*JHER Vol. 18, September, 2013, pp. 62-69*

# Production, Proximate and Sensory Evaluation of "*Gulguli*" a Nigerian Indigenous Snack/Meal

**Abubakar[1], H.F., Umoh[2], E.J., Ikya[3], J.K. & *Oni[4], O.K.**

[1]Department of Extension and Management Sciences, College of Education, Mubi, Nigeria
[2]Department of Home Science and Management, University of Agriculture, Makurdi. Nigeria
[3]Department of Food Science and Technology, University of Agriculture, Makurdi. Nigeria
[4]Department of Food Science and Technology, University of Mkar, Mkar. Nigeria

**Abstract**

The study was carried out to improve on the production of *Gulguli* using sorghum. A formula was developed from the original production of *Gulguli* from African arrowroot lily ("Dumsu") /groundnut at the ratio of 80:20 as control (sample A) to sorghum/groundnut blends by varying the levels of groundnut. The blends were formulated thus: sample B (sorghum/groundnut, 80:20), sample C (sorghum/groundnut, 70:30), sample D (sorghum/groundnut, 60:40) and sample E (sorghum/groundnut, 50:50). Standard techniques were used to analyze the proximate and organoleptic attributes. Data were statistically analyzed using pair comparison test method. Results showed that sample B had the highest moisture content (39.00%) and carbohydrate content (61.50%). However, sample E appears to have the most desirable/highest nutrient profile (crude fat content 40.20%, ash content 2.80%, crude protein 26.25%, and crude fibre 1.95%) and organoleptic attributes (7.60) on a 9-point descriptive hedonic scale, thus most acceptable for consumption.

**Keywords**: *Gulguli,* Indigenous, Production, Proximate, Sensory Evaluation

## Introduction

*Gulguli* is a indigenous snack/meal from African arrowroot lily (*Tacca involucrata*) / "Dumsu" (Fulani name for African arrowroot lily) and groundnut (*Arachis hypogeal L.*) which are consumed by both adult and children among "Fulanis, Verawas, Dandankwo, Chambawas, Kilba' and many other tribes in Adamawa State of Nigeria. Nowadays people are using sorghum (*Sorghum bicolor L.*) as an alternative for the production of *Gulguli*. Sorghum is one of the most important crops in Africa with more than 35% grown directly for human consumption (Anglani, 1998; Awika and Rooney, 2004). Dikko, Hilhorst and Traore (2005) emphasized that sorghum grains are generally used for the preparation of "ogi" (porridge) and couscous. Kangama and Rumei (2005) stressed that more that 7000 sorghum varieties have been identified; therefore there is a need of their further uses in the production of traditional diets.

African arrowroot lily (or "Dumsu") is a perennial plant that belongs to the

family *Araceae* of the other Arales. It is native to tropical Africa, and is widely distributed in most parts of the forest and savannah regions of Nigeria. The tuber is spherical in shape and measures up to 5cm in diameter and it is one of the unconventional and less exploited sources of food for human and animal nutrition (Igbabul, 2000). Groundnut (*Archis hypogeal L.*) is an indigenous legume whose fruits are formed underground (Olapade, Oke and Olaokun, 2003). It is a protein rich tuber that grows well in semi-arid regions. It contains about 25% protein and 40% oil (Ihekoronye and Ngoddy, 1985). The chemical composition of unshelled groundnut consists of 4-13% water, 36-54% fat, 21-36% protein, 12-45% carbohydrate and 2-3% ash (Okorie, Ebiringa and Ehirim, 2005).

The conventional raw material of *Gulguli* production are "Dumsu" and groundnut. Access to "Dumsu" in recent time is scarce and facing extinction. Increase in its cultivation which could have been a solution is hindered because "Dumsu" is inherently a wild plant which does not survive the low rainfall in northern area of Nigeria where it is staple; therefore, sorghum is currently used as traditional substitute for "Dumsu" in the production of *Gulguli*. However, consumers are no longer accepting *Gulguli* prepared from sorghum and groundnut because its critical blending ratio is not yet determined.

**Objective of the Study**

The general objective of this study therefore, was to determine the acceptable ratio of sorghum and groundnut in the production of *Gulguli* with a view to enhancing its acceptability thereby popularizing the consumption in Nigeria. Specific objectives were:

i. To formulate sorghum/groundnut blends of varying ratios for the production of *Gulguli*
ii. To evaluate the proximate composition and sensory attributes of the blends
iii To recommend acceptable blend that can also retain more consistent product qualities.

