ISSN:
Print - 2277 - 0593
Online - 2315 - 7461

Journal of Natural Sciences, Engineering and Technology

PROCESS TECHNOLOGY, CHEMICAL COMPOSITION AND QUALITY OF "AADUN" A MAIZE- BASED NIGERIAN SNACK

M.A. IDOWU[1]* AND S.O. ADEDOKUN[2]

[1]Department of Food Science and Technology, Federal University of Agriculture, Abeokuta, Nigeria
[2]Department of Food Technology, The Polytechnic Ibadan, Saki Campus, Oyo State, Nigeria
***Corresponding author**: idowumchl@yahoo.com

ABSTRACT

Process technology, chemical composition and sensory quality of "aadun"- a maize based Nigerian snack were investigated. Process technology was established through oral interview and visitation to processors at Abeokuta and Ibadan, while "aadun" samples were evaluated for their chemical composition and sensory quality using laboratory samples as control. Although ingredient composition varied widely among processors, roasted maize flour and palm oil constitute about 71 and 27 % of the ingredients respectively. Pepper, salt and other spices added up to only 1- 2%. The major unit operations identified in "aadun" processing were: cleaning, roasting, milling, sieving, mixing, molding and packaging. "Aadun" was found to be very rich in calorie (495.34- 618.84kcal/ 100g), low in protein (4.95- 6.08%) and a good source of phosphorus (538.45- 600mg/100g) and magnesium (245.05- 255.12mg/100g). Sensory quality of "aadun" is processor dependent as samples differ significantly ($p > 0.05$) in their colour, aroma, texture and overall acceptability but not in taste. "Aadun" samples generally had low microbial loads with total plate count ranging between 1.2 $x10^3$ and 3.3$x10^3$cfu/g.

Key words: "Aadun", maize snack, process technology, chemical composition, sensory quality

INTRODUCTION

In Nigeria, maize (*Zea mays* L) is grown annually as a single crop or sometimes intercropped with legume plants (Okoruwa, 1995). It is the second most important cereal crop, ranking behind sorghum in the number of people it feeds with an estimated annual production of about 7 million tonnes (CBN, 2003). Maize is commonly consumed as a staple food in form of the meal, flour or starch and as snacks by ordinary cooking or roasting of fresh corn, or modified by fermentation to obtain a product such as "mosa". Other snacks traditionally manufactured from maize include "guguru", "kokoro", "lanpata", "abari"and "aadun" (Oke, 1967; Akinjogbin, 1984; Akinyele, 1998).

"Aadun" has been described as one of the energy giving snacks commonly consumed by Nigerians and it is predominantly produced in Yoruba speaking areas of Southwestern Nigeria (Akinyele, 1998). "Aadun" is known for its reddish colour, ease of disintegration in the mouth, fine texture and sweetness. It is traditionally used for marriages, naming ceremonies and had been eaten in

the past by warriors, children, women and people of all ages (Akinjogbin, 1984; Adedokun, 2006). However, despite the wide consumption of "aadun", like many other Nigerian traditional snacks, its process technology, chemical composition, sensory quality, storage stability and safety remain largely uninvestigated. Furthermore, its product quality and packaging need to be standardized in order to upgrade the snack to an internationally acceptable product.

This paper therefore reports the process technology, chemical composition and sensory quality of "aadun", a widely consumed maize-based Nigerian snack. It also provides information on the microbial load of the snack.

MATERIALS AND METHODS

Maize (*Zea mays* L) grains (white variety), red palm oil, pepper and common salt were purchased from Kuto market, Abeokuta. Commercial "aadun" samples were obtained fresh from processors at Abeokuta and Ibadan.

Investigation of traditional processing technology of "aadun"

To establish traditional method of processing "aadun", 3 different processors per location (Abeokuta and Ibadan) were identified and visited 3 times. Rapid Rural Appraisal technique of oral interview and observation was used since most of the processors were illiterate (Metrick, 1993). Questions were asked to determine the ingredient composition, and unit operations involved in the preparation of "aadun". During each visit, "aadun "samples were produced and samples obtained from the different processors at each location were bulked together as Abeokuta and Ibadan samples. The samples were kept at -18^{o}C inside a REFCO freezer until use.

