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Innovations in the Traditional Kunun Zaki Production Process

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Abstract: The traditional kunun zaki production process has been improved upon. The usual 24 hours process has been shortened to a maximum of 12 hours. Steeping of the grains in warm water with 5% sodium metabisulphite help in softening them. Liquefaction and saccharification of gelatinized sorghum starch with sweet potato and *Cadaba farinosa* crude extracts did not increase the amount of reducing sugar after 6 hours of incubation. Similarly, the specific density of the slurry remained the same after 6 hours of incubation with the crude enzyme extracts. Due to shortened saccharification process, the nutrient content of kunun zaki from improved process was a bit higher. The protein content was 5.4 and 4.1% for the improved and traditional processes respectively. The product from improved process was preferred to that in the traditional process.

Key Words: Sorghum starch, saccharification process, *Cadaba farinosa*

Introduction

Kunun zaki is a cereal-based beverage in Nigeria. The cereals utilized in its production are millet, sorghum and maize in decreasing order of preference (Gaffa *et al*., 2002a). Sometimes, the cereals could be used in composite form in its production but this is more common with only millet and sorghum grains. The preferred ratio of mixing is 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 (Adeyemi and Umar, 1994). The steeping duration depends on the cereal used but may vary between 12 and 72 hours for millet/sorghum and maize respectively (Gaffa, 2000). Grinding of the steeped grains mixed with spices (ginger, clove, red and/or black pepper) is done with local milling machines and part of the slurry (3/4 volume) is gelatinized with boiling hot water (Onuorah *et al*., 1987a). The remaining part of the slurry (1/4 volume ungelatinised) containing liquefying agents (sweet potato tuber paste, malted rice, extract of *Cadaba farinosa* stem) is mixed with the gelatinized portion when the temperature is about 60 – 70 ^{O}C. The mixture is altogether left overnight at room temperature for chance fermentation and filtered using local sieve the next morning. The filtrate-kunun zaki is consumed as a beverage with or without addition of sugar as a sweetener. The whole process lasts about 24 hours. The nutrient content and microbiological quality of this product has been reported (Gaffa *et al*., 2002b and c; Onuorah *et al*., 1987b). The consumption rate of the beverage has also been studied (Gaffa *et al*., 2002a). Owing to the high demand for this product and the high consumption rate, it is thought that the present traditional production process is outdated, inefficient, time consuming and with product quality varying between batches. In this present study, attempts have been made to improve on the traditional production process with the hope of maintaining nutrient and improving microbiological quality of the final product. The nutrient and sensory qualities of kunun zaki from the new process has been analyzed and compared with the traditional process.

Materials and Methods

Materials: *Sorghum bicolor*, dry sweet potato chips (*Ipomea batatas*) and ginger (*Zingiber officinale*) were all bought in bulk in Bauchi Central market, Nigeria. All items were bought in their standard measures as offered for sale. The ratio of ingredients used is presented in Table 1

Preliminary investigation: Attempts were made to find out whether the long period of chance fermentation was really necessary or whether the process comes to a halt after some time. Crude extracts of sweet potato and *Cadaba farinosa* were used on gelatinized starch. Two methods were employed in determining the termination time: the specific density method and estimation of reducing sugar. In the specific density determination, 30 ml of gelatinized (2% w/v) starch were dispensed in eight clean beakers each. To this was added 0.25% (v/v) of extracts from *C. farinosa* and dry sweet potato separately in each case. The preparations were in triplicate and allowed to stand in water bath at 60 ^{O}C for 0, 1, 2, 3, 4, 5, 6 and 7 hours respectively. At the end of each period, the specific density of each was determined using the method of Giese (1995).

Table 1: Kunun zaki beverage formulation

Ingredients	Quantities (g)
Sorghum bicolor	1346
Dry sweet potato chips	100
Ginger	16
Kunun zaki (ml)*	8963*

As final volume of the beverage.

Table 2: Nutrient content of kunun zaki produced by improved production process and the traditional process

Constituents	Nutrient contents	
	Improved	Traditional
Moisture	89.77	91.54
Crude protein	5.39	4.48
Crude fat	0.32	0.34
Ash	1.30	1.22
Carbohydrate	3.22	2.42
pH	5.43	4.92
Total soluble solids	7.50	6.00

Table 3: Sensory evaluation scores for kunun zaki samples produced by the improved method and the traditional process

Parameters	Sample codes with scores	
	AIM	TRD
Colour	23	11
Sweetness	29	5
Flavour	25	9
Mouth feel	26	8
Overall acceptability	29	5

AIM – Kunun zaki produced by the improved method TRD – Kunun zaki produced by the traditional method

Measurement was carried out gravimetrically using a specific density bottle and compared with equal volume of water at the same temperature. In the estimation of reducing sugar, extracts from *C. farinosa* and dry sweet potato were also used. In each case, 100μl of each extract was added to 1000μl gelatinized (1% w/v) sorghum starch in eight different test tubes. This was incubated as in specific density determination. The reducing sugar produced in each case was determined using Somogyi's colorimetric method (1952).

