

## Cereal Utilization in Nigeria

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### ABSTRACT

The study examined the level at which cereals are utilized in Nigeria. Cereals are consumed in large quantities when compared to other food crops and it has important common features and this basis form the milling and processing operation. Cereals in Nigeria are locally produced. The major cereals in Nigeria consist of maize, sorghum, millet and rice. Maize is utilized in various ways such as tuwo, masa, pito, moi - moi, egbo, guruguru, agidi, ogi. Sorghum which is locally called guinea-corn is a very important part of diet which could be in form of boiled porridge. Sorghum is utilized in various ways such as kunun zaki, burukutu, pito. Millet is a cereal grain that Nigerians use in millions of tones in many homes, especially among the poor predominantly, in Northern Nigeria. Millet is utilized in various ways such as Kunun zaki, ogi, pito, masa. Rice which is everyday diet for many Nigerians, is utilized and processed to tuwo cinkafa, masa and prepared based on individual's choice. Apart from utilizing the major cereal in various ways it has also contributed in increase in the Nigeria economy. Knowledge of cereal utilization in Nigeria will help to promote cereal usage among urban and rural dwellers.

**Keywords:** Cereal utilization, Nigeria, Burukutu, Pito, Kunun-zaki, ogi,

### INTRODUCTION

Cereals belong to the monocot families, 'Poaceae or Gramineae' and are cultivated widely to obtain the edible components of their fruit seeds. Botanically, these fruits are called 'caryopsis' and are composed of endosperm, germ and bran. Cereal grains are grown in greater quantities and provide more food energy worldwide than any other type of crops. They are therefore called staple crops [1].

In tropical Africa, cereal grains are milled and used to produce thick porridges, which are known by various names in different parts of the continents. In West Africa particularly in Nigeria, Ghana, Burkina Faso, one of such thick porridges is called *fura*, a semi solid dumping cereal meal, [2]. Cereal grains are the major sources of proteins for people of Nigeria. Those receiving less than 20% of the calories and protein intake from cereals mainly consist of people in Southern Nigeria where starchy roots and tubers are staple foods[3].

The major cereals in Nigeria include Maize, Sorghum, Millet and Rice. Cereals are utilized in various ways in Nigeria. Maize is utilized in different ways such as ogi. Ogi is a porridge prepared from fermentation of maize in Nigeria.

It is a staple food that can be served as a weaning food for infants or breakfast for adults. 'Ogi' can also be prepared from millet and sorghum. Pito which is produced from maize is a traditional alcoholic drink in Nigeria. Popcorn (*guguru*), *egbo*, *agidi*, *moi-moi*, and *tuwo* are also produced from maize. Sorghum is utilized in different ways which include production of *burukutu* - a local alcoholic beverage in Nigeria. The process involves malting, mashing, boiling, fermentation and maturation. It can also be produced using a combination of maize and sorghum. *Kunun zaki* is also produced from sorghum which can be combined with millet or maize depending on individual preference. *Pito* and *Ndaleyi* are as well made from sorghum [4].

Millet is one of the major cereals utilized in Nigeria to produce *kunun zaki*, *fura* and the process involves decortication/dehulling, washing, drying, milling, fermenting, moulding, steaming, and drying. *Masa*, *pito*, *ogi* are all produced from millet. Rice is one of the major cereals in Nigeria which is used to make *tuwo* and can be consumed with beans soup and *masa*. It is used to produce *kunun* by mixing it with millet. The tropical Africa has many cereal crops [5] with diverse utilization most of which are not properly documented. The aim of this

## Cereal Utilization in Nigeria

work was to review the level at which cereal crops are utilized in Nigeria.

### MAIZE UTILIZATION

Maize (*Zea mays*.L) is a major important cereal being cultivated in the rain forest and the derived savannah zones of Nigeria. Land races, improved high yielding, pest and diseases resistant varieties of maize have been developed. Maize is a cereal plant that produces grains that can be cooked, roasted, fried, ground, pounded or crushed to prepare various food items like pap, 'tuwo' and host of others [6].

Maize (*Zea mays*L., Poaceae) is the most important cereal in the world after wheat and rice with regard to cultivation areas and total production [7,8]. In the year 1992, Central Bank of Nigeria indicated that the production in Nigeria is quite common in all parts of the country, from the north to the south, with an annual production of about 5.6 million tonnes. Maize products consist of ogi, agidi, egbo, Popcorn, moi-moi etc. [9].