Preparation of laboratory "aadun "samples

Laboratory "aadun" samples were prepared by using the recipe and method of Adedokun (2006). The ingredient composition consists of roasted maize flour (71.0%), palm oil (27%), pepper (1.57%) and salt (0.34%). Maize grains were cleaned, roasted using an electric hot plate (NAKAI model) at 260-270^{o}C for 10 minutes, milled (Attrition disc mill) with dry pepper, sieved (<0.4mm), mixed with red palm oil and salt, molded and packaged in polyethylene and kept at -18^{o}C inside a REFCO freezer until use.

Chemical analyses

Moisture, crude protein, crude fat, crude fibre and total ash were determined using the AOAC (2000) methods; carbohydrate was determined by difference, while energy values were calculated using the Atwater factor (FAO/WHO, 1998). Calcium and magnesium were determined after wet ashing using the Buck Scientific Atomic Absorption Spectrophotometer (Model 210). Phosphorus was determined using the vanado- molybdate colorimetric method (Kirk and Sawyer, 1991). Free fatty acid and peroxide values were determined by volumetric method as described by Kirk and Sawyer (1991).

Sensory evaluation

A taste panel evaluation of "aadun" was conducted using a panel of 50judges made up of staff and students of the University of Agriculture, Abeokuta, who are regular consumers of the product. The attributes evaluated were colour, aroma, taste, texture and overall acceptability. "Aadun" samples were placed in white ceramic plates at ambient temperature before each tasting session. Ranking method was used where judges were asked

to rank samples according to their preference, the most preferred was ranked first, while the least preferred sample was ranked last (Iwe, 2002). Responses of the panelist were collated and subjected to statistical analysis of variance using the Microsoft Excel statistical package for data analysis. Means were separated using Duncan's Multiple Range Test (DMRT) to establish if there were significant differences between the samples (Larmond, 1977; Iwe, 2002).

Microbial analyses

Total plate and fungi counts were determined using the method of Harrigan and MacCance (1982) as described by Atanda and Akano (1997). Coliform counts were determined using the method of most probable number (MPN). Each of 3 tubes of Lauryl Sulphate tryptose (LST) broth containing inverted Durham tube was inoculated with 1.0ml from the serial dilution. The LSTs tubes were incubated at 37^{o}C for 48 hours. The tubes showing acid and gas production was recorded while the MPN values were calculated (FAO, 1979).

RESULTS AND DISCUSSION

Process technology of "aadun"

Roasted maize flour (71%) and palm oil (27%) were the main ingredients of "aadun" as revealed by traditional processors of "aadun" from Abeokuta and Ibadan. Dry pepper, common salt and other spices consist of about 1-2% of the total weight of the ingredients depending on location or preference of the processor. For samples of "aadun" obtained from Abeokuta, the palm oil was first heated to a high temperature (>100^{o}C) briefly, while pepper and other spices were fried inside hot oil. This accounts for the slightly brown/dark colour of "aadun" from Abeokuta compared with the bright red colour characteristic of Ibadan samples. Although ingredient composition of "aadun" may be location/processor specific, the major unit operations involved in the processing of "aadun" is generally the same, irrespective of location or processor. Hence, the unit operations identified in the traditional processing method of "aadun" were roasting, milling, sieving, mixing, molding and packaging (Fig 1). Roasting of maize grain was achieved inside a frying pan using firewood as source of heat, temperature of roasting therefore varies between 250^{o}C and 280^{o}C since it can not be properly controlled. Roasting to a golden brown colour is often used as index of a well roasted corn. This type of roasting method has also been reported in the preparation of maize- soy mix for production of "ampla"- a Nigerian traditional breakfast meal where maize grains were also roasted to a tan- brown colour (Keku, 2006). Milling of the roasted maize grains could either be done along with dry pepper as ingredient or separately. Where the dry pepper is milled separately, it is added to the roasted maize flour at the mixing stage (Fig 1). Milling is usually done by using attrition disc mills without any preset gap between the milling surfaces. Sieving is usually to a particle size of <0.4mm and is achieved manually to obtain a uniform product which is necessary for an acceptable fine texture in "aadun". Mixing of roasted maize flour, dry pepper, palm oil and spices is usually achieved manually by hand. The proper mixing of all the ingredients is very essential to the final quality and stability of "aadun".

