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Production and Quality Evaluation of *Dambu-Nama* – A Nigerian Dried Meat Product

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ABSTRACT

The quality attributes of *dambu-nama*, a dried Nigerian meat product were studied for sixteen (16) weeks comparing traditional products and packaging systems with a laboratory product and simple modern packaging. The most optimum processing time, viz cooking and steaming for 60, 90 and 120 min respectively, was determined. The six resulting products were subjected to a 9-point hedonic scale and results showed that the product of cooking for 90 min was the most adequate and acceptable in all organoleptic attributes by the sensory panellists. Process standardization was achieved by optimization of the cooking time and formulation of a standard ingredient mix. Proximate composition of the finished product showed that moisture ranged from 5.50% laboratory *dambu-nama* (LDBN) to 7.60% traditional dambu-nama (TDBN), protein from 46.51% (LDBN) to 39.19% (TDBN), Ash from 5.76% (LDBN) to 4.90% (TDBN), crude fibre from 0.015% (LDBN) to 0.72% (TDBN), crude fat from 15.65% (LDBN) to 24.94% (TDBN), and carbohydrate by difference of 26.54% (LDBN) to 22.64% (TDBN). The hydrogen ion concentration (pH), bulk density, Thiobarbituric acid (TBA), microbiological and sensory attributes of the product packed in low density polyethylene (LDPE), high density polyethyelene (HDPE), Aluminium foil (Af) and plastic containers (Pc) stored at 30 ± 10°C were evaluated at 0, 3, 6, 9 and 16 weeks. The traditional *dambu-nama* packed in plastic containers grew visible moulds while others did not show any visible growth. The findings show that boiling for 90 minutes is the best processing technique for preparation of high quality *dambu-nana*.

Keywords: *Dambu-nama*, standardization, physico-chemical, microbiological and sensory evaluation.

Introduction

Meat is the flesh of animals consumed for food. In the tropics, the bulk of meat consumed is derived from sheep, cattle, goat, pig, deer, antelope, rabbit, squirrel, rat, elephant, camel and other mammalian animals both domesticated and wild. It is also obtained from poultry, including chickens, turkey, ducks, guinea fowl, geese and meat from other avian and reptilian animals; fish, crayfish, crabs, lobster and other sea foods; snails and other molluscs and insects (Ihekoronye and Ngoddy, 1985).

Meat is highly perishable and needs to undergo some form of preservation if it is not to be wasted. A substantial amount of the dietary protein in Nigeria is obtained through crops. The level of animal protein intake is only about 17 per cent of the total protein consumed by the average Nigerian, which is a far cry from the minimum recommended. This situation could be improved upon by developing the food processing sector, especially meat and meat products (Igene *et al.*, 1997). This view is similar to that of Ihekoronye and Ngoddy (1985) that states that cereal grains provide people of the tropics with about 75% of their caloric intake and 67% of their protein intake.

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Dambu-nama is a Nigerian traditionally spiced, cooked, pounded, shredded and dried meat product which is commonly obtained using beef, goat meat, mutton, or camel meat and is popularly consumed in the Northern parts of Nigeria. The product appears to have developed as a means of preserving meat, in the absence of facilities for refrigerated storage by the early Fulani and Hausa herdsmen (Igene *et al*., 1990).

The traditionally processed *Dambu-nama* delicacy is highly acceptable to consumers because of its soft and tender taste compared to the hard, non-soft *kilishi* product. However, it poses very serious health hazards because of the handling and processing methods by the local manufacturers as well as the hawking system all of which expose the pre- and post-processed products to microbial contamination. There is a demand to improve the processing, storage, distribution and overall quality of Nigerian traditional meat products (Okonkwo, 1984).

Developing countries, including Nigeria, have limited access to meat and meat products because of its high cost. This is due to the fact that production and rearing of animals is far below demand and the preservative technology is grossly inadequate, resulting in high perishability of meat and meat products.

The major advantage of *dambu-nama* over *suya* and *kilishi* is the increased surface area after pounding and it is cheaper.

