EFFECT OF PACKAGING MATERIALS AND STORAGE LENGTH ON OXIDATIVE RANCIDITY AND SENSORY EVALUATIONOF *BALANGU* READY-TO-EAT MEAT

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ABSTRACT

A study was conducted to evaluate the influence of packaging materials and storage period on Storage stability (Thiobarbituric Reactive Substances), Appearance and ordor of *balangu* RTE-MP in a 3×4 factorial arrangement involving three packaging materials (aluminium foil, kraft paper and polyethylene film) and four storage length (0 , 24, 48 and 72 hrs) in a completely randomised design. Packaging materials and storage period had significant effect (P<0.05) on the Thiobarbituric Reactive Substances (TBARS), appearance (colour) and odour of *balangu* samples (Table 1). The TBARS value was significantly higher in samples packaged in polyethylene film than aluminium foil packaged samples, which was higher than samples packaged in paper. Appearance was scored significantly higher by paper packaged samples than aluminium foil packaged samples which did not differ significantly with paper and polyethylene film packaging, but higher than polyethylene film packaged samples. Similarly, samples packaged in paper had scored significantly higher than aluminium foil and polyethylene film which did not differ significantly. At storage, TBARS values, appearance and odor score increased from control with increase in storage period. There was also a significant interaction (P<0.01) between packaging materials and storage period on all the parameters measured after the storage period.The study concluded that the favourable combination of packaging material and storage length that could optimize storage stability, appearance and odor of *balangu* could be packaging in kraft paper or aluminium foil and utilized within up to 24 hrs of post-production.

Keywords: Packaging, Storage Length, Storage Stability, Appearance, Odour, *Balangu*,

INTRODUCTION

According to Adejumo and Ola (2008), in Nigeria there are diverse and numerous types of locally produced Ready-to-eat foods sold in public places for immediate consumption, and the packaging used for these foods is traditionally meant for take away, with little or no attention paid to the safety of the consumers and the shelf-life of the food. Furthermore, the hygienic state of the packaging materials and their appropriateness for the food products are not considered in their selection. Almost all the food products packaged by the local processors and vendors of Ready-to-eat meat products RTE-MPs in Nigeria are unlabeled. No indication is given of the names of the products, their sources, composition nor any information on appropriate storage conditions and instructions for use. Consequently, the role of packaging in the food industry, which includes protection, containments, transportation, preservation and advertisement are not achieved by most of the packaging materials and methods used by street food vendors in Nigeria. This in turn results in a huge loss of the food product not only during packaging processes but also during transportation and sales as a result of contamination by food spoilage microorganisms, dust and chemical contamination (Adejumo and Ola, 2008).

In Nigeria, RTE-MPs are widely produced and consumed with little or no due inspection. The highest regulatory body responsible for food safety, the National Agency for Food and Drugs Administration and Control (NAFDAC) is only concerned with pre-packaged foods in the registered companies. Little or no attention is paid to the control and or inspection of the local industries of RTE-MPs production where there is almost complete noncompliance with safety guidelines for the production of the RTE-MPs. This situation could place the consuming population at high risk of infection by foodborne pathogens which could be present in the RTE-MPs as a result of unhygienic processing,

handling, packaging and or storage. Abubakar *et al.* (2011) reported that appropriate and affordable technologies that are simple, cheap and effective in processing and preserving animal products must be sought and evaluated. Little or no attention is paid to the processing and packaging technics and there is scanty information concerning evaluating effectiveness of post-lethality packaging treatments that will allow products to be held for a shorter period of time without proliferation of bacteria. It is based on this that this research was designed, to conduct a study to compare packaging materials and storage period for physico-chemical, storage stability and sensory characteristics of balangu.

MATERIALS AND METHODS

The study was conducted in Kebbi and Sokoto States, North-West region of Nigeria. This study investigated the influence of packaging materials on storage stability, and sensory characteristics of *balangu*.

Experimental design

This study consisted of three packaging materials: Aluminum foil (ALF), kraft paper (KPA) and polyethylene film (PEF) with four storage times (0, 24, 48, and 72 hours). A total of twelve treatment combinations were obtained in a 3×4 factorial experiment involving three packaging materials and four storage periods in a completely randomized design.

Preparation of samples, packaging materials and packaging

The packaging materials used for the experiment were purchased from metropolitan supermarkets and processed according to required dimensions. A package consisted of a sheet of a material with the dimension of 25×25cm^2. *Balangu* was prepared from sliced beef in a portable drum kiln specifically designed to process the product under good hygienic condition. The sliced beef was placed on a brown craft paper sheet that has been spread over the wire mesh two feet above glowing fire from firewood. After two hours with regular turning interval of 15 minutes, *balangu* was produced. After gradual cooling for 30 minutes in the kiln, a clean knife was used to cut pieces of samples with dimension of 3×3cm^2. A total of 120 *balangu* samples were prepared and ten samples were randomly allotted to each of the already prepared packaging material, carefully wrapped and represented a packaging treatment according to the 12 treatment combinations. All 12 wrapped packages were then arranged in a flat platform at room temperature for their respective storage period. After each storage period, three samples were randomly taken from each treatment combination and evaluated for storage stability and seven samples were used for sensory evaluation.