At this stage, palm oil is allowed to percolate all the fine particles of the roasted maize flour, while spices are evenly distributed to achieve a fine texture and uniform product. Molding is done manually inside the packaging material which is usually a leaf of

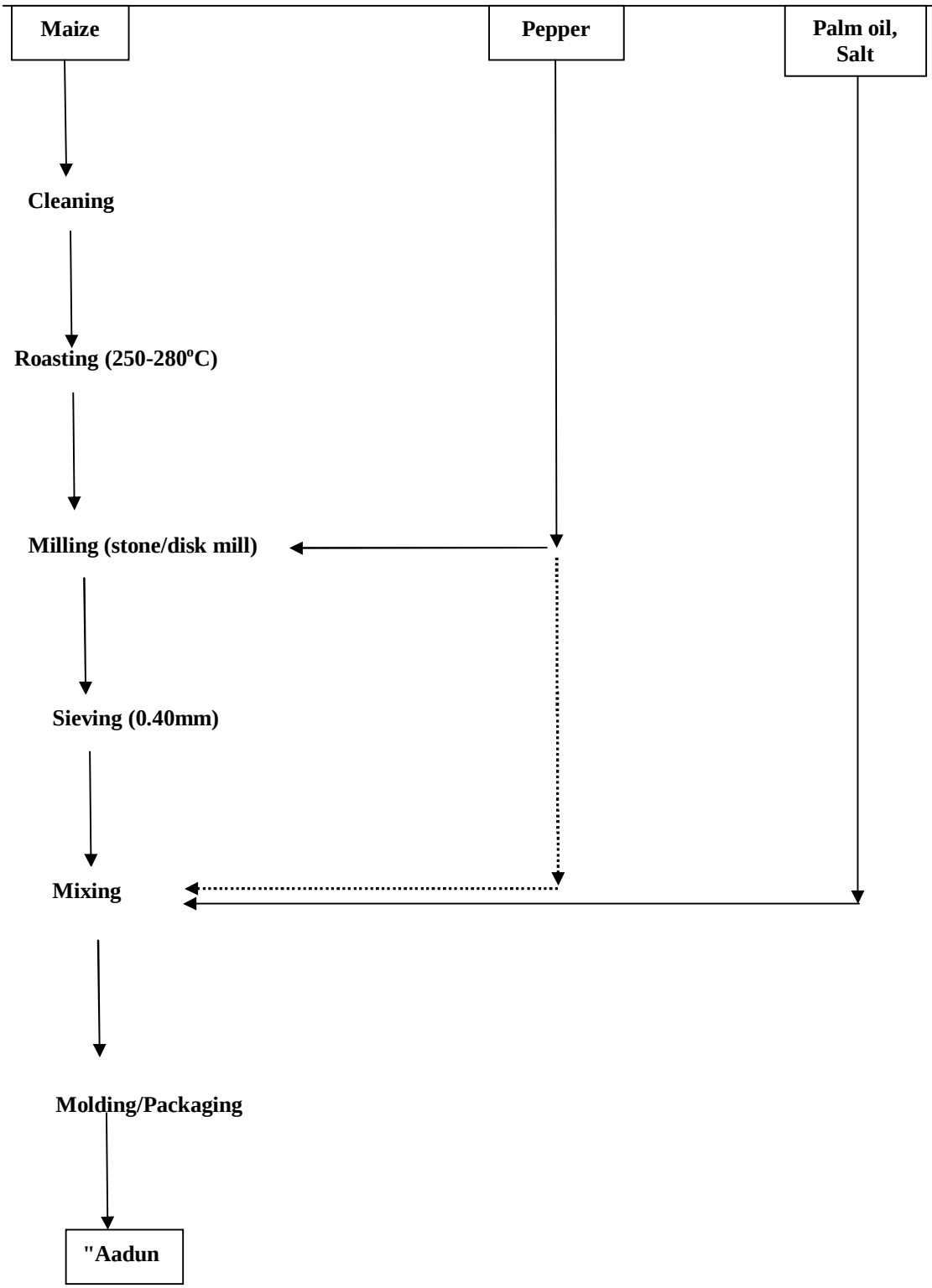

Figure 1: Traditional processing of "aadun"

Tomatococcus daniellii. Similar use of leaf had earlier been reported for packaging of "agidi"- a stiff gel of fermented maize (Adeyemi and Oluwamukomi, 1989). Although local vendors may present "aadun" to consumers in unpackaged and exposed form, or bulk packaged them in wooden boxes with transparent glass sides exposed to air and sunlight; most of the retail sales of "aadun" are often in leaves. Leaf as a packaging material had earlier been reported to be highly porous and may not offer adequate protection for food against microbial and chemical deterioration (UNIFEM, 1996). Information from processors revealed that variations in product quality of "aadun" could be due to differences in ingredient composition, method of processing or handling after production. It is therefore necessary to standardize the ingredient composition and optimize the process technology particularly the roasting, mixing, molding and packaging which were largely achieved manually in the traditional method of processing. A temperature range of 260-270^{o}C was used to roast maize grains in the preparation of the laboratory "aadun" samples because an electric hot plate was used, thus reducing the wide variation (250-280^{o}C) in the temperature of roasting used in the traditional processing method.

Chemical composition, sensory quality and microbial load of "aadun"