The objectives of this study include improving and standardizing some of the traditional processing methods using appropriate processing techniques as well as evaluating the physico-chemical, sensory and microbiological properties of the improved products.

Materials and Methods

Beef (hind quarters) was purchased from Makurdi International Market Abattoir, Makurdi, Nigeria. The ingredients (onions, ginger, salt, magi, sweet pepper, hot pepper, garlic and vegetable oil (Grand Pure Soya Oil) were purchased from the same market. One kilogram (1 kg) each of beef was subjected to six treatments, viz cooking (boiling) at 60, 90 and 120 min and steaming at 60, 90 and 120 min respectively. The beef was trimmed, washed and cured in 0.02 g of meta-bisulphite for 30 min. The sample was then cooked or steamed till tender with the ingredient mix and then pounded using local pestle and mortar. The matrix was removed and physical fibre separation was done before samples were oven dried the second time at 60°C for about 3 – 4 h. The first oven drying was done at the same temperature for only 30 min, cooled and packed in a 250 ml airtight plastic containers, namely Af, Ldpe and Hdpe films from where samples were drawn for subsequent analysis.

Proximate composition

The moisture content, crude protein, crude fat, crude fibre and ash contents were determined using AOAC (1995) methods while the carbohydrate was determined by difference (Ihekoronye and Ngoddy, 1985).

Sensory evaluation before storage

The organoleptic quality assessment of both laboratory *dambu-nama* (LDBN) and traditional *dambu-nama* (TDBN) was evaluated using a 9-point hedonic scale (9 = like extremely to 1 = dislike extremely). The evaluation was based on colour, flavour/aroma, texture, taste/mouth-feel and general acceptability using the six products from the six treatments and the control (TDBN). Fifteen semi-trained panellists were used.

Storage studies/packaging

The samples, LDBN and TDBN, were packed in four packaging materials: low density polyethylene (LDPE), high density polyethylene (HDPE), aluminium foil (AF) and plastic containers (PC) respectively. These were stored under ambient room condition (30 ± 1°C) where samples were drawn at intervals of 0, 3, 6, 9 and 16 weeks for physico-chemical analysis, microbiological analysis and sensory analysis.

Physico-chemical analysis

The pH was determined by the use of pH meter (Model: Labtech Digital 15-2R). The thiobarbituric acid (TBA) was determined according to the second method described by Kirk and Sawyer (1991) in Pearson's composition and analysis of foods. The bulk density was determined according to the method described by Onwuka (2005).

Microbiological analysis

The method reported by Adegoke (2004) was adopted for total plate counts while the method described by Collins *et al.* (1989) for total yeast and mould counts was adopted.

Sensory evaluation on storage

A 9-point hedonic scale (9 = like extremely, 2 = bad and 1 = very bad) was used for sensory quality studies during storage.

Statistical analysis

Sensory scores before storage and proximate composition value were subjected to statistical methods of analysis and means separation using LSD test method (Steel and Torrie, 1981).

Results and Discussion

Proximate composition

The result of the proximate composition of the laboratory *dambu-nama* and the traditional *dambu-nama* (control) is as presented in Table 1. The proximate composition of LDBN and TDBN (control) are significantly different ($p < 0.05$). This may be due to the processing methods, the type of ingredient mix and the part of the carcass used for processing. Similar results had been reported by Igene *et al.* (1990) in their studies of *Kilishi*.

Consumer evaluation and acceptance

Table 2 shows that LDBN was superior to the TDBN (control) as evaluated by the panellists. LDBN cooked for 90 min was the most preferred out of the two processing methods of cooking and steaming at various times of 60, 90 and 120 min. This result may be due to the standardization of ingredient mix and adequate cooking for 90 min. However, the contributions of each of the ingredients to the overall *dambu-nama* flavour and quality is yet to be determined. A similar view had been reported by Igene *et al.* (1990) in their preliminary studies on the traditional processing of *kilishi*.