Determination of storage stability (Lipid oxidation)

The oxidation of lipids was measured by determining the amount of the Thiobarbituric acid reactive substances (TBARS), expressed as mg malondialdehyde per kilogram (mgMDA/kg) of muscle or TBA units. Thiobarbituric acid reactive substances values were measured using the method of Witte *et al.* (1970).

Determination of sensory characteristics

Determination of sensory characteristics was subjectively conducted using the method of quantitative descriptive analysis (QDA) based on the principle of a panelist's ability to verbalize perceptions of a product. Hedonic scales according to Watts *et al.* (1989) were used to evaluate the colour appearance and odor of the product after each storage period using a panel of seven (7) judges.

Data Analysis

Data on sensory and storage stability were transformed and analyzed using non-parametric analysis to obtain means. The means were subjected to the GLM procedure to compare the effect of packaging and storage period on the RTE-MP. Significant means were separated using Tukey test at 5% level of significance.

RESULTS AND DISCUSSION

Storage stability (Thiobarbituric Reactive Substances)

Packaging materials and storage period had significant effect ($P<0.05$) on the Thiobarbituric Reactive Substances (TBARS), appearance (colour) and ordour of *balangu* samples (Table 1). The TBARS value was significantly higher in samples packaged in polyethylene film than aluminium foil packaged samples, which was higher than samples packaged in paper. Appearance was scored significantly higher by paper packaged samples than aluminium foil packaged samples which did not differ significantly with paper and polyethylene film packaging, but higher than polyethylene film

packaged samples. Similarly, samples packaged in paper had scored significantly higher than aluminium foil and polyethylene film which did not differ significantly. At storage, TBARS values, appearance and odour score increased from control with increase in storage period. There was also a significant interaction (P<0.01) between packaging materials and storage period on all the parameters tested after the storage period.

Table 1 Effects of packaging materials and storage period on the storage stability and sensory qualities of *balangu*

Treatments	Parameters		
	TBARS (mgMDA/kg)	Appearance (colour)	Odour
Packaging materials			
Aluminum foil	1.133[b]	4.071[ab]	2.321[b]
Paper	0.232[c]	4.429[a]	2.643[a]
Polyethylene film	2.133[a]	3.750[b]	2.286[b]
SE	0.049	0.134	0.104
Storage period (hours)			
0 (control)	0.058[a]	7.762[a]	4.238[a]
24	0.766[b]	4.762[b]	2.952[b]
48	1.843[c]	2.333[c]	1.476[c]
72	2.664[d]	1.476[d]	1.000[d]
SE	0.057	0.155	0.120
Interaction			
Packaging × Storage period	**	NS	**

a,b,c,d = means with different superscript along the same column within a subset differ (P<0.05)
** = P<0.001
NS= Not significant

In the current study, balangu packaged in polyethylene film and aluminum foil had developed higher TBARS (2.133 and 1.133g MDA/kg, respectively) than paper packaging (0.232g MDA/kg). This might be due to the fact that packaging *Balangu* which is an intermediate moisture meat product and hence, has relatively high moisture content with other concentrated nutrients like protein which could probably result in the production of free radicals (Min, 2008) or porosity of packaging materials (Ahn *et al*., 2000; Muhammad and Muhammad, 2007). TBARS values increased with increase in storage time. The storage period of 72 hours had higher value (2.664g MDA/kg) than 48 and 24 hours (1.843 and 0.766g MDA/kg, respectively). Controls had lower TBARS value (0.058g MDA/kg). The higher TBARS value could be as a result of extension of storage time leading to the production of free radicals (Kanatt *et al.* 2006). Several research findings (Kim *et al.*, 2014; Bağdatli and Kayaardi, 2015; Akinneye and Aringbagba, 2015) had reported similar trends of TBARS values in relation to storage time using different meat and other food products.

Appearance and Odour

In the current study, results of indicated that all packaging materials scored values that were below the desirable levels in the appearance scale after storage. However, paper had scored higher (4.429) than aluminum foil and polyethylene film packaging materials (4.071 and 3.750, respectively). At the storage length, samples in control (0 hrs) had shown better performance in color appearance (7.762) equivalent to extremely desirable. After 24 hours, the samples scored 4.762 equivalents to slightly desirable on the rating scale. This indicated that though balangu is produced for immediate consumption, yet, its colour appeal could extend up to 24 hrs stored at room temperature. At 48 and 72 hrs storage, the samples were rated extremely undesirable. It could be as a result of complete deterioration of the meat pigments and prolonged storage.

The current study shows that paper packaged balangu performed better (2.643) demonstrating that the samples have developed less off-odor than the aluminum foil and polyethylene film packaged balangu which scored 2.320 and 2.286, respectively and were categorized as having moderate odor development after storage. Apart from the control (0 hrs), other storage period indicated samples stored after 24 hrs had developed small odor (2.952) while those stored for 48 and 72 hrs had extreme odors scoring 1.476 and 1.000, respectively. The odors could be due to the production of low-molecular-weight volatile substances (Lamikanra and Dupuy, 1990).

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