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QUALITY EVALUATION OF *DAKUWA* AND EFFECT OF RATIOS OF TIGERNUT TO GROUNDNUT IN *DAKUWA* PRODUCTION

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ABSTRACT

Evaluation of market and laboratory-processed samples of *Dakuwa* and effects of ratios of tiger nut to groundnut mix (4:1, 3:1, 2:1 and 1:1) on their organoleptic acceptability were carried out through field, laboratory and sensory studies. Results showed tiger nut and groundnuts were major cereals used for *Dakuwa* production, though sorghum and maize in place of tiger nuts were used by few producers. Ratios of tiger nut to groundnut varied (3:1, 2:1 and 4:1) but ratio 2:1 was most popular. Significant differences were observed for moisture, lipid, protein, ash and pH of both laboratory and market samples ($P \leq 0.05$). High microbial load of market samples suggested unsanitary production and handling. Laboratory and market samples were respectively for moisture: 11.67 to 16.50 and 23.33 to 39.20; for lipid: 24.86 to 30.04 and 24.97 to 32.56; for protein: 7.80 to 9.00 and 7.90 to 10.27; ash: 1.63 to 2.50 to 3.48; and pH: 5.79 to 5.95 and 6.15 to 6.59 while higher microbial loads were observed for market samples. Except MD-DD, all samples of *Dakuwa* were acceptable as their sensory scores were less than 4.0 on a 7-point scale. Significant differences were observed on general acceptability for both the market and laboratory samples ($P \leq 0.05$). MD-BB was most liked for market samples whereas LD-BB was most liked for laboratory sample. The least liked ratio of tiger nut to groundnut in *Dakuwa* formulation was 4:1. In conclusion, no significant differences ($P \geq 0.05$) were observed between *Dakuwa* samples made from ratios 3:1, 2:1 and 1:1 but numerically ratio 2:1 was the most acceptable.

Keywords: *Dakuwa*, Groundnut, Tigernut, quality.

INTRODUCTION

Dakuwa is a traditional snack, prominent in northern Nigeria. It is made from roasted tiger nut and groundnut; it can also be made from roasted sorghum and maize (Bagirie and Adegoke, 2008). In the production of *dakuwa*, the quantity of tiger nut is usually higher than that of groundnut probably due to the high fat content of the groundnut of which if too high may render the product unacceptable. To this effect some communities use defatted groundnut paste in an effort to reduce the oil content of the final product Nuru (1985). It is produced by cleaning and roasting tiger nut and groundnut separately. They are milled together with spices (ginger and pepper) and is pounded with sugar added to it. Mixing of various proportions of legumes is pounded continuously until a thick, stiff mass is obtained Nuru (1985). It was reported that the pounding continues until it becomes sticky, then it is molded and packed (Bagirie and Adegoke, 2008).

In their assessment of market samples of *dakuwa* produced in Niger State Nigeria, Ocheme and co-workers reported non uniformity in proximate and mineral (sodium, potassium, calcium and phosphorus) compositions, microbial loads and sensory values ($P \leq 0.05$) of products (Ocheme *et al.*, 2011).

Dakuwa production is a major occupation for many women and young girls who can be seen hawking the products throughout the northern states of Nigeria. It is a shelf-stable product and can be kept for about six (6) months at room temperature (Nuru, 1985). "*Dakuwa*" commands great economic importance among the local communities of northern Nigeria as the product features prominently in social functions such as wedding and other ceremonies. It is used during traditional festival such as "*gulla-gulla*" (traditional festival), "*share*" (traditional festival), and "*Dogo-Dogo*" in Michika local government area Adamawa State and occasion like the installation of chiefs and emirs (Nuru, 1985).

Local snacks generally face a lot of problems that militate against their development. Those problems specific to *dakuwa* include differences in raw materials, processing operations hygiene, etc and these result in not only non uniform but also poor quality products. Therefore, the objectives of this research are to find out different methods of *dakuwa* production, to find out the effect of ratios of groundnut to tiger nut mix on *dakuwa* acceptability and to evaluate self-laboratory and market samples of *dakuwa*.

MATERIALS AND METHODS

The raw materials used for this research were: groundnuts, tiger nut, white crystal sugar and spices (ginger and pepper) which were obtained from the Jemita modern market Yola, Adamawa State. Reagents for analysis were obtained from the Department of Food Science and Technology laboratory of Modibo Adama university of Technology (MAUTECH) Yola, Adamawa State, Nigeria.

