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Effects of Different Preservative Treatment on the Sugar Content of Kunu- Zaki in University of Agriculture Makurdi, Benue State Nigeria

Beetseh C. I. Ph. D (Corresponding author)
Federal University of Agriculture, Makurdi (FUAM),
E-mail: igbaxclem@gmail.com

Yoo M. A. MNSE
Lower Benue River Basin Development Authority (LBRBDA), Makurdi
E-mail: markaertoryoo@yahoo.com

Achikpi F.
Federal University of Agriculture, Makurdi (FUAM)

Abstract
This study is to determine the shelf life of kunuzaki under different temperatures regimes, and the role of additives to the alteration in its shelf life or chemical components and also to possibly find a means of extending its shelf life using additives and temperature without the lowering its nutritional quality. During the study it was observed that appropriate concentrations of sodium benzoate and pasteurization can be used as preservative and preservative method respectively for extension of the shelf life of kununzaki under ambient temperature (30-31^{0}C). Sodium benzoate, when used at a concentration of (sodium benzoate (0.144g) for 35cl of kununzaki, slows down undesirable changes in the physicochemical characteristics of kunun zaki. This concentration of sodium benzoate brought about the least changes in pH compared to the other preservative treatments and also exhibited the best potential for use in the preservation of kunun zaki. Sodium benzoate can be used to extend shelf life of kunun zaki up to a period of three (3) days when preserved at ambient temperature (30-31^{0}C). In addition to having the ability to extend the shelf life of kunun zaki, sodium benzoate has no side effects to the consumer when put in appropriate quantity.
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1.0 Introduction

1.1 Background of Study

Kunu-zaki is a non-alcoholic, non-carbonated and refreshing cereal beverage popular in Northern Nigeria and is becoming widely consumed in southern Nigeria (Sowonola and Tunde-Akintunde, 2005). It serves as breakfast drink, appetizer, weaning food and is also medicinal (Akoma et al., 2006). It is also used as drink for social gatherings and religious festivities. It is made from cereals including millet (Pennisetum typhoideum), sorghum(Sorghum bicolor), maize (Zea mays), rice (Oryza sativa)and "acha" (Digitallsexilis) The relative abundance of any of these in any locality determines to a large extent the type of grain for making the beverage.

Optional additives includes spices (ginger, red pepper, black pepper, clove andgarlic), together with saccharifying agents such as sweet potatoes and tiger nut (*Cyperusesculentus*) which may be added to enhance flavour,groundnut (*Arachis hypogea*) is added for proteinenrichment while *Cadabafarinosa*crude extract is used as a thinning agent (Gaffa et al., 2002).]. Additives used in fortifications are used to compensate for looses during processing, addition at levels higher than those found in the original food and includes adding nutrients in the original and addition to levels specified in the standards of identity [Nieman et al 1992].

Over the years, people of different ages have enjoyed its refreshing taste. This taste is admired not only by the resource poor populace but also the well to do. It is cheap since it is produced from locally sourced materials which are readily available. Consequently, the drink serves as alternative to carbonated drinks in social gatherings and during religious festivities .In fact, [Adejuyitan *et al,* .2008]revealed that Kunu is more nutritious when compared to carbonated drinks. It is also taken as remedy by alcoholic addict. As explained by [Abulude*et al.*2006]The method of production is basically the same but with some variance from place to place based on cultural norms, taste and habit for example, some people in some regions prefer it with much pepper and sugar while some with little or no pepper and sugar.

kunun-zaki lasts for about 24h (Adeyemi and Umar, 1994)but has been shortened to a maximum of 12 h (Gaffa and Ayo, 2002). Traditional *kunun-zaki* is rich in carbohydrates, B-vitamins and minerals but is low in Protein content which may have a negative effect on the nutritional status of infants to whom it is fed as a weaning drink. *Kunun-zaki* has a shelf life of about 24 h (Adeyemiand Umar, 1994) at ambient temperature