Table 1: Proximate composition of *dambu-nama* prepared from beef hindquarter

Parameter	Sample codes		
	LDBN (%)	TDBN (%)	LSD
Moisture	5.50 ± 0.01	7.60 ± 0.01	0.05
Ash	5.76 ± 0.02	4.90 ± 0.04	0.08
Crude protein	46.51 ± 0.03	39.19 ± 0.03	0.03
Crude fat	15.65 ± 0.03	24.94 ± 0.02	0.08
Crude fibre	0.015 ± 0.02	0.72 ± 0.02	0.04
Carbohydrate (by diff.)	26.54 ± 0.03	22.64 ± 0.02	0.02

Values are means ± standard deviation of duplicate determination.
LDBN = Laboratory *dambu-nama*
TDBN = Traditional *dambu-nama* (control)

Chemical analysis

The results of changes in pH, TBA and bulk density of *dambu-nama* on storage are presented in Figures 1, 2 and 3.

The initial pH of TDBN (6.04) was higher than that of LDBN (5.87). There was a gradual decrease in the pH of the two samples in the different packaging materials on storage. The pH drop may not be a consequence of microbial activity since microbial growth was insignificant. However, it may be attributed (Rustom *et al.*, 1995) to protein-protein reactions during storage leading to the release of free H+.

TBA is a measure of the level of lipid oxidation in a product and is expressed as MgMA/g sample. There was a gradual increase in the TBA values in the various packaging materials. There appeared to be a rapid onset of lipid oxidation during processing (meat slicing/drying) at the first week of storage. Thereafter, the rate of lipid oxidation appeared to be very slow and gradual. It is possible that the

oxidative stability of LDBN may be attributed to the antioxidant properties of the phenolic substances in plants used as spices. The spices were used in all the samples, however the traditional *dambu-nama* might have not been spiced adequately. Igene *et al.* (1990) expressed a similar view in his preliminary studies of *kilishi*.

Table 2: Sensory evaluation of *dambu-nama* prepared from beef using different processing methods (techniques) at various times

Parameters	TDBN	$CDBN_1$	$CDBN_2$	$CDBN_3$	$SDBN_1$	$SDBN_2$	$SDBN_3$	LSD
Colour	6.23^a	6.92^a	6.85^a	7.23^a	5.08^b	5.92^a	5.62^b	1.55
Flavour/aroma	7.31^a	7.15^a	6.54^a	6.54^a	5.54^a	5.85^a	6.62^a	1.56
Taste/mouth-feel	6.38^a	7.54^a	7.08^a	7.08^a	6.08^a	6.62^a	6.08^a	1.72
Texture	5.23^b	7.08^a	7.15^a	7.15^a	5.85^a	6.54^a	5.85	1.79
General accept.	6.23^a	7.38^a	7.62^a	6.77^a	6.15^a	6.69^a	6.23^a	1.60

Means value within the same row with the same superscript are not significantly ($p < 0.05$) different.

TDBN = Traditional dambu-nama (control)
$CDBN_1$ = Cooked *dambu-nama* (60 min)
$CDBN_2$ = Cooked *dambu-nama* (90 min)
$CDBN_3$ = Cooked *dambu-nama* (120 min)
$SDBN_1$ = Steamed *dambu-nama* (60 min)
$SDBN_2$ = Steamed *dambu-nama* (90 min)
$SDBN_3$ = Steamed *dambu-nama* (120 min)
LSD = Least significant difference

Table 3: Microbiological analysis of *dambu-nama* under ambient storage (30 ± 10^oC) using various packaging materials