### OGI

This is a porridge prepared from fermented maize, sorghum or millet. In Nigeria the usual first weaning food is called 'ogi', pap, 'akamu', or 'koko' and is made from maize, millet, or guinea corn. In most parts of Nigeria, mothers introduce the thin gruel to infants at three to six months of age. The baby is fed on demand with a spoon or a cup, although in certain parts of the country, a few mothers use the traditional forced hand-feeding method [10].

The traditional preparation of ogi involves soaking of the corn kernels in water for 1-3 days followed by wet milling and sieving to remove the bran, hulls and germ [11]. The pomace is retained on the sieve and later discarded as animal feed while the filtrate is fermented (for 2-3 days) to yield ogi, which is sour, white starchy sediment. Ogi is often marketed as a wet material wrapped in leaves or transparent polythene bags.

### IMPROVED METHOD OF OGI

According to Ladunni et al. [12], to improve the method of ogi production involves the reduction of the moisture content of *ogi* through drying which enhances the shelf-life, provides convenience and allows for easy reconstitution of the ogi powder. In addition to this, an experiment was carried out on the effect of drying methods on the selected properties of ogi by using foam mat drier and cabinet drier. The results found that

the foam mat dried ogi powder had lower moisture content, increased fat, protein and ash content when compared with the cabinet drier sample.

### AGIDI

This is a gel-like traditional fermented starchy food item produced from (*Zea mays*). Although, millet and sorghum can also serve as raw materials, its colour depends on the cereal used. It is cream to glassy white from maize, light brown from sorghum and grey to greenish from millet. It is known by different localities such as "eko" (Yoruba) "komu" (Hausa) "Agidi" (Ibo) [13,14].

Agidi is prepared by wet sieving with the aid of clean cloth. The mixture is allowed to settle and the ogi slurry supernatant decanted, boiled and cooked with occasional stirring to get agidi meal. Agidi can be prepared as 'jolloff agidi' which can be consumed at any time without the requirement of stew.

### EGBO

Egbo is produced from maize grains. The maize grains are cooked intensely until it become very soft and burst open. It is eaten in this form or with cooked beans, coconut or little groundnut oil.

### POPCORN

Locally there are two types of popcorn, hard and soft. The former is simply called 'guguru', while the latter is 'guguru alakuko' by the Yorubas. Popcorn is made by putting maize grains inside saucer shaped earthen pot containing sand and heated with firewood. The heat generated changes the colour of the whitish grains to brownish (i.e guguru

). Further heating bursts the grains to reflect the internal whitish parts. This is called guguru alakuko. Sometimes honey or sugar may be added to guguru. It may be heated alone or with groundnut [9].

### TUWO

The production of tuwo corn using maize involves two methods: grit non-soaking and grit soaking. This involves cleaning, tempering and decortications to obtain the grain grits. The grits are then milled using a plate mill and sieved to obtain the ultimate flour and this represent the grit non-soaking method. The grit soaking method involves soaking the maize grits for 2-3 hours, draining of water, sun drying of wet grits for 1-2 hours depending on weather condition,

## Cereal Utilization in Nigeria

milling of the dried grits to flour and sieving to obtain the ultimate flour [15]. Tuwo is taken with beans soup, vegetable soup or prepared using rice. It involves boiling the rice till it gets very soft. It can also be eaten with beans soup [9].

### PITO Prepared from Malted Maize

In the preparation of pito, moulds (including *Penicillium* sp. *Aspergillus* sp. and *Rhizopus oryzae*) are encouraged to grow on the surface of the kernels during malting. The mould-covered malt is ground, mixed with water, cooked and filtered. The filtrate undergoes a primary souring fermentation overnight [9].

The sour extract is concentrated by boiling. It is fermented again in the presence of *Candida* sp.; *Geotrichum candidum* and *Lactobacillus* sp. inoculated with the previous brew and is left standing overnight. The final product is dark-brown acidic liquid, with alcoholic content of

about 3% present, which must be consumed within 48 hours [9].

### MOI - MOI Prepared from Maize

The maize husk is peeled off and all the hair-like strands removed. Then a sharp knife is used to slice down the corn to strip off the seeds from the cob. The corn seed, pepper, onions, prawn heads/tails and crayfish are placed in a blender and blended together. A little water is added to help move the blades of the blender. The blended content is transferred into a wide bowl and water is added to get a lighter but not watery consistency. Then palm oil, vegetables, softened prawns, seasoning cubes and salt to taste are added. This is mixed thoroughly until the palm oil is well incorporated. Finally, it is poured into a container of choice, sealed and placed in a steamer or pot of boiling water for 45 minutes to 1 hour until it solidifies. Maize moi-moi is consumed alone or with pap, garri, and rice.