(28±2°C).Attempts to improve the shelf life have met with some success, pasteurization in bottles followed by refrigeration storage (Osuntogun and Aboada, 2004) prolonged the shelf life to 8 days while sodium benzoate treatment followed by refrigeration improved the shelf life to 21 days (Olasupo et al., 2000). Kunu-zaki is a traditional non-alcoholic fermented beverage widely consumed in the northern part of Nigeria. Obadina et al. (2008) observed that kunuzaki is now widely consumed in the Southern parts among low and middle income workers who cannot afford industrial beverages. The beverage is characterized by sweet-sour taste, creamy, refreshing quality as well as its flowing consistency (Obadina et al., 2008). They may exist as liquid or thin gruel preparation with high water content which supplies the body with water sufficient to maintain health (Oguntimein, 1994). Kunu is the generic name for all kinds of non-alcoholic beverages that are cereal based with specifications usually attached to denote the base cereal grain (Sowonola et al., 2005, Nahemiah et al., 2014). There are various types of kunu processed and consumed in Nigeria. These include kunuzaki, kunugyada, kunuakamu, kunutsamiya, kunubaule, kunujiko, ashamu and kunugzakimba. Of these, kunuzaki is the most widely produced and consumed (Inatimi et al., 2011). Kunuzaki are made from sorghum, maize, millet, guinea corn or rice (Odunfa and Adeyeye, 1985, Adebayo et al., 2010). Spices such as ginger, alligator pepper, red pepper and black pepper are added as flavour and taste improver (Adebayo and Idowu, 2003). The process of cleaning, steeping, wet milling, sieving, settling, decantation and slurry recovery were applied in the preparation (Adebayo et al., 2010). Kunuzaki is acceptable to all age groups and is being served at home and public places as a refreshing drink and complimentary food for infants. It can also be consumed in the morning as breakfast by adults and children, serve as appetizer to entertain guests in rural and urban settings (Onuorah et al., 2005). Akoma et al. (2006) reported that kunuzaki have immense social, economic and medicinal importance to its numerous consumers. It is relatively cheap and nutritious when compared to carbonated drinks (Adejuyitan et al., 2008). It contains all the essential nutrients such as carbohydrates, fat, protein, minerals and vitamins (Ugwuanyi et al., 2015). According to Elmahmood et al. (2007), kunuzaki is produced at village technology level, its production protocols, packaging and distribution are not yet standardized. Kunu-zaki stored at ambient temperature (28 ± 2 °C) has a shelf life of about 24 h (Adeyemi and Umar, 1994). Attempts have been made to improve the shelf life of kunuzaki by using pasteurization method coupled with refrigeration storage (Osuntogun and Aboada, 2004) and the use of sodium benzoate treatment followed by refrigeration method (Olasupo et al., 2000). With these methods, the keeping qualities of kunuzaki beverage were prolonged. Black Velvet tamarind (Dialiumguineense) is also an additive that is added to kunuzaki,it is a woody plant that occurs in the rain forest region of West Africa. Velvet tamarind fruit is most valued for its high ascorbic acid content, minerals and sugar. However, it has been earlier shown that the fruit could be processed into beverages, soft drinks, alcoholic drinks, syrup/concentrate and jams (Okafor, 1975). Since the fruit is high in ascorbic acid and most people (children and adult) consume the beverage kunuzaki, the addition of black velvet tamarind (Awin-Yoruba, TsmaiyaKurm-Hausa) to kunuzaki could improve the nutritional value of kunuzaki. The use of black velvet tamarind as a sweetener in kunuzaki could also be a good source of natural sweetener for people allergic to artificial sweeteners. The major challenge with this drink is that it has a short shelf life and therefore highly perishable. According to Ayo et al. , this could be traced to its high moisture content and poor hygienic practice during preparation. Due to different fat content in grains, their shelf lives vary; hence there is a need to ascertain the grain which would give the best quality when Kunu is produced. Therefore, the aim of this study is to compare the shelf lives, acceptability and nutritional value of Kunu drinks prepared from different grains i.e. maize, millet and sorghum.

1.3 Specific Objective

I. The Chemical evaluation of kunuzaki
II. The evaluation of changes in qualityofkunuzaki at different temperature regimes
III. The determination of the shelf life of kunuzaki
IV. The evaluation of the various chemical components of kunuzaki
V. The role of additives in kunuzaki

1.4 Scope of Study

The purpose of this study is to determine the shelf life of kunuzaki under different temperatures regimes, and the role of additives to the alteration in its shelf life or chemical components and also to possibly find a means of extending its shelf life using additives and temperature without the lowering its nutritional quality.

