

## Sensory and Chemical Evaluation of Beef Based *Dambu-nama* (BBDN)

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**Abstract:** The bioavailability of the Beef Based *Dambu-nama* (BBDN) were evaluated by the analysis of the amino acids, minerals, vitamins and proximate composition using four processing treatments. Samples of Beef Based *Dambu-nama* (BBDN) were processed using (4) separate treatments and analyzed for their sensory and chemical characteristics. The chemical properties evaluated includes; chemical, amino-acid composition and the mineral contents. The treatments were 425 (cooked for 90 min and not fried), 509 (cooked for 60 min and fried for 10 min) and 511 (cooked for 60 min and not fried). The sensory result showed high acceptability of the product though sample 430 (cooked for 90 min and shallow fried for 10 min) was the most preferred. Result of the proximate composition showed that the crude protein was high (37.14-45.86%), low fat content (11.2-17.84%) and high ash content (4.87-5.18%), which indicate that BBDN (beef based *Dambu-nama*) have a high nutrient content. The Thiobarbituric Acid (TBA) value of 0.40-0.45 mgmalaldehyd e/g sample also indicates that there is no lipid oxidation while the high relative pH of 6.32-6.34 indicates that the animal was stressed before or during the slaughtering process. Similarly, the low moisture content (5.10-7.00%) guarantees longer shelf life because of the low water activity which inhibits microbial growth. The amino acid composition also showed that BBDN have excellent values for both essential and non-essential amino acid which are important components for healing and protein synthesis processes. The mineral concentration of BBDN also showed that the Ca/P, Na/K ratio was higher than (1) and thus an excellent food because sodium and potassium are required to maintain osmotic balance of body fluid, pH of the body and regulate muscle and nerve irritability.

**Keywords:** Amino acid, beef based *Dambu-nama*, mineral compositions, proximate and sensory

### INTRODUCTION

Meat makes a valuable contribution to diet in developing countries because of its nutritional importance, as a source of protein, having high biological value, an excellent source of many nutrients; especially protein, fat, B-vitamin, Iron, Zinc and Vitamin A and essential and non-essential amino-acid needed to build, maintain and repair body tissues (Alonge, 1984). Protein malnutrition is a major public health problem in developing world: diets in these parts predominantly starch, the major food crops being roots and tubers (Arberoumand and Deokule, 2009).

Meat deterioration begin soon after it has been slaughtered due to chemical changes, enzymatic action and the action or presence of micro-organisms (bacteria, yeast and mould) which may result in oxidative rancidity, discoloration, moldiness, off flavor, sliminess etc., the major source of these deteriorative changes are the micro-organism and these render the meat unacceptable and unfit for human consumptions (Forrest *et al.*, 2001). All handling, processing and storage methods are therefore primarily concern with

minimizing microbial contamination and retarding microbial growth and activity. Food of animal origin such as meat and meat products contain important nutrients like amino-acids, vitamins, mineral and fatty acid which are essential for growth and development.

Although modern method of meat preservation might be preferred by consumers, refrigeration equipment is expensive to install and difficult to maintain in tropical developing countries, so dried meat produce often maintain their importance.

There are many methods used to prepare dried meat. These include exposure of strips of lean meat to the sun, as in the manufacture of perminican by North American Indians or a combination of salting followed by air drying as in the preparation of charqui (in south American) and Biltong (in south African) (Lawrie, 1991).

*Dambu-nama*-a dried meat product is produced mainly by Hausas and Fulani's in Northern part of Nigeria. The traditional method of preparation has been standardized (Eke *et al.*, 2012). The objective of this study is to evaluate the sensory, chemical, amino acid (essential and non essential), minerals and vitamins

composition of the beef based *Dambu-nama* subjected to four processing treatments.

## MATERIALS AND METHODS

**Materials:** Materials for the production of *Dambu-nama* are beef and ingredient mix (onion ginger, garlic, maggi, sweet pepper, hot pepper and tatashe) were purchased from Makurdi international market and the abattoir, respectively.

**Sample preparation:** Two kilogram (2 kg) each of the beef (*Longissimus dorsi*) was subjected to four treatments. The beef was trimmed of connective tissue and visible fats, cured in 0.02 g of Meta bisulphate for 30 min (Eke *et al.*, 2012). Two samples were cooked for 60 and 90 min without frying while the other two samples were cooked for 60 and 90 min but fried in vegetable oil for 10 min, respectively.