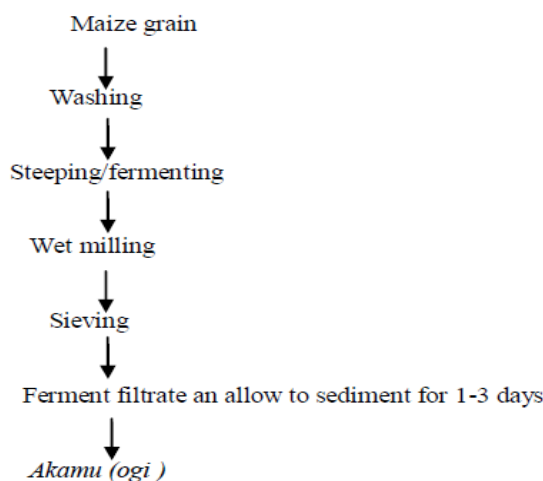


Figure 1. Processing of traditional Ogi

Source: Umo and Fields [16]

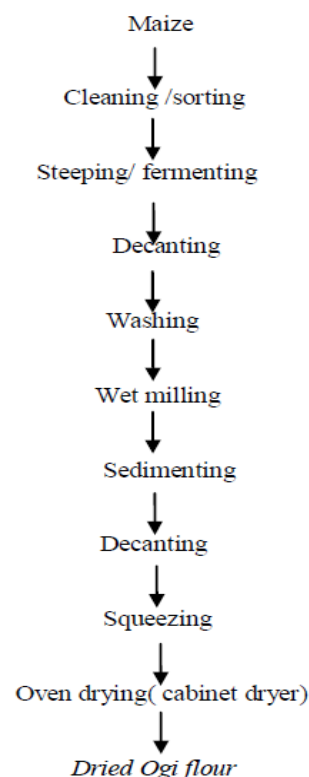


Figure 2. Improved Method of ogi production

Source: Sridhar and Batt [17]

## SORGHUM UTILIZATION

Sorghum (*Sorghumbicolor*) locally called guinea-corn, is the most extensively grown cereal in the country [19]. Nigeria and Sudan produce about 63% of Africa's total production [20]. It is a very important part of diet which could be in the

form of boiled porridge or gruel, unleavened bread rice-like products [21]. Sorghum is the most amenable cereal grain to different processing technologies including: primary, secondary, and tertiary methods [22]. Sorghum consumption for food is mainly in the form of flour or paste processed into two main dishes:

## Cereal Utilization in Nigeria

“OGI” or “AKAMU”, a thin porridge and “TUWO”, a thick porridge. Other dishes that are sometimes made from sorghum include a

number of deep fried snacks, steamed dumplings [23].

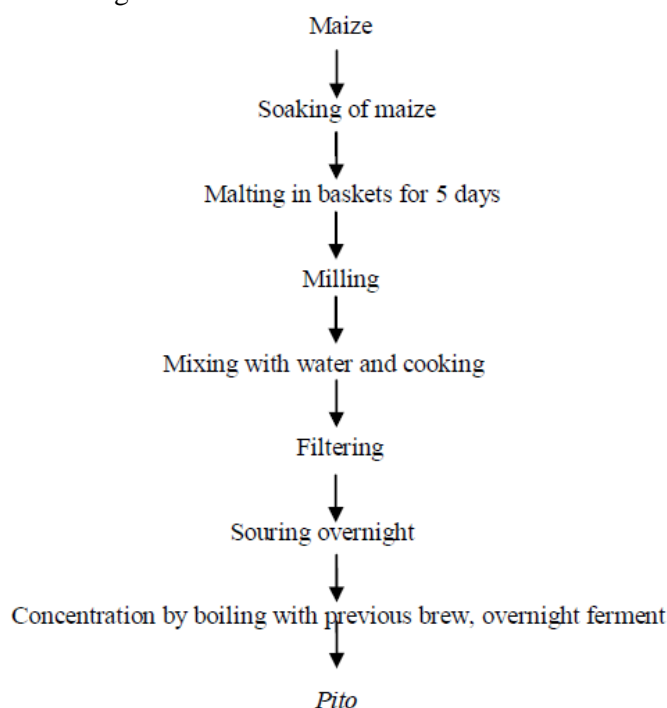


Figure3. Preparation of pito using maize grain.

Source: FAO [18].