**Materials and Methods**

***Materials*:** "Dumsu", sorghum and groundnut were purchased from a local market in Yola South local government area of Adamawa State while sugar, salt, water and polythene bags were purchased from North Bank market in Makurdi, Benue State, Nigeria and transported to the laboratory for treatment and analysis.

**Processing methods:**

***"Dumsu" flour***

Step 1: "Dumsu" tubers (10kg) were washed; peeled, grated and excess water added and allowed to settle over night

Step 2: water decanted off and the tubers spread on flat surface to dry ($40^0$C for 12hrs)

Step 3: dry milled in attrition miller

Step 4: then sieved with 500mm mesh.

***Sorghum grain***

Step 1: Sorghum grains (5kg) were sorted and cleaned by washing with clean water

Step 2: dried at $40^0$C for 12hrs
Step 3: dry milled in attrition miller and
Step 4: then sieved with 500mm mesh.

***Groundnut seeds***

Step 1: Groundnut seeds (3kg) were sorted to remove dirt
Step 2: roasted in a frying pan on a gas cooker marked 3 to dark brown
Step 3: dehulled, winnowed and ground to fine paste in attrition miller.

***Formulation of composites (blends*):** A formula was developed from the original production of *Gulguli* from "Dumsu"/groundnut at the ratio of 80:20 as control (sample A) to sorghum/groundnut blends by varying the levels of groundnut as shown in Table 1. The blends were separately mixed thoroughly in a kenwood kitchen mixer.

**Table 1:** Blends of Ingredients for *Gulguli* Production

| Sample | Dumsu" (g) | Sorghum (g) | G/nut (g) | Sugar (g) | Salt (g) | Water (g) | Total (g) |
|---|---|---|---|---|---|---|---|
| A | 43.20 | 0.00 | 10.80 | 15.61 | 0.39 | 30.00 | 100 |
| B | 0.00 | 43.00 | 10.80 | 15.61 | 0.39 | 30.00 | 100 |
| C | 0.00 | 37.80 | 16.20 | 15.61 | 0.39 | 30.00 | 100 |
| D | 0.00 | 32.40 | 21.60 | 15.61 | 0.39 | 30.00 | 100 |
| E | 0.00 | 27.00 | 27.00 | 15.61 | 0.39 | 30.00 | 100 |

Key: Sample A ("Dumsu"/groundnut, 80:20 as control), sample B (sorghum/groundnut, 80:20), sample C (sorghum/groundnut, 70:30), sample D (sorghum/groundnut, 60:40) and sample E (sorghum/groundnut, 50:50).

***Preparation of Gulguli:*** The processing procedure used for *Gulguli* production was according to the following steps:
Step 1: The flour was formed into paste with the addition of water.
Step 2: Sugar and salt were added followed by manual mixing.
Step 3: The paste (30g) was moulded on a pastry board to a uniform thickness of 1.5cm and cut into 7cm length.
Step 4: The product was wrapped in fresh leaves of palm front or "barkeje" leaves.
Step 5: The product was steamed at $130^0$C for one hour (1hr). It was then cooled and packaged in polythene bag until analysis commenced.

**Proximate Analysis**

The micro-kjeldahl method as described by Pearson (1991) was used to estimate the crude protein. The value obtained was multiplied by nitrogen factor (N x 6.25%) to get the percent crude protein content of the sample. Crude fat was estimated by extraction with petroleum ether using Soxhlet method of Association of Official Analytical Chemist (2000). Total ash was estimated by incinerating 2g of the sample at $550^0$C for about 8hrs until the content was carbon free as described by AOAC (2000). The crude fibre was determined using the method of AOAC (2000).and modified method of Pearson (1991) while total carbohydrate was obtained by difference as described by Pearson (1991)

**Sensory Evaluation:**

***1. Instrument for Data Collection*:** The instrument for data collection in this

study was a structured questionnaire titled Evaluation of *Gulguli.* The face validity of the instrument was done by experts in the field of Home Science and Management of University of Agriculture, Makurdi. The validated questionnaire made up of sensory evaluation for appearance/colour, texture (smooth, loose and gummy), taste (sweet, salty and bland) and general acceptability was used and the reliability determined. Ratings were based on a 9-point descriptive hedonic scale with 9 (like extremely) being the maximum and 1(dislike extremely) the minimum in accordance with method described by Iwe (2002).