2.0 Literature Review

The free encyclopedia, Wikipedia defines kunu-zaki(also known as kunu) as a popular beverage which is usually made from a grain such as millet and sorghum,although it can be made from maize as well, as a grain based beverage, kunu is a member of the horchata family(a name given to various plant milk beverages of similar taste and appearance. The variety of the drink made from sorghum is milky light brown colour, whilst that which is

made from millet and maize is whitish in color.

The international journal of research in agricultural sciences, defines Kunuzaki as one of the drinks produced from cereal grains in Nigeria, particularly the northern part of the country. It is produced from grains such as maize, millet and sorghum . The relative abundance of any of these in any locality determines to a large extent the type of grain for making the beverage . Over the years, people of different ages have enjoyed its refreshing taste. This taste is admired not only by the resource poor populace but also the well to do. It is cheap since it is produced from local sourced materials which are readily available. Consequently, the drink serves as alternative to carbonated drinks in social gatherings and during religious festivities.

2.1 Varieties Suitable For Kunun Zaki Production

Kunu is made from varieties of cereal grains and additives and they are named from theirmain ingredient or taste,this popular Nigeria drink has many names; kunu drink, kunu, knunu,kunuzaki or kunuzaki.

- Kunuaya; the main ingredient is tigernuts (Aya in the Hausa language, ofio by the Yorubas, akiawusa by the Igbos and Hausa groundnut in Pidgin.
- Kunugeda or gyada: is made from rice called shinkafa in the Hausa language and groundnut.
- Kunutsamiya:is produced mainly from guinea corn and flavoured with tsamiya.
- Kunuzaki(kunu) is the general name for all kunudrinks, but addition of other additives changes its taste,colour or chemical properties. Kunuzaki is produced from millet as its main ingredient.

2.2 Cereals

Cereals belong to various tribes of the grass family and they constitute importantcrops, which serve as industrial raw materials and staple food worldwide. Worldcultivated cereals include wheat, maize, rice, barley, oats, rye, sorghum, millet and rice.

An important characteristic of cereals is that it has high carbohydrate, low fat and a fairContent of protein. The functionality of these components in the different cerealsdetermine to a large extent, their uses asfood and industrial raw material.

2.3 Beverages

Beverages are foods consumed in the liquid form. They are either alcoholic or non-alcoholic. Alcoholic beverages are those beverages that contain significant alcoholic (ethanol) content. The ethanol in alcoholic beverages is produced by yeast fermentation of sugars. Examples of alcoholic beverages include: beers, distilled spirits and liquors. Non-alcoholic beverages play a very important role in the dietary pattern ; of people in developing countries like Nigeria. They are regarded as after meal drinks or refreshing drinks. Most of these beverages are made up of about 90% water, sugar, flavouring agents and sometimes preservatives. They are very nutritious and are of medicinal value. For example, the gruel kunun zaki produced from millet contains about 76.3%starch, 11.6% proteins, 3.3% fat, 1.9% ash along with a wide array of amino acids (Lichtenwalner et al, 1979).

Kununzaki is one of the indigenous non-alcoholic beverages prepared from millet(Pennisetumglaucum L.), maize (Zeamuys), or rice (Oryzasativu). Its wide acceptance has extended beyond the savannah region of Nigeria. It is consumed at anytime of the day by both adults and children as breakfast drink, food complement, refreshing drink for visitors, appetizers and is commonly served in social gatherings. Kununzaki is a drink either packed for sale in polyvinyl chloride (PVC) bags, bottled or in bulk in large containers and distributed under ambient temperature or cooled in refrigerators where available. The traditional method of production shown (Figure 1) is based on the process common in Bauchi and Gombe States of Nigeria as reported by Gaffa et al, 2002b)

