. The twelve samples of the pork sausages were cooked at 70^{o}C for twenty minutes in a water bath. The weight losses were obtained as the difference between the pre-cooking weight and the post-cooking weight.

Chemical Analysis

Sample from each batch of the sausage mix was collected, oven-dried to get the dried samples for determining the chemical composition of each batch. The analysis was carried out in the Feed Quality Laboratory.

Refrigeration of Sausages

Samples of sausage mix were stuffed separately into 24mm cellulose casing which was tied at both ends and divided into links. Each batch was replicated three times and labeled. The three replicates from each batch were weighed separately. The initial weights were recorded and the samples refrigerated at 2^{o}C for 24 hours. The final weights were taken to determine the weight losses after refrigeration. Refrigeration weight losses were taken to be the difference between the pre-refrigeration and post-refrigeration weights of the samples.

Sensory Evaluation

The sensory evaluation of cooked samples was performed by 5 trained panelists. The panelists were trained prior to sensory evaluation on scoring, visual assessment and flavor characteristics. The parameters monitored at the time of evaluation were colour, tenderness, juiciness and acceptability. Two samples, which were cut into 2cm sections were coded and presented in sequence at each tasting session. Panelists were isolated

from each other in order to prevent communication during the assessment. Each panelist was asked to rinse his or her mouth between samples to avoid any carry-over effect. The evaluators scored each sample on a 7-point scale (1= Unacceptable, 2= Very poor, 3= Poor, 4= Fair, 5= Good, 6= Very good, 7= Excellent).

Statistical Analysis

The data collected were analyzed using the General Linear Model procedure of SAS (1999). Significantly different means were compared using DMRT (Duncan, 1955).

$Y_{ij} = \mu + T_i + \Sigma_{ij}$

Y_{ij} = Observed value of dependent variable

μ = Population mean

T_i = Effect of i^{th} fat replacement

Σ_{ij} = Residual error.

RESULTS AND DISCUSSION

The effect of replacing pork back fat with melon seed meal on proximate composition of pork sausage is shown in Table 2. The sausage containing 66 and 100% replacement levels of MSM were higher in crude fibre than the two others (control and batch2 (33% level). This finding reflects the high crude fibre content in melon seed meal analyzed by Abiola *et al*. (2004).

The fat content decreased with increased level of MSM. This could be as a result of replacing a whole back fat (100%) with plant fat that had other nutrient constituents with lesser fat (Abiola *et al*., 2004). The range however falls between 36 and 26% and still dangles around the normal range. This is in agreement with the findings of Sofos and Allen (1977) who reported a decrease in the fat content of meat product using non-meat ingredients such as soy protein.

Generally, MSM showed statistical significance ($P< 0.05$) on the protein content of the sausages with no particular pattern. However, batch 3 showed the highest value protein level while batch 2 had the lowest value. Whereas batch 1 and batch 4 were not significantly different from each other. Although the protein content of batch 3 was significantly higher than the protein levels of other batches. This could be as a result of the effect of MSM as Abaelu *et al*. (1979) reported that melon contained as much as 28% protein level.

Table 2: Effect of replacing pork back fat with melon seed meal on proximate composition of pork sausage

	Batches (% replacement of MSM)			
Parameters (%)	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Dry matter	95.67+0.33	96.17+0.17	96.33+0.33	96.13+0.33
Ash	3.67+0.33	3.50+0.58	4.0+00.29	3.17+0.33
Crude protein	28.81+0.46b	25.73+0.73c	36.09+0.26a	29.93+0.60b
Ether extract	36.00+0.00a	31.33+0.17b	28.67+0.44c	25.50+0.00d
Crude fibre	1.00+0.00b	1.17+0.17b	1.83+0.17a	1.67+0.17a

a, b: means in the same row with different superscripts are significantly different ($P < 0.05$)

Table 3 shows the effect of replacing pork back fat with MSM on cooking weight losses of pork sausage. There were no significant differences among the treatment means ($P > 0.05$). However, batch 3 had the highest cooking weight loss while batch one had the lowest value. The higher protein of MSM sausages must have increased the water holding capacity. On heating, gelation of protein usually results in the formation of matrix which entraps water and fat and stabilizes the sausage. The similarity in the cooking weight loss observed in this study is contrary to the observation of Abiola and Adegbaju (2001) who reported that proteins have the ability to trap moisture and reduce moisture loss. The variation in the pork sausage may be attributed to the denaturation and shrinkage of endomysial and perimysial collagen sheaths that result in loss of water at high temperature. This indicate that cooking loss increased as the temperature increased. Soniran and Okubanjo (2002) reported that cooking loss increased as the internal temperature increased.