"Aadun "samples varied widely and are significantly different ($p>0.05$) in their chemical composition except in moisture and ash contents (Table 1). However, "aadun" samples obtained from Ibadan were not significantly different ($p<0.05$) from the laboratory samples in their chemical composition except in percentage free fatty acid and peroxide value probably due to different sources of palm oil used as ingredients. Range of values obtained for crude protein, crude fat, crude fibre, carbohydrate and energy were 4.95±0.35 - 6.08±0.46%, 27.25±0.68 - 52.54±0.75%, 3.75±0.76 - 5.84±0.46%, 30.52±0.58 - 57.53±0.78% and 495.34±0.64 - 618.84±0.17kcal/100g respectively. Also range of values for phosphorus, calcium and magnesium were 538.45±0.67 - 600.00±0.24mg/100g, 11.83±0.76 - 15.34±0.23mg/100g and 244.23±0.81 - 255.12±0.34mg/100g respectively. It is apparent from the result that "aadun" is low in protein, but high in calories. It also contains appreciable amount of phosphorus and magnesium but low in calcium. The free fatty acid and peroxide values of "aadun" samples were also low. The low protein content of "aadun" suggests the need for enrichment with a protein source if consumed in large quantity. In some parts of the country such as Kogi state, cooked beans are often added as an attempt to enrich "aadun" with a protein source. The high calorie content on the other hand is desirable for a snack and could be due to high inclusion of palm oil (27.1%) as ingredient. This high percentage of fat (palm oil) may however predispose "aadun" to oxidation and rancidity during storage (Berk, 1991).

Laboratory "aadun" samples were ranked as the most preferred samples in terms of colour (1.42±0.05), aroma (1.58±0.73), taste (1.36±0.56), texture (1.62±0.70) and overall acceptability (1.50±0.46) (Table 2). "Aadun samples obtained from Ibadan were ranked next to the Laboratory samples in terms of colour (1.68±0.65), texture (1.70±0.71) and overall acceptability (1.84±0.54), while samples obtained from Abeokuta were the least preferred in terms of colour (2.74±0.60), texture (2.50±0.72) and overall acceptability (2.23±0.57), they were however better rated in their aroma and taste than samples ob-