After cooking the samples was pounded and the matrix were separated manually. The separated matrix was dried in hot air oven for 30 min at 60°C and then fried for 10 min while the other two samples that were not fried were dried straight. The fried sample was then dried for the second time for 4-5 h at 60°C to a moisture content of 5-10%. The product was cooled and packaged in Low Density Polythene (LDPE) from were samples were drawn for subsequent analysis.

**Chemical analysis:** The moisture content, crude protein, crude fat, crude fiber and ash content were determined using (AOAC, 2005) methods while the carbohydrates was determined by difference (Ihekoronye and Ngoddy, 1985). pH was determined using pH meter (Lab tech digital 152R). Thiobarbituric Acid (TBA) and the Peroxide Value (PV) were determined using the method of Kirk and Sawyer (1991). The protein solubility at pH of 6.3, available lysine, ammonia and tyrosine was all determined according to the method described by Okonkwo and Obanu (2001). The amino acid profile was determined using ion exchange chromatography (AOAC, 2005). The concentration of some selected minerals was determined using atomic absorption spectrophotometer

(AAS model: Perkin Elmer 2380, USA 1976) according to AOAC (2005) method.

**Sensory evaluation:** The organoleptic quality assessment of the four samples (425, 511, 509 and 430) was evaluated using a 9-point hedonic scale (9 = like extremely to 1 = dislike extremely). The evaluation was based on color, flavor/aroma, texture, taste/mouth feel and general acceptability. A fifteen semi-trained panelist were used and scores obtained was subjected to statistical analysis and means separated using LSD test method (Steel and Torrie, 1960; Iwe, 2002)

## RESULTS AND DISCUSSION

The result of the sensory evaluation of the beef based *Dambu-nama* using four treatments is presented in Table 1. Result showed that there was no significant difference in all the sensory attributes at 5% level of probability. However, sample 430 (cooked for 90 min and fried shallowly for 10 min) was the most acceptable. These may be due to the tendered texture obtained from the cooking and the flavor/aroma, taste impacted by the oil used for frying.

Table 2 showed the chemical composition values obtained from the four treatments. Results showed that at  $p \leq 0.05$ , there was a significant difference for crude protein, carbohydrate, available lysine values for all the treatments. The low moisture values connote low water activity which inhibits microbial growth (Eke *et al.*, 2011). The thiobarbituric acid value ranged between 0.40 mg malonaldehyde/kg samples to 0.45 mg malonaldehyde/kg sample. These indicate the extent of lipid oxidation and these values fall within the acceptable limit (Ogunsola and Omojola, 2008). The available lysine value ranged between 5.86 g/100 g samples to 7.21 g/100 g, this shows that the meat sample cooked for 90 min have a lower value and indicates the nutritive status of the meat. The animal is usually slaughtered without stunning thus subjected to a lot of stress which affects its nutritive value (Okonkwo and Obanu, 1984).

The pH of the samples is relatively high and this can be attributed to the stress the animal encountered before or during slaughtering (Okonkwo and Obanu, 1984).

Table 1: Mean sensory score for Beef Based *Dambu-nama* (BBDN)

Parameter	Sample code				LSD
	511	425	509	430	
Appearance	7.00±1.13 <sup>a</sup>	7.27±1.03 <sup>a</sup>	7.20±1.08 <sup>a</sup>	7.67±1.18 <sup>a</sup>	0.67
Flavor/aroma	6.87±1.68 <sup>a</sup>	6.80±1.52 <sup>a</sup>	6.60±1.72 <sup>a</sup>	7.07±1.39 <sup>a</sup>	0.47
Taste/mouth feel	7.67±1.35 <sup>a</sup>	6.87±1.64 <sup>a</sup>	7.33±1.45 <sup>a</sup>	7.47±1.55 <sup>a</sup>	0.80
Texture	6.73±1.83 <sup>a</sup>	6.67±1.54 <sup>a</sup>	6.53±1.92 <sup>a</sup>	7.13±1.55 <sup>a</sup>	0.60
General acceptability	7.40±1.45 <sup>a</sup>	6.93±1.16 <sup>a</sup>	7.40±1.24 <sup>a</sup>	7.53±1.30 <sup>a</sup>	0.60

Values are mean±standard deviations; Values with same superscript within the same row are not significantly different; LSD: Least significant difference; Sample 425: Cooked for 90 min and not fried; Sample 430: Cooked for 90 min and fried for 10 min; Sample 509: Cooked for 60 min and fried for 10 min; Sample 511: Cooked for 60 min and not fried

Table 2: Chemical composition of Beef Based *Dambu-nama* (BBDN)

