EFFECT OF MEAT TYPE AND PACKAGING MATERIALS ON THE MICROBIAL PROPERTY OF STORED DRIED MEAT STRIPS

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ABSTRACT
The objective of this study was to investigate the effect of meat type (Pork and beef) packaging materials (polythene bags, sealed plastic container, brown envelopes) on the microbial quality of dried meat stripes. The experiment which was conducted using a 2 x 3 factorial arrangement in a completely randomized design. The dried beef and pork in different packaging materials were kept under room temperature and examined on day 0, 14, 28, 42. Data collected were the initial dry weight, final weight, Bacteria and Fungi count, fortnightly (2weeeks). These were used to analyzed for moisture content and microbial activities. Packaging material has no effect on the bacteria load, amount of deactivated bacteria, fungi load and amount of deactivate fungi. Pork had higher bacterial load than beef and brown Paper absorbed more moisture than the other packaging materials. Dried beef strips can be stored for 42 days without harmful effect before consumption and that the use of sealed plastic container and polyethylene bags for packaging of dried beef and pork.
Key words: Dried meat strips, Pork, Beef, Packaging materials, Bacteria, Fungi

INTRODUCTION
Meat, traditionally preserved by drying, is made available sometimes in packaged linen bags, baskets or pottery to facilitate storage and transport and to provide some kind of protection against dirt, insects, etc. With teeming population of consumers, however, this traditional system now becomes outmoded because more time is needed between slaughtering and ultimate consumption, giving room for deterioration in quality and spoilage.

Over the years, a number of traditional Nigerian/African meat products have gained universal acceptability. These products included barbecued meats such as *'tsire' (suya)* and *balangu;* sun-dried or dehydrated meat products such as *kilishi*, and smoke-dried meat products like *banda*, *kundi* and *unam inung*. These traditional meat products are popular, convenient and leisure food items whose consumption has become invariant with socioeconomic class. However, poor packaging or absence of same restricts their usage and stability. They are still packaged with newspaper, clay pot and sometimes inappropriate single film polyethylene which are possible source of contamination (Uzeh *et al.*, 2006). This constrains the marketing and distribution of large amounts of meat products to distant consumption centre. Some of the causes of these poor packaging are finance and technology. There is need to seek ways to extending the shelf stability of these meat products through packaging to augment the impact of processing for longer shelf-life. Packaging films such as polyethylene, sealed plastic container and brown paper offers likely advantage; it will guarantee low cost while incorporating the barrier properties of polypropylene. Since cost and technology are major constraints to improved packaging of these meat products, attempt was proposed in this work to exploit available technology and cheaper raw material.

MATERIALS AND METHODS
The experiment was carried out at the Meat Quality Laboratory of the Department of Animal Production and Health of the Federal University of Agriculture, Abeokuta which is at longitude 7º9’39” N and latitude 3º20’54” E and 74m. The area is in the derived savannah vegetation zone of south west Nigeria, it is characterized by a binomial rainfall pattern which peaks in July and September. The meat from the thigh muscle of beef was source from an Abbatoir in Abeokuta town, while pork was source from the University farms and packaging materials were sourced from Kuto market in Abeokuta metropolis. This is the packaging experiment which was conducted using a 2x3 factorial arrangement in a completely randomized design. The factors are dried meat from two sources i.e. Beef and Pork, and packaged in three materials i.e.

brown envelopes, Polyethylene bags and sealed plastic containers. The dried beef and pork in the different materials were kept under room temperature and examined on days 0, 14, 28, 42. Change in Strip Weight, was taken by subtracting the initial strip weight from the final strip weight. This was use to determine the moisture gain. Microbial Analysis (Bacterial load, Fungi load) was also determine from each collected samples from each treatment and analyzed for microbial activity as described by Adeyeye, 2016.
All data collected were subjected to ANOVA in a completely randomized design using a 2x3 factorial arrangement and significant means (P>0.05) was compared using Duncan multiple range test.

RESULTS

The main effect of meat types, packaging materials and storage conditions on dried meat strips is displayed in Table 1. On day 0, the total bacterial count was higher (P<0/05) in pork than in beef. On day 14, % moisture gain were not significantly (p>0.05) affected by meat types. Total bacterial count and total fungi count were significantly (p<0.05) higher in pork. The deactivated bacterial was also significantly (p=0.03) higher in beef having a higher deactivation ($0.76cfu\times10^5$) than pork ($0.24cfu\times10^5$).
Meat strips packed in brown paper bags were significantly (P<0.05) higher (3.70%) than values obtained for those packed in Polyethylene bags and sealed plastic containers.
On the twenty-eighth day of storage, meat type significantly affected the total bacterial count (p=0.00) and total fungi count (p=0.02) with pork recording higher values than beef in both parameters. The moisture gain (%), deactivated bacteria ($cfu\times10^5$) and deactivated fungi ($cfu\times10^5$) were not significantly influenced (P>0.05) by meat type. The packaging materials had significant effect (p=0.00) on percentage moisture gain with meat strips packed in brown paper having higher value than those packed in polyethylene bag and sealed plastic container. Total bacterial count, total fungi count, deactivated bacterial and deactivated fungi were not significantly (p>0.05) influenced by the packaging materials used. Influence of meat type on dried meat strips at the 42nd day of storage revealed that only total fungi count was significant (p<0.05) affected pork ($2.49\ cfu\times10^5$) had a higher total fungi value than beef ($1.53\ cfu\times10^5$). Packaging materials significantly (p<0.05) affected the amount of moisture gained from the atmosphere. Brown paper gained the highest moisture (6.17%) while sealed plastic container gained the lowest (1.67%) moisture. Total bacterial count, total fungi count, deactivated bacterial and deactivated fungi were however not significantly (p>0.05) influenced by the different packaging materials. Trends observed in days 0, 14, 28 and 42 revealed that total fungi count was higher than total bacterial count and in all the days considered. Moisture gain did not differ significantly for both meat types, pork had higher values for total bacterial count and total fungi count on all days observed. Moisture gain for all packaging materials used showed that moisture gained in meat strips packed in Brown Paper was greater than Polyethylene bags and sealed Plastic Containers that had similar values. The interactive effect of meat types and packing materials did not have significant effect on all the parameters measured, as a result were not presented in this report.

