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Proximate Composition, Thiobarbituric Acid and Sensory Properties of Chicken-Breadfruit Patties with *Piper guineense* and *Monodora myristica* Oleoresins

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Abstract The proximate composition, thiobarbituric acid value (TBA) and sensory properties of *Piper guineense* and *Monodora myristica* oleoresin spiced chicken-breadfruit patties at refrigerated storage for four weeks were evaluated. Breadfruit flour replaced 15 % of chicken and two concentrations (0.5 and 1 %) of *P. guineense* and *M. myristica* oleoresins were separately incorporated in the production of the patties. Moisture, protein and fat content of the patties varied significantly ($P \leq 0.05$) from 22.9- 36.98 %, 11.14 - 18.13 % and 2.49 - 3.66 % respectively. Ash, fibre and carbohydrate ranged from 3.30 - 4.20 %, 0.84 - 4.61 % and 40.89 - 50.06 % respectively. The initial TBA values for the samples varied significantly ($P \leq 0.05$) from 2.96- 3.51 mg maloadehyde/kg with an increase of 13 - 21. 17 - 24, 20 - 27 and 24 - 29 % at week 1, 2, 3 and 4 respectively. *P. guineense* and *M. myristica* oleoresins significantly ($P \leq 0.05$) reduced oxidative rancidity. Colour, flavour and overall acceptability of the patties decreased significantly ($P \leq 0.05$) from moderate likeness to slight dis-likeness. Breadfruit flour, *P. guineense* and *M. myristic*a oleoresins will be of relevance in the production of an acceptable compositionally balanced chicken-breadfruit patties with less rancidity.

Keywords: *Piper guineense, Monodora myristica, oleoresin, chicken-breadfruit patties, proximate and sensory properties, thiobarbituric acid value*

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1. Introduction

Meat consumption in developing countries has increased from an average of 10 kg per capita consumption in the 1960s to 26 kg in 2000. This is anticipated to reach 37 kg around the year 2030 according to FAO projections [1]. Meat and meat products are good sources of high-quality protein, essential amino acids, fats, certain vitamins, minerals and other minor substances [2]. Meat or flesh food products include beef, poultry, mutton, game, fish, and seafood, etc. and products derived from them are patties, burgers, sausages, bacon, ham, salami, jerky, corned beef etc. In developing countries such as Nigeria, meat and meat products in all its forms are expensive and unaffordable to a large number of the population [3]. To make them affordable, meat and non-meat ingredients are used as extenders. Prinyawiwatkul *et al*., [4], included fermented cowpea and peanut flour as extenders in the production of chicken nugget. Tenin, [5], used bean flour as an extender in the production of beef sausage while Onweluzo *et al*., [6], assessed the suitability of *Detarium microcarpus* seed flour as a binder in buffalo meatloaves. However, the suitability of breadfruit (*Artocarpus altilis*) an underutilised indigenous fruit commonly found in the Eastern and Western part of Nigeria as an extender in the production of meat products have not be assessed.

Patties also known as hamburger or burger are produced from edible animal tissues passed through a meat grinder after removal of hard parts such as the bones, tendons and connective tissues (in some cases the tendons and other connective tissues may be added depending on the quality and type of product) [1]. Patties just like other meat products are prone to rapid microbial and chemical deterioration (lipid oxidation, colour, odour changes) as a result of their high moisture and nutrient content. This is also a contributory factor to the high cost of meat products. To prevent and reduce spoilage of meat products, synthetic and natural preservatives are added to the products. Synthetic preservatives like butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) have been used in the prevention of oxidation of meat products [7].

