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Effect of period, energy level and packaging material on sensory parameters of meat floss produced from broiler chickens

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***Target Audience:** Meat consumers, Meat processors, Meat Scientist, Animal Scientists, Extension Staff and Public Health Officers.*

Abstract

The research was conducted to investigate the effects of storage period, energy levels and packaging materials on sensory parameters of meat floss produced from broiler chickens fed varying energy levels. Two hundred and seventy Cobb- 500 Strain day old chicks were raised intensively for 8 weeks in a Completely Randomized Design. The meat floss experiment was laid in a 3x4x6 factorial arrangement. The factors were 3 dietary energy levels (2, 400, 2, 600 and 2, 800 Kcal/kg); 4 Packaging Materials (High Density Polyethylene, Low Density Polyethylene, Polyvinyl Chloride and Aluminum Foil) and 6 Storage Period (0, 2, 4, 6, 8, 10 weeks). Sensory evaluation was conducted using JMP Pro 13.1.0 statistical package to determine the overall acceptability of the product. The results showed that there were decreases in overall acceptability rating with increases in period of storage, irrespective of the energy levels from where the meat floss was produced. It was concluded that highest scores (6.70 to 8.10) were obtained in the early period of storage and less scores (4.5 to 5.0) at the tail end of the trial irrespective of the packaging materials.

***Key words:** Energy Levels: Packaging Materials: Meat Floss: Broiler Chickens and Storage Duration.*

Description of Problem

The ever increasing human population coupled with the diminishing available agricultural lands has made it difficult for small scale farmers to keep ruminant animals (1). In Nigeria, there exists a persistent insufficient intake of animal protein. An average Nigerian consumes 7.5 g/head/day of animal protein as against 35 g consumed by an average Briton (2).

Meat is a good culture media, high in moisture and nutrients, usually neutral in pH, hence contamination with spoilage organisms is almost unavoidable, thereby making its preservation difficult (3). Meat is sold directly to the consumers and in most cases in Nigeria under poor sanitary conditions where, little processing and packaging are done which subject the meat to spoilage leading to poor shelf life. Meat products for sale in Nigeria are commonly displayed in the open and prone to contamination by pollutants (4). The meat processing technology in Nigeria is still at an infant stage, yet to be upgraded and modernized to cope with the increasing consumer demand (5). Most a times, meats are being preserved using different methods for a considerable length of time with associated changes in the nutrient composition (6). There is a lot of variation in the nutrient composition of meat, which is due to ways meat is cooked, time lapse between slaughter, animal in question and

the preservation methods (7).

The acceptability of poultry muscle as food depends largely upon chemical, physical and structural changes that occur on muscle as it is converted to meat (8). Meat and meat products are very important components of human diets, this is because of their high nutritive value. In Northern Nigeria, *Tsire*, *Balangu*, *Dambun-Nama*, (meat floss), *Kilishi* and *Ragadada* are the commonest meat products (9). These meat products are processed locally which creates an avenue for the processors to convert low price meat cuts into high priced processed products (10). Organoleptic qualities are excellent guide to nutrition and cooking has been used to improve these qualities. For meat to be acceptable by consumers after chemical treatment there is the need to ascertain the effect of these chemicals on the sensory attributes of the products (11). Consumers prefer good quality throughout the entire shelf life of any food product (12) thus, meat packaging constitute an important aspect of food processing industry and many meat packaging systems are available with different attributes and applications (13). However, these packaging materials are very expensive which led to the use of local packaging materials that are cheaper but could have no adverse effect on packaged meat (14).

The growing importance of meat floss as an indigenous fast food makes it necessary to obtain information on its organoleptic qualities under different storage periods and packaging conditions. Knowledge gained could help to promote sound nutrition, improve public health and could be used to formulate good policies regarding meat products (15). The aim of this study was to determine the effect of storage period, energy levels and packaging materials on sensory parameters of meat floss.