Production processes for kunun zaki

Traditional process: The traditional process followed is that which is common in Bauchi and Gombe states of Nigeria already reported (Gaffa *et al.*, 2002b) and is outlined in Fig. 1. Ingredients used were as in Table 1.

Improved production process: The same ingredients as presented in Table 1 were employed in this process. However, the washing was more thorough. The grains were steeped in clean warm water (60-70 ^{O}C) in ratio 1:2 (v/v) using a sterile beaker. To the steeped grains, 0.5% (w/w) sodium metabisulphite was added. The steeped

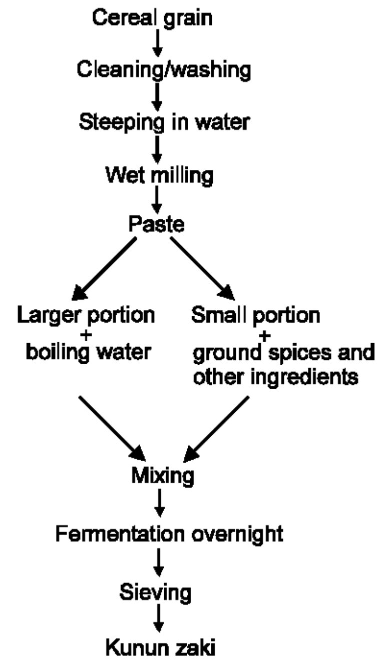

Fig. 1: Flow diagram of traditional kunun zaki production in Bauchi and Gombe State, Nigeria

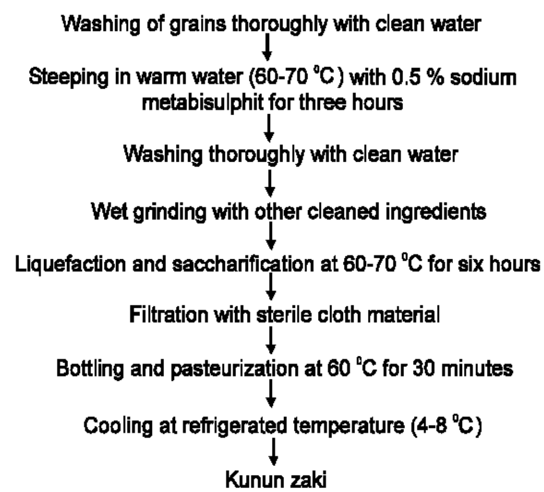

Fig. 2: Improved kunun zaki production process

grains and sweet potatoes were allowed to remain in the water for three hours. The soaked grains were removed from the water and washed again with fresh water. It was then ground to paste with a disc attrition-grinding machine that had earlier been washed thoroughly. The paste was divided into two unequal parts in ratio 1:3 (v/v). Boiling hot water was added to the larger portion to gelatinize. When the temperature dropped to 65-70 ^{O}C, the smaller portion was added. This was stirred using a sterile glass rod and allowed to stand at room temperature (25-28 ^{O}C) for six hours to effect liquefaction. The mixture was filtered at the end of

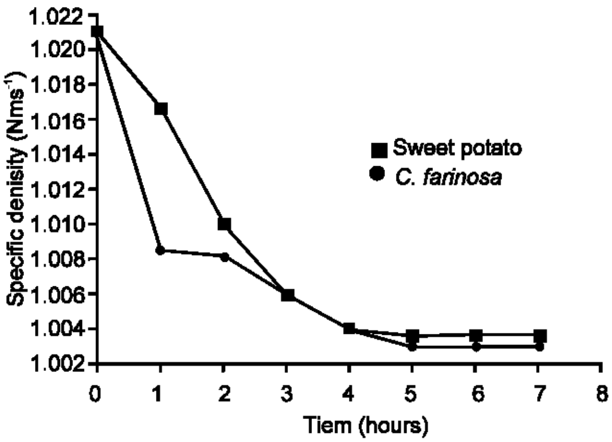

Fig. 3: Termination of starch liquefaction and saccharification by *C. Farinosa* and sweet potato extract (2 % w/v) on gelatinised sorghum starch