tained from Ibadan. Although "aadun" samples obtained from Ibadan were not significantly different from the laboratory samples except in aroma; Samples obtained from Abeokuta were significantly different ($p>0.05$) from Ibadan and laboratory samples in colour, texture and overall acceptability. All "aadun" samples were however not significantly different ($p<0.05$) in taste. The observed difference in colour of "aadun" obtained from Abeokuta from the other samples may be due to the pre- frying of the pepper and spices before mixing with the roasted maize flour. The preference of the panelists for colour and texture of the laboratory and Ibadan samples may be a reflection of the attractive carotene (red) colour of palm oil and fine particle size of roasted maize flour used as ingredients. The variation in ingredient composition and the accompanied differences in the sensory quality of "aadun" therefore, underscore the need to optimize the particle size, colour and aroma of "aadun" for consistency and international product acceptability. Oyewole (2002) had earlier reported the need for upgrading African foods through optimization of process and packaging to meet international standards.

"Aadun" samples generally had low total aerobic plate ($1.2x\ 10^3$ - $3.3x10^3$ cfu/g) and fungi (< 10 sfu/g) counts (Table 3). These values are well within the permitted limits of Codex Alimentarius for cereals and derived products (10^5cfu/g) (Codex, 1990). The detection of coliform in "aadun" samples obtained from Ibadan is however not desirable and suggests possible faecal contamination of the samples.

Table 1: Chemical Composition of Commercial and Laboratory "Aadun" Samples

Composition	Abeokuta	Ibadan	Laboratory
Moisture (%)	3.41±0.65a	4.51±0.44a	3.52±0.45a
Crude Protein (%)	6.08±0.46a	4.95±0.35b	5.41±0.65b
Crude Fat (%)	52.54±0.75a	27.25±0.6b	30.06±0.45b
Crude Fibre (%)	5.84±0.46a	3.95±0.65b	3.75±0.76b
Ash (%)	1.61±0.56a	1.81±0.75ab	1.51±0.57a
Carbohydrate (%)	30.52±0.58b	57.53±0.78a	55.75±0.76a
Energy (Kcal/100g)	618.84±o.17a	495.34±0.64b	515.15±0.43b
Phosphorus (Mg/100g)	600.00±0.24a	540.34±0.34b	538.45±0.67b
Calcium (Mg/100g)	15.34±0.23a	12.01±0.43b	11.83±0.76b
Magnesium (Mg/100g)	255.12±0.34a	245.04±0.45b	244.23±0.81b
Free Fatty Acid (%)	0.36±0.43a	0.38±0.36a	0.27±0.38b

Data represent mean± standard deviation of 3 replicates
Values with same letters in a row are not significantly different ($p<0.05$)

Table 2: Sensory quality of commercial and laboratory "Aadun" samples

"Aadun" samples	Colour	Aroma	Taste	Texture	Overall Acceptability
Ibadan	1.68±0.65a	2.16±0.68b	1.70±0.71a	1.80±0.67a	1.84±0.54a
Abeokuta	2.74±0.60b	2.06±0.87b	2.50±0.72b	1.62±0.68a	2.23±0.57b
Laboratory	1.42±0.50a	1.58±0.73a	1.62±0.70a	1.36±0.56a	1.50±0.46a

Data represent means ± standard deviation of 3 replicates
Mean scores with same letters in a column are not significantly different ($p<0.05$)
Preference based on ranking: 1= Most preferred; 3= Least preferred.

Table 3: Microbiological quality of commercial and laboratory "Aadun" samples

Parameter	Abeokuta	Ibadan	Laboratory
Total aerobic plate count (cfu/g)	$1.4x10^3$	$3.3x10^3$	$1.2x10^3$
Fungi (mould & yeast) count (sfu/g)	<10	<10	<10
Coliform count (mpn)	0	18	0

CONCLUSION

Ingredient composition and sensory quality of "aadun" may vary, the major unit operations involved in its processing are essentially the same. Although "aadun" contains low microbial load and it is rich in calorie, phosphorus and magnesium; there is a need to standardize its ingredient composition and optimize its process technology and packaging in order to upgrade the snack to an internationally acceptable product.