## KUNUN ZAKI

This is a traditional non-alcoholic fermented beverage widely consumed in the northern part of Nigeria [24 - 27]. The cereals utilized in its production are millet, sorghum and maize in decreasing order of preference [28]. Sometimes, the cereals could be used in composite form in its production but this is more common with only mixing 1:2 (w/w) sorghum/millet. The traditional production process involves steeping the grains in local household utensils such as buckets; drums, calabashes or earthenware vessels [29]. The steeping duration depends on the cereal used but varies between 17-72 hours for millet/sorghum and maize respectively [30]. Grinding of the steeped grains mixed with spices (ginger, clove, red and or black pepper) is done with local milling machines [31]. The remaining part of the slurry (1/4 volume ungelatinized) containing liquifying agents (sweet potato paste, malted rice etc) are mixed with the gelatinized portion when the temperature is about 60-70°C. The mixture is altogether left overnight at room temperature for chance fermentation and filtered the next morning using local sieve. It can be consumed with or without sugar [29].

## IMPROVED METHOD OF KUNUN ZAKI

Improved method of kunun zaki is different from the traditional method by steeping in warm water (60-70°C) with sodium metabisulphite for 3 hours to extend the shelf-life of the product and inactivate the enzymes. The pasteurization is for the destruction of both spoilage and pathogenic microorganisms. In an attempt to improve kunun zaki Ojimekwe et al. [32] reported the effect of different preservatives on the shelf - life of kunun zaki. Single and combined preservatives were evaluated within eight days storage period for changes in pH, total titratable acidity, peroxide value and microbial load. The untreated sample recorded higher microbial load as well as deterioration in other quality parameters. The combined preservative treatment with ginger/sodium metabisulphite and pasteurization/sodium metabisulphite enhanced the quality of the beverage [33].

## BURUKUTU

Burukutu is a popular alcoholic beverage of vinegar-like flavour consumed in Nigeria. The production of burukutu involves the processes of malting, mashing, boiling, fermentation and maturation [29, 34]. The sorghum grains are steeped in water for 18-24 hours at 30°C for 5

## Cereal Utilization in Nigeria

days. Kilning however can be carried out under the sun or in the oven at 50°C within 24 hours. Garri (fermented cassava product) is added to the mixture of ground malt. Mixing and boiling for two days resulted in a cloudy alcoholic beverage [35].

### NDALEYI

Ndaleyi is an important indigenous food to North Eastern Nigeria. It is produced from sorghum or pearl millet and a popular food in Borno State, Nigeria [36]. Its production involves a similar process with ogi production from millet and sorghum except that the grains are steeped for longer period [37].

### PITO

Pito is a sorghum-based alcoholic beverage common to the people of Nigeria, Togo and Ghana [38, 39]. The production of pito involves malting, milling, mashing, filtering and fermenting. Sorghum grains are soaked in water

for 48 hours, drained and allowed to stand for 5 days in a basket lined with moistened banana leaves. The malted grains are mixed with water and boiled together. The mash is allowed to cool and filtered using fine mesh. The filtrate is allowed to stand overnight until it assumed a sour flavour. The mixture is boiled to a concentrate. A starter from the previous brew is added to the cooled concentrate, which is allowed to ferment overnight.

Pito contains lactic acid, sugar and amino acids and has alcohol content of 3% [29]. In Nigeria, it is made by small (household level) producers, and is typically served in a calabash outside the producer's home where benches are sometimes provided. It can be served warm or cold. Warm pito gets its heat from the fermentation process. Pito brewing can provide an important source of income for cash-poor households in rural areas. It has never been bottled or canned [29].

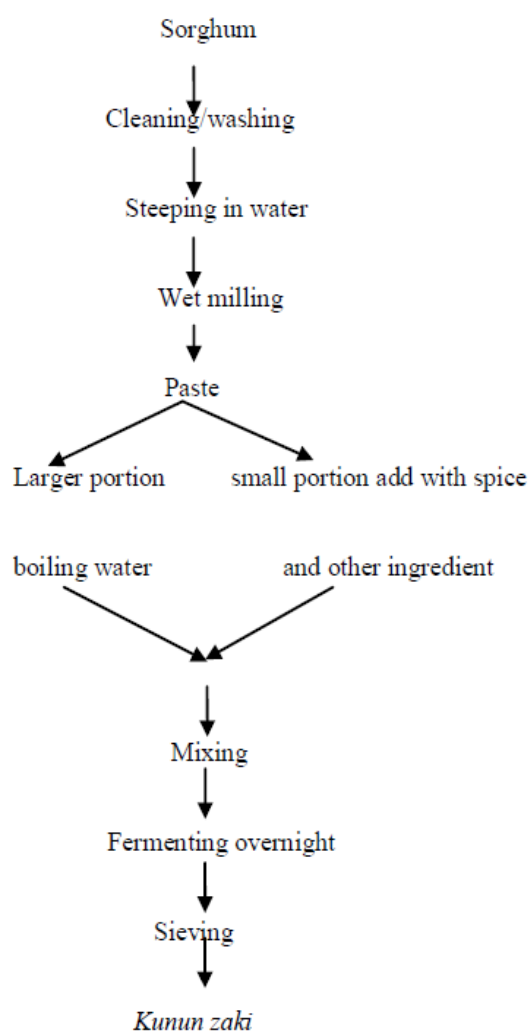


Figure 4. Traditional Production of Kunun Zaki

Source: Ekwueme [40]