The growing awareness and demand for healthier foods by consumers has made Food Technologist further

research on the use of natural preservatives. The use of natural preservatives gives most consumers' assurance on the safety of their foods. Natural preservatives used include herbs and spices. They have many phytochemicals which are potential sources of antioxidants. Spices are used to impart aroma, colour and taste to food. The volatile oil gives the aroma while the oleoresins impart the taste [8]. Oleoresins are concentrated liquid forms of spices obtained by solvent extraction [9]. Extracted oleoresins have same properties and characteristics as the whole spice. They are said to possess some phytochemicals, such as flavonoids, tannis, phenolic acids, phenolic diterpenes etc., and as such possess antioxidant properties [10]. O' Grady *et al.*, [11] used bearberry to improved oxidation stability in pork while Ogbonna *et al.*, [12] prevented lipid oxidation in coconut oil using essential oil from *Piper guineense* and *Xylopia aethiopica*. There is currently no report on the use of our local spices such as *Piper guineense* and *Monodora myristica* in the preservation of patties.

This study was therefore aimed at the evaluation of the proximate composition, thiobarbituric acid value (TBA) and sensory properties of chicken-breadfruit patties with *P. guineense* and *M. myristica* oleoresins as preservatives.

2. Materials and Methods

2.1. Chicken, Breadfruit and Other Ingredients

Dressed chicken (Broilers), matured breadfruit (*Artocarpus altilis*), spices: *Piper guinenses* and *Monodora myristica*, salt, garlic, onions, sugar, whole egg and other ingredients used were obtained in local markets in Bonny Island, Rivers State.

2.2. Preparation of Minced Chicken and Breadfruit Flour

The chicken was deboned and the meat was minced in a Binatone mincer. The minced meat was stored in a clean glass bowl with lid briefly in a refrigerator before use. The breadfruits were sorted, washed and peeled. The pulps were cut vertically into six portions to ease the removal of the core. The portioned pulps were sliced with a Black and Decker slicer (FB1600B, China). The sliced pulps were dried in an oven at 60^{o}C for 10 h. The dried pulps were then milled using an electric grain milling machine (ZT-400, China) and sieved through a 200 mm sieve using a food industrial grain analysis LB sieve shaker (HY-200, Henan, China) to obtain the breadfruit flour. The flour was packed in a zip-lock bag and stored in a cool dried place until required for use.

2.3. Extraction of *P. guineense* and *M. myristica* oleoresins

The spices (*P. guinenses* and *M. myristica)* were sorted, cleaned, washed, dried, toasted, dehulled (*Monodora myristica*) and ground to fine powder using Black and Decker blender (FX775-B5, China). The oleoresins of the *P. guineense* and *M. myristica* were extracted using solvent extraction method as described by Ogbonna *et al*., [12]. The extracted oleoresins were separated from the solvent by evaporation and then allowed to cool in a desiccator. The oleoresins recovered were held in dark glass bottles and kept in a dark cupboard.

2.4. Preparation of Chicken-breadfruit Patties with *P. guineense* and *M. myristica* Oleoresins as Preservatives

Minced chicken (807.5 g), breadfruit flour (142.5 g), salt (12.0 g), chopped garlic (11.0 g), chopped onions (130 g), sugar (10.0 g); 2 medium sizes of fresh eggs and water (50 ml) were thoroughly mixed together. *P. guineense* oleoresins (0.5 %) was added to the ingredients and manually mixed for 5 mins. This was repeated thrice but with 1 % of *P. guineense* oleoresins, 0.5 and 1 % of *M. myristica* oleoresin in each of the formulation. About 30 g of the mixture was then shaped using patties moulder of 12 cm diameter and 0.5 cm thickness. Control patties without the oleoresins was also prepared. The formed patties were packed in zip-lock bags and store for 4 weeks at refrigeration temperature (4°C) for four weeks. Samples were withdrawn weekly for analysis.

2.5. Proximate Composition of *P. guineense* and *M. myristica* Oleoresin Spiced Chicken-Breadfruit Patties

The proximate compositions of the *P. guineense* and *M. myristica* oleoresin chicken-breadfruit patties were determined using AOAC, [13] methods. Moisture content was calculated after drying at 105°C to constant weight in an air oven (DH6-9140A, China). The crude protein content was determined using the Kjedahl method. Fat content was determined by solvent extraction using Soxhlet extraction techniques. The ash content was determined gravimetrically. Briefly, 1 g of the sample was heated on a mantle (Gehadt, Germany) until smoking ceased and then, incinerated in a muffle furnace (M110, China) at 550°C for 3 h. The crude fibre content was determined using the standard acid hydrolysis method. Carbohydrate content was obtained by difference.