REFERENCES

Adeyemi, I.A., Oluwamukomi, M.O. 1989. An investigation into the storage stability of Agidi, a Nigerian fermented maize gel. *J. Cereal Sci.,* 10: 239- 246.

Adedokun, S.O. 2006. Effect of packaging material and storage condition on quality attributes of "aadun" -a maize based Nigerian snack. M. Sc. Thesis, Department of Food Science and Technology, University of Agriculture, Abeokuta, Nigeria. 90pp.

Akinjogbin, I.A. 1984. Some discarded food items of Nigeria. Historian perspectives. Paper presented at the 8th Annual Conference of the Nigerian Institute of Food Science and Technology, held at the University of Ife (OAU), Ile- Ife, Osun State, Nigeria.

Akinyele, I.O. 1998. Street foods and their contribution to food security and nutritional status of Nigerians. *West Afr. J. Fd. and Nutr.*, 1(1): 8- 20.

AOAC, 2000. *Official methods of analysis* 17th ed.: Association of Official Analytical Chemists, Arlington, Virginia.

Atanda, O.O., Akano, D.A. 1997. The incidence of different types of microorganisms and aflatoxin content of dry "tatase" pepper (*Capsicum annum L.)* stored for sale in dry season. *Nig. J. Micro*., 11: 36-38.

Berk, Z. 1991. *Braverman's introduction to the Biochemistry of foods*. 5th ed. Elsevier Scientific Publishing Co. Amsterdam. Oxford, New York.

CBN, 2003. *Annual report and statement of account*. Central Bank of Nigeria. Lagos.

Codex, 1990. *Codex standard for cereals, pulses, legumes and derived products*. Codex Alimentarius 1st ed. 6: 115-120.

FAO, 1979. *Manuals of Food Quality Control: Microbiological analysis*. Food and Agricultural Organization of United Nations, Rome Italy.

FAO/WHO, 1998. *Preparation and use of food based dietary guidelines*. Report of a joint FAO/WHO consultation Technical repot series 880. World Health Organization, Geneva.

Harrigan, W.F., McCance, M. 1982. *Laboratory methods in food and dairy microbiology*; Academic Press Inc. Ltd. London. Pp. 482.

Iwe, M.O. 2002. *Handbook of Sensory Evaluation Methods and Analysis*. Publ. Rojoint communication services Ltd. Uwani -Enugu, Nigeria.

Keku, K.O. 2006. Production, chemical composition and storage stability of "ampla"- A breakfast meal from a mixture of roasted corn and soyabean. M.Sc. Thesis, Department of Food Science and Technology, University of Agriculture, Abeokuta.

Kirk, S.R., Sawyer, R. 1991. *Pearson's Com position and Analysis of Foods.* 19th ed. Longman Group Limited U.K. Pp 621-644.

Larmond, E. 1977. *Methods for sensory evaluation of food*. Food Research Central Exptal. Farm. Canada Dept. of Agric. Ottawa. Pp72.

Mettrick, H. 1993. *Development oriented research in Agriculture*. Publ. The international centre for development oriented Research in Agriculture (SCRA) Wageningen, Netherlands. Pp 1-90.

Oke, O.L. 1967. Chemical studies on the Nigerian foodstuff Ogi. *Food Tech*., 21: 202-204.

Okoruwa, E.A. 1995. *Utilization and processing of maize*. International Institute of Tropical Agriculture (IITA) Ibadan. Nigeria. Research guide 35: 1-29.

Oyewole, O.B. 2002. *The powers at the roots: Food and its Microbial allies*. University of Agriculture, Abeokuta. Inaugural lecture series 15: 56.

UNIFEM, 1996. *Packaging*. Food cycle technology source books. Intermediate Technology publication in association with The United Nations Development Fund for Women, Ed. M. Whtton. Pp. 1-32.

(Manuscript received: 5th June, 2009; accepted: 20th April, 2011).