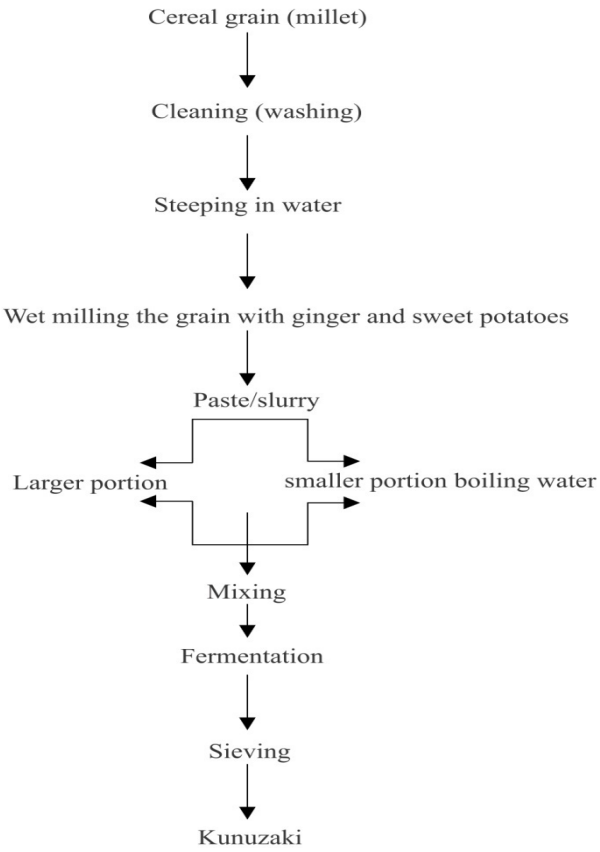

Figure 1: Flow diagram of traditional ***Kununzaki*** production in Bauchi and Gombe States of Nigeria (Gaffa***et*** al, 2002b).

The traditional process of ***Kununzaki*** production (Figure ***1)*** has been modified to yield gruels with reduced pathogenic microorganisms (Figure 2). The washing is more thorough, the grains are steeped in clean warn (70°C) water in a 1:2 (wh) ratio using a beaker.

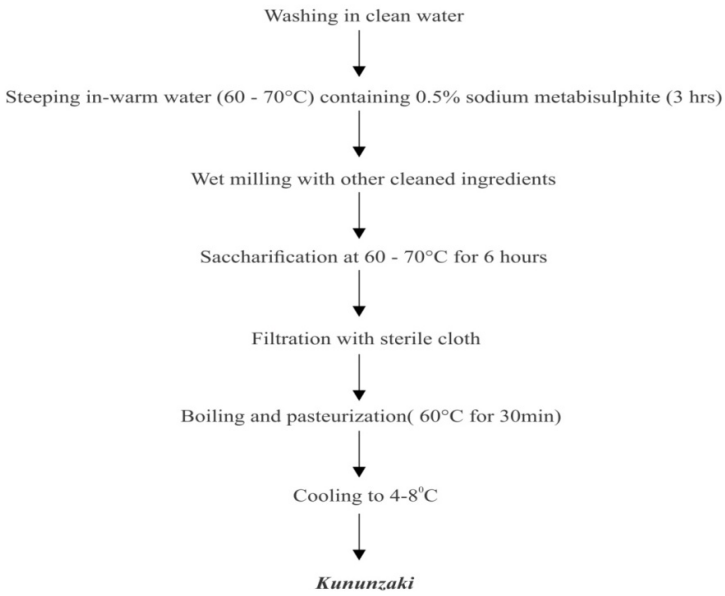

Figure 2: Modified ***Kunun zaki*** production (Gaffa, 2002)

2.5 Shelf Life of Kunu Zaki

shelf life is the length of time that a commodity maybe stored without becoming unfit for use, consumption or sales, or in other words it might refer to whether a commodity should no longer be on a pantry shelf(unfit for use) or no longer on a shops shelf(unfit for sale but not unfit for use) it applies to cosmetics, foods and beverages, medicines, chemical etc, but here were mainly concerned about the shelf life a cereal beverage(kunuzaki).

Shelf life is the recommended maximum time for which products or freshly harvested produce can be stored, during which the defined quality of a specified portion of the goods remains acceptable under expected or specified conditions of distribution, storage and display.

Shelf life depends on the degradation mechanism of the specific product. Most can be influenced by several factors: exposure to light, heat, moisture, transmission of gases mechanical stresses, and contamination by microorganisms.product quality is often mathematically modeled around a parameter (concentration of a chemical compound, a microbial index, or moisture content).

For some foods, health issues are important in determining shelf life, bacterial contaminants are ubiquitous, and foods left unused too long will often be contaminated by substantial amount of bacterial colonies and become dangerous to eat, leading to food poisoning. However shelf life alone is not an accurate indicator of how long the food can safely be stored. For example pasteurized milk can remain fresh for five days after its sell by date if it is refrigerated properly. However improper storage of milk may result in bacterial contamination or spoilage before the expiration date.