Table 4 shows the effect of replacing pork back fat with melon seed meal on refrigeration weight losses of pork sausages. The effect of MSM on refrigeration weight losses did not show any particular trend. However, the weight loss was higher ($P < 0.05$) in the batches with 100% MSM replacement than those of the other batches. This is in agreement with the findings of Abiola *et al*. (2004) who observed highest refrigerated weight loss in low fat sausage. The higher refrigeration weight loss recorded in this study is at variance with the findings of Abiola and Ewebajo (2009) who observed similar refrigeration weight losses in beef sausage substituted wheat flour for cassava flour. The higher refrigeration weight loss observed in the batches with 100%MSM suggests that pork back fat should not be completely replaced in pork sausage in order to minimize refrigeration weight loss.

Table 3: Effect of replacing pork back fat with MSM on cooking weight losses of pork sausage

	Batches (% replacement)			
Parameters	0%	33%	66%	100%
Initial weight (g)	50.00+0.00	50.00+0.00	50.00+0.00	50.00+0.00
Final weight (g)	49.85+0.07	49.64+0.05	49.59+0.01	49.70+0.15
Weight loss (g)	0.15+0.07	0.36+0.05	0.41+0.10	0.30+0.90
Weight loss (%)	0.30+0.14	0.73+0.11	0.83+0.20	0.60+0.17

Table 4: Effect of replacing pork back fat with melon seed meal on refrigeration weight losses of pork sausages

Parameters (%)	Batches (% replacement of MSM)			
	1 (0%)	2 (33%)	3 (66%)	4 (100%)
Initial weight (g)	50.00+0.00	50.00+0.00	50.00+0.00	50.00+0.00
Final weight (g)	49.05+0.12ab	49.40+0.24a	48.56+0.08b	47.87+0.19c
Weight loss (g)	0.95+0.12bc	0.60+0.24c	1.44+0.08b	2.13+0.19a
Weight loss (%)	1.91+0.24bc	1.21+0.49c	2.89+0.17b	4.26+0.37a

[a, b]: means in the same row with different superscripts are significantly different ($P < 0.05$)

The effect of replacing fat with MSM on sensory properties of pork sausage is shown in Table 5. The scores for colour did not follow any regular pattern. Batch 3 however had the highest score rating for colour. This could be attributed to the colour characteristic of MSM. Consumer being already accustomed to ted colour of pork sausage would basically appreciate the pale colour sausage. Results obtained on juiciness decreased with decrease in the level of fat in the sausage. The juiciness score of 5.80 recorded for batch one sausage was significantly higher than the score obtained for MSM sausages. The panelists reacted more positively ($P < 0.05$) to the juiciness of batch one pork sausages than the rest of the samples. Probably the more familiar pork with fat the panelists are familiar with had better impression on them. It could also be attributed to the higher fat content of batch one sausage. Batch two of the pork sausages had the highest score for flavor. The release of more flavor components due to increase MSM solubilization at higher temperature may have contributed to the improved pork sausage flavor. Soniran and Okubanjo (2002) reported that increase in pork flavor is caused by the greater activities of the Mailard reaction and associated reactions involving muscle protein. No significant difference was observed for tenderness. Batch 4 had the lowest numerical score. This implies that tenderness decreased with increase in the level of MSM in the sausage. High content of fat in human diet is very disadvantageous because of it cholesterol content which could cause coronary heart disease (Austin, 1989; Ruusunen and Puolanne, 2005). The increase in the acceptability observed in this study is in agreement of Abiola and Ewebajo (2009) who reported that cassava flour improved the acceptability beef sausage.

Table 5: Effect of replacing fat with MSM on sensory properties of pork sausage

	Batches (% replacement)			
Parameters	0%	33%	66%	100%
Colour	5.80+0.00	5.73+0.13	5.87+0.07	5.60+0.00
Juiciness	5.80+0.20[a]	5.00+0.31[ab]	4.93+0.33[b]	4.20+0.00[b]
Flavour	5.27+0.47	5.33+0.18	5.13+0.18	4.93+0.07
Tenderness	5.53+0.27	5.53+0.24	5.13+0.27	4.87+0.07
Acceptability	5.67+0.18[a]	5.47+0.07[a]	5.47+0.20[a]	4.93+0.07[b]

[a, b, c]: Means in the same row with different superscripts are significantly different ($P < 0.05$).

CONCLUSION

It is apparent from the overall results of this study that MSM could successfully substitute for pork back fat in the production of an acceptable pork sausage. The results of this study indicate that up to 66% pork back fat can be replaced with MSM in pork sausage without adverse effect on processing yield. The incorporation of MSM into pork sausages reduced the fat content, increased protein level and improved the overall acceptability of the finished products. This could satisfy the growing demand of consumers for a likeable sausage with improved flavor and low fat content because of the risk associated with high intake of fat.

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