Parameter	Sample code	Packaging material	Storage period (weeks)				
			0	3	6	9	16
TPC (Cfu/g) x 10^2	LDBN	Ldpe	1.40	1.48	1.62	1.79	3.01
		Hdpe	1.40	1.46	1.58	1.63	2.80
		Af	1.40	1.55	1.69	1.84	2.93
		Pc	1.40	1.62	1.77	1.89	3.06
	TDBN (control)	Ldpe	2.88	2.92	3.14	3.28	3.96
		Hdpe	2.88	2.90	2.99	3.05	3.41
		Af	2.88	2.90	3.03	3.21	3.86
		Pc	2.88	2.99	3.26	3.37	4.07
YMC (Cfu/g) x 10^2	LDBN	Ldpe	0.78	0.81	1.02	1.32	1.58
		Hdpe	0.78	0.80	0.96	1.00	1.20
		Af	0.78	0.92	0.99	1.24	1.42
		Pc	0.78	1.15	1.27	1.33	1.63
	TDBN (control)	Ldpe	0.96	1.00	1.26	1.58	1.93
		Hdpe	0.96	0.98	1.20	1.45	1.81
		Af	0.96	1.02	1.33	1.42	1.93
		Pc	0.96	1.09	1.39	1.57	2.03

LDBN = Laboratory *dambu-nama*, TDBN = n Traditional *dambu-nama*, LDPE = low density polyethylene, HDPE = High density polyethylene, AF = Aluminium foil, PC = Plastic Container, Cfu/g = Colony forming unit/gram, TPC = Total Plate Count, YMC = Yeast and Mould Count.