Materials and Methods

Location of Study area

The experiment was conducted at the Poultry Demonstration Farm of the Department of Animal Health and Production, Binyaminu Usman Polytechnic, Hadejia, Jigawa State. Hadejia has a projected population of 139, 490 (16), It is located in the sudan savannah zone of Nigeria, which lies between 10^0 02'28. 14" E Longitude and 12^0 27'12.49" N Latitude. The study area possesses palatable grasses (*Andropogan gayanus, Cyanodon dactylum* and *Pennisetum pedicelatum*) and legumes (*Centrosema pubescens* and *Stylosanthes hamata*) with crops residues such as sorghum stover, millet stalks, rice straws, cowpea haulms, ground nut hay and agro-byproducts which include wheat offal, cotton seed cake, ground nut cake and cereal bran. Major livestock slaughtered include cattle, sheep, goat and camel. Table 1 presented the monthly break down of livestock slaughtered at Hadejia Abattoir. Information from (17) showed that on daily basis, average of 400 chickens (improved and indigenous), 70 guinea fowls. 40 pigeons, 10 ducks and 1 turkey were slaughtered.

Table 1: Break Down of Livestock Slaughtered at Hadejia Abattoir

Month	Livestock			
	Cattle	Sheep	Goat	Camel
January	220	120	382	191
February	261	131	566	161
March	118	110	486	184

Source: Meat Inspector, Hadejia Abattoir: 2019

The study area has an annual rainfall ranging from 700-800mm accompanied by strong wind. The temperature of the area ranged from 31 to 40^0C. (18) stated that the combination of rain fall and temperature is controlled by the movement of the Inter Tropical Discontinuity (ITD) which results in four seasons in a year, viz: Dry and Cool Season from December to January (*Bazara*), Dry and Hot Season from March to May (*Rani*), Wet and Warm Season from June to November (*Damina*) and a season of decreasing rain fall and fallen temperature from October to November (*Kaka*).

Experimental diets

Three experimental diets containing different energy levels of 2 400, 2 600 and 2 800 Kcal/Kg designated as A, B and C, respectively were formulated and fed to the broiler chickens. The crude protein of the Starter and Finisher diets were fixed at 24 and 20%, respectively. The ingredients and nutrient composition of the experimental starter and finisher diets were presented in Tables 2 and 3, respectively.

Table 2: Ingredient and Nutrient Composition of Experimental Starter Diets

Ingredient	Dietary Energy Levels (Kcal/Kg)		
	A	B	C
Maize	22.00	33.00	44.00
Soybean Meal	24.00	26.00	29.00
Ground nut cake	15.00	16.00	16.00
Wheat Offal	33.00	19.00	5.00
Bone Meal	3.00	3.00	3.00
Limestone	2.00	2.00	2.00
Common Salt	0.30	0.30	0.30
*Premix	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Lysine	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**
Composition Calculated			
ME(Kcal/kg)	2417	2613	2810
Crude Protein (%)	24.00	24.00	24.10
Lysine (%)	1.40	1.40	1.40
Methionine (%)	0.60	0.60	0.60
Calcium (%)	1.60	1.60	1.60
Phosphorus (%)	0.70	0.70	0.70
Crude Fibre (%)	5.60	4.80	4.00
Ether Extract (%)	3.80	3.90	3.90
Proximate Composition(%)			
Moisture	5.59	4.55	4.04
Ash	11.94	10.45	12.67
Crude Fat	3.77	3.94	3.83
Crude Protein	24.97	25.66	24.60
Crude Fibre	5.93	5.68	5.01
Carbohydrate	47.81	49.73	49.81

