

Effect of Roasting Temperature on the Quality and Acceptability of *Dakuwa*

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Abstract
The effect of roasting temperature on the quality of dakuwa was studied with a view to ascertaining the best temperature at which to roast the maize grains and groundnut for the production of dakuwa. Maize grains and groundnut were germinated for 72 hours after which they were dried and roasted at 120, 130, 140 and 150^{0}C. The groundnut was decoated after which both maize and groundnut were milled separately. After milling, the maize flour and groundnut paste were mixed together in equal ratio. To this mixture, 10% and 5% respectively of table sugar and granulated red pepper were added. The mixture was then milled and moulded into balls. The dakuwa produced were analysed for proximate composition, mineral content, microbial count and organoleptic properties using standard methods. Results of proximate composition and mineral content showed significant ($p<0.05$) variations in moisture (3.2-5.9%), protein (16.5-19.1%) and iron (0.00-0.03mg/100g) contents. The total microbial count, colour and overall acceptability also differed significantly ($p<0.05$). The sample roasted at 140^{0}C had the best results.
Keywords: *Dakuwa,* roasting, proximate composition, mineral, sensory.

1.0 Introduction

Snacks are sweet or savoury foods eaten to provide light sustenance in a quick and convenient format, eaten between or as an alternative to main meals (IFIS, 2005). Snack foods are essential vehicles for delivery of essential nutrients because of the growing change in eating habits (Henshaw and Agunbiade, 2004). Snacks serve as a source of macro nutrients and are used for refreshment and entertainment at homes and parties and their production is a means of livelihood and employment especially for women in developing countries (Oke *et al*., 1995). Snacks often contain substantial amount of sweeteners, preservatives and appealing ingredients such as chocolate and peanut.

In Nigeria, snacks are mainly produced and consumed in their areas of production and production is based on art, not scientific knowledge. This leads to possession of variable characteristics (Ingbian and Akpapunam, 2005). Snacks vary with people, culture and geographical locations. Some of the problems associated with the local production of snacks include non standardization of equipment, process and raw material, inadequate hygiene during and after production, and little or no packaging. Consequently the production has not increased beyond cottage industry level.

Dakuwa is a common snack food in central and northern Nigeria. It is produced from a mixture of maize and groundnut flours, ground pepper, ginger, sugar and salt. These ingredients are thoroughly mixed, pounded together and moulded into balls that can be eaten without further processing (Abdulrahman and Kolawole, 2003). Nkama and Gbenyi (2001) and Bagirei and Adegoke (2008) reported that *dakuwa* is also produced from cereals (maize, millet, sorghum), tiger nuts and groundnuts while Oladele *et al*. (2009) reported that the acceptability of *dakuwa* is a function of its flavour, colour and the ingredients used. Ocheme *et al*. (2011a, 2011b) reported that *dakuwa* produced in Niger State (north central Nigeria) varied in composition from one producer to another as a result of non-standardisation in all aspects of production.
The objective of this work is to ascertain the appropriate roasting temperature for *dakuwa* processing with a view to standardizing the processing.

2.0 Materials and Methods

The maize (yellow variety) and groundnut (redskin) used for preparing *dakuwa* were obtained from local farmers at Gidan kwano, Chanchaga Local Government area of Niger State, Nigeria while the sugar and granulated red pepper were obtained from Minna central market, Minna, Nigeria.

Maize grains and groundnut were manually cleaned by handpicking and winnowing. They were then washed in tap water and 400g each were soaked in 2litres of water for 12 hours after which they were germinated for 72 hours. At the end of germination, the maize grains and groundnut was oven dried at 60^{0}C for about 1 hour. The groundnut was then roasted at 120, 130, 140 and 150^0 for thirty minutes while the maize was roasted at 120, 130, 140 and 150^{0}C for sixty minutes. The groundnut was decoated after which both maize and groundnut were milled separately using a local attrition mill. After milling, the maize flour and groundnut paste were mixed together in a ratio of 50:50. To this mixture, 10% and 5% respectively of table sugar and granulated red pepper were added. The mixture was then milled and moulded into balls.