Market samples of *dakuwa* used for this research were collected from four different producers who sell their *dakuwa* in the commercial centre of Modibo Adama university of Technology (MAUTECH) Yola, Adamawa State, Nigeria. They four *dakuwa* samples were labeled MD-AA, MD-BB, MD-CC and MD-DD.

Oral Interview

Oral interview was conducted on five producers of *dakuwa* selling the product at Modibo Adama University of Technology (MAUTECH), Yola, Nigeria commercial

centre. Information sought was on their methods of production, types and ratios of raw materials employed in their production. Also different market samples from four interviewed producers/sellers were selected for study of chemical and sensory evaluations.

Raw Materials Preparations

Before the *dakuwa* processing, the raw materials were prepared first. The method of Abodurin and Belewu were adopted in production of roasted tiger nut [4]. Here, tiger nut was sorted and graded to remove impurities. It was weighed and roasted for 12-14 minute at 130°C before sifting to remove debris.

Groundnut, which is the second important raw material, was sorted and cleaned to remove impurities. It was weighed roasted for about 10 – 14 minutes at 120°C and dehulled manually using hands Okaka (1997). For the spices, dried ginger and pepper were pounded into powder and then sieved using a sieve to remove large particles (Bagirei and Adegoke,2008).

Dakuwa processing

This was done as described by Bagirei and Adegoke (2008). The tiger nut and groundnut were milled together. The spices were added to the milled tiger nut and groundnuts and then pounded until it became sticky. Then it was molded with hands and packaged in a polythene bag. The processing flow chart is as shown in Figure 1 and the ratios of roasted groundnut to tiger nut used for *Dakuwa* processing in the laboratory and their corresponding sample labels are given in Table 1.

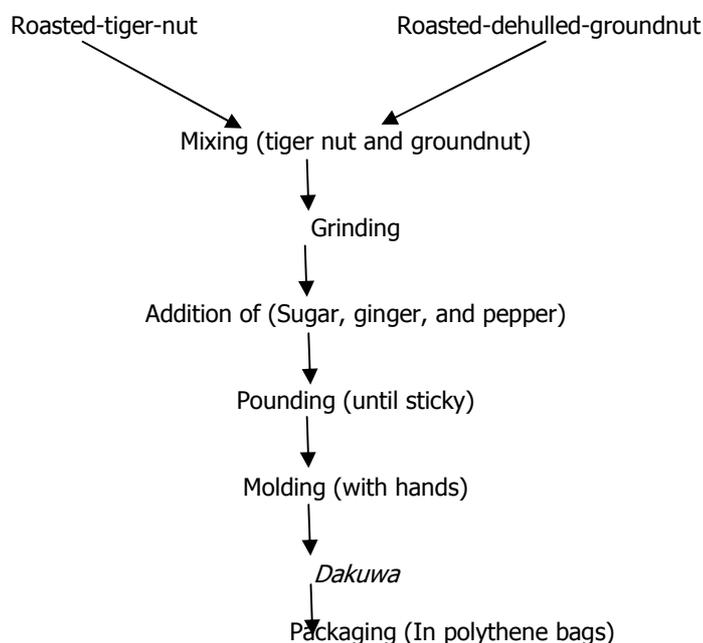


Figure 1: Flow chart for *Dakuwa* processing.

Table 1: Tiger nut to groundnut ratio used in laboratory preparation of *Dakuwa*

S/No	Groundnut weight (G)	Tiger nut weight (T)	Ratios of (T) to (G)	Labels
1.	1kg	250g	4: 1	LD-AA
2.	1kg	333.33g	3: 1	LD-BB
3.	1kg	500g	2: 1	LD-CC
4.	500g	500g	1: 1	LD-DD

Methods of analyses

Physicochemical analyses were as reported by Kirk (1991) and AOAC (1990). Moisture content determination was by hot-air oven method while lipid analysis was by soxhlet apparatus and protein content determination by Micro-Kjedahl method. Ash content determination was done using a muffle furnace while the digital pH metre was used for pH measurement Kirk (1991). A seven-point Hedonic scale was used to evaluate organoleptic acceptability of both market and laboratory samples of *dakuwa*. Sensory factors were; taste, flavor, color, appearance, texture (mouth feel), softness (finger feel) and general acceptability. Sensory scores ranged from 1 = liked much to 7 = disliked much. Total plate bacterial count for both market and laboratory samples was carried out Diliello (1982).

RESULTS AND DISCUSSION

Oral Interview

It was found out that the raw materials for the production of *dakuwa* were mainly tiger nut and groundnuts. Also sorghum and maize were used also used by few of the producers in place of tiger nuts. Findings also showed that the ratios of tiger nut to groundnut varied and included 3:1, 2:1 and 4:1 but ratio 2:1 was most popular.