*Starter Premix provided per kg diet: Vitamin A 10,000mg, Vitamin D3, 20,000mg, Vitamin E 23,000mg, Vitamin K3 2,000mg, Vitamin B1 1,800mg, Vitamin B2 5,500mg, Niacin 27,500mg Pantothenic acid 7,500mg, Vitamin B6 3000mg, Vitamin B12 1500mg, Folic acid 750mg, Biotin H2 600mg, choline Chloride 500,000mg, Cobalt 200,000mg, Copper 3,000mg, Iodine 1000mg, Iron 20,000mg, Manganese 40,000mg, Selenium 200mg, Zinc 30,000mg, Antioxidant 1,250mg

Table 3: Ingredient and Nutrient Composition of Experimental Finisher Diets

Ingredient	Dietary Energy Levels (Kcal/Kg)		
	A	B	C
Maize	33.00	40.00	50.50
Soybean Meal	18.00	17.00	20.00
Ground nut cake	7.00	10.00	11.80
Wheat Offal	39.00	27.00	11.70
Bone Meal	3.00	3.00	3.00
Limestone	2.00	2.00	2.00
Common Salt	0.30	0.30	0.30
*Premix	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Lysine	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**
Composition Calculated			
ME(Kcal/kg)	2430	2602	2816
Crude Protein (%)	19.80	19.70	20.20
Lysine (%)	1.20	1.10	1.20
Methionine (%)	0.50	0.50	0.50
Calcium (%)	1.60	1.60	1.60
Phosphorus (%)	0.70	0.70	0.70
Crude Fibre (%)	5.40	4.70	3.90
Ether Extract (%)	3.60	3.70	3.70
Proximate Composition(%)			
Moisture	5.58	5.27	4.35
Ash	11.06	10.38	11.92
Crude Fat	4.05	4.30	4.55
Crude Protein	22.87	22.09	20.46
Crude Fibre	5.82	5.63	5.38
Carbohydrate	50.62	52.32	53.34

*Finisher Premix provided per Kg diet: Vitamin A 8,500iu, Vitamin D3 1,500iu, Vitamin E 10,000mg, Vitamin K3 1,500mg, Vitamin B1 1,600mg, Vitamin B2 4,000mg, Niocin 20,000mg, Pantothenic Acid 5000mg, Vitamin B6 1,500mg, Vitamin B12 1000mg, Folic Acid 500mg, Biotin H2 750mg, Choline Cloride 175,000mg, Cobalt 200mg, Copper 3000mg, Iodine 1000mg, Iron 20,000mg, Manganese 40,000mg, Selenium 200mg, Zinc 30,000mg, Antioxidant 1,250mg.

Experimental animals and their management

A total of two hundred and seventy (270) day old broiler chicks of Cobb 500 strain were purchased from a reputable distributor. The chicks on arrival were weighed and randomly allotted to three treatments containing ninety birds per treatment; each treatment had three replications of thirty birds. The birds were managed under deep litter system with wood shavings as litter material. The chickens were vaccinated against Newcastle Disease and Gumboro. The pen was cleaned and disinfected using recommended disinfectant (7% Tar Acid Phenol and 2% Cresylic Creosote) to avoid microbial contamination. Routine management was carried out as described by (19). Experimental feed and fresh clean water were provided *ad-libitum*. The feeding trial lasted for eight (8) weeks. At the end of the production, 27 birds (three birds per replication) were slaughtered for the preparation of meat floss.

Preparation of spice mixtures for meat floss production

Two spice mixtures were formulated as shown in Tables 4 and 5. The ingredients used for the formulations were purchased from a local spice market within the study area. Each spice was dried and ground separately using a table top grinder (Model BLSTMG. PN133093-002) and the coarse particles removed using a sieve of 1.0 mm mesh diameter. The cooking and shredding recipes were separately stored in airtight polyvinyl chloride containers for subsequent use.