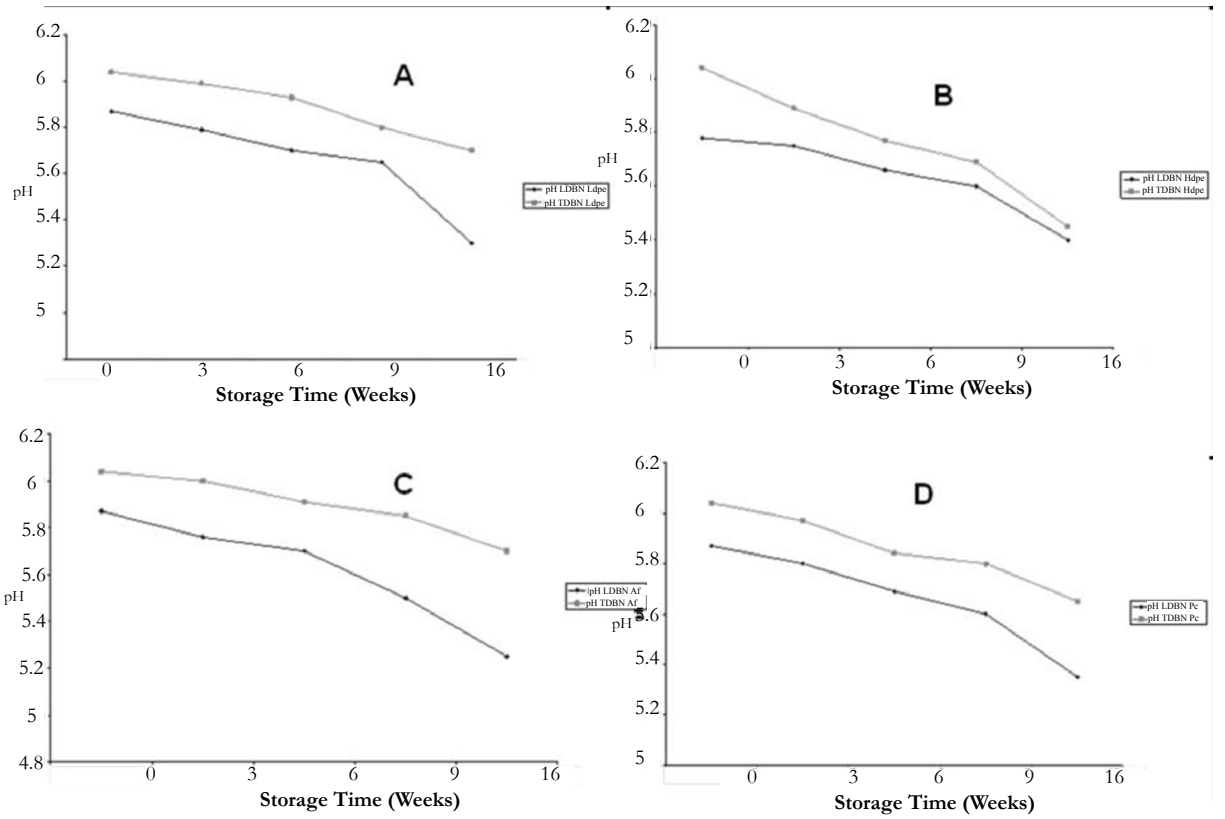

Fig. 1: Variation in pH with time for LDBN (*) and TBN (*) stored in Ldpe (A), Hdpe (B), Af (C) and Pc (D) respectively for 16 weeks

Similarly, Igene and Abulu (1984) demonstrated that a number of plant extracts can prevent rancidity, showing that pepper (pods and seeds), onion extract and potato peeling were effective in retarding lipid oxidation.

There was a gradual increase in the bulk density in the various packaging materials. It is the measure of the mass per volume of the sample. The knowledge of bulk density assists in packaging studies, i.e. the higher the bulk density the less the packaging materials can contain. TDBN had a higher bulk density of 1.097 g/ml compared to LDBN of 0.663 g/ml.

Microbiological analysis

The result of count for LDBN for total plate, yeast and mould count were within a safe range of less than 300 colonies per gram (NACMCF, 1997). This may be an indication of good hygienic handling and processing of meat. However, the control (TDBN) has colony counts that were higher than 300. This may be as a result of unhygienic handling by local processors. According to Oyeleke and Danbaba (2007), although the presence and source of these organisms does not present high health hazards, their control is desirable and the presence of some pathogenic organisms call for attention. Bacteriological quality of this product may be enhanced with good manufacturing practices (GMP).

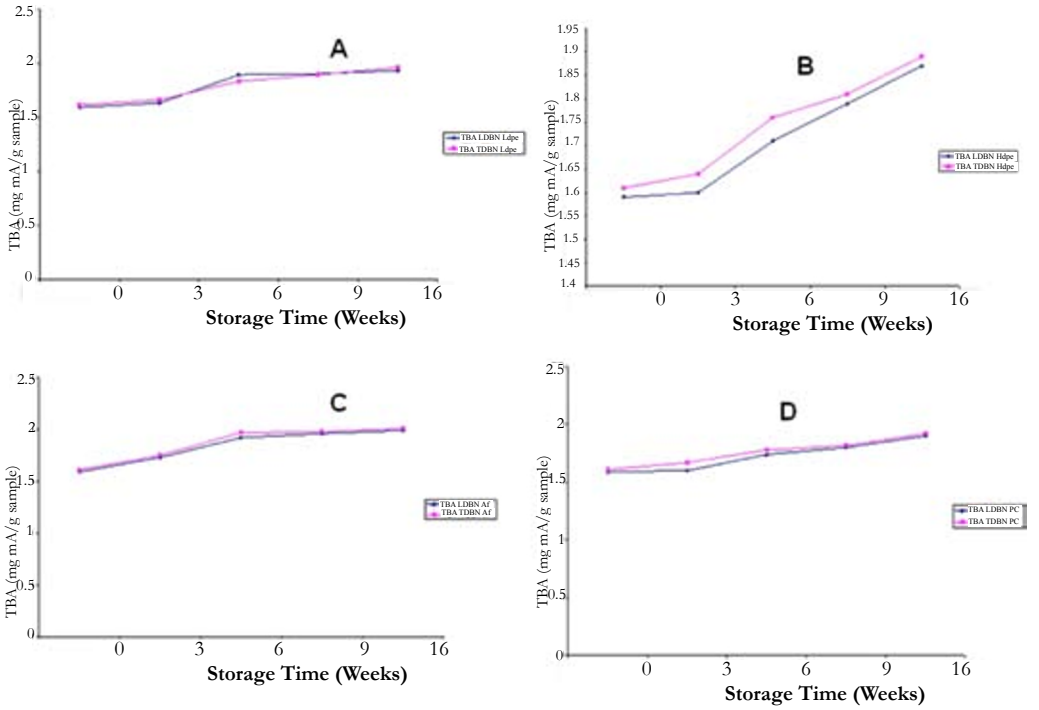

Fig. 2: Variation in TBA with time for LDBN (*) and TBN (*) stored in Ldpe (A), Hdpe (B), Af (C), and Pc (D) respectively for 16 weeks

