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(Review Article)

Composition of various grain extract and advances in preservation

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Abstract

This review paper focus on the nutritional composition of grain extract called 'kunu' in Nigeria and advances in preservation techniques. This is a local beverage from sorghum, millet and acha. Literature reviewed showed that the extract comprised of Ash, carbohydrate, protein and lactic acid. The extract can be fortified for higher yield of proximate composition and preservation. The review also showed progress in the advances in the preservation methods of grain extracts which can be synchronized into the local ways of extract processing and preservation, Scientific validation of indigenous knowledge of extraction methods coupled with modern scientific inputs would provide guidelines for evolving a simple, efficient system for grain extract utilization and enhanced composition.

Keywords: Nutritional Composition**;** Preservation; Grain extract; Local beverage; Grain processing

1. Introduction

Grain extracts commonly called kunu is a non-alcoholic cereal/grain based beverages consumed in Nigeria with high percentage in Northern parts of the country. It is a favorite beverage of both low income earners and high class people, but recently, it is also taken as thirst quencher and refreshment in other geopolitical region of Nigeria (Adeleke and Abiodun, 2010). kunu is a cheap beverage, because the ingredients used for the preparation are cheap and readily available in local markets and stores. The common grains used for beverage extract are sorghum, millet and acha (fonio) (Oke, 1980, Gaffa et al., 2002).

Gaffa et al (2002) analyzed the nutritional composition of different types of kunu (grain extract) produced from maize, millet sorghum and acha in Bauchi and Gombe States to comprise the following proximate composition; moisture ranged from 84.10 -95.90 %, PH values were between 3.12 -5.46 while acidity was found to be 0.02- 0.11% as lactic acid. The carbohydrate was found to be 2.66 – 7.92 %, protein 2.52 – 4.03%, fat 0.35 – 1.51 % and total soluble solids were between 0.50 – 7-77 %.

Microbial quality and proximate composition of kunu (grain extract) drinks produced and sold in Akwa Ibom state, Nigeria was investigated by Ekanem *et al* (2018) and they reported that kunu extract from grain cereals has 68 % moisture, 9.33 % crude protein, 5.5 % crude fat, 3.14 % ash and 49.2 % carbohydrate, calorie was found to be 283.67 kal. High composition of proximate properties for grain extract enriched with tigernut milk has also been reported by Adaramola-Ajbola *et al* (2019). The researchers reported that enriched sample had higher level of potassium, magnesium and phosphorus than the control sample. Similar research by Bolarinwa *et al.*,(2017), proximate composition of grain extract fortified with tigernut and *vigna racemosa* showed an increase of 28 - 102 % for protein, 6 – 21 % ash and 2 – 11 % carbohydrate. They also reported increase in mineral content of the extract.

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Proteins from grains and seeds are probable sources of a wide range of bioactive peptides that positively impact man's health (Arendt and Zannini, 2013). Grain and seed high in protein include wheat, brown rice, millet, cornmeal, oatmeal, amaranth, buckwheat, couscous, quinoa, whole-wheat pasta, flaxseeds, chia seeds, pumpkin seeds, peanuts, walnuts, almonds, sunflower seeds, cashews, date, kiwi, and cumin.

Table 1 Proximate Composition of Cereal Grains (% Dry Weight)

Cereals	Crude Protein	Crude Fat	Ash	Crude Fiber	Carbohydrate
Barley	11.0	3.4	1.9	3.7	55.8
Corn	9.8	4.9	1.4	2.0	63.6
Oats	9.3	5.9	2.3	2.3	62.9
Pearl millet	11.5	4.7	1.5	1.5	63.4
Rice, brown	7.3	2.2	1.4	0.8	64.3
Rye	8.7	1.5	1.8	2.2	71.8
Sorghum	8.3	3.9	2.6	4.1	62.9
Wheat	10.6	1.9	1.4	1.0	69.7

Source: C. Alais, G. Linden. Food Biochemistry. New York: Ellis Horwood, 1991, p. 222.