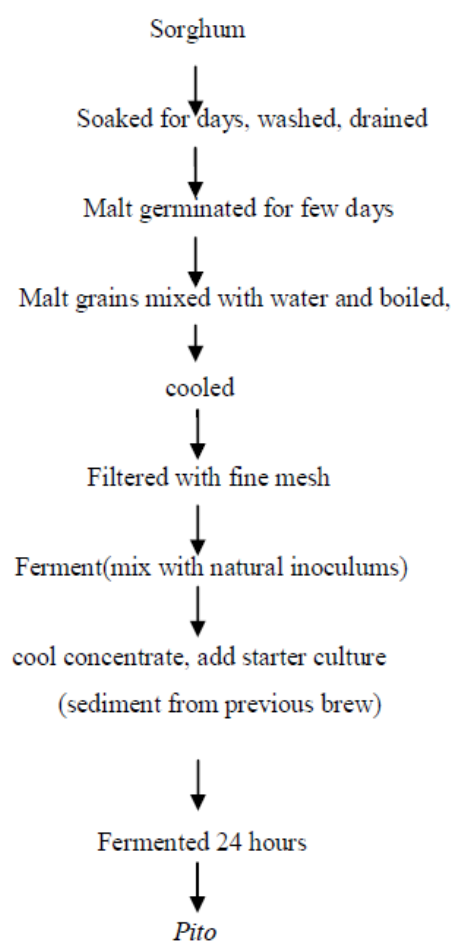
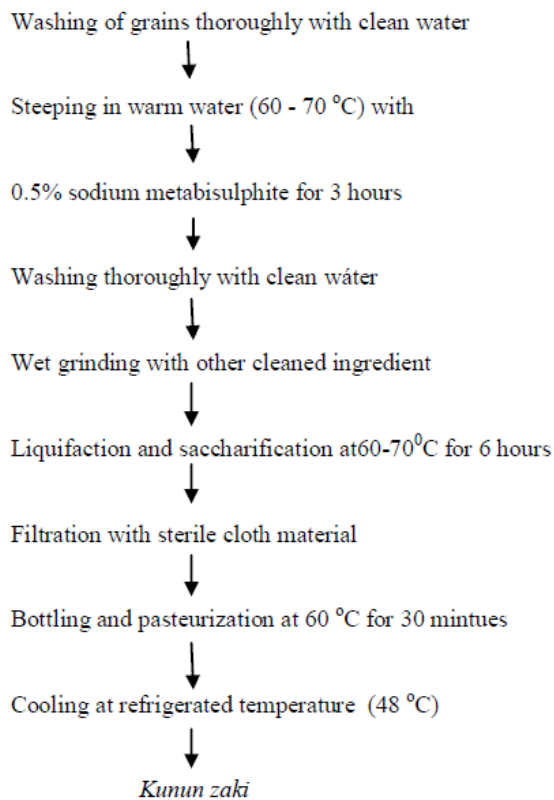


Figure 5. Flow chart for Production of Pito

Source: Nathaniel [41]

