

Effect of pre-cooking pearl millet (*Pennisetum glaucum*) flour on the reduction of dregs in *oshikundu*

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Abstract

Oshikundu or *ontaku* is a low- or non-alcoholic fermented drink commonly produced in over half of Namibian households on daily basis. It is prepared using water, pearl millet (*Pennisetum glaucum*) flour and sorghum (*Sorghum bicolor*) malt flour. Like many African fermented drinks, *oshikundu* is a dynamic drink with live fermenting microorganisms that can lead to spoilage of the drink. Thus, the optimal shelf life is not known. The amount and quality of ingredients and conditions of processing are not standardised. *Oshikundu* has a lot of insoluble solids which tend to settle and form a sediment (dregs) at the bottom. To reduce the amount of dregs, this study used smaller amounts of sorghum malt and pearl millet flour that produced the same volume of *oshikundu*, as that produced using traditional amounts. The duration of heating pearl millet flour adjunct was also varied to improve the solubilisation of starch but not to change the consistency of *oshikundu* from the way it is prepared traditionally in households. The amount of total solids in *oshikundu* prepared in this study was significantly lower from those of common household-made *oshikundu*.

Keywords: *Oshikundu*, pearl millet, total solids, *Sorghum bicolor*, dregs

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1 Introduction

Oshikundu is a traditional cereal based fermented beverage popularly consumed in Namibia. It is prepared in over half of Namibian homes almost every day for own consumption. It is also sold at the informal markets. It is apparently a sour-tasting, mildly effervescent gruel of low or no alcohol content (Taylor, 2004) and contains suspended matter (dregs), which tends to settle to the bottom during storage. This can affect its stability (Briggs, Boulton, Brookes & Stevens, 2004). It is prepared by using water, pearl millet flour and sorghum malt. Pearl millet malt flour can also be used instead of malted sorghum flour. Similar products have been reported in Africa (Taylor and Emmambux 2008). For example *togwa* in Tanzania, is made from maize meal and finger millet (Hellström, Vázquez-Juárez, Svanberg & Andlid, 2010) and in Nigeria, *kunun-zaki* is made using pearl millet and white *fonio* (Akoma, Jiya, Akunmka & Mshila, 2006). For pearl millet, food additive such as sugar can be added.

The amount of ingredients, the conditions of preparation and hygiene is as variable as the number of households that makes *oshikundu*. Generally, 500 mL of water is boiled and added to about 200 g of pearl millet flour (Taylor, 2004) and mixed thoroughly and uniformly using a wooden spatula to avoid lumps formation. This results in a relatively thick paste. The paste is cooled to about 40°C. Milled sorghum malt (about 50 g) is then added and mixed well into the paste. This mixture is intermittently stirred while left to cool further for about 30 min or more. Thereafter, the paste can either be diluted with water (1 to 1.5 L) (Taylor, 2004) or left overnight and then diluted the following morning. The diluted mixture is left to ferment spontaneously (without back-slopping, addition of small amount of previously fermented *oshikundu* and/or dregs) or it is back-slopped and left to ferment.

The amount of dregs (*ehete*), i.e. the suspended particulate matter in *oshikundu*, which settles to the bottom ranges between 2 and 10% (Embashu, 2014), as is. This amount of dregs is a problem to some consumers. Not everyone who drinks *oshikundu* likes the presence of dregs. One may thus find that some people especially children would scoop off the watery part of *oshikundu* and leave the dregs in the container. The dregs then goes to waste because it is relatively thick to consume on its own without it being part of the sour-tasting and effervescent liquid component. Therefore, this study investigated the effect of time of pre-cooking the pearl millet adjunct (flour) on the amount of dregs in *oshikundu*. Preliminary results indicate that intelligent control of adjunct pre-cooking can reduce the amount of dregs.

2 Materials and Methods

2.1 Experimental Materials

Pearl millet and malted sorghum flours used was purchased from Oshakati open market in April 2015 and was stored at ambient conditions in a storage room at the University of Namibia before use within 4 months.

2.2 Pre-gelatinisation of Pearl Millet and *Oshikundu* Samples Preparation

Pearl millet flour was subjected to four different hydrothermal treatments over time. The amounts used in the present study were lower than those reported by Taylor (2004) and Embashu (2014). This is to minimise the amount of sediment in the product. About 58 g of pearl millet meal was added to 400 ml of boiled water and mixed by stirring. This was left to cool for roughly 30 minutes, to about 45°C. The same amount of pearl millet meal was treated as above but was removed from the heat source as soon as it started to boil. The above was repeated but paste was boiled for further 5 minutes before being removed from the heat source. The last treatment was done as the others except that the paste was boiled for further 10 minutes. About 2.4 g of sorghum malt was added before diluting with 600 ml of water. This was followed by back-slopping i.e. the addition of a 15 ml of previously fermented *oshikundu*. All samples were then incubated at 30°C for 24 hours. After *oshikundu* was left to ferment. About 15 ml aliquots were frozen till moisture and total solid analysis (conducted within 2 weeks).

2.3 Traditionally-prepared Oshikundu

Traditional *oshikundu* samples (2) were collected from two different households in Windhoek. These were used to compare total solids between *oshikundu* samples made with the precooked pearl millet paste and the traditionally-processed oshikundu.