Table 4: Composition of Spice Mixture used for Broiler Chicken Meat Floss Production (g/100g)

Ingredient	Quantity
Common Salt (Sodium Chloride)	10.00
Thyme (Thymus vulgaris L.)	12.50
Curry Powder®	12.50
Onions (*Allium cepa* L. var. cepa)	50.00
Stalk Cube	15.00
Total	**100.00**

Source: (10)
® Trade name

Table 5: Composition of Shredding Recipe before Frying used for Broiler Chicken Meat Floss Production (g/100g)

Ingredients	Quantity
Pepper (*Piper nigrum* L.)	35.00
African Nut Meg (*Monodora myristica* (Gaertn.) Dunal)	2.50
Ginger (*Zingiber officinale* Rosc.)	4.00
Garlic (*Allium sativum* L.)	3.00
Cloves (*Syzygiuma romaticum* (L.) Merr. et L.M. Perry)	2.50
Curry Powder®	3.50
Thyme Leaves (*Thymus vulgaris* L.)	2.50
Common Salt (Sodium Chloride)	5.00
Onions (*Allium cepa* L. var. cepa)	12.00
Stalk Cube	30.00
Total	**100.00**

Source: (10)
® Trade name

Cooking of meat

After slaughtering, scalding and dressing of the birds, the bones and the muscles were separated; lean meat was cut into pieces of approximately 4 cm by 2.5 cm dimension, washed with clean water and mixed with spices. Each meat type was cooked on an adjustable Pifco Japan Electric Hot Plate (Model Number ECP 2002). The cooking recipe was added in the ratio of 1 g of spice to 100 g of meat. Four (4) medium-sized (500 g) onions (approximately 50 g of onions on Dry Matter basis) were thinly sliced and added. Water was added at the

ratio of 1.5 litres to 1.0 kg of meat. The meat samples were cooked to an internal temperature of 72 ºC and the broth was allowed to dry with the meat. The meat samples were removed and allowed to equilibrate to room temperature and weighed. equilibrate

Meat shredding

The cooked meat samples were pounded into shreds using a mortar and pestle. The shredding recipe was added in the ratio of 1:20 (50 g of spice to 1000 g of meat), while 12 g onion on dry matter basis was added to every 100 g of spice used. These were weighed and added a little at a time as pounding progressed for uniform mixing of the recipe.

Frying of meat to floss

The shredded meat from each meat type was separately shallow fried using stainless steel pot in Soy bean oil (Grand®) which was pre-heated to 70 ºC. The ratio of oil to meat was 1 liter to 500 g of meat. The meat samples were fried at 70 strokes per minute (20) until a golden brown colour was obtained (20 minutes). Figure 1demonstrates chicken meat floss production.

Draining of oil

The product was poured into a colander after frying and pressure applied to remove excess oil and prevent the final product from sticking. The dry spongy product from each meat type was poured into separately marked flat containers, allowed to cool and separated into strands.

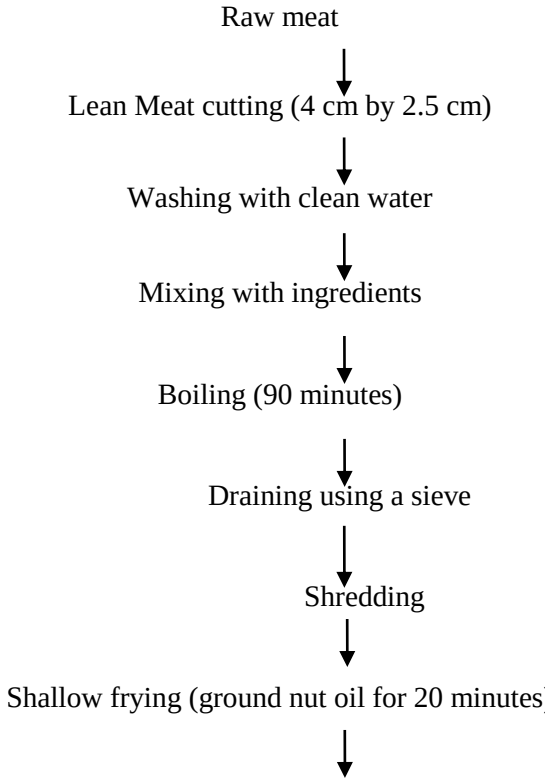

Figure 1: Procedure for broiler chicken meat floss preparation: (20)

Packaging of broiler chicken meat floss

Four (4) different packaging materials: Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), Aluminium Foil (AF) and Polyvinyl Chloride (PVC) were used to store broiler chicken meat floss at 30 ^{o}C±10 ^{o}C (21) for ten weeks. The effects of packaging materials on sensory parameters of broiler chicken meat floss were determined fortnightly as described by (22).