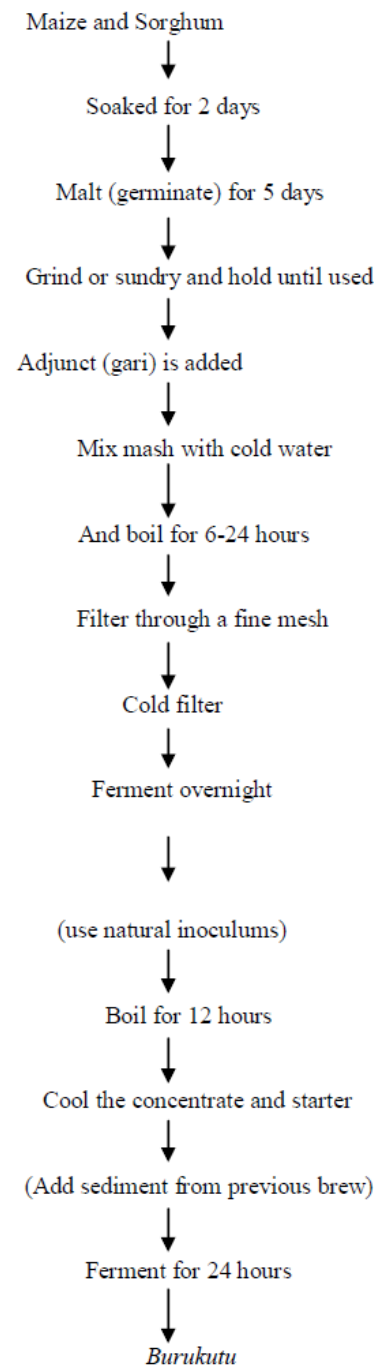


## Cereal Utilization in Nigeria



**Figure 6:** Processing of improved Kunun Zaki

Source : Gaffa [30]



**Figure 7.** Flow chart for the Production of Burukutu. Egwin et al. [42]

## MILLET UTILIZATION

Millet is one of the most extensively cultivated cereals in the world, after rice, wheat and sorghum, particularly in arid to semi-arid regions [43]. Millet is a principal food cereal cultivated in drought prone semi-arid regions of Africa. Nigeria uses millions of tonnes of millet for many homes, especially among the poor predominantly in Northern Nigeria [44]. It is also used in making a popular fried cake known

as masa. Its flour is also used in preparing tuwo, a thick paste also referred to as “toh” in Northern Africa. Millet products consist of kunun zaki, fura, Sinasirs, etc.

## FURA

This is wet milled and fermented millet paste. Aduku et al. [45] described it as cooked millet. The production of fura involves soaking the cereal grains in water overnight and sprouted out for 48 hours at room temperature, washed,

## Cereal Utilization in Nigeria

dried and blended with spices, then compressed into balls and boiled for 30 minutes [2]. While still hot, the cooked dough is worked through the mortar with pestle (with addition of hot water) until smooth slightly elastic cohesive lump, fura, is formed.

In addition to improved millet products, Inyang [46] reported the effect of germination and fermentation of pearl millet on the proximate, chemical and sensory properties of instant fura. This consisted of germinated fermented and ungerminated grains to produce fermented fura and traditional *fura* respectively using standard assay procedure to evaluate nutrient composition and phytic acid levels. Germinated and fermented fura samples increased in protein, ash, crude fibre, phosphorus, calcium, iron while the phytic acid levels reduced. Germination appeared to be a promising food processing method for improving nutrient and

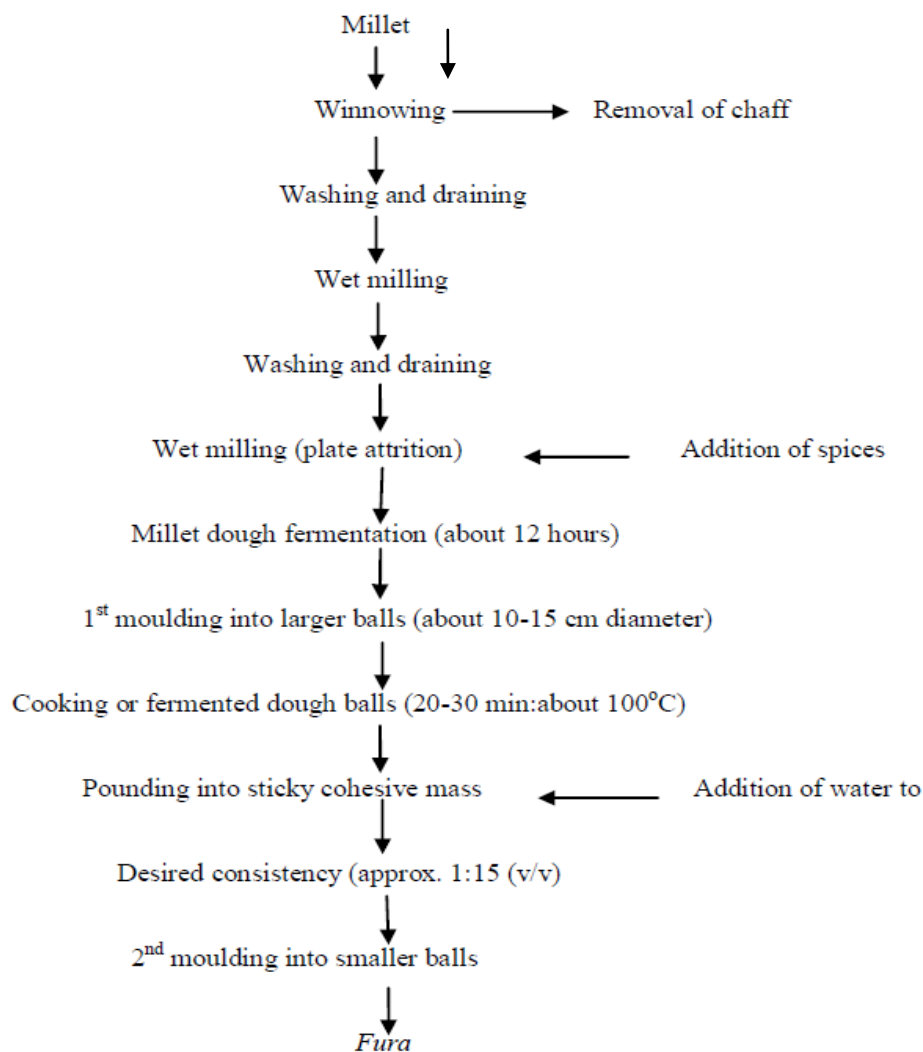
energy densities of fura but when combined with fermentation, it reduced phytic acid.