The samples were analysed for proximate composition and mineral content using the method of AOAC (2000) while total microbial count of the samples were carried out using the pour plate method as described by Roberts and Greenwood (2003). The sensory attributes were tested as described by Iwe (2002). Fifteen semi-trained judges made up of students and staff of the Department of Food Science and Nutrition, Federal University of Technology, Minna, Niger state who were familiar with *dakuwa*. The samples were served on tray to each judge separately. Attributes assessed included colour, texture, taste and over all acceptability.

The data obtained were analysed using one way analyses of variance by means of SPSS 16 statistical software.

3.0 Results and Discussion

3.1Proximate composition

The proximate composition of *dakuwa* produced using different roasting temperatures is shown in Table 1. Roasting temperature had a significant effect ($p<0.05$) on the moisture and protein contents of the samples. The higher the roasting temperature, the lower the moisture content of the samples. The protein content of the samples which varied significantly ($p<0.05$) between 16.5% and 19.1%, increased with increasing temperature up to 140^{0}C after which it dropped. Roasting temperature had no significant effect ($p>0.05$) on crude fibre, ash, crude fat and carbohydrate contents of the samples. The significantly lower moisture content in samples roasted at 140^{0}C and 150^{0}C was probably due to higher drying rates at those temperatures compared with the lower temperatures leading to lower moisture content. This is an advantage with respect to keeping quality as lower moisture content will markedly reduce microbial activities. The significant difference observed in the crude protein of the samples is probably due to inter conversion of the constituents of the *dakuwa* from one form to the other as a result of denaturation and/or hydrolysis of proteins and breaking of polysaccharide bonds (Belitz *et al*., 2009). The lack of significance in the ash, crude fibre, fat and carbohydrate contents of the samples shows that though these constituents may be changed from one form to another during roasting, it had no effect on their quantity.

Table 1: Proximate composition of *dakuwa* produced using different roasting temperatures

	Roasting Temperatures (^{0}C)			
Parameter (%)	**120**	**130**	**140**	**150**
Moisture	5.90 ± 0.40^a	4.70 ± 0.01^{ab}	3.90 ± 0.50^{bc}	3.20 ± 0.10^c
Crude Protein	16.50 ± 1.00^b	18.75 ± 0.42^{ab}	19.10 ± 1.08^a	18.90 ± 0.80^{ab}
Crude Fat	24.18 ± 1.00^a	24.50 ± 1.00^a	24.36 ± 1.00^a	25.52 ± 1.00^a
Ash	1.05 ± 0.15^a	1.20 ± 0.20^a	1.03 ± 0.20^a	1.50 ± 0.50^a
Crude Fibre	2.67 ± 0.15^a	2.61 ± 0.15^a	2.13 ± 0.23^a	2.33 ± 0.23^a
Carbohydrate	49.70 ± 2.65^a	48.24 ± 2.45^a	49.48 ± 2.35^a	48.75 ± 1.03^a
AIA (% Ash)	0.24 ± 0.01^a	0.27 ± 0.00^a	0.24 ± 0.00^a	0.25 ± 0.00^a

Values are means ± standard deviation of triplicate determinations. Means in the same row with common superscripts are not significantly different ($p>0.05$).
AIA = Acid insoluble ash; CP = Crude protein

3.2 Mineral content

The mineral contents of the samples are shown in Table 2. There were no significant variations in the sodium, potassium, calcium and phosphorus contents of the samples. Iron was detected in samples roasted at 140 and 150^{0}C only with values of 0.03mg/100g each. The lack of significant differences in the calcium, magnesium, phosphorus and manganese content among the samples shows that the temperature difference had no effect on the mineral content *dakuwa.* By implication, in the course of *dakuwa* production, with respect to mineral content, milling and sieving operations may be of more significance than roasting temperature.