Experimental design

The meat floss experiment was laid in a 3x4x6 factorial arrangement in a Completely Randomized Design. The factors were 3 dietary energy levels (2, 400, 2, 600 and 2, 800 Kcal/kg); 4 Packaging Materials (High Density Polyethylene, Low Density Polyethylene, Aluminum Foil and Polyvinyl Chloride) and 6 Storage Period (0, 2, 4, 6, 8, 10 weeks). Sensory evaluation was conducted using JMP Pro 13.1.0 statistical package to determine the overall acceptability of the product.

Data collection

Sensory evaluation was carried out using a 9 point hedonic scale of 1= dislike extremely, 2= Dislike very much, 3= Dislike moderately, 4= Dislike slightly 5= Intermediate, 6= Like slightly, 7 = Like moderately, 8= like very much and 9= Like extremely (23; 24; 25; 26 and 27). The data on sensory parameters were collected using structured questionnaires. A total of one hundred and eighty (180) copies of questionnaires were administered to the taste panelists using empirical procedure of "taste and tell". Each respondent was served with four (4) copies of score cards. After every two weeks, triplicate of the samples were given to fifteen (15) member semi-trained panelists comprising of ten males and 5 females with age ranged between 17 to 25 years to assessed the meat floss. Assessment was performed under bright light (28). The products were stored at room temperature (37 ^{0}C) for ten weeks. Sample preparation was done using the method described by (5). The broiler chicken meat floss (15 g each) from different meat types (triplicate) was presented sequentially to the panelists on a clean saucer and their preference recorded (29: 30). Meat floss were coded as 432 (Treatment A-HDPE), 448 (Treatment A-LDPE), 388 (Treatment A-AF), 477 (Treatment A-PC), 666 (Treatment B-HDPE), 789 (Treatment B-LDPE), 454 (Treatment B-AF), 765 (Treatment B-PC), 459 (Treatment C-HDPE), 471 (Treatment C-LDPE), 634 (Treatment C-AF) and 703 (Treatment C- PC). Meat floss from each treatment was evaluated independent of the other. The panelists were provided with clean water for use in-between treatment meat samples. Each panelist was presented the blind coded samples and asked to score each sample for colour, juiciness and flavour (31; 32).

Results

The effect of period, energy level and packaging material on panelist colour preference is presented in figure 2. Results showed that highest scores (6.70 to 8.10) were obtained in the early period of storage across the four (4) packaging materials and less scores (4.5 to 5.0) were recorded at the tail end of the trial irrespective of the packaging materials. The mean panels rating for colour in all the meat floss showed generally higher scores which indicated that all the meat floss have meat of good quality in terms of colour.