2.6. Determination of Thiobarbituric Acid Values (TBA) of *P. guineense* and *M. myristica* Oleoresin Spiced Chicken-breadfruit Patties Stored for 4 Weeks at Refrigeration Temperature

The method by Darwish *et al*., [14] was used in the determination of thiobarbituric acid value. Briefly, 20 ± 1 g of the patties and 40 ml of 7.5% trichloroacetic acid were homogenised with a spatula for 1 min and left to stand for 30 min. Thereafter it was filtered using Whatman NO. 1 filter paper. 5 ml of the filtrate were prepared with 5 ml of thiobarbituric acid (TBA) solution (0.2883g TBA/100 ml water) in a test tube. Blank was carried out using 5 ml distilled water and 5 ml TBA solution. The tubes were covered and heated in a boiling water bath for

40 min, then, cooled in an ice bath. Absorbance at 538 nm was measured using ultraviolet-visible scanner spectrophotometer (LKB 4045 Cambridge, England). The thiobarbituric acid (TBA) value was calculated by multiplying the absorbance by the factor of 7.8 and the result expressed in mg of malonaldehyde per 1 kg sample.

2.7. Sensory Analysis of *P. guineense* and *M. myristica* Oleoresin Spiced Chicken-breadfruit Patties Stored for 4 Weeks at Refrigeration Temperature

Sensory properties (colour, appearance, flavour and overall acceptability) of the spiced chicken-breadfruit patties from the different treatment with *P. guineense* and *M. myristica* oleoresins were carried out using a panel of 20 assessors consisting of men, women who are staff and students of the Department of Food Science and Technology, River State University, Port Harcourt. The assessors were regular consumers of patties. The colour, appearance, flavour and overall acceptability of the samples were evaluated in sensory evaluation boots, where coded patties samples were presented in random order with a ballot sheet for each sample. The scores were based on a 9-point hedonic scale, with the degree of likeness of the product attribute expressed as 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely. Assessors were provided with water for rinsing the mouth and expectoration cups with lids for panellists who did not wish to swallow the samples.

2.8. Statistical Analysis

Data obtained were subjected to statistical analysis using IBM SPSS (One-way ANOVA) software for Windows version 21.0 (SPSS Inc). The significant differences between the means were analysed using Duncan's Multiple Range Test. Statistical differences were established at a probability of 5%.

3. Results and Discussion

3.1. Proximate composition of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties

The result of the proximate composition of the *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties are presented in Table 1.

The moisture content of the samples varied from 22.92 – 36.98 %. The moisture content of the control sample was significantly ($P \leq 0.05$) the highest. The moisture content of all the samples under investigation was low when compared to the moisture content of burger (57.48 %) made from chicken and defatted peanut flour [15]. The low moisture content could be attributed to the supplementation of 15 % of chicken with breadfruit flour, thereby increasing the solid content of the product. The moisture level of any product is an indication of its keeping quality. Reduced moisture content decreases the water activity of the products which invariably affects the activity of microorganism in the food.

Crude protein of the samples ranged from 11.14 – 18.13 % for the control and Patty with 1 % *M. myristica*. The results of the protein content were comparable with the results of the protein content (16.48 – 18.58 %) of chicken patties formulated with dietary fibre from wheat sprout [16]. The protein content (11.14 %) of the control sample was significantly ($P \leq 0.05$) the least, while those with spice oleoresins had higher protein content. The higher protein content of the other samples could be attributed to the addition of spice oleoresin in the production of the patties. Imo *et al.*, [17] and Nkwocha *et al.*, [18] reported that the protein content of *P. guineense* and *M. myristica* were 12.99 % and 12.09 % respectively. It was also observed that samples with 1 % level of spice oleoresin had significantly ($P \leq 0.05$) higher protein content than samples with 0.5 % level of spice oleoresin.