Oral interview results also showed that the processing operations for *dakuwa* differ from place to place based on the raw materials, their ratios and spices. Some producers use tiger nut and groundnut only, others uses maize and sorghum and others add sugar and spices while others do not. Report shows that three of the producers roast the tiger nut and groundnut for about 12-15 minutes, they are then cleaned by removing the impurities, it is then milled them separately and pounded with sugar until it becomes sticky. One of the producers, after roasting the tiger nut, maize and groundnut, it was then milled together with sugar and spices added to it, it was then pounded until it becomes sticky.

Personal observation showed that the safety of most of these products is questionable. They were not produced under sanitary and healthy environment. The processing utensils were not clean. For example, two of the producers did not wash their hands before moulding the *dakuwa* into balls. One of the producers worked in a dirty environment and one of the producers did not clean the dishes used.

Physicochemical analyses

Table 2 gives the percentage moisture, lipid, protein and ash compositions of market and laboratory processed *dakuwa* samples. The pH and total bacterial plate count of *dakuwa* samples are also given table 2. Significant differences were observed for moisture, lipid, protein and ash contents as well as for the pH of the *dakuwa* samples ($P \leq 0.05$). The values of the moisture contents of the market samples of *dakuwa* were much higher (23.33 to 39.20) when compared to the values (11.67 to 16.50) of laboratory processed *dakuwa* samples.

But this trend in variation for the between the *dakuwa* samples was also observed for total bacterial count, partially observed for the pH and not observed for protein, lipid and ash contents (Table 2).

The high microbial load of the market samples is an indication of unsanitary production handling of the samples. Additionally, all the *dakuwa* samples were slightly acidic but the pHs of market samples were comparatively slightly lower than the laboratory processed samples.

Table 3 refers to the mean sensory scores of 15 taste panelists on the market samples of *dakuwa*. The samples were not uniform as significant differences were observed flavour, appearance, taste, colour and general acceptability while there was no significant difference observed for the texture i.e. mouth-feel and finger-feel ($P = 0.05$). This result confirms the findings of Ocheme *et al.* (2011). Generally the most disliked sample was the MD-DD, which the best sensory score was 3.50 for firmness and the worst was 4.40 for flavour. Also the best organoleptically rated *dakuwa* market sample was the MD-BB, which the best sensory score was 2.10 for colour and the worst was 3.0 for both taste and texture.

Table 4 gives the sensory values of laboratory prepared *dakuwa* samples with different ratios of tiger nut to groundnut formulations. Significant differences were observed only in appearance, colour, softness and general acceptability ($P \leq 0.05$).

The mean sensory scores for all the sensory factors and for all the samples were all less than 4.0 on a seven-point Hedonic scale. In general the least liked ratio of groundnut to tiger nut in *dakuwa* formulation was the 4:1, where all the sensory factors were least rated. In conclusion, there were no significant differences observed between *dakuwa* samples made from ratios 3:1, 2:1 and 1:1. This finding is contrary to the report of Adegoke and Bagirei (2008) and Nuru (1985) that ratio 2:1 is most acceptable in *dakuwa* formulation.

Table 2: Total bacterial count, pH and percentage moisture, lipid, protein and ash compositions of market and laboratory processed *dakuwa* samples.

No	Sample	(T) to (G) ratio	%M.C	%Fat	%Protein	%Ash	pH	TPC
1	MD-AA	N/A	23.33 ± 1.53 ^d	27.85 ± 0.23 ^b	7.90 ± 0.10 ^a	3.27 ± 0.21 ^f	6.15 ± 0.15 ^c	TNTC
2	MD-BB	N/A	28.33 ± 0.76 ^e	24.97 ± 0.15 ^a	8.90 ± 0.78 ^b	3.48 ± 0.08 ^g	6.39 ± 0.01 ^d	TNTC
3	MD-CC	N/A	34.00 ± 1.00 ^f	32.56 ± 0.41 ^f	10.50 ± 0.10 ^c	2.50 ± 0.01 ^d	6.55 ± 0.04 ^e	34.00×10 ²
4	MD-DD	N/A	39.20 ± 0.82 ^g	31.10 ± 0.10 ^e	10.27 ± 0.11 ^c	2.50 ± 0.01 ^d	6.59 ± 0.01 ^e	29.00×10 ²
5	LD-AA	4: 1	11.67 ± 0.67 ^a	24.86 ± 0.32 ^a	7.80 ± 0.10 ^a	1.63 ± 0.15 ^a	5.89 ± 0.01 ^{ab}	3.00×10 ²
6	LD-BB	3: 1	12.50 ± 0.50 ^a	28.33 ± 0.63 ^b	8.00 ± 0.05 ^a	1.83 ± 0.08 ^e	5.79 ± 0.01 ^a	2.29×10 ²
7	LD-CC	2: 1	14.53 ± 0.45 ^b	28.95 ± 0.05 ^c	8.23 ± 0.15 ^a	2.98 ± 0.02 ^c	5.85 ± 0.02 ^{ab}	2.06×10 ²
8	LD-DD	1: 1	16.50 ± 0.50 ^c	30.04 ± 0.05 ^d	9.00 ± 0.05 ^b	2.20 ± 0.10 ^c	5.95 ± 0.05 ^b	2.10×10 ²