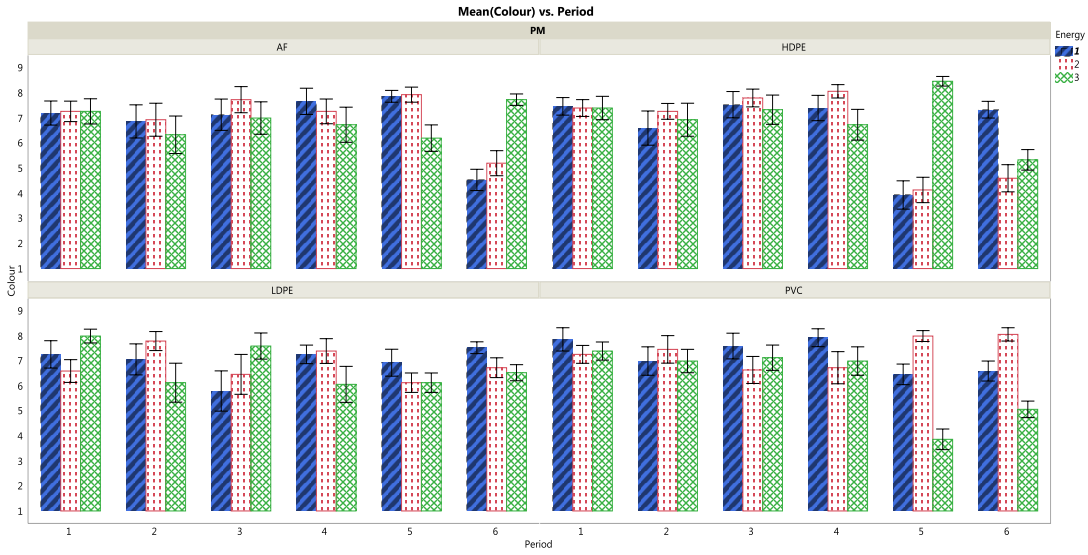

Figure 2: Effect of Period, Energy Level and Packaging Material on Panelists' Meat Floss Colour Preferences

Figure 3 presented the effect of Period, energy level and packaging material on panelist juiceness preference. Meat floss packaged in Aluminium foil produced from birds fed 2, 600 and 2, 800 Kcal/Kg received higher scores of 8.20 and 8.10, respectively while that stored in Polyvinyl Chloride and produced from 2, 400 and 2, 600 Kcal/Kg were rated 7.10 and 8.30, respectively.

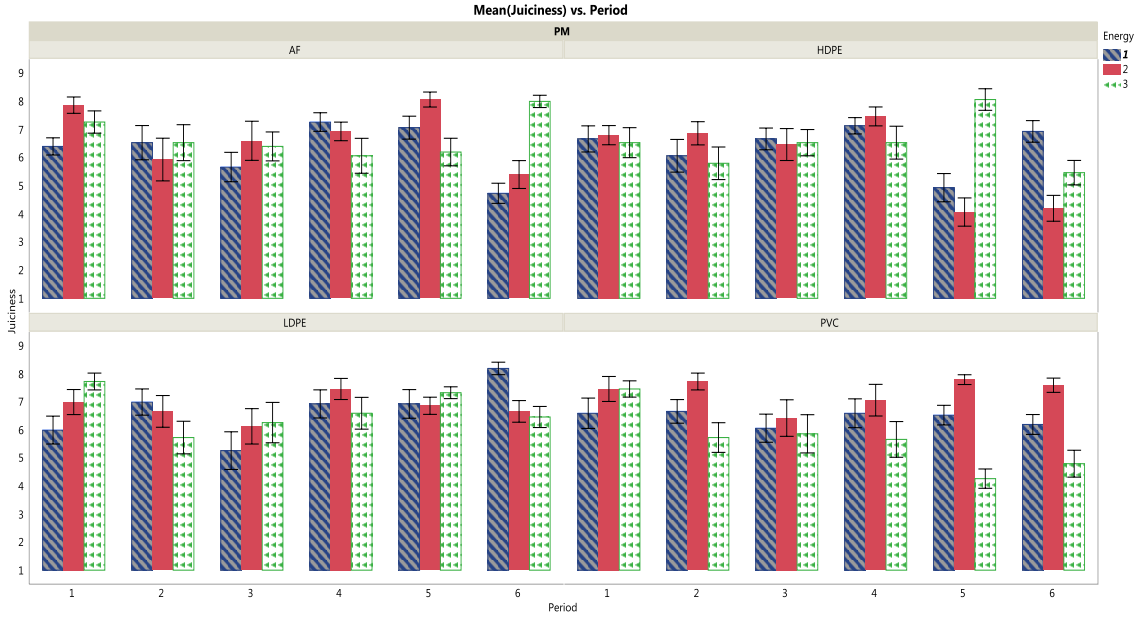

Figure 3: Effect of Period, Energy Level and Packaging Material on Panelists' Meat Floss Juiceness Preferences