2.4 Moisture and Total Solids contents determination

Clean crucibles were placed in the oven at 105°C for 2-3 hours to dry. These were then placed in a desiccator to cool for about 45 min. Each crucible was weighed, appropriately

labelled. Samples were vigorously shaken to mix them well and about 5g aliquots of each of *oshikundu* samples was put into the dried crucibles. The crucibles were then placed in the oven set at 105°C. They were left to dry for 24 hours. Thereafter they were removed and placed in a desiccator to cool for about 45 min and weighed. The moisture and total solids were calculated (James, 1995; Bradley Jr, 2010). Total solids were calculated as: Total solid (%) = 100 - % Moisture.

2.5 Statistical Analysis

For each treatment, three independent samples were prepared. For moisture content determinations, duplicates were analysed per sample. The average values and their respective standard deviations ($n = 6$) were computed in Statistica 12 software using one-way analysis of variance. To detect the differences between the means, Fisher least significance difference test was performed at a p-value of 0.05.

3 Results and Discussion

Moisture (%) of *oshikundu* achieved by pre-cooking pearl millet flour increased with prolonged cooking time (Table 1). The sample prepared by addition of just boiled water had a moisture content of 97.5%, whereas the one made from paste that was cooked for 10 min had 98.5%. This then resulted in a total solids content that decreased with prolonged heating time. The increase in moisture content with prolonged heating can be attributed to pre-gelatinization. Water is presumably retained by the pearl millet starch granules due to continued water intake and swelling of the granules (Beleia, Varriano-Marston & Hosney 1980) favoured by exposure to increased temperatures.

Table 1: Moisture and total solids of *oshikundu* made by pre-cooking pearl millet flour and traditional *oshikundu*

	<i>Oshikundu</i> boiled water added	<i>Oshikundu</i> boiled paste instant	<i>Oshikundu</i> boiled paste for 5 minutes	<i>Oshikundu</i> boiled paste for 10 minutes	Traditional <i>oshikundu</i>
Moisture (%)	97.54 ± 0.9 ^a	97.84 ± 1.2 ^a	98.04 ± 0.1 ^a	98.51 ± 0.1 ^a	94.77 ± 0.5 ^b
Total solids (%)	2.46 ± 0.9 ^a	2.16 ± 0.9 ^a	1.96 ± 0.1 ^a	1.49 ± 0.1 ^a	5.24 ± 0.5 ^b

[‡]Values are means ± standard deviation. Means with same letter superscript are not statistically significant at ≥ 0.05 .

Dregs or suspended particles mostly comprise pearl millet adjunct, sorghum malt and possibly yeast and bacteria cells. The major component in *oshikundu* besides water, is

pearl millet flour and sorghum malt flour (Embashu, Cheikhyoussef, Kahaka & Lendelvo 2013; Embashu, 2014). The sorghum malt comprises starch hydrolysis products including fermentable sugars. It also provides hydrolytic enzymes such as alpha- and beta-amylases which hydrolyse starch molecules (Taylor, 2004). These comes about during the malting of sorghum grain.

Alpha-amylases hydrolyse starch into lower molecular weight starch products such as oligosaccharides, dextrans and thereby solubilising the starch granules and molecules (Taylor, 2004). Beta-amylases effectively hydrolyse the products into smaller products with the primary release of maltose (Taylor, 2004). However, in food processing starch has to be gelatinised for its molecules to be readily accessible for hydrolysis by these enzymes (Dewar and Taylor 1999; Taylor, 2004). Pearl millet flour primarily comprises starch (Taylor, 2004) which in the *oshikundu* making process most likely just partially undergoes gelatinisation upon its mixing with boiling water (Annor, Marcone, Bertoft & Seetharaman, 2014). However, this short-lived exposure of starch granules to hot water and in concentrated amounts will not disorganise the starch granules to expose the polymers to hydrolytic enzymes. Thus, the dregs presumably consist of mostly raw starch and some partially gelatinised starch. To the best of the authors' knowledge, there is no literature on the approach to reduce the amount of *oshikundu* dregs, and this is the first study to investigate how to reduce the dregs in *oshikundu* to improve the beverage quality and ultimately prolong the shelf life of this product. While it is true that the Namibian people possess different indigenous knowledge systems (Shapi, Mu Ashekele & Cheikhyoussef 2012; Mu Ashekele, Embashu & Cheikhyoussef 2012) and that their traditional practices especially in rural areas have an important role and values for these communities' daily life activities, it is noteworthy that such practices have been an art. This contribution therefore highlights the importance of the intersection of traditional practices and cuisines with science and technology. This intersection can potentially lead to improved quality of indigenous products and to their transformation into high quality products that can be commercially manufactured. This would ultimately contribute to the economic development of Namibia. This study provides two strategies to reduce the dregs in *oshikundu*. The total solids and thus amount of dregs can be reduced by using lower amounts of dry ingredients while producing the same yield and by pre-gelatinisation of adjunct. These approaches can positively contribute to the stability and possibly wider consumer acceptability of *oshikundu*.

4 Conclusion

Use of smaller amounts of dry ingredients and pre-gelatinisation of pearl millet flour in the process of making *oshikundu* can significantly decrease total solids in *oshikundu*. This suggests that the amount of suspended particles in *oshikundu* that tends to settle during storage

can also be reduced through this route. For enhanced stability and possibly wide consumer appeal, this is a positive contribution towards processing of *oshikundu* at an industrial and commercial level.

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