NB:

- i. Figures are means of three replicates
- ii. Means in the same column bearing the same superscript are not significantly different from each other ($P \leq 0.5$).
- iii. MD-AA, MD-BB, MD-CC & MD-DD = Market samples of *dakuwa*
- iv. LD-AA, LD-BB, LD-CC & LD-DD = Laboratory processed samples of *dakuwa*
- v. M. C. = Moisture content
- vi. TNTC- Too numerous to count; TPC- Total plate count
- vii. (G) to (T) ratio = Groundnut to tiger nut ratio in *dakuwa* formulation in the laboratory N / A = Not available

Table 3: Organoleptic Assessment of Market samples of *Dakuwa*

Sensory factors	MD-AA	MD-BB	MD-CC	MD-DD
Flavour	2.90 ± 1.10 ^a	2.60 ± 0.97 ^a	2.90 ± 0.74 ^a	4.40 ± 1.43 ^b
Appearance	3.10 ± 1.45 ^a	2.40 ± 1.35 ^a	3.70 ± 1.89 ^a	3.90 ± 1.10 ^b
Taste	2.50 ± 0.97 ^a	3.00 ± 1.49 ^a	3.00 ± 1.49 ^a	4.40 ± 1.32 ^b
Colour	2.70 ± 1.60 ^a	2.10 ± 1.29 ^a	2.70 ± 1.25 ^a	4.30 ± 1.25 ^b
Texture (Mouth-feel)	3.68 ± 1.73	3.00 ± 0.82	2.60 ± 1.35	3.90 ± 1.45
Softness (finger-feel)	2.80 ± 1.14	2.70 ± 1.25	2.50 ± 1.27	3.50 ± 1.51
General Acceptability	3.30 ± 1.06 ^a	2.80 ± 0.63 ^a	3.10 ± 1.37 ^a	4.30 ± 0.95 ^b

- i. Sensory scores are means of fifteen taste-panelists ± standard deviations on a 7-point Hedonic sensory scale with 1=liked very much and 7 = disliked very much
- ii. Within each row, means with same or no superscript are not significantly different from each other ($P = 0.05$).

Table 4: Organoleptic Assessment of Laboratory produced samples of *Dakuwa*

Samples (G) to (T) Ratio	LD-AA	LD-BB	LD-CC	LD-DD
(G) to (T) Ratio	4: 1	3: 1	2: 1	1: 1
Sensory factors				
Flavour	3.00 ± 1.37	2.16 ± 0.90	2.26 ± 0.93	2.84 ± 1.61
Appearance	3.58 ± 1.42 ^b	2.00 ± 0.58 ^a	2.26 ± 1.05 ^a	3.32 ± 1.80 ^a
Taste	3.32 ± 1.42	2.26 ± 1.41	2.47 ± 1.35	3.00 ± 1.80
Colour	3.95 ± 1.58 ^b	2.79 ± 1.32 ^a	2.42 ± 0.77 ^a	3.00 ± 1.41 ^a
Texture (Mouth-feel)	3.68 ± 1.73	2.37 ± 1.38	2.74 ± 0.99	3.00 ± 1.41
Softness (finger-feel)	3.90 ± 1.70 ^b	2.11 ± 0.81 ^a	2.26 ± 1.05 ^a	2.32 ± 1.53 ^a
General Acceptability	3.63 ± 1.07 ^b	2.32 ± 0.67 ^a	2.47 ± 0.47 ^a	2.90 ± 1.33 ^a

- i. Sensory scores are means of fifteen taste-panelists ± standard deviations on a 7-point Hedonic sensory scale with 1=liked very much and 7 = disliked very much
- ii. Within each row, means with same or no superscript are not significantly different from each other ($P = 0.05$).
- iii. (G) to (T) ratio = Groundnut to tiger nut ratio in *dakuwa* formulation in the laborator

Table 5: Mean sensory scores (Hedonic taste) on market and laboratory processed *Dakuwa* samples.