### KUNUN ZAKI

Kunun zaki can also be produced from millet or in combination with sorghum or maize using the same process as earlier described for the production. It is consumed as non alcoholic beverage especially in Northern part of Nigeria. Traditionally, it is consumed during meetings and traditional marriages [42].

### SINASIR

This is a thin pancake made from ground millet. It is known as kisra in Sudan. Its production varies from place to place. A thick paste is made from flour and water, which is inoculated with a starter usually from a previous batch of sinasir or yoghurt. This is allowed to ferment and dough is made into batter by addition of some water. The batter is then baked or toasted on high oiled metal or clay sheet [47]



**Figure 8:** Traditional production of Fura.

Source: James [48]

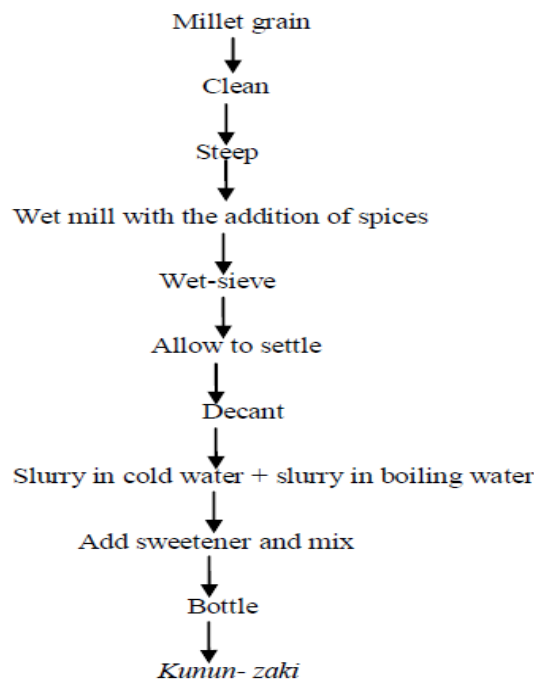


Figure9. Traditional production of kumun - zaki

Source: Nathaniel [41].

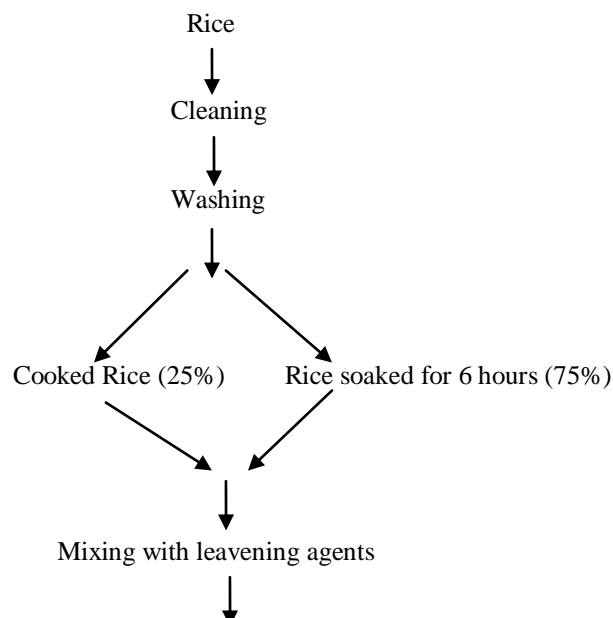
### RICE UTILIZATION

Rice is an increasingly important crop in Nigeria. It is relatively easy to produce and is grown for sale and for home consumption. In some areas there is a long tradition of rice growing, but for many, rice has been considered a luxury food for special occasions only. With the increased availability of rice, it has become part of the everyday diet of many in Nigeria. Rice is one of the major cereals in Nigeria. It is utilized as tuwo cinkafa, masa and also cooked based on individual choices. Rice is consumed as boiled, fried, ground with stew or soup. Rice