***2. Panel of Judges*:** The population was made up of the entire academic staff and the students of Food Science and Technology and Home Science and Management, University of Agriculture, Makurdi from were sample of five (5) academic staff, ten (10) students was drew. The purposive sampling technique was adopted in the selection of the panel of judges because the academic staff and senior students have better knowledge of food than other junior students and would therefore give better interpretation on what would be required on them.

***Statistical Analysis*:** Data was analyzed using pair comparison test method of Ihekoronye and Ngoddy (1985). Test of significant ($P<0.05$) difference among the samples were determined by Analysis of Variance (ANOVA) as described by Steel *et al.,* (1997) while Turkey's Least Significant Difference Test was used to separate the means as given by Ihekoronye and Ngoddy (1985).

**Results**

**Table 2:** Proximate Composition of *Gulguli* made from different composites and the control

| Sample | Moisture content (%) | Crude fat (%) | Ash (%) | Crude protein (%) | Crude fibre (%) | Carbohydrate (%) |
|---|---|---|---|---|---|---|
| A | 39.50±0.05 | 18.80±0.21 | 3.00±0.23 | 17.50±0.11 | 2.15±0.32 | 58.55±0.19 |
| B | 39.00±0.15 | 18.60±0.16 | 1.00±0.15 | 17.60±0.18 | 1.30±0.18 | 61.50±0.14 |
| C | 37.50±0.16 | 20.80±0.13 | 2.00±0.17 | 19.80±0.16 | 1.60±0.25 | 54.80±0.16 |
| D | 35.50±0.17 | 30.05±0.14 | 2.40±0.19 | 21.88±0.21 | 1.78±0.16 | 43.89±0.13 |
| E | 33.50±0.14 | 40.20±0.21 | 2.80±0.13 | 26.25±0.11 | 1.95±0.13 | 28.80±0.11 |

**Key**: Sample A ("Dumsu"/groundnut, 80:20 as control), sample B (sorghum/groundnut, 80:20), sample C (sorghum/groundnut, 70:30), sample D (sorghum/groundnut, 60:40) and sample E (sorghum/groundnut, 50:50).

The results of proximate composition of *Gulguli* are presented in Table 2. Moisture content of the formulated samples ranged from 39.00% for sample B to 33.50% for sample E. It decreased proportionately in all the formulated samples (B-E) with increased groundnut level. The crude fat content for the formulated samples ranged from 18.60 to 40.20%, with sample E having the

highest crude fat content of 40.20% while sample B had the lowest crude fat content of 18.60%. It increased proportionately in all the formulated samples (B-E) with increased groundnut level.

Ash content of all the formulated samples ranged from 1.00% for sample B to 2.80% for sample E. It increased proportionately in all the formulated samples (B-E) with increased groundnut level. The crude protein of sample E had the highest value (26.25%) while sample B had the least (17.60%). There was proportional increased in all the formulated samples (B-E) with increased groundnut level. Crude fibre of all the formulated samples ranged from 1.30% for sample B to 1.95% for sample E. It increased proportionately in all the formulated samples (B-E) with increased groundnut level. Carbohydrate content of sample B (61.50%) was the highest while sample E (28.80%) had the lowest value. The definite trend noticed showed proportional decreased in all the formulated samples (B-E) with increased groundnut level.