The taste panel evaluation results on the effect of period, energy level and packaging material on panelist flavour preference is shown in Figure 4. Meat floss produced from birds fed diet containig 2, 800 Kcal/Kg and packaged in Aluminium foil, High Density Polyethylene and Low Density Polyethylene had the highest rating of 8.50, 8.10 and 8.00, respectively.

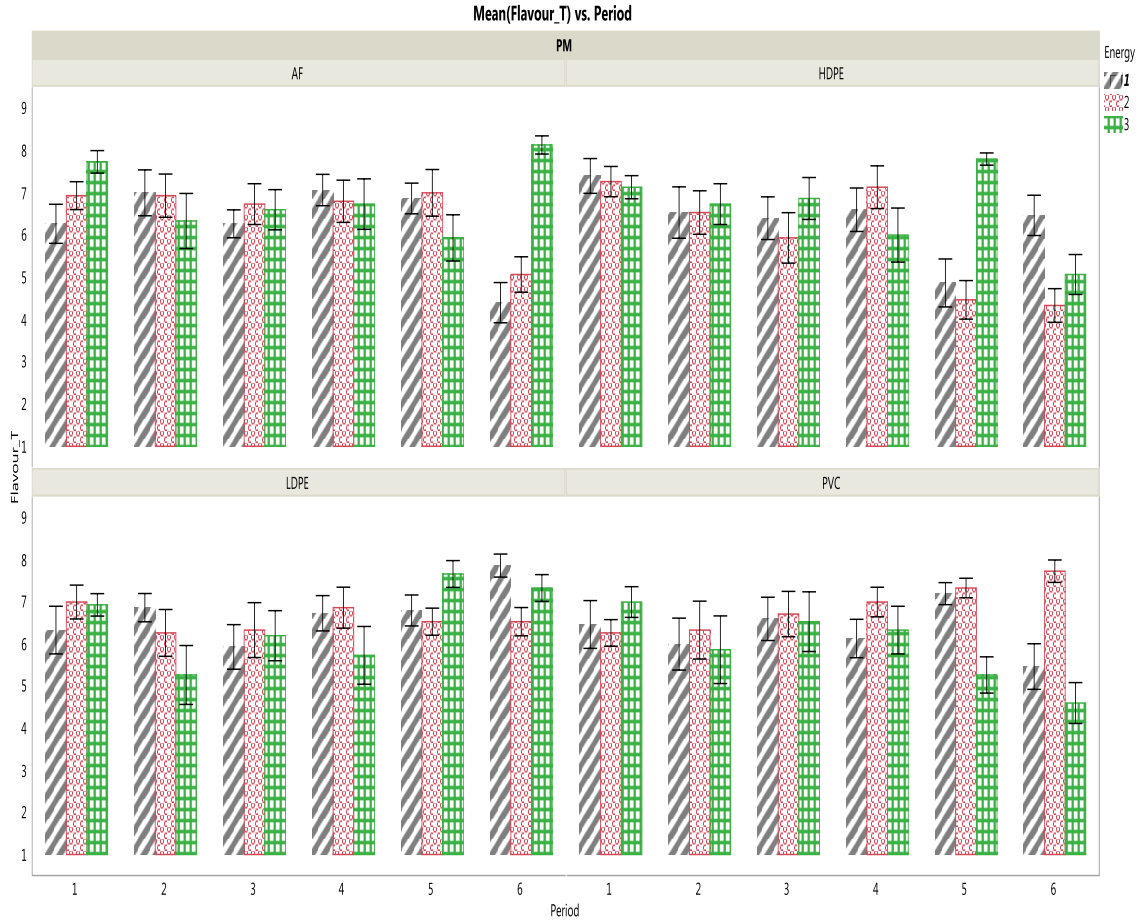

Figure 4: Effect of Period, Energy Level and Packaging Material on Panelists' Meat Floss Flavour Preferences