DISCUSSION

Generally, the shelf life of products is defined as the period between the packaging of a product and its end use when the product properties remain acceptable to the product users (Lorenzo and Gomez, 2012). Changes such as microbial growth, lipid oxidationand colour changes in meat with storage affect the shelf life and acceptance of meat (Esmer *et al*., 2011). The
differences in the total bacterial count for both meat types may be due to the sources of the meat types from and the contamination may be as a result of the environmental conditions and handling (Borch *et al.,* 1996). The application of high temperature during the process of drying of the meat was expected to have deactivated the microbial load of the meat product. However, the presence of bacterial counts after drying implicates the presence of thermophilic bacteria which have the ability to thrive under heat levels equal to or higher than the 70ºC drying temperature utilized in the present study. Such microbes could also arise from the environment (because the environment may not be void of microbes, which can get into products from the air). This corroborate the reports by Saad *et al*., (2011) that processed meats can be contaminated from different sources such as processing, cooking and even the environment.

Table 1: Main Effect of Meat Type, Packaging Materials and Storage Conditions on Dried Meat Strips

		Meat Type			Packaging Material				
	Parameters	**Beef**	**Pork**	**P-value**	**BP**	**SPC**	**PB**	**P-value**	**SEM**
Day 0	Total Bacterial Count	1.97[b]	2.589[a]	0.00	2.28	2.28	2.28	1.00	0.08
	Total Fungal Count	3.62	4.144	0.05	3.88	3.88	3.88	1.00	0.12
Day 14	Moisture Gain (%)	1.36	1.94	0.41	3.70[a]	0.22[b]	1.00[b]	0.00	0.39
	Total Bacterial Count	1.21[b]	2.35[a]	0.00	1.66	1.85	1.83	0.54	0.14
	Total Fungal Count	3.03[b]	4.18[a]	0.02	3.46	4.08	3.28	0.35	0.32
	Deactivated Bacteria	0.76[a]	0.24[b]	0.03	0.62	0.43	0.44	0.74	0.13
	Deactivated Fungi	0.59	-0.04	0.24	0.43	-0.20	0.60	0.43	0.32
Day 28	Moisture Gain (%)	4.59	3.82	0.32	8.24[a]	1.61[b]	2.78[b]	0.00	0.61
	Total Bacterial Count	0.79[b]	1.72[a]	0.00	1.07	1.39	1.31	0.28	0.12
	Total Fungal Count	1.17[b]	1.68[a]	0.00	1.30	1.48	1.49	0.49	0.08
	Deactivated Bacteria	1.17	0.87	0.22	1.21	0.89	0.97	0.53	0.12
	Deactivated Fungi	2.45	2.47	0.96	2.58	2.40	2.39	0.87	0.14
Day 42	Moisture Gain (%)	3.75	3.53	0.80	6.17[a]	1.48[b]	3.26[b]	0.00	0.55
	Total Bacterial Count	1.17	1.71	0.05	1.36	1.49	1.40	0.91	0.12
	Total Fungal Count	1.53[b]	2.49[a]	0.00	2.09	1.93	2.00	0.90	0.15
	Deactivated Bacteria	0.79	0.88	0.82	0.92	0.79	0.81	0.95	0.16
	Deactivated Fungi	2.09	1.66	0.39	1.79	1.95	1.88	0.97	0.21

[a, b,]; Means in the same row with different superscripts differ significantly (P<0.05)

Notes: BP- Brown Paper; SPC- Sealed Plastic Containers; PB- Polyethylene Bags; OS- Opened Shelf; CS Closed Shelf

The role of food packaging in the food industry is being increasingly recognized as it has multiple factors and is very important in terms of increasing product shelf life by retarding food quality degradation and ensuring food safety (Olayemi and Omojola, 2017). The higher moisture gain recorded for meat stored in brown paper bags might be due to the greater oxygen permeability of the medium which might have resulted in a greater introduction of air from the atmosphere with consequent increased oxygen and moisture content in the meat. The paper medium has been reported to have a poor barrier to air and is moisture sensitive than the other packaging materials (Marsh and Bugusu, 2007), this however did not result in a higher bacterial count when compared with the other storage mediums utilized. However, it can be concluded dried beef strips can be store for 42 days without harmful microbial growth and that the sealed plastic containers and polyethylene bags might serve as better storage mediums for dried beef and pork strips, owing to the fact that the moisture gain by the meat strips were lower.

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