**Table 3:** Mean Sensory Evaluations of *Gulguli* made from different composites and the control

| Colour | Texture | | Taste | | | General acceptability |
|---|---|---|---|---|---|---|
| | Smooth | Loose | Gummy | Sweet | Salty | Bland | |
| A | 6.73±1.71$^{a}$ | 6.20±2.27$^{a}$ | 5.53±2.20$^{a}$ | 6.27±2.02$^{a}$ | 7.27±1.71$^{a}$ | 5.07±2.76$^{b}$ | 6.00±2.17$^{a}$ | 7.40±2.03$^{a}$ |
| B | 5.93±2.22$^{ab}$ | 5.80±2.42$^{a}$ | 4.53±2.72$^{a}$ | 5.40±2.61$^{a}$ | 6.20±2.60$^{b}$ | 4.93±2.87$^{c}$ | 5.38±2.32$^{b}$ | 6.00±2.75$^{a}$ |
| C | 5.40±1.92$^{c}$ | 6.10±1.28$^{a}$ | 5.07±2.05$^{a}$ | 5.67±2.09$^{a}$ | 6.00±2.51$^{b}$ | 5.13±2.64$^{b}$ | 6.47±1.73$^{a}$ | 6.60±2.53$^{a}$ |
| D | 5.80±2.04$^{b}$ | 5.60±1.72$^{ab}$ | 5.87±1.81$^{a}$ | 6.20±1.47$^{a}$ | 6.33±1.95$^{b}$ | 5.33±2.13$^{a}$ | 6.00±1.82$^{a}$ | 6.93±2.15$^{a}$ |
| E | 5.73±1.98$^{b}$. | 6.50±1.41$^{a}$ | 6.53±1.40$^{a}$ | 6.80±1.21$^{a}$ | 6.60±2.20$^{b}$ | 5.47±2.62$^{a}$ | 6.33±1.79$^{a}$ | 7.60±1.96$^{a}$ |
| LSD | 1.27 | 0.75 | 3.65 | 1.53 | 0.97 | 0.27 | 0.67 | 1.72 |

Values with different superscript a, b, ab, and c down the column are not significantly (P≥0.05) different.

**Key**: Sample A ("Dumsu"/groundnut, 80:20 as control), sample B (sorghum/groundnut, 80:20), sample C (sorghum/groundnut, 70:30), sample D (sorghum/groundnut, 60:40) and sample E (sorghum/groundnut, 50:50).

Table 3 shows the sensory evaluation results of the *Gulguli* made from different composites and the control. The result shows that the *Gulguli* made from sorghum/groundnut, 50:50 (sample E) was the most acceptable while the one from sorghum/groundnut, 80:20 (sample B) was least acceptable.

**Discussion**

Results in Table 2 showed that moisture content was found to decrease proportionately in all the formulated samples (B-E) with increased groundnut level. All the formulated samples (B-E) were significantly different (P<0.05) from the control (Sample A, 39.50%) with slight decreased noticed in sample B (39.00) while sample E was having the least (33.50%). The moisture content was high in samples B than other formulated

samples because sample B was less dense. The lowest moisture content noticed in sample E could be ascribed to it density, which was more than other samples because of its highest ratio of groundnut paste.

The low crude fat levels observed in sample B (18.60%) while compared with other formulated samples was expected since sample B had least ratio of groundnut blends. Also, the fact that legumes store energy in form of starch rather than fats/lipids could be attributed to the low crude fat levels. However, the low crude fat content is beneficial to the products as it will guarantee longer shelf life for the products since chances for rancidity will be reduced drastically.

The highest ash content (2.80%) in sample E was a clear indication that sample E is a good source of mineral compared to other formulated samples. This can also be attributed and agreed with the work of Richard (2003) and Christine and Gibson (2007) who reported increased ash content as a result of food supplementation and fermentation.

The highest protein content (26.25%) in sample E could be attributed to the increased ratio of groundnut level in the blend. This is because a common knowledge knows that groundnut is a legume which contains appreciable amount of protein. Also, food supplementation enhances protein content which invariably increases the nutritional worth of the products.

Crude fibre of all the formulated samples ranged from 1.30 to 1.95%, with sample E having the highest crude fibre content of 1.95% while sample B had the lowest crude fibre content of 1.30%. There were significantly different ($P<0.05$) in the crude fibre content of the samples. Certain physiological responses have been associated with the consumption of dietry fibre, such as lowering of plasma cholesterol, lowering of nutrient bioavailability, and increase in faecal bulk. Hence, sorghum/groundnut blends in the ratio 50:50 (sample E) with highest crude fibre content would imply higher lowering of nutrient bioavailability.

Carbohydrate content of all the formulated samples ranged from 28.80 to 61.50%, with sample B having the highest carbohydrate content of 61.50% while sample E (28.80%) had the lowest value. The high carbohydrate content noticed in sample B might be attributed to the high proportion of sorghum in the sample. Also, the significant ($P<0.05$) decrease in the carbohydrate content of sample E (28.80%) could be attributed to the high proportion of groundnut supplementation in the sample.