Likewise pasteurized kunu-zaki will last for longer hours if well refrigerated, Kunu contains lactic acid bacteria such as Lactobacillus, Streptococcus and Leuconostoc species which could cause spoilage. Bacteria such Staphylococcus, Pseudomonas, Bacillus and fungi such as Penicillium, Aspergillus, Trichoderma and yeast have been isolated from processed kunuzaki Osuntoki and Korie, (1997). The presence of these organisms in small number could render a beverage unsuitable for human consumption .Kunu has a very high moisture content and total solid which may encourage the growth of strains of microorganisms to hazardous levels during storage at ambient temperature Olasupo et al(2008). This study reports on the microbiological quality and chemical properties of kunuzaki stored at ambient temperature. The antibiogram of notable food borne bacteria was also determined.

Kunun zaki, a non alcoholic drink, is an easily perishable product that cannot stay more than 24hours after production without significantly deteriorating, A result of one of the study shows that a combination of pasteurization with chemical treatment can extend the shelf life of kunuzaki by 2 weeks, but pasteurization alone cannot extend it beyond 24hours, this is an indication that acceptable beverages with longer shelf life could be produced or preserved with combination of chemical treatment and pasteurization. Additives such as preservatives and antioxidants can be used to prolong the shelf life of these products.

2.6 Temperature in Shelf Life Determination

2.6.1 Pasteurization of kunuzaki

The current practice is to heat the kunu-zaki to a temperature for sufficient time, to assure practical sterility as wee as cloud stability by inactivating the natural juice enzymes (Rothschild et al., 1975)

Pasteurization is a process in which kunun zaki is treated with mild heat, usually to less than 100^0C (212^0F),to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contribute to spoilage.

Pasteurization can also be the partial sterilization of foods with heat to a temperature that destroys harmful microorganisms without major changes in the chemistry of the food**.**

Nearly all chemical reactions can occur at normal temperatures (although different reactions proceed at different rates). However most reactions are accelerated by high temperatures, and the degradation of foods is no exception, the same applies to the breakdown of many chemical explosives into more unstable compounds;

The usually quoted rule of thumb is that chemical reaction double their rate for each temperature increase of 10^0c (18^0F) because activation energy barriers are most easily surmounted at higher temperatures, however as with many rules of the thumb, there are many caveats and exceptions. The rule works best for reactions with activation energy values of around 50kJ/mol, many of these are important at the usual temperatures we encounter. Its is often applied in shelf life estimation ,sometimes wrongly, for instance in industry that triple time can be stimulated in practice by increase in temperature by 15^0c(27^0F) example storing a product for one month at 35^0c(95^0F) stimulates three months at 20^0C(68^0F). this is mathematically incorrect . If the rule was precisely accurate, the required temperature increase would be about 15.8^0C(28.4^0F), and in any case the rule is only a rough approximation and cannot always be relied on.

The same thing is true up to a point, of the chemical reactions of living things, they are catalyzed by enzymes which change reaction rates, but with no variation in catalytic action, the rule of thumb is still mostly applicable. In the case of bacteria and fungi, the reactions need to feed and reproduce speed up at higher temperatures, upto the point that the proteins and other compounds in their cell themselves begin to break down or denature, so quickly that they cannot be replaced. This is why high temperatures kill bacteria's and other microorganism: tissue breakdown reactions, such rates that they cannot be compensated for and the cell dies. On the other hand, elevated temperatures short of these result in increased growth and reproduction; if the organism is harmful, perhaps to dangerous levels.

2.6.2 Refrigeration

Refrigeration is the process of cooling a substance to a temperature below the ambient temperature in other to chill it or preserve it. To force bacteria to slow down their growth, they can be cooled. That is why shelf life is generally extended by temperature control: (refrigeration, insulated shipping containers, controlled cold chains, etc) and why some foods and medicine must be refrigerated .since such storing of such goods is temporal in nature and shelf life is dependent on the temperature controlled environment, they are also referred to as cargo even when in special storage to emphasize the inherent time-temperature sensitive matrix. Temperature data loggers and time temperature indicators can record the temperature history of a shipment to help estimate their remaining shelf life.