Fat content of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties ranged from 2.49 – 3.66 %. The fat content of Patty with 1% *P. guineense* was significantly ($P \leq 0.05$) the highest while that of the control was significantly ($P \leq 0.05$) the lowest. All other samples were not significantly ($P \geq 0.05$) different from each other. The fat content of the *P. guineense* and *M. myristica* patties were lower than the fat content of patties produced with Moringa seed flour (10.05 – 11.46 %) and patties produced with wheat sprout dietary fibre (10.82 – 19.98 %) respectively, reported by Fahad *et al.*, [19] and Yun-sang *et al.*, [16]. The reduction in fat content of the *P. guineense* and *M. myristica* chicken-breadfruit patties could be attributed to the removal of the skin of the chicken which is known to be rich in oil during processing of the patties.

The ash content of the patties ranged from 3.30 – 4.20 %. The ash content (3.30 %) of the control was significantly ($P \leq 0.05$) the lowest while ash content (4.20 %) of patty with 0.5 % *M. myristica* was significantly ($P \leq 0.05$) the highest. Ash is the inorganic residue remaining after ignition or complete oxidation of organic matter in food stuff and a representation of the mineral content of foods [20]. The ash content of the *P. guineense* and *M. myristica* oleorosine patties were higher than the value of 1.9 % for hamburger and regular single patties [21]. These *P. guineense* and *M. myristica* oleorosine patties could be good sources of minerals.

The fibre content ranged from 0.84 – 5.61 %. Fibre for the control samples was significantly ($P \leq 0.05$) lower than the samples with spice oleoresins. Fibre is important for optimum health. Adequate consumption helps to protect against colon cancer, keep blood lipids within normal range thereby reducing the risk of obesity, hypertension and cardiovascular diseases [22]. The carbohydrate content of the samples varied significantly ($P \leq 0.05$) from 40.89 % for Patty with 0.5 % *M. myristica* to 50.06 % for 1 % *M. myristica*. Carbohydrate in diet is very crucial in the supply of energy, impartation of textural properties and as dietary fibre which is of great value in maintain the functioning of the body [22].

Table 1. proximate composition (%) of freshly prepared *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties

Patty Samples	Moisture	Protein	Fat	Ash	Fibre	Carbohydrate
Control	36.98±1.09^{a}	11.14±0.15^{d}	2.49±0.36^{b}	3.30±0.02^{c}	0.84±0.58^{b}	45.25±0.90^{b}
0.5% *M. myristica*	22.92±3.18^{c}	15.96±0.28^{c}	3.20±0.68^{ab}	4.20±0.44^{a}	3.66±2.24^{a}	50.06±2.91^{a}
1% *M. myristica*	30.57±0.47^{b}	18.13±0.00^{a}	3.06±0.11^{ab}	3.54±0.08^{bc}	3.81±0.57^{a}	40.89 ±2.45^{b}
0.5% *P. guineense*	23.62±0.21^{c}	16.03±0.14^{c}	3.54±0.38^{ab}	3.96±0.23^{ab}	3.79±0.39^{a}	49.06±0.13^{a}
1% *P. guineense*	26.36±0.54^{c}	17.51±0.00^{b}	3.66±0.35^{a}	3.75±0.13^{abc}	4.61±0.01^{a}	44.11±0.77^{b}

Values are mean ± standard deviations of triplicate samples. Values with the same superscripts in the same column are not significantly different (P≥0.05).

3.2. Thiobarbituric Acid Values of *P. guineense* and *M. myristica* Oleoresin Spiced Chicken-breadfruit Patties Stored for 4 Weeks at Refrigeration Temperature

There was significant (P≤0.05) variation in the init ial TBA values of the *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties. The values were 3.51±0.35, 3.33±0.23. 3.11±0.45, 3.20±0.08, 2.96±0.24 mg maloadehyde/kg respectively, for 0.5 % *M. myristica*, 1 % *M. myristica*, 0.5 % *P. guineense* and 1 % *P. guineense*. With the variations in the initial TBA content of the samples, comparison among treatments was based on the percentage increase in TBA content relative to the initial contents as shown in Figure 1.