Table 2 Proximate analysis of Kunu-zaki produced from three different grains (Sorghum, maize and millet)

Proximate parameters	Maize	Sorghum	Millet
Moisture (%)	39.17 ± 0.09^{a}	38.33 ± 0.08^{b}	38.9 ± 0.09^{a}
Protein (%)	15.27 ± 0.089^{a}	17.53 ± 0.089^{b}	14.17 ± 0.089^{c}
Lipid (%)	1.27 ± 0.08^{a}	1.87 ± 0.09^{b}	1.67 ± 0.08^{b}
Ash (%)	2.77 ± 0.08^{a}	3.77 ± 0.08^{a}	1.87 ± 0.08^{a}
Crude fibre (%)	8.13 ± 0.08^{b}	7.67 ± 0.08^{a}	8.43 ± 0.08^{b}
Carbohydrate (by different)	33.39 ± 0.08^{a}	30.83 ± 0.08^{b}	34.96 ± 0.12^{a}

Source: Kunle et al., 2017

Table 3 Mineral compostion of Kunu zaki produced from three different grains (Sorghum, maize and millet)

Minerals	Maize	Sorghum	Millet
Iron (mg/100g)	6.33 ± 0.08^{a}	13.17 ± 0.08^{b}	8.17 ± 0.09^{c}
Zinc (mg/100g)	0.17 ± 0.03^{a}	0.50 ± 0.05^{b}	0.37 ± 0.003^{b}
Calcium (mg/100g)	90.0 ± 2.89^{a}	80.0 ± 2.89^{b}	111.67 ± 4.41^{c}
Magnesium (mg/100g)	2.77 ± 0.08^{a}	3.77 ± 0.08^{a}	1.87 ± 0.08^{a}
Selenium (mg/100g)	8.13 ± 0.08^{b}	7.67 ± 0.08^{a}	8.43 ± 0.08^{b}

Source: Kunle et al., 2017

The barley grain is reported to contain between 8 and 30% protein as a percentage of total mass (Qi *et al*., 2006, Howard *et al*., 1996). This protein is synthesized in the endosperm and the aleuronic layer during grain development and accumulates during grain filling. The crude protein content is used to predict malting and, therefore, brewing quality (Gupta *et al*., 2010). The protein content of the barley grain has a complex relationship with quality concerning malting barley. While high protein barley would be desirable for feed applications, a lower level is desirable for malting varieties. The ideal protein content for malting barley resides between 10 and 12%, and too high or low a protein content can negatively affect malting quality. Tables 1, 2 and 3 shows the proximate and nutritional compositions of various grain extract.

2. Advances in Grain Extract Preservation

There have been positive measures on how to preserve grain extract for long time storage that enables availability of product when out of season and accessibility of product where they are not produced. Some preservative techniques are discussed below.

2.1. Thermal treatment

Heat or thermal treatment is considered as one of the novel techniques for food preservation. For many years, the technique is well proven in various food sectors: from bakery and dairy to fruits and vegetables ((Wurlitzer et al. 2019; Gharibi et al. 2020). The process generally involves heating of foods at a temperature between 75 and 90 °C or higher with a holding time of 25–30 s. Study on preservation enhancement of apple juice beverage by pasteur-ization and thermal treatment of maize showed a great impact on the flavor, digestibility, glycemic index, aroma, color and sensory attributes (Charles-Rodrı´guez et al. 2007; Zou et al. 2020).

The heating of foods reduces the pathogens. However, extensive research has also concluded nutrient losses, energy wastages, flavor changes and reduction in the food matrix (Rosello´-Soto et al. 2018). A study conducted on light and dark honey showed changes in physicochemical characteristics, antioxidant activities and nutrient variations post-treatment (Zarei et al. 2019). Liquid foods, juices and beverages too have a negative impact causing gelatinization and browning reactions (de Souza et al. 2020). Adjustments and slight modification to former technologies have recently contributed to significant advances with a combination of electrical and thermal methods. Different processes like electroplasmolysis, ohmic heating, and microwave heating of foods have created a dramatic impact in the food industry advancements.