According to the USDA, food kept frozen continuously are safe indefinitely. Kunu-zaki stored at ambient temperature (28 ± 2 °C) has a shelf life of about 24 h (Adeyemi and Umar, 1994). Attempts have been made to improve the shelf life of kunuzaki by using pasteurization method coupled with refrigeration storage (Osuntogun and Aboada, 2004) and the use of sodium benzoate treatment followed by refrigeration method (Olasupo et al., 2000). With these methods, the keeping qualities of kunuzaki beverage were prolonged.

*kunun-zaki*lasts some 24 h (Adeyemi and Umar, 1994)but has been shortened to a maximum of 12 h (Gaffa and Ayo, 2002). Traditional *kunun-zaki*is rich in carbohydrates, B-vitamins and minerals but is low in Protein content which may have a negative effect on the nutritional status of infants to whom it is fed as a weaning drink. *Kunun-zaki*has a shelf life of about 24 h (Adeyemi and Umar, 1994) at ambient temperature (28±2°C). Attempts to improve the shelf life have met with some success, pasteurization in bottles followed by refrigeration storage (Osuntogun and Aboada, 2004) prolonged the shelf life to 8 days while sodium benzoate treatment followed by refrigeration improved the shelf lifeto 21 days (Olasupo et al., 2000).

3.0 Materials and Methods

3.1 Materials and Reagents

Sorghum grains (Sorghum vulgare)

i.
ii. maize (Zea mays)
iii. malted grain of millet
iv. Sweet potatoes

v. ginger (Zingiber officinate)
vi. Cloves (Eugenia coryphée)
vii. red pepper (Capsicum onnum)
viii. Sodium benzoate
ix. and Sodiummetabisulphite (BDH).

3.2 Methodology

Sorghum and maize of ratio 2:1 were cleaned separately to remove adhering particles of stones and plant debris. The grains were washed with potable water to remove adhering particles that may serve as contaminants. The sorghum and maize were steeped for 24 and 48 hours respectively to soften the kernel. Some steeped grains were spread on clean table surface and allowed to germinate for seventy two (72) hours at room temperature.

Germinated grains were subsequently dried at 450C for 24 hours. The sorghum, maize and spices were milled together with small quantity of water to form a paste, while the sweet potatoes and the malted grains were milled separately.

Slurry I:

The slurry from the wet milling was dispersed in small quantity of cold water, followed by addition of 50% boiling water and was stirred to give partly cooked slurry.

Slurry II:

This was made up of sweet potatoes and malted grains grounded together and were diluted with small quantity of cold water. This was then added to slurry I and stirred. The mixed extracted kunun zaki was allowed to cool for 1-2 hours. The cooled extract was filtered through a muslin cloth.

Addition of chemical preservatives

The filtrate was divided into four batches and each was re-divided into two different batches. Chemicals of different proportion were added (sodium benzoate (0.144g) or sodium metabisulphite (0.189g) or a combination of the two). One set of the samples contained no preservatives and another set was pasteurized while the third batch received chemical treatment. The fourth batch was only pasteurized and served as control.

Packaging

Kunun zaki was filled aseptically into 33cl sterilized plastic bottle and corked.

Pasteurization

The filled bottle were transferred into hot water bath and heated at 60^{o}C for 1 hour. The product was removed, cooled and stored at ambient temperature(30 to 31^{O}C) for one week and the changes in color, taste, total acidity, total sugar and pH value were monitored.

3.3 pH Determination

The pH of kunun zaki was determined using a pH meter ,The pH meter was first standardized with a buffer solution of pH 4.0 and then introduced into a small beaker containing 100ml of kunun zaki.

3.4 Total Acidity (As Lactic Acid)

A portion (10ml) of kunun zaki was measured into a 250ml conical flask and four drops of phenolphthaleine indicator was added. This was titrated with the standard 0.1N NaOH to distinct faint pink point. The total titratable acidity was expressed as lactic acid (g/100ml) as described by (Pearson, 1976).

3.5 Total Sugars

The total sugar content of the kunun zaki drink was determined following the methoddescribed by (Dubios et al., 1956).