Discussion

Colour has a powerful influence on consumer acceptance for food products especially meat product and serves as a visual indication of meat quality (33). In addition, the colour of meat floss is always enhanced by the use of red pepper. Consumers often based their meat purchasing decisions on colour but usually make repeat purchase based on product flavor and texture (34). In a fresh muscle, the colour of meat is related to the level of pigmentation (myoglobin) present in the muscle, when meat is processed however, it changes the characteristics of fresh meat. In meat floss production, a colour change is a result of the frying process and the use of plant ingredients, giving it a final golden

brown colour. It was reported (35) that chicken meat packaged in Polyvinyl Chloride had the highest sensory scores followed by those packaged in polythene bags and A4 paper wrappers while those packaged with cartons had the least. In a related experiment (31) reported juiciness sensory scores of 7.70, 6.90, 6.75, 7.35 and 7.20 for broiler chicken, spent layers, duck, guinea fowl and local chicken respetively, which were within the values obtained in this study. Juiciness is made up of two effects viz the impression of moisture released during chewing and the salivation produced by flavour factor (36).

According to (37), meat juiciness is an important component of meat tenderness and palatability and it has two major parts; the first is the impression of wetness produced by the release of fluid from the meat during the first few chews, while the second is the more sustained juiciness that apparently results from the stimulating effect of fat on the production of saliva and the coating of fat that builds up in the tongue, teeth and other parts of the mouth. Juiciness is an important factor in sensory evaluation as it facilitates the chewing process as well as brings the flavour component in contact with the taste buds, it depends on the raw meat quality and the cooking procedure (38). The two sensory descriptive words for juiciness, in cooked meat, are initial and sustained juiciness (39); Initial juiciness is the amount of fluid released by the cut surface of meat, during compression between the forefingers and thumbs (40) and is positively correlated with the water holding capacity of meat (41). Sustained juiciness is described as the perceived juiciness after a few seconds of mastication, due to the presence of intramuscular fat stimulating saliva secretion (42). The sensory scores for flavour of meat floss from local chicken (8.05) and exotic chicken (7.55) as reported by (31) was similar to the finding of this study. Similar results were reported by (43) on the flavour of *dambu* from different types of livestock as 7.8, 7.7 and 7.7 for beef meat floss, mutton meat floss and chevon meat floss, respectively. According to (44) flavour, texture and appearance (colour) are the most important characteristics of food because they are the attributes the consumer can readily assess. They reported that flavour determines the acceptance or rejection of food by consumers even though appearance evokes the initial response. (44) defined flavour as a complex sensation that is derived from food including particularly the sensation of taste and smell.

Flavour characteristics are difficult to measure with consumer because their vocabulary is insufficient to describe the complex flavor found in most meat products (45). Physiologically, the perception of flavour involves the detection of four basic sensations including saltiness, sweetness, sourness and bitterness by the nerve endings on the surface of tongue (46). The several spices used in meat floss production also added to the flavour of the product (36).

Conclusions and Applications

1. Highest scores were obtained in the early period of storage across the four (4) packaging materials and less scores were recorded at the tail end of the trial irrespective of the packaging materials.
2. Meat floss packaged in Aluminium foil produced from birds fed 2, 600 and 2, 800 Kcal/Kg received higher scores compared with that stored in Polyvinyl Chloride and produced from 2, 400 and 2, 600 Kcal/Kg.
3. Meat floss produced from birds fed diet containing 2, 800 Kcal/Kg and packaged in Aluminium foil, High Density Polyethylene and Low

Density Polyethylene had the highest rating.

4. Meat floss should be consumed immediately after production as its scores for sensory parameters decreased with increased storage period.

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