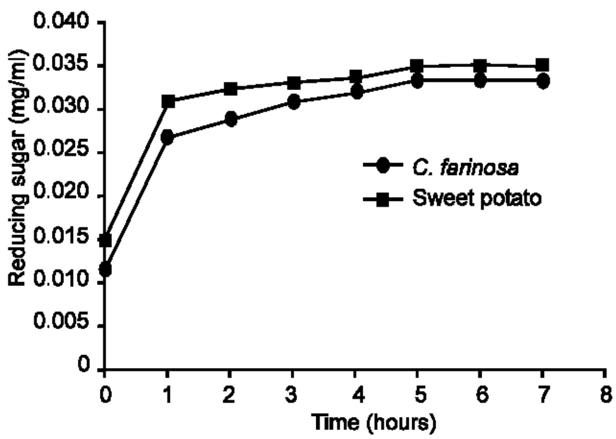

Fig. 4: Termination of starch liquefaction and saccharification by C. Farinosa and sweet potato extract (2% w/v) on gelatinised sorghum starch

the six hours using a muslin cloth that was boiled to sterilize. The improved method is outlined in Fig. 2.

Nutrient qualities of kunun zaki samples produced by the traditional and improved methods: The kunun zaki obtained from this process (improved) was compared in its nutritional quality (using the standard methods of Association of Official Analytical Chemists AOAC, 1984) and sensory attribute with that produced by the traditional process. The paired comparison test described by Ihekoronye and Ngoddy (1985) was adopted in sensory evaluation of the products.

Results

The effect of starch liquefaction on specific density of gelatinized sorghum starch: Fig. 3 shows that the specific density of the gelatinized starch decreased as a result of liquefaction brought about by the addition of *C. farinosa* and sweet potato extracts. The result also showed that the specific density decreased as the incubation time increased for both extracts. There were no decreases after the 5th hour in all the extracts.

Termination in the production of reducing sugar during incubation with liquefying agents: Fig. 4 showed the termination time in the amount of reducing sugar produced during liquefaction of gelatinized sorghum starch. Generally, optimum production of reducing sugar was obtained within the first 60 min (Fig. 4) after which there was no appreciable change in total reducing sugar with both *C. farinosa* and sweet potato. However, a higher peak was observed for sweet potato. The increase in number of hours of incubation caused slow but progressive increase in the amount of reducing sugar up to the sixth hour. No further increase was noticed after this period. The traditional kunun zaki production process takes not less than 24 hours before the final product is obtained. This wastes a lot of time and gives room for contaminants to get into the product. Based on our findings liquefaction takes not more than 6 hours.

Nutrient qualities of kunun zaki produced by traditional and improved methods: The nutrient contents of kunun zaki produced by the traditional and improved methods are presented in Table 2. Moisture content was slightly higher (91.54) in the traditional product compared to the improved product. Generally, the values for all the parameters were similar except for pH that was lower (4.92) in the traditionally produced kunun zaki product compared to that in the improved (5.43).

Sensory comparison between kunun zaki samples from the improved and the traditional process: In Table 3, average scores from the 34 member panelists on the sensory paired comparisons between the kunun zaki samples produced by the improved method and that produced by the traditional method is presented. In all the parameters assessed, the sample produced by the improved method had the highest scores. However, statistical analysis showed that there was no significant difference at 5% in colour between the samples. With the rest of the parameters (sweetness, flavour, Mouth feel, and overall acceptability) there were significant differences. Majority of the judges preferred the sample from the improved production process to that from the traditional process.