Parameters	Sample codes				LSD
	425	430	509	511	
Moisture (%)	5.20 <sup>a</sup>	6.00 <sup>b</sup>	7.00 <sup>c</sup>	5.10 <sup>a</sup>	0.10
Crude protein (%)	41.47 <sup>a</sup>	43.74 <sup>b</sup>	37.14 <sup>c</sup>	45.88 <sup>d</sup>	0.19
Crude fat (%)	11.33 <sup>a</sup>	17.84 <sup>b</sup>	16.26 <sup>c</sup>	11.21 <sup>a</sup>	0.55
Ash (%)	5.18 <sup>a</sup>	5.08 <sup>ac</sup>	4.87 <sup>b</sup>	5.00 <sup>c</sup>	0.12
Carbohydrate (%)	37.06 <sup>a</sup>	27.29 <sup>b</sup>	34.91 <sup>c</sup>	32.91 <sup>d</sup>	0.16
pH	6.33 <sup>a</sup>	6.34 <sup>a</sup>	6.32 <sup>a</sup>	6.33 <sup>a</sup>	0.00
Available lysine (g/100 g protein)	653.90 <sup>a</sup>	586.55 <sup>b</sup>	623.10 <sup>c</sup>	721.60 <sup>d</sup>	1.17
TBA (mg mal/kg)	0.45 <sup>a</sup>	0.46 <sup>a</sup>	0.40 <sup>b</sup>	0.45 <sup>b</sup>	0.00
Peroxide value	0.25 <sup>a</sup>	0.45 <sup>b</sup>	0.55 <sup>c</sup>	0.45 <sup>b</sup>	0.00

Values are means±standard deviations of triplicate determinations; Means with the same superscript within the rows are not significantly different ( $p \geq 0.05$ ); LSD: Least significant difference; Sample 425: Cooked for 90 min and not fried; Sample 430: Cooked for 90 min and fried for 10 min; Sample 509: Cooked for 60 min and fried for 10 min; Sample 511: Cooked for 60 min and not fried

Table 3: Mineral concentrations of Beef Based *Dambu-nama* (BBDN)

Parameters	Sample codes				LSD
	425	430	509	511	
Ca	43.10 <sup>a</sup>	50.17 <sup>b</sup>	50.10 <sup>b</sup>	40.30 <sup>c</sup>	0.69
P	588.40 <sup>a</sup>	756.40 <sup>b</sup>	764.20 <sup>b</sup>	565.10 <sup>c</sup>	11.25
Mg	258.30 <sup>a</sup>	286.40 <sup>b</sup>	246.07 <sup>c</sup>	221.60 <sup>d</sup>	1.05
Na	1450.04 <sup>a</sup>	1756.60 <sup>b</sup>	1756.60 <sup>b</sup>	1242.50 <sup>c</sup>	3.72
K	1125.40 <sup>a</sup>	1384.00 <sup>b</sup>	1314.80 <sup>c</sup>	1112.20 <sup>d</sup>	4.60
Mn	153.17 <sup>a</sup>	181.50 <sup>b</sup>	181.40 <sup>b</sup>	128.73 <sup>c</sup>	1.55
Cu	0.12 <sup>a</sup>	0.28 <sup>a</sup>	0.20 <sup>a</sup>	0.60 <sup>a</sup>	0.73
Pb	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND
S	-	0.12	0.01	-	-

Values are means±standard deviations of triplicate determinations; Means with the same superscript within the rows are not significantly different ( $p \geq 0.05$ ); LSD: Least significant difference; Sample 425: Cooked for 90 min and not fried; Sample 430: Cooked for 90 min and fried for 10 min; Sample 509: Cooked for 60 min and fried for 10 min; Sample 511: Cooked for 60 min and not fried; ND: Not detected

Table 4: Amino acid compositions of Beef Based *Dambu-nama* (BBDN)