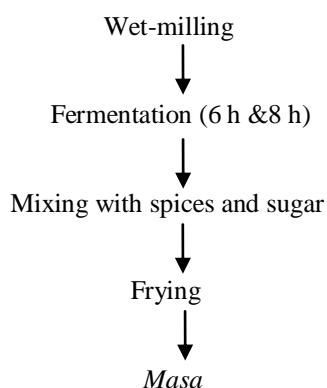
is cooked by washing and boiling in water [42].

### MASA

Egwin *et al.* [42] described masa as fermented puff batter made from rice, millet, maize or sorghum that is traditionally cooked in pan with individual cup-like depression. Masa is a popular staple food consumed by over 80% of the Northern Nigerian population of about 47 million [49]. It is prepared to create variety in cereal-based foods for sale and serves as a breakfast and snack item. Though it is as popular as the Nigerian *ogi*, it has only received very little attention [36].







**Figure10.** Processing of Masa.

Source: Igwe et al. [50]

**Table 1.** Statistical Pattern of Cereal Utilization in Nigeria. CEREAL PRODUCTION (metric tons)

YEAR	VALUE
1990	17, 678, 000
1991	18, 615, 000
1992	19, 5597, 000
1993	20, 090, 600
1994	20, 373, 200
1995	22, 512, 600
1996	21, 665, 000
1997	21, 853, 000
1998	22, 040, 000
1999	22, 405, 000
2000	21, 370, 000
2001	20, 090, 000
2002	21, 37, 3000
2003	22, 736, 000
2004	24, 321, 000
2005	26, 031, 000
2006	28, 864, 000
2007	27,171,000
2008	30, 209, 000
2009	21, 267, 630
2010	24, 656, 270
2011	20, 702, 508
2012	21, 435, 640
2013	19, 625, 30
2014	25, 829, 680

Source: FAO [44]

**Nutritional Information of Cereals**

All cereal grains have high energy values, mainly from the starch fraction, but, also from the fat and protein portions. Apart from moisture content and inedible substances such as cellulose, cereal grains contain carbohydrates- mainly starches (comprising 65 to 75% of their total weight), as well as proteins (6 to 12%) and fat (1 to 5%) along with traces of minerals and vitamins [51].

Many fortified cereals provide more iron, folic acid, zinc, B vitamins and fiber than

conventional non-cereal breakfast choices. Many fortified cereals also add vitamin A, thiamin, niacin, calcium, phosphorous, magnesium and/or potassium. When combined with fortified milk, the levels of healthful micronutrients and macronutrients in cereals provide for a nutrient-dense breakfast. Eating cereal also has added benefit of promoting milk consumption in children. Forty-one percent of the milk consumed by 6- to 12-year olds is consumed with cereals [52].

**Health Benefits of Cereals**

## Cereal Utilization in Nigeria

Studies show that cereal consumption is correlated with health benefits for men, women, kids and people of various ethnicities. Children and adolescents who eat a ready-to-eat breakfast have a lower Body Mass Index (BMI) and waist circumference than those who don't eat cereal at breakfast or who skip breakfast [53- 57]. Those who eat cereal may benefit from positive health benefits related to satiety, body weight and the risk for chronic disease [58 - 61]. Consumption of cereals results in lower levels of both total blood cholesterol and "bad" cholesterol (LDL) [58]. Cereal eaten with low-fat fortified milk at breakfast promotes increased intake of calcium, which is associated with healthier body weights [62]. Eating cereal's regularly may protect against cardiovascular disease risk [63]. Adolescents who eat a healthy breakfast also tend to exercise daily. There is an association between people who eat cereal's for breakfast and those who get higher levels of physical activity [64]. Girls who eat cereals are less likely to become overweight as young adults than non-cereal eaters. Frequent cereal eaters tend to have healthier body weights [65].

## CONCLUSION

Cereals have high level of utilization in Nigeria, which are mainly processed traditionally. It is the major functional food consumed in Nigeria due to its abundant availability and it is amenable to different processing technologies. Cereals have been utilized in various ways based on individual choices and its safety of consumption. It also plays an important role in the economy sector and in the life of Nigerian citizens.

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## Cereal Utilization in Nigeria

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