Discussion

Effect of liquefaction on specific density and production of reducing sugars from gelatinized sorghum starch. The progressive increase in the amount of reducing sugars with time (Fig. 4) indicates that the enzyme activity at the start of the reaction was fast resulting in increase of reducing sugars in the beverage. This trend is similar to the reduction in the specific density of the beverage (Fig. 3) that decreases with time. The reason why there was no further increase in reducing sugar with time after the 6th hour may be that the beta amylase enzyme for the hydrolytic process had completed the reaction. It could also be that the bonds of the starch molecules left unattached are not susceptible to the enzymes. This may also be the reason for the leveling of the graph (Fig. 3) after five hours during the specific density determination. Generally, the hydrolysis of starch is accomplished by two stages depending on the nature of bonds holding the molecules. The initial rapid and random attack on the substrate leads to rapid loss in viscosity. The second stage involves the hydrolysis of alpha-1, 4-glycosidic bonds by the beta amylases yielding reducing sugars. This view agrees with Karel (1975). The slight differences in nutrient contents of the kunun zaki produced by the improved method and that through the traditional process (Table 2) were due to slight variations in the production process. The low pH value of 4.92 observed for kunun zaki from the traditional process could be due to the metabolic activities of contaminating microorganisms particularly lactic acid bacteria that play a role in the production process. Maintenance of hygienic conditions in the laboratory may have caused the pH of the improved beverage to be higher (5.3). The protein content (5.4%) of the beverage from the improved processing was higher than that (4.1%) in the traditional process. This proves that when the carbohydrate content of a food is nearly depleted, the nitrogenous compounds are metabolized by microorganisms in the product and agrees with Brown and Booth (1991). It could also be that the level of contamination was so high leading to this reduction in protein content. The contamination, probably with extended liquefaction process in the traditional process has affected the moisture content. The enzymes from liquefying agents and the metabolic activities of contaminants seem to have continued hence larger molecules could have broken down leading to these changes. The drop in total soluble solids is also linked to metabolic activities of the contaminants. The introduction of sodium metabisulphate and the shortening of liquefaction process to 6 hours is the reason for reduction in the level of contaminants. The reduction in level of contaminants leads to maintenance of high nutrient content in the beverage from the improved process. The lack of significant statistical difference in the sensory scores for colour (Table 3) of improved and traditional kunu zaki shows that colour variation does not affect acceptability of the bevaerage. The high total soluble solids (TSS) value (7.50%) of the beverage from the improved process and the pH value of 5.43 were thought to have influenced the kunun zaki acceptability. The TSS imparts sweet taste to the beverage and the pH a less harsh or slightly acidic taste to the food. In the improved production process of kunun zaki outlined in Fig. 4, the complete deviation from the traditional process was avoided. This was for the purpose of maintaining flavour, taste and other characteristics that are known to be peculiar with this beverage so that consumers will not reject it. It is known that if foods are not prepared according to individual's likes or dislikes, either small quantities of the product will be consumed or the disliked food rejected. This view agrees with Adams and Erdman (1988).

It is concluded that Kunun zaki can be produced within a shorter period than the usual 24 hours. The liquefaction process may take just 6-7 hours to be completed. This reduces the chances of more contaminants in the food as well as the risk of food borne infections. Moreover the nutrients are maintained under such conditions and the products are also acceptable to all consumers.

References

Adams, C.E. and J. W. Erdman, 1988. Effect of home preparation practice on nutrient content of foods. In: Nutritional evaluation of food processing. 3rd edition. Karmas, E. and Harris, R.S. (Eds). AVI publishing company, Westport Connecticut. pp: 157-163.

Adeyemi, I.A. and S. Umar, 1994. Effect of method of manufacture on quality characteristics of kunun zaki, a millet based beverage. Nig. Food J., 12: 34-41.

Association of Official Analytical Chemists (AOAC), 1984. Official Methods of Analysis. 14th edition. Benjamin Franklin Status, Washington, D.C.

Brown, M. H. and I. R. Booth, 1991. Acidulants and low pH. In: Food preservatives. Russell, N.J. and Gould, G.W. (Eds). Blackie publishers. pp: 22-41.

Gaffa, T., 2000. Improving traditional kunu production and its storage stability. Ph.D Thesis. Biological Sciences Programme, Abubakar Tafawa Balewa University, Bauchi- Nigeria.

Gaffa T., I. A. Jideani and I. Nkama 2002a. Traditional production, consumption and storage of kunu- a non alcoholic cereal beverage. Plant Food Human Nutr., 57: 73-81.

Gaffa T., I. A. Jideani and I. Nkama, 2002b. Nutrient and sensory qualities of kunun zaki from different saccharifying agents.Int.J.Food Sci.Nutr., 53:109-115.

Gaffa, T., I. A. Jideani and I. Nkama, 2002c. Nutrient composition of different types of kunu produced in Bauchi and Gombe states of Nigeria. Int. J. Food Properties., 5 : 351-357.

Giese, J., 1995. Measuring physical properties of foods. Food Tech., 49: 53-63.

Ihekoronye, A. I. and P. O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. 1st ed. Macmillan Publishers, London. pp: 113-132.

Karel, K., 1975. Carbohydrates. In: Enzymes in Food Processing. 2nd ed. R. Gerald, (ed.) Universal Foods Corporation, Milwankee, pp: 87-99.

Somogyi, M., 1952. Notes on sugar determination. J. Biol. Chem., 195:19-23.

Onuorah, S. I., A. A. Adesiyun and J. O. Adekeye, 1987a. Occurrence of Staphylococci and Coliforms in kunun zaki and utensils used in its preparation in Samaru-Zaria. J. Food and Agri., 1: 31-34.

Onuorah, S. I., A. A. Adesiyun and J. O. Adekeye, 1987b. Survival and multiplication of *Staphylococcus aureus* and *Escherichia coli* in a Nigerian cereal drink (kunun zaki): Effects of spices, pH and temperature. J. Food and Agri., 1: 31-34.