Table 2: Some mineral contents of *dakuwa* produced using different roasting temperatures

	Roasting Temperatures (^{0}C)			
Mineral (mg/100g)	**120**	**130**	**140**	**150**
Sodium	7.14 ± 1.01^a	$8.64.\pm1.00^a$	8.32 ± 1.00^a	8.15 ± 1.00^a
Potassium	108.36 ± 1.24^b	105.13 ± 1.00^a	105.32 ± 1.52^a	104.20 ± 1.12^a
Calcium	29.95 ± 0.52^a	29.46 ± 1.72^a	34.42 ± 2.14^a	32.48 ± 0.91^a
Phosphorus	308.39 ± 3.10^a	311.42 ± 1.35^a	314.64 ± 3.08^a	306.78 ± 2.26^a
Iron	ND	ND	0.03 ± 0.00^a	0.03 ± 0.00^a
Magnesium	6.35 ± 1.00^a	6.35 ± 1.00^a	7.33 ± 1.00^a	7.33 ± 1.00^a
Manganese	1.50 ± 1.00^a	2.20 ± 1.10^a	1.90 ± 1.00^a	2.30 ± 1.00^a

Values are means ± standard deviation of triplicate determinations.
Means in the same row with common superscripts are not significantly different (p>0.05)

3.3 Microbial load

The microbial load of the samples is shown in Table 3. All the samples showed bacterial and mould growth while yeast growth was only detected in the sample roasted at 120^0C. The sample roasted at 130^0C had the highest bacterial count of $7.9x10^2$ while that roasted at120^0C had the lowest count of $1.15x10^2$. No mould was detected in the sample roasted at 130^0C while that roasted at 150^0C had the highest mould count of $6x10^2$. The significantly higher bacterial count in the sample roasted at 120^0C could be as a result of the lower toasting temperature. Generally, most pathogens are killed by pasteurization in the temperature range of 60–90^0C (Lewis, 2006). However, temperatures in excess of 100^0C are needed to inactivate heat resistant spores. To ensure that food products are commercially sterile, a temperature of 110-125^0C must be applied for ten minutes or longer (Lewis, 2006). Since the toasting temperatures were above pasteurization temperatures, the bacteria present are probably not pathogens but spoilage organisms which presence may be due to contamination after production of the samples. The level of microbes in the samples were within the acceptable limit set by the International Commission for Microbiological Safety of Foods (ICMSF, 1986)

Table 3: Total microbial count of *dakuwa* produced using different roasting temperature

	Roasting Temperatures (^{0}C)			
Type of organism (cfu/g)	**120**	**130**	**140**	**150**
Bacteria	$1.15x10^{2c}$	$7.90\ x10^{2a}$	$2.30x10^{2a}$	$1.30x10^{2b}$
Yeast	$7.2x10^{2a}$	ND	ND	ND
Mould	$1x10^{2b}$	ND	$1x10^{2b}$	$6x10^{2a}$

Means in the same row with common superscripts are not significantly different (p>0.05)
ND = not detected

3.4 Sensory properties

The mean sensory scores of the samples are shown in Table 4. The colour of the sample roasted at 120^0C was most preferred and was significantly different (p<0.05) from other samples. On the basis of texture, aroma and taste, there was no significant difference in the samples' scores. Overall, samples roasted at 140^0C were most preferred while those roasted at 150^0C were the least preferred. The significantly higher mean sensory score recorded by the sample roasted at 120^0C indicates that the panellists preferred lighter coloured *dakuwa* as compared with slightly darker ones since roasting at higher temperatures will cause more caramelization to occur thereby yielding a darker or more coloured product. The lack of significance with respect to texture is expected given that all the samples had the same particle size. The mean sensory scores for aroma and taste indicate that the roasting temperatures did not significantly affect the formation of aroma precursors.

Table 4: Mean sensory scores of *dakuwa* produced using different roasting temperature

	Roasting Temperatures (^{0}C)			
Attribute	**120**	**130**	**140**	**150**
Colour	6.20^a	5.47^b	5.53^b	5.60^b
Texture	6.73^a	6.73^a	6.60^a	6.54^a
Aroma	6.27^a	6.40^a	6.60^a	6.13^a
Taste	5.40^a	5.67^a	5.40^a	5.33^a
Overall acceptability	6.13^{ab}	5.80^b	6.53^a	5.10^c

Means in the same row with common superscripts are not significantly different (p>0.05).
Scores are based on a seven point scale: 7 = like very much; 4 = neither like nor dislike; 1 = dislike very much.

4.0 Conclusions

Roasting temperature affected the moisture, crude protein and crude fat of *dakuwa* but had no effect on the mineral content. Though roasting temperature significantly affected the colour and overall acceptability of the samples, none of the sample was rejected on all attributes tested. On the basis of crude protein, moisture and iron contents as well as overall acceptability, the roasting of maize grains and groundnut should be done at 140^0C.