Parameters	Sample codes				LSD
	425	430	509	511	
Lysine	654.37 <sup>a</sup>	586.50 <sup>b</sup>	623.10 <sup>c</sup>	722.57 <sup>d</sup>	2.66
Methionine	412.83 <sup>a</sup>	375.03 <sup>b</sup>	382.40 <sup>c</sup>	426.40 <sup>d</sup>	2.71
Threonine	452.17 <sup>a</sup>	420.40 <sup>b</sup>	421.20 <sup>b</sup>	450.60 <sup>a</sup>	20.24
Isoleucine	441.73 <sup>a</sup>	397.73 <sup>b</sup>	412.13 <sup>c</sup>	456.70 <sup>d</sup>	2.43
Leucine	584.30 <sup>a</sup>	546.80 <sup>b</sup>	563.70 <sup>c</sup>	611.90 <sup>d</sup>	2.74
Phenylalanine	276.50 <sup>ab</sup>	223.07 <sup>a</sup>	284.63 <sup>b</sup>	324.73 <sup>b</sup>	54.04
Valine	701.70 <sup>a</sup>	653.33 <sup>b</sup>	685.27 <sup>c</sup>	712.57 <sup>d</sup>	1.53
Tryptophan	204.43 <sup>a</sup>	176.97 <sup>b</sup>	189.70 <sup>c</sup>	213.40 <sup>d</sup>	2.14
Histidine	210.53 <sup>a</sup>	198.17 <sup>b</sup>	207.67 <sup>a</sup>	253.40 <sup>c</sup>	6.47
Arginine	508.47 <sup>a</sup>	583.97 <sup>b</sup>	612.27 <sup>a</sup>	674.33 <sup>a</sup>	196.70
Serine	330.00 <sup>a</sup>	296.10 <sup>b</sup>	325.87 <sup>c</sup>	391.10 <sup>d</sup>	2.41
Tyrosine	544.80 <sup>a</sup>	513.53 <sup>b</sup>	523.23 <sup>c</sup>	586.40 <sup>d</sup>	2.41
Cysteine	572.03 <sup>a</sup>	545.20 <sup>b</sup>	579.50 <sup>c</sup>	584.60 <sup>d</sup>	3.27
Alanine	750.63 <sup>a</sup>	715.00 <sup>b</sup>	756.77 <sup>a</sup>	963.93 <sup>c</sup>	26.67
Aspartic acid	854.83 <sup>a</sup>	766.00 <sup>b</sup>	992.23 <sup>c</sup>	995.00 <sup>c</sup>	2.77
Glutamic acid	1223.30 <sup>a</sup>	1024.40 <sup>b</sup>	1138.00 <sup>a</sup>	1232.70 <sup>c</sup>	19.98
Glycine	643.47 <sup>a</sup>	580.60 <sup>b</sup>	655.90 <sup>c</sup>	727.47 <sup>c</sup>	12.14
Proline	293.77 <sup>a</sup>	243.77 <sup>b</sup>	283.70 <sup>c</sup>	320.33 <sup>d</sup>	3.89
Asparagine	111.03 <sup>a</sup>	998.67 <sup>b</sup>	115.83 <sup>c</sup>	212.00 <sup>d</sup>	3.96
Glutamine	124.63 <sup>a</sup>	101.63 <sup>b</sup>	102.70 <sup>b</sup>	135.00 <sup>c</sup>	3.52

Values are means±standard deviations of triplicate determinations; Means with the same superscript within the rows are not significantly different ( $p \geq 0.05$ ); LSD: Least significant difference; Sample 425: Cooked for 90 min and not fried; Sample 430: Cooked for 90 min and fried for 10 min; Sample 509: Cooked for 60 min and fried for 10 min; Sample 511: Cooked for 60 min and not fried

The mineral concentrations of the sample are presented in Table 3. Sodium (Na) and potassium (K), followed closely by Phosphorus (P) were the most predominant minerals found in *Dambu-nama*, the Na value ranged from 1242.50 to 764.20 mg/kg. K values ranged from 1112.20 to 1384.00 mg/kg and the p values ranged from 565.10 to 764.20 mg/kg. Potassium and

sodium are required to maintain osmotic balance of the body fluid, pH of the body, regulate muscle and nerve irritability, control glucose absorption and enhance normal retention of protein during growth (Fasasi *et al.*, 2010; NRC, 1989). The Recommended Daily Allowance (RDA) for K, Na and P for adult man is 2,500 and 800 Mg respectively assuming 100% absorption (NRC, 1989). Na/K ratio in the body is of great importance for prevention of high blood pressure. Modern diets, which are rich in animal proteins and phosphorus, may promote the loss of calcium in the urine (Shill and Young, 1988). If the ratio of Ca/P is above one, the food is considered good, thus *Dambu-nama* is an excellent product because it have a high Ca/P ratio. The amino acid composition of *Dambu-nama* as presented in 4. Result showed that the most predominant essential amino acid is Valine (653.33 to 712.07 g/100 g) and followed by Lysine (586.50 to 722.57 g/100 g). The non essential amino acid from Table 4 have glutamic acid (1138.00 to 1232.70 g/100 g), which is followed closely by aspartic acid 766.00 to 995.00 g/100 g), respectively. Amino acids are important component for healing and protein synthesis processes, any deficiency in these essential components will hinder the recovery process (Zuraini *et al.*, 2006). According to Witte *et al.* (2002), glycine together with other essential amino acids such as alanine, proline, arginine, serine, isoleucine and phenyl alanine form a poly peptide that will promote growth and tissue healing.