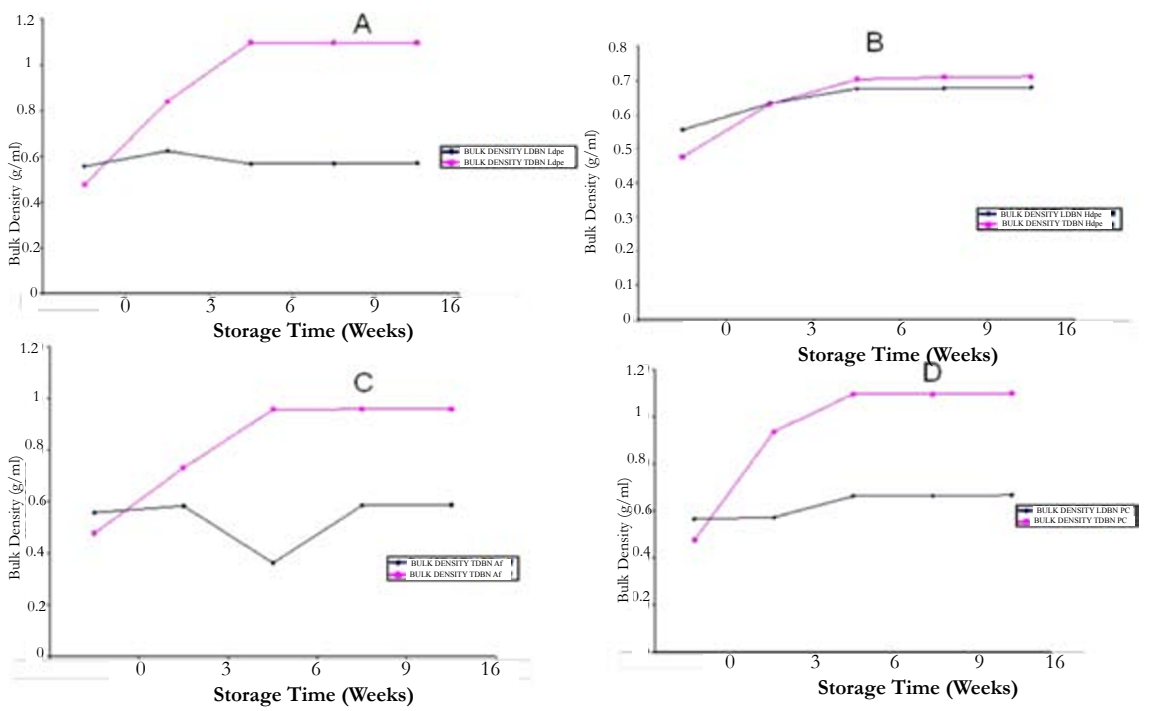

Fig. 3: Variation in bulk density with time for LDBN (*) and TBN (*) stored in Ldpe (A), Hdpe (B), Af (C), and Pc (D) respectively for 16 weeks

Conclusion

From this study the following conclusions are drawn: that cooking (boiling) for 90 min is the best processing technique that gives high fluffiness. The young, vulnerable and aged populace can consume *dambu-nama* because of its tenderness when compared to *kilishi* or *suya*. The added ingredients improve its proximate values and also act as an antioxidant. The packaging materials employed are better used as primary packaging materials for the purpose of commerciailizing the product; these packaging materials will not look attractive and they are too flexible and may take up moisture.

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