3.6 Total Solid

Total solid was determined by evaporating 25ml of kunun zaki to dryness on boiling water bath which was followed by drying to constant weight in an oven at 130oC for 2-3 hours.

$$\% \text{ Total solid} = \frac{\text{Dry weight}}{\text{Weight of sample}} \times 100$$

3.7 Colour

The colour of kunun zaki was determined following the procedure described in (AOAC,1980). A portion (20 ml) of filtered kunun zaki was mixed and filtered through filter paper.

Absorbance of clean total filtrate was determined at 340nm using spectrophotometer Colour = 100 x A where A = absorbance.

4.0 Results and Discussion

4.1 Results

The results of this experimental work is tabulated below:
Table 1.

4.2 Effect of Different Preservative Treatment on The Ph Value Of Kunu-Zaki Fro 1-3rd Day Of Storage Time.

Treatment	Days 1	2	3
Control	3.77	3.52	3.36
Sodium benzoate	4.17	3.82	3.52
Pasteurized	3.48	3.51	3.36

The PH showed an increasing trend in its acidity with storage time in all the samples tested,

Parameters obtained for the proximate analysis are presented in Table 1. The pH was 3.77 which indicates an acidic pH. These values are within the range of 3.80 and 3.99 reported by Innocent et al. (2011), 2.42 to 3.83 recorded by Otaru et al. (2013), 5.25 to 5.65 reported by Amusa and Ashaye, (2009). The acidity of the kunu drinks may be due to the presence of some bacteria which help in acid fermentation of the kunu products.
Table 2.

4.3 Effects of Different Preservative Treatment On The Sugar Content Of Kunu- Zaki 1-3rd Day Storage Time

Treatment	Days 1	2	3
Control	3.95	3.8	3.7
Sodium benzoate	4.0	4.0	4.0
Pasteurized	3.95	3.7	3.65

Treatment	S/N	Temperature	Average	Total average	Standard deviation
Control	1	34^0C	3.95,3.93,3.96	3.95	7.89
	2	34^0C	3.80,3.82,3.79	3.80	7.61
	3	34^0C	3.70,3.72,3.69	3.70	7.41
Sodium benzoate	1	34^0C	4.00,4.02,3.99	4.00	8.02
	2	34^0C	4.01,4.00,3.99	4.00	8.00
	3	35^0c	4.00,4.02,3.99	4.00	8.00
pasteurized	1	38^0C	3.95,3.96,3.94	3.95	7.89
	2	35^0C	3.70,3.72,3.69	3.70	7.41
	3	35^0C	3.60,3.61,3.59	3.60	7.32

The change in total sugar content of kununzaki with storage time is shown in table 2. The sugar content generally decreased with storage time, chemical treatment and pasteurization did not prevent this decrease. The decrease in total sugar was more pronounced in day3 of the storage time for the treatment (Pasteurized and Sodium benzoate).The sample which was pasteurized without chemical treatment initially had a total sugar content of 3.95. At the end of the 3rd day of storage, the total sugar reduced to 3.65. Similar trend of total sugar reduction with storage time was found in sample treated with sodium benzoate or sodium metabisulphite or their combinations without pasteurized treatment. samples treated with these chemicals and also were given pasteurized treatment remained virtually stable in their sugar content until after three(3) days of storage. pH analysis, the stability of the samples as conferred by sodium benzoate and sodium metabisulphite is only relevant as long as the sample was pasteurized and the combination of these chemicals did not provide any significant additive effects

4.4 Discussion

4.1. Physico-chemical characteristics of kunun zaki

The pH and sugar content of the samples (treated and control samples) was observed to decrease as the period of keeping increased which is consistent with the findings of Agary OO, Nkama I and Akoma O. (2010). Adedokun II, Okorie SU, Nwokeke BC and Onyeneke EN. (2012). Ojimelukwe P, Elijah A, Ekong U and Nwokocha K. (2013). This decrease in pH is an indication of fermentation activity by microorganisms taking place in the samples resulting in acid production and accumulation which manifests as decrease in pH. This is typical of

carbohydrate rich foods such as Kunun zaki. Therefore, effectiveness of a preservative is dependent on the ability of the preservative to inhibit the activity of microorganisms in the food sample thereby slowing down changes in pH. The fact that changes in the pH of the kunun zaki sample treated with sodium benzoate were not significant up to Day 2 and only became significant on Day 3, added to the fact that the same sample recorded the highest pH values among all the other samples indicate that the sodium benzoate treatment must have had an inhibitory effect on the microorganisms present in the sample.