## CONCLUSION

Beef Based *Dambu-nama* (BBDN) was highly acceptable by the sensory panelists in all sensory parameters. The crude protein, ash, amino acid (essential and non essential) and mineral values are very high but low fat content. This connotes high biological value and low lipid oxidation. Similarly, the relatively high pH value connotes that the animal was stressed before or during slaughtering process. Similarly, the moisture content (5.10-7.00%) guarantees longer shelf life because of the low water activity which inhibits microbial growth. The amino acid composition

also showed that BBDN have excellent values for both essential and non essential amino acid which are important component for healing and protein synthesis processes. The mineral concentration of BBDN also showed the Ca/P, Na/K ratio was higher than (1) and thus an excellent food because sodium and potassium are required to maintain osmotic balance of the body fluid, pH of the body and regulate muscle and nerve irritability.

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#### REFERENCES

- Alonge, D.O., 1984. Smoke preservation of meats in Nigeria: Quality and public health aspects. Ph.D. Thesis, University of Ibadan, Ibadan.
- AOAC, 2005. Official Methods of Analysis. 16th Edn., Association of Official Analytical Chemists, Washington, D.C.
- Arberoumand, A. and S.S. Deokule, 2009. Studies on nutritional values of some wild edible plants from Iran and India. Pak. J. Nutr., 8(1): 26-31.
- Eke, M.O., C.C. Ariahu and T.M. Okonkwo, 2011. Moisture sorption characteristics of *Dambu-nama*- A Nigeria dried meat product. Nig. Food J., 30(1).
- Eke, M.O., C.C. Ariahu and T.M. Okonkwo, 2012. Production and quality evaluation of *Dambu-nama*- A Nigerian dried meat product. Nigerian Food J., 30(2).
- Fasasi, O.S., I.A. Adeyemi and O.A. Fagbenro, 2010. Proximate, Mineral, Amino Acid and Fatty acid composition of fermented cassava flour "fufu"-fish powder mix. Nig. Food J., 28(2): 81-90.
- Forrest, J.C., E.D. Aberie, D.E. Gerard, W.E. Mills, H.B. Hedrick, M.D. Judge and R.A. Merke, 2001. The Principles of Meat Science. 4th Edn., Kendall/Hunt Publishing Co., USA.
- Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. 1st Edn., Macmillan Publisher Ltd., London.
- Iwe, M.O., 2002. Hand Book of Sensory Methods and Analysis. Rojoint Communication Services Ltd., Enugu, Nigeria.
- Kirk, R.S. and R. Sawyer, 1991. Pearsons Composition and Analysis of Foods. 9th Edn., Longman Scientific and Technical, London, pp: 530-608.
- Lawrie, R.A., 1991. Meat Science. 6th Edn., Pergamon Press, London.
- NRC (National Research Council), 1989. Recommended Dietary Allowances. 10th Edn., National Academy Press, Washington D.C., USA.
- Ogunsola, O.O. and A.B. Omojola, 2008. Nutritional evaluation of dehydrated shredded meat product. *Dambu-nama*. Pak. J. Nutr., 7(4): 554-556.
- Okonkwo, T.M. and E.A. Obanu, 1984. Studies on the commercial production, consumption and quality of hot smoked meat ("*Banda*" - *Ann-Okpo*" in Nigeria. M.Sc. Thesis, UNN, Nigeria.
- Okonkwo, T.M. and E.A. Obanu, 2001. Improvement of Nigerian smoked meat products through intermediate moisture food processing. Ph.D. Thesis, UNN, Nigeria
- Shill, M.E.G. and V.R. Young, 1988. Modern Nutrition in Health and Disease. In: Nutrition Nieman, D.C., D.E. Butterworth and C.N. Nieman (Eds.), Wine Brow Publisher Dubugne, USA, pp: 276-282.
- Steel, R.G.D. and J.H. Torrie, 1960. Principles and Production of Statistics. McGraw Hill Book Co. Inc., New York.
- Witte, M.B., F.J. Thornton, U. Tantry and A. Barbul, 2002. L-Arginine supplementation enhances diabetic wound healing: involvement of nitric oxide synthesis and arginase pathways. *Metabolism*, 51(10): 1269-1273.
- Zuraini, A., M.N. Somdict, M.N. Solibah, Y.M. Goh, A.K. Arifah, M.S. Zakaria, N. Sonchit, M.A. Rajion, Z.A. Zakaric and A.M. Mat Jais, 2006. Fatty acid and amino acid composition of three local malasian channa spp. *Fish. Food Chem.*, 4(97): 674-678.