Refernces

Abdulrahman, A.A. and Kolawole, O.M. (2003). Traditional preparation and uses of maize in Nigeria. *African Journal of Biotechnology*, (3) 1-5.

Achi, O.K. (2005). The potential for upgrading traditional fermented foods through biotechnology. *African Journal of Biotechnology*, 4 (5): 375-380.

AOAC. (2000). *Official Methods of analysis,* 17thedition. Association of Official Analytical Chemists. Washington, D.C.

Bagirei, S.Y. and Adegoke, G.O. (2008). Effects of roasting and *Aframomum Danielli* extract on aflatoxin level of dakuwa: an indigenous snack. *Proceedings of the 32nd Annual Conference and General Meeting of Nigerian Institute of Food Science and Technology*, Ogbomosho, Nigeria. Otunola ET, Ade-Omowaiye BIO, Fapojuwo OO, Adejuyitan JA, Akinwande BO, Abioye BF. (Editors).

Belitz, H.D., Grosch, W. and Schieberle, P. (2009). *Food Chemistry* (4th Revised and extended edition). Springer-Verlag: Berlin, Heidelberg.

Henshaw, R.B. and Agungiade, M.O. (2004). Food Oils and Fats Technology: Utilization and Nutrition. Chapman and Hall, England

ICMSF (1986). International Commission of Microbiological Standards for Foods. *Microorganisms in Food 2. Sampling for microbial analysis. Principles and Specific Applications.* University of Toronto Press, Toronto, Canada.

IFIS (2005). *Dictionary of Food Science and Technology*. Blackwell Publishing, Oxford, UK.

Ingbian, E.K. and Akpapunam, M.A. (2005) Appraisal of traditional technologies in the processing and utilisation of *mumu*, a cereal based local food product. *African Journal of Food, Agriculture, Nutrition and Development*, 5 (2) 11-15.

Iwe, M.O. (2002). *Handbook of Sensory Methods and Analysis*. Rojoint Communications Services Ltd, Enugu, Nigeria.

Lasekan, O.O. and Akintola, A.M. (2002) Production and nutritional evaluation of puffed soy-maize snack. *Nigerian Food Journal*, 20: 15-19

Lewis, M.J. (2006). *Thermal Processing.* In: Food Processing Handbook. Brennan, J.G. (Editor). WILEY-VCH, Weinheim, Germany.

Nkama, I. and Gbenyi, D.I. (2001). The effect of malting of millet and sorghum on the residua phytates and polyphenols in dakuwa – a Nigerian cereal-legume snack food. *Nigerian Journal of Tropical Agriculture*, 3: 270-275.

Ocheme, O.B., Ariahu, C.C. and Igyor, M.A. (2011a). Assessment of traditionally produced dakuwa (a cereal/legume based Nigerian snack) in Niger State, Nigeria *Nigerian Food Journal*, 29(1): 63-69

Ocheme, O.B., Ariahu, C.C., Ingbian, E.K and Igyor, M.A. (2011b). A survey of the traditional methods of processing *dakuwa* (a cereal/legume based snack food) in Niger State, Nigeria. *Nigerian Food Journal*, 29(1): 103-112

Oke, O.V., Oluwole, O.B., Adeyoju, O.A., Ajayi, T.O., Ozumba, A.U. and Solomon H.M. (1995) Effects of packaging on moisture content and organoleptic qualities of coconut snack during storage. *Nigerian Food Journal*, 18 (2) 13-15.

Oladele, A.K., Ibanga, U.I. and Adebesin, O.L. (2009). Effect of substituting maize with tigernut on the quality and acceptability of dakuwa. *Proceedings of the 33rd Annual Conference and General Meeting of Nigerian Institute of Food Science and Technology*, Yola, Nigeria. Nkama I, Idakwo P, Negbenebor CA, Abubakar U, Bagerie SY, and Chibuz EZ. (Editors).

Roberts, D. and Greenwood, M. (2003). Practical Food Microbiology (3rd Edition). Blackwell Publishing, Oxford.

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