The control had significantly (P≤0.05) the highest increase in TBA values throughout the storage period. (21, 24, 27 and 28 % respectively, at week 1, 2, 3 and 4). Among the oleoresin patties, patties with *P. guineense* had significantly (P≤0.05) higher increases than patties with *M. myristica*. In terms of the levels of concentration of the oleoresin, patties with 1 % oleoresin (14 and 19 % increase respectively, for *M. myristica* and *P. guineense*) had significantly (P≤0.05) higher increase than patties with 0.5 % oleoresin (9 and 13 % increase respectively, for *M. myristica* and *P. guineense*). The trend was the same at week 2, where patties with 1% oleorosin (19 and 22% increase in mm amd pp respectively) had significantly (P≤0.05) higher increase than pat ties with 0.5% (17 and 19% increase in mm and pp respectively). In week 3, patties with 0.5% oleorosin (22 and 26 % increase respectively, for *M. myristica* and *P. guineense*) had significantly (P≤0.05) higher increase than patties with 1% (20 and 25% increase in *M. myristica* oleoresins and *P. guineense* patties respectively). In week 4, 0.5 % *M. myristica* had significantly (P≤0.05) higher increase in TBA than the 0.1% while the reverse was the case for *P. guineense* where patties with 1% oleoresin had significantly (P≤0.05) higher increase in TBA than the 0.5 %. Generally, there was increase in TBA content with increase in storage time and the increase was significantly (P≤0.05) higher in the control sample than the oleoresin spiced patties. While the increase in patties with 1% oleoresin was significantly (P≤0.05) higher than patties with 0.5% oleoresins. Among the spices, the increase was significantly (P≤0.05) lower with the incorporation of *M. myristica* oleoresin than with *P. guineense* oleoresin.

Thiobarbituric acid (TBA) test is used to evaluate the rate of oxidative rancidity (malonaldehyde formation) which takes place in meat and other lipid-containing products. It is used to detect decomposition of foods containing high unsaturated fatty acid and linolenic acid which do not appear in peroxide value determination [23]. The result revealed that patties without oleoresin exhibited higher oxidative rancidity. This is in agreement with studies that have shown that natural plant extracts reduce the oxidative rancidity in patties. Hettiarachchy *et al.*, [24] reported oxidative stability of beef patties with the use of natural extracts of Fenugreek (*Trigonella foenumgraecum*). Peanut skin extract had similar reducing effect on the lipid oxidation of chicken patties [25]**.** Contrary to expectation, patties with higher concentration of oleoresin exhibited greater level of oxidation within the first two weeks of storage. This could be attributed to the fat content of the concentrated extract. The spice type also affected the rate of oxidative rancidity during the period of storage. The incorporation of *M. myristica* oleoresin had a more positive effect than *P. guineense* in the prevention of rancidity.

3.3. Sensory Properties of *P. guineense* and *M. myristica* Oleoresin Spiced Chicken-breadfruit Patties Stored for 4 Weeks at Refrigeration Temperature

The colour and appearance of the *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties at refrigerated temperature for a period of four weeks are shown in Figure 2. The degree of likeness of the colour and appearance of the patties decreased significantly (P≤0.05) with storage time but there was no significant (P≥0.05) variation among the patties in each week. In week 1, the colour and appearance of the patties were moderately liked, the values ranged from 7.15 for the control to 7.24 for 1 % *P. guineense*. In week 2, the patties colour and appearance were slightly liked, the values ranged from 6.32 - 6.41 for the control and 1 % *P. guineense*. In week 3 and 4, the colour and appearance were neither liked nor disliked with values of 5.42 - 5.52 and 5.08 -5.18 for the control and 0.5 % *P. guineense*.