2.2. Freezing

Cooling and freezing of products have been extensively applied for preservation of leafy vegetables, spices and milk products to maintain the sensorial attributes and nutrition qualities. Extensively used freezing techniques involve air blast, cryogenic, direct contact and immersion freezing, while advanced techniques involve high pressure freezing, ultrasound assisted freezing, electromagnetic disturbance freezing and dehydration freezing (Cheng et al. 2017; Barbosa de Lima et al. 2020).

2.3. Ultrasound

Ultrasound treatment involves use of high intensity and frequency sound waves which are passed into food materials. The process deals with ultrasonic radiation passing through the target solution. This action causes a disturbance in the solid particles in the solution leading to particles breaking and diffusing into the solvent (Cares et al. 2010). It should be noted that the intensity of the technique should be kept constant. This is because as intensity increases, intramolecular forces break the particle–particle bonding resulting in solvent penetrating between the molecules, phenomenon termed as cavitation (Fu et al. 2020; Khan et al. 2020). Ultrasound is slowly paving way into two most thriving sectors in the food industry, namely wine making and dairy production.

Production of wine fermentation and alcoholic drinks always faces an issue in tackling microorganisms or yeast. Conventional methods generally involve use of chemical preservatives like sulfur oxide to prevent spoilage or thermal pasteurization followed by filtration to get the pure beverage. A recent study reported significant reduction of about 85–90% lactic acid bacteria with high power ultrasound at 24 kHz for 20 min for treatment of wine (Luo et al. 2012; Gracin et al. 2016).

2.4. Ozone treatment

With the growing demands of consumer slowly moving towards healthy meals and sustainable lifestyle, the demand for organic foods have increased rapidly. Consumers need a functional food that is free from additives, preservatives with a decent shelf life span. Thus, the concept of ozone treatment technology has risen in recent years. Ozone can serve as preservative due to its diverse properties and quick disintegration. ozone removes the necessity to store harmful chemicals as the gas can be made instantly. Ozone treatment does not require much energy as compared to thermal treatment giving more importance to the shelf life (Pandiselvam et al. 2019).

2.5. Nanotechnology

Nanotechnology involves any material or nanoparticle having one or more dimensions to the order 100 nm or less (Auffan et al. 2009; nature, precise action on active sites and high surface area (Joshi et al. 2019). The reason for the success of nanotechnology is due to its promising results, no pollutant release, energy efficient and less space requirements. Apart from these success factors, nanotechnology has also shown versatile applications in terms of safety, toxicity and risk assessment in areas of agriculture, food and environment (Kaphle et al. 2018).

The usage of chitosan and chitosan-based additives and films has been recently explored with multiple functional- ities with positive outcomes. Chitosan-based films, in general, possess antioxidant, antimicrobial and antifungal properties making it a good replacement for synthetic chemicals (Yousuf et al. 2018). The use of chitosan-based derivatives offer a promising solution towards maintaining the shelf life of foods without changing sensorial properties (Kulawik et al. 2020). A recent study proved that chitosan-based matrices can also be used for clarification, preservation and encapsulation of different beverages (alcoholic, non-alcoholic as well as dairy based), fruit juices, tea and coffee (Morin-Crini et al. 2019). Apart from this, nanocomposites (combination of different nanomaterials) have shown efficient thermal and barrier properties at a low cost.

2.6. Plant as Preservatives

Kunu extract prepared from two different cereals (millet and sorghum) by slurry recovery method were preserved using lime, lemon, phyllanthus, sodium benzoate and a combination of lime and lemon. The sensory quality were preserved better by the combination of lime and lemon as preservatives (Fapohunda and Adeware, 2012).

3. Conclusion

In conclusion, this review work has brought to light the micro and macronutrients of grain extracts that are beneficial for human consumption; furthermore, it has shown that advanced preservation techniques used for other food materials can also be applied to grain extract to extend the product shelf life.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no known conflict of interest.

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