Table 3 shows the mean sensory evaluation results of the *Gulguli* made from different composites and the control. Statistical analysis indicates that there was no significant difference ($P>0.05$) between all the samples with respect to texture (smooth, loose and gummy) and general acceptability except for their appearance and taste (sweet, salty and bland). There was a significant different ($P<0.05$) for sample C (sorghum/groundnut, 70:30) which had the least appearance preference of 5.40 when compared with sample A ("Dumsu"/groundnut, 80:20) which

had highest appearance preference of 6.73. Similarly sample A had the highest taste (sweet) preference of 7.27 followed by sample E (6.60) while sample B had the least taste (sweet) preference of 6.20. The means score for sample A (5.07) salty taste showed decrease in sample B (4.93) which was the least salty taste preference, while sample E (5.47) showed the highest salty taste preference and that indicated that the higher the level of groundnut in the sample the lower the resistant of salt. However, the result of the general acceptability shows that the "Gulguli" made from sorghum/groundnut, 50:50 (sample E) was the most acceptable while the one from sorghum/groundnut, 80:20 (sample B) was least acceptable.

**Conclusion**

The study has shown that sorghum/groundnut can be blended to produce an acceptable and nutritionally rich *Gulguli*. From the results, the "Gulguli" made from sorghum/groundnut, 50:50 (sample E) was the most acceptable with respect to sensory characteristics and nutritional value while the one from sorghum/groundnut, 80:20 (sample B) was least acceptable.

**Recommendations**

- Sorghum instead of "Dumsu" can be used as an alternative for the preparation of "Gulguli". However, the 50% sorghum and 50% groundnut blend should be used for the preparation of *Gulguli*.
- Further research can be done as to ascertain *Gulguli* shelf life and development of attractive and cost effective package.

**References**


Anglani, C. (1998). Sorghum for Human Food: A Review. *Plant Food Human. Nutrition*. 5 (2) 85 – 89.

Awika, J.M. and Rooney, L.W.(2004). Sorghum Phytochemical and their Potential Aspect on Human Health Phytochemistry. *Journal of Nutrition.* 6 (5) 1199 -1221.

AOAC (2000). Official Methods of Analysis, 17th ed. Association of Official Analytical Chemist. Arlington, VA.

Christine, H. and Roslaind, S. G. (2007). Traditional Food Processing and Preparation Practices to enhance the Bioavailability of Micronutrients in Plant-based Diets. *Journal of Nutrition.* 13 (7) 1097-1100.

Dikko, M.H., Hilhorst, R. and Traore, A.S. (2005). Indigenous West African Plants as Novel Sources of Polysaccharide Degrading Enzymes Application in Reduction of Viscosity of Cereals Porridges. *African Journal of Biotechnology*. 4 (1) 1095 – 1104.

Igbabul, B.D. (2000). Moisture Sorption Phenomena and Thermodynamic Properties of the African Arrowroot Lily Tuber in relation to Process Variables and Packaging. Ph.D. Thesis. Department of Food Science and Technology, University of Agriculture, Makurdi. Pp1-9.

Ihekoronye, A. I. and Ngoddy, P. O. (1985). Integrated Food Science and Technology for the Tropics 1st ed. *Macmillan Publisher*, London. Pp:12-28, 165-193 and 264-265.

Iwe, M.O. (2002). Sensory Method and Analysis. *Region Communication and Service* Ltd. Pp 35-40.

Kangama,C.O. and Rumei, X.J. (2005). Introduction of Sorghum Hum into

China. *African Journal of Biotechnology*. 4 (1) 575 – 579

Okorie, S.U; Ebiringa, D.C and Ehirim, F.N. (2005). Effect of Cooking and Germination Time on the Chemical Composition of Groundnut. Proceedings of the 29th Annual Conference, Nigerian Institute of Food Science and Technology. 11-13 October. P193.

Olapade, A.A., Oke, O.V. and Olaokun, O.O. (2003). Consumer Acceptability of "Okoro" prepared from Maize Supplemented with Groundnut. Proceedings of 26th Annual Conference of NIFST 25 – 27 Oct. Abuja – Nigeria.

Pearson, D. (1991). The Chemical Analysis of Foods. 7th ed. *Ediburgh Churchill Living Stone*. Pp 4-60.

Richard, F.H. (2003). Influence on Protein Sources on Trace Element and Mineral Bioavailability. *Journal of Nutrition.* 1 (33) 29735-29775.

Steel, R.G.D., Torrie, J.H. and Diekey, D.A. (1997): Principles and Procedures of Statistics. A Biometric Approach. 3nd ed. New York, *McGraw –Hill Book Co*.