The degree of likeness of the flavour of the patties decreased significantly (P≤0.05) with increase in storage time as shown in Figure 3. The flavour of the patties in week 1 and 2 did not vary significantly (P≥0.05) among the treatments. The degree of likeness in week 1, ranged from 7.03 - 7.33 for % *P. guineense* and for the control while in week 2 it ranged from 6.01 – 6.25 for 1 % *P. guineense* and 1% *M. myristica*. In week 3, the degree of likeness of the flavour varied significantly (P≤0.05) among the treatments. Patties with *M. myristica* oleoresin were moderately liked (6.14 - 6.18 for 0.5 and 1 % *M. myristica* oleoresins) while the control and patties with *P. guineense* oleoresin were neither liked nor disliked. In

week 4, the degree of likeness varied significantly (P≤0.05) from 4.28 - 5.71. The control samples and 0.5 % *M. myristica* patties were dislike slightly while others were neither liked nor disliked.

Figure 4, presented the overall acceptability of the *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties. There was significant (P≤0.05) decreased with storage time. In week 1, the value of overall acceptability was range from 7.13 - 7.32 indicating that the patties were of moderate likeness. In week 2 and 3, the patties overall acceptability reduced to that of slight likeness with values ranging from 6.01 - 6.35. In week 3, the control and patties with 1 % *P. guineense* were neither liked nor disliked while others were slightly liked. In week 4 all the samples were neither liked nor disliked.

The changes in sensory attributes (colour, appearance, flavour and overall acceptability) might be attributed to lipid oxidation, microbial and enzymatic activities [26]. The decrease in flavour during refrigerated storage has been reported by Mahajan *et al*., [27] in chicken sausage, Malav *et al.*, [28] in restructured chicken meat blocks and Insha Kousar *et al*., [29] in chevon sausage. Decreased overall acceptability was reported by Kumar *et al*., [30] for pork patties with advancement in storage period. The decline in overall acceptability might be attributed to a decrease in both the colour and flavour of all the samples during storage.

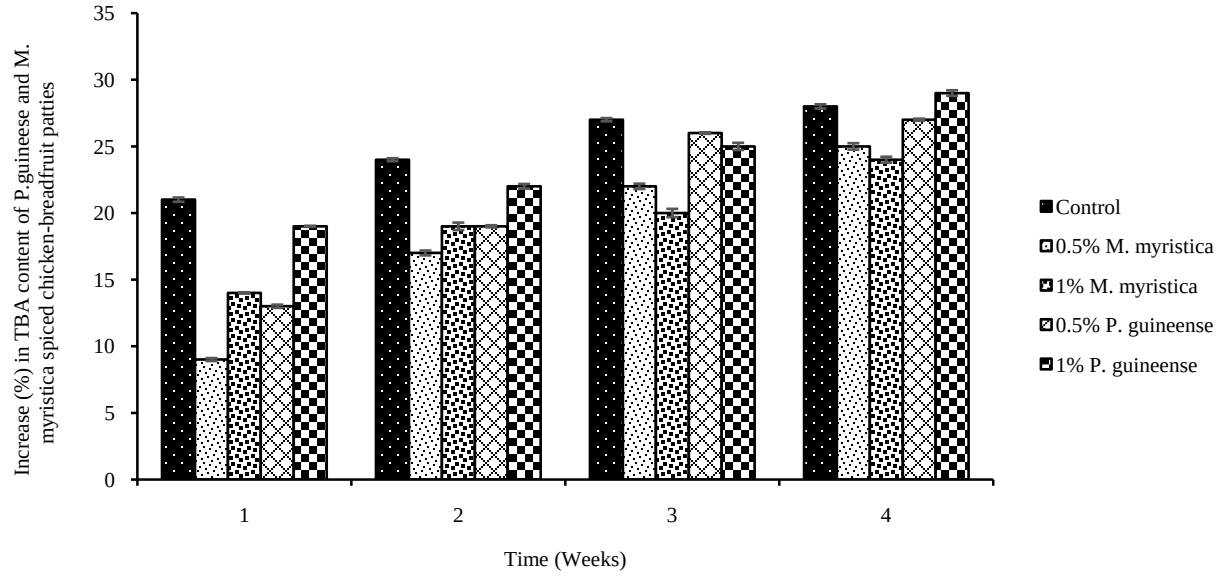

Figure 1. Increase (%) in thiobarbituric acid (TBA) relative to the initial TBA contents of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties

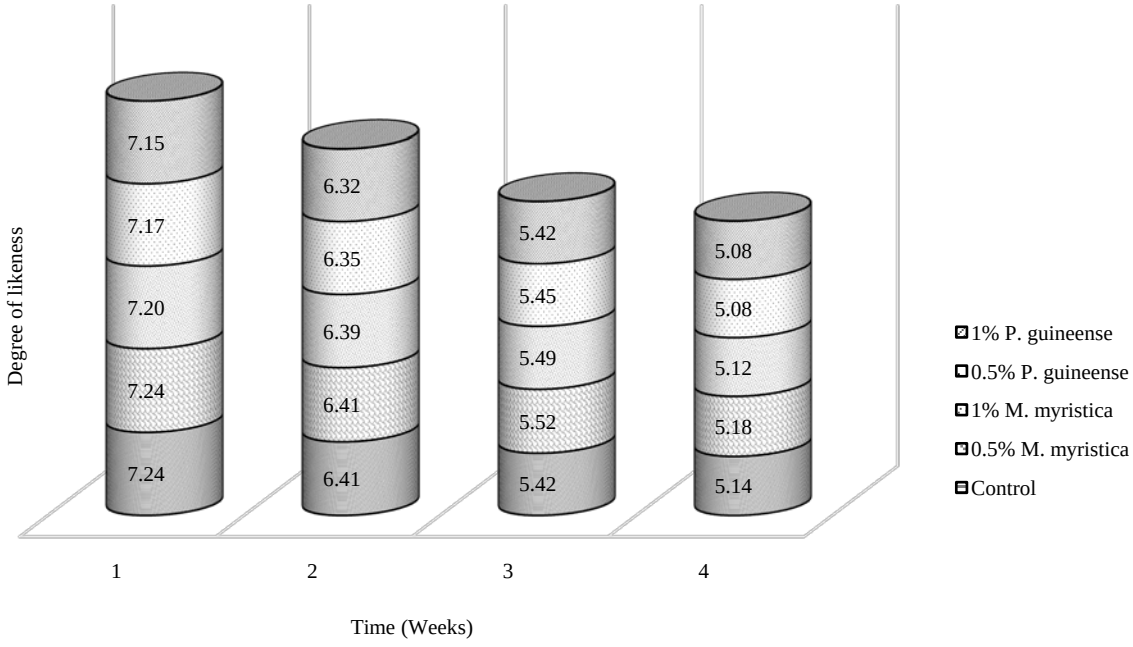

Figure 2. Appearance and colour of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties, 9-point hedonic scale: 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely

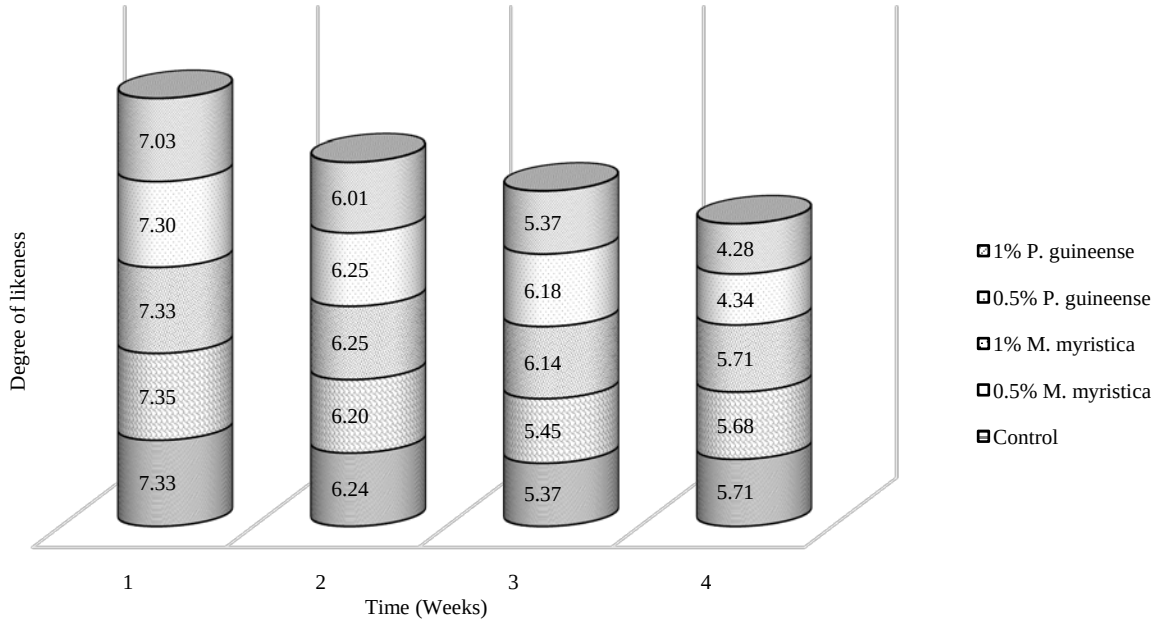

Figure 3. Flavour of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties, 9-point hedonic scale: 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely

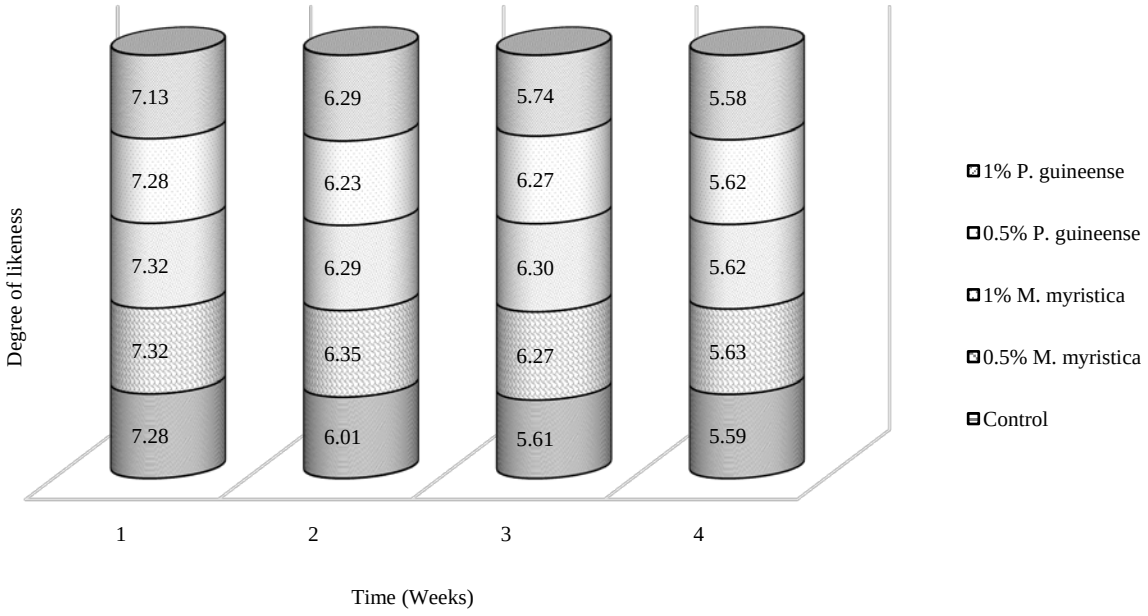

Figure 4. Overall acceptability of *P. guineense* and *M. myristica* oleoresin spiced chicken-breadfruit patties, 9-point hedonic scale: 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely

4. Conclusion

The results of the study showed supplementation of 15 % of chicken with breadfruit flour and the use of spice oleoresin in the production of chicken-breadfruit patties yielded compositionally balanced patties with organoleptically acceptable characteristics after week 1 of storage. The study also indicated *P. guineense* and *M. myristic*a spice oleoresins have antioxidant effect on chicken-breadfruit patties.

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