No	Samples	(T) to (G) ratio	Flavour	Appearance	Taste	Colour	Texture (Mouth-feel)	Softness (finger-feel)	General Acceptability
Lab-samples									
LD-AA	N/A		3.00 ± 1.37 ^a	3.58 ± 1.42 ^{cd}	3.32 ± 1.42 ^a	3.95 ± 1.58 ^b	3.68 ± 1.73 ^{bc}	3.90 ± 1.70 ^c	3.63 ± 1.07 ^{cd}
LD-BB	N/A		2.16 ± 0.90 ^a	2.00 ± 0.58 ^a	2.26 ± 1.41 ^a	2.79 ± 1.32 ^a	2.37 ± 1.38 ^a	2.11 ± 0.81 ^a	2.32 ± 0.67 ^a
LD-CC	N/A		2.26 ± 0.93 ^a	2.26 ± 1.05 ^{ab}	2.47 ± 1.35 ^a	2.42 ± 0.77 ^a	2.74 ± 0.99 ^{abc}	2.26 ± 1.05 ^a	2.47 ± 0.47 ^{ab}
LD-DD	N/A		2.84 ± 1.61 ^a	3.32 ± 1.80 ^{bcd}	3.00 ± 1.80 ^a	3.00 ± 1.41 ^a	3.00 ± 1.41 ^{abc}	2.32 ± 1.53 ^a	2.90 ± 1.33 ^{abc}
Market samples									
MD-AA	4: 1		2.90 ± 1.10 ^a	3.10 ± 1.45 ^{abcd}	2.50 ± 0.97 ^a	2.70 ± 1.60 ^a	3.68 ± 1.73 ^{abc}	2.80 ± 1.14 ^{ab}	3.30 ± 1.06 ^{bc}
MD-BB	3: 1		2.60 ± 0.97 ^a	2.40 ± 1.35 ^{abc}	3.00 ± 1.49 ^a	2.10 ± 1.29 ^a	3.00 ± 0.82 ^{abc}	2.70 ± 1.25 ^{ab}	2.80 ± 0.63 ^{abc}
MD-CC	2: 1		2.90 ± 0.74 ^a	3.70 ± 1.89 ^d	3.00 ± 1.49 ^a	2.70 ± 1.25 ^a	2.60 ± 1.35 ^{ab}	2.50 ± 1.27 ^{ab}	3.10 ± 1.37 ^{abc}
MD-DD	1: 1		4.40 ± 1.43 ^b	3.90 ± 1.10 ^d	4.40 ± 1.32 ^b	4.30 ± 1.25 ^b	3.90 ± 1.45 ^c	3.50 ± 1.51 ^{bc}	4.30 ± 0.95 ^d

NB:

- Figures are means of three replicates
- Means in the same column bearing the same superscript are not significantly different from each other ($P \leq 0.5$).
- MD-AA, MD-BB, MD-CC & MD-DD = Market samples of *dakuwa*
- LD-AA, LD-BB, LD-CC & LD-DD = Laboratory processed samples of *dakuwa*
- (T) to (G) ratio = Tiger nut to groundnut ratio in *dakuwa* formulation in the laboratory N / A = Not available

Comparison between the mean sensory scores of market and laboratory samples of *Dakuwa* is shown in table 5. Significant differences were observed for all the sensory parameters ($P \leq 0.05$). Except for the market sample MD-DD, no other *Dakuwa* samples have any sensory score above 4.0 i.e. neither liked nor disliked. Also, laboratory samples produced from 2:1 and 3:1 tiger nut to groundnut ratio in *Dakuwa* formulation were rated the best.

Conclusion

Survey results on methods of *dakuwa* production showed non-uniformity among different types of *dakuwa* producers. This was also reflected in the

physicochemical and organoleptic attributes of the different *Dakuwa* market samples. For the laboratory processed samples using four ratios of groundnut to tiger nut (1:1, 2:1, 3:1 and 4:1) it was found out that as the quantity of groundnut increased, the texture of the *Dakuwa* became stickier. Also the total plate count of all the laboratory *dakuwa* samples were within the acceptable limit 10^2 to 10^3 cfu/ml as reported by Adams and Moss (1999). Finally, *Dakuwa* produced from ratios 3:1 of groundnut to tiger nut was found to be the best overall in general acceptability, flavor, appearance, and color for both market and laboratory *Dakuwa* samples.

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