4.2. Sensory quality of kunun zaki

The sensory quality (aroma, taste, colour, texture and overall acceptability) of the variously treated kunun zaki samples declined with increase in keeping time. This agrees with the findings of Fapohunda and Adeware (2013) and Ojimelukwe (2013) who reported that the sensory quality of kunun zaki under preservation declined with time. This decline in sensory quality is suggestive of continuous microbial activities in the product which would result in the production of metabolic wastes such as hydrogen sulphide and other nitrogenous wastes that affect the sensory quality of the product. In spite of the aforesaid, the fact that the observed decline in taste, color, texture and overall acceptability for the treated samples remained statistically non-significant for a period of three days as against 24 hrs observed for the control sample suggests that the preservatives used must have had some inhibitory effects on spoilage organisms in the product. Though there were gradual decreases in the taste, aroma, color, texture and overall acceptability qualities of the sample treated with sodium benzoate and pasteurization, the changes were not statistically significant all through the three (3) days of preservation. This retention of sensory quality of kunun zaki sample treated with sodium benzoate points to the preservative quality of sodium benzoate on the product. The observed decline in aroma quality of the samples could be as result of production of off flavors associated with the production of hydrogen sulphide (H2S) and acetic acid Seema R. (2015). The decline in taste of the samples could be as a result of continuous accumulation of acids and toxic metabolites as a product of microbial fermentation. Colour deterioration of the samples could have resulted from possible accumulation of microbial metabolic products which may have affected the colour. The decline in texture of the kunun zaki samples

Kunun zaki preserved with sodium benzoate was found to be the best in terms of overall acceptability. The overall acceptability of the kunun zaki samples under preservation would naturally depend on how acceptable the resultant changes in the other sensory characteristics are to the consumers.

The acceptability of the samples that was pasteurized up to a period of 2 days of keeping suggests that these treatments possess preservative properties. The sample treated with sodium benzoate, however, exhibited the best preservative property, being found to be acceptable throughout the 3-day preservation period. Sodium benzoate can therefore be used at this concentration to extend the shelf life of kunun zaki for three days. The samples that contained the combination of lemon juice and honey showed the least preservative effect on the products.

5.0 Conclusion and Recommendation

5.1 Conclusion

This study determined the effect of chemical preservative and pasteurization in the extension of shelf life in kunu-zaki, and it was observed that.

Appropriate concentrations of sodium benzoate and pasteurization can be used as preservative and preservative method respectively for extension of the shelf life of kunun zaki under ambient temperature (30-31^{0}C). Sodium benzoate , when used at a concentration of (sodium benzoate (0.144g) for 35cl of kunun zaki, slows down undesirable changes in the physicochemical characteristics of kunun zaki. This concentration of sodium benzoate brought about the least changes in pH compared to the other preservative treatments and also exhibited the best potential for use in the preservation of kunun zaki. Sodium benzoate can be used to extend shelf life of kunun zaki up to a period of three (3) days when preserved at ambient temperature (30-31^{0}C). In addition to having the ability to extend the shelf life of kunun zaki, sodium benzoate has no side effects to the consumer when put in appropriate quantity.

5.2 Recommendation

Kunu-zaki, a non-alcoholic, non-carbonated and refreshing cereal beverage popular in Northern Nigeria and is becoming widely consumed in southern Nigeria (Sowonola and Tunde-Akintunde, 2005). It serves as breakfast drink, appetizer, weaning food and is also medicinal (Akoma et al., 2006) it is also used as drink for social gatherings and religious festivities.

Because of the health benefits an refreshing taste , I strongly recommend the proper intake of kunu-zaki for the following reasons;

- The key ingredient millet contains a poly nutrient called lignin, lignin has cancer fighting properties and its beneficial in the treatment of heart diseases.

- kunuzaki is good for women tht have reached menopause as it helps them to relax their muscles
- Kunuzaki is recommended for breastfeeding mothers as it increases flow of breast milk.
- It is known to help reduce the risk associated with diabetes.
- The ginger content of kunuzaki helps to lower the cholesterol level and prevents the formation of blood clots in the body.
- With kunuzaki you get a healthy super functioning digestive system, because it is rich in fibres.
- Kunuzaki helps in the prevention of chronic inflammatory diseases such as rheumatoid arthritis.

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