

Quality Evaluation of Three Sudanese Sorghum Cultivars for (Asida) Porridge Making

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Abstract: Three Sudanese sorghum cultivars (Tabat, Hageen and Feterita) were collected from Khartoum local market, cleaned milled on roller mill to extract 78% flour, the same cultivars were decorticated to extract 78% flour milled on stone mill and plate mill. Sorghum grains were tested for hardness; flours were tested for milling quality (granulation, moisture losses, protein recovery and ash contents). About 78% of wheat flour extraction was collected from Khartoum local market, the optimum blend of sorghum to wheat flours for Asida (Porridge) making was selected to be 10%. Asida produced from the three cultivars with the three milling methods were sensory evaluated: The mean score for color, texture, taste and overall acceptability showed no significant differences at ($p < 0.05$) between the overall acceptability of Tabat milled on roller mill, decorticated Tabat milled on plate and stone mills, this group of flours produced the best Asida quality, followed by decorticated Hageen milled on plate mill and Hageen milled on roller mill, respectively. The least overall acceptance was evaluated as Feterita milled on stone mill followed by Feterita milled on plate mill, its red color is revealing undesirable sensory attributes. However, Asida taste showed the least variation among the evaluated quality parameters, decorticated Tabat milled on stone mill was rated the best, followed by Tabat milled on roller mill.

Keywords: Porridge quality, Sorghum milling, hardness.

I. INTRODUCTION

Sorghum bicolor L Moench ranks as the fifth important cereal in the world and the second most important cereal food, after maize for millions of people living in the semi arid and sub-tropical regions of Africa [1] and the first among cereals consumed in the Sudan; cereals per capita were estimated at 140 kg/annum, 90 kg of which is sorghum, 10 kg millet and 40 kg wheat [2]. Annual sorghum production ranges between 3.4 to 4.2 million tons which accounts for 20% of Africa's production and about 10% of world's production [3], [4]. It is an important element to Sudanese diet as a source of calories and proteins. It is consumed in numerous ways, boiled grain (*Balila*), *Kisra*, flat thin bread like pan cake, *Nasha* (thin porridge), thick porridge (*Asida*) with fermented or non fermented flour, *Hilu-Mur* drink, *Abra*y drink like *Kisra* but more fermented and with whiter decorticated flour, *Moose* which is prepared by mixing *Kisra* with sugar and water. It is also used for making alcoholic beverages like *Marisa*, *Baganiya* and *Husowa*. It was also reported to be used for cosmetics and body care [5]. However, *Kisra* and *Asida* are the most important forms of using sorghum flour throughout the country. The most common and simple food prepared from sorghum or millet is porridge (*Asida*). Stiff (thick) porridges are consumed in almost all countries where sorghum and millets are cultivated [6]. Generally, thick porridges are solid, and can be eaten with the hand. The preparation of stiff porridge entails adding flour to boiling water in increments accompanied by vigorous stirring. The flour is cooked until it forms a thick, homogeneous and well gelatinized mass devoid of lumps. Porridge texture preference differ from region to region for example: in Western and Southern Sudan they like it to be very stiff, while in the middle and Khartoum region they prefer the relatively soft one. It

is also differs according to acidity taste, fermentation of slurry, the range of acidity varies between non-fermented if it is to be eaten with sugar or milk (Bani Karbo), very acidic if it is to be eaten with water and salt, and moderate acidic if it will be eaten with stew. The sorghum flour is blended with wheat flour for (porridge) making; this will enhance color and add a nutritional value as well. In some countries finely milled flour is used; whereas, in others coarsely milled flour or a combination of coarse and fine flour is used. The flour may be made from roasted, germinated, fermented and/or dehulled grains [7]. The Grain color and texture of the flour are important characters contributing to the quality of the porridge [8]. The present study aimed to choose the optimum blend of wheat flour added to sorghum flour to get the best Asida (Porridge) quality and to evaluate three Sudanese sorghum cultivars for Asida making. Also to evaluate the effect of milling method on Asida (Porridge) quality.

II. MATERIALS AND METHODS

A. *Materials:*

Three Sudanese sorghum cultivars with different grain hardness: Tabat, Hageen and Feterita were obtained from Khartoum local market season 2013 cleaned, decorticated to get 78% flour and then milled on commercial stone, plate mill and roller mill; (Elnilain) a Sudanese wheat cultivar (season 2014) was obtained from Khartoum local market and milled on roller mill with 78% extraction rate and used as (Porridge) Asida quality improver.

B. *Kernel Hardness:*

A Tangential Abrasive Dehulling Device (T.A.D.D) Model 4E-115) was used to measure hardness (Abrasive Hardness Index) by percentage weight of sample retained after subjecting 20 grams of grain to 1.5 min of abrasion with a #104 Norton carborundum plate. The grain pericarp was rubbed off, and the fines that were generated exit underneath the cups and are swept out of the machine into a fines collection bag by means of an air - flow produced by the fan; A low T.A.D.D. percent translates to harder endosperm grain [9], calculated with formula

$$\% \text{ T.A.D.D.} = \frac{\text{Dehullrd grains} \times 100}{\text{sample weight}}$$

C. *Flour Granulation Test:*

Flour granulation test was done as described by [10], using Buhler lab sifter MLI 300 -C. 50 g of flour were placed and sifted on sifter clothed with 280 μm . The sifting time was 5 minutes, stocks overtailed the screen were carefully weighed and the over pan was weighed, percentage related to 50 g were calculated.

D. *NIR Test:*

NIR Perten type 8600 (1) tester (Perten Instrument –Instrument vagen31SE-126 53 Hagersten. Sweden) was used. The test was performed on sorghum calibrated apparatus to obtain: moisture, protein and ash content. The milling moisture loss was calculated by subtracting the moisture content of the milling produces from the moisture content of the milled grain. Protein recovery was calculated by the following equation:

$$\text{Proteinrecovery} = \frac{\text{flour protein} \times 100}{\text{grain protein}}$$

E. *Blend optimization:*

The composite flour for this research is base flour improved by other grain flour to modify quality of the finished product. Wheat flour was added to sorghum flour for producing Asida. The best recipe of the composite flour for Asida was reached by surveying 20 women by giving them two containers of sorghum and wheat flour respectively to make the normal mixture of flour for Asida making, the average blend was chosen to perform the test.

F. *Porridge (Asida) Making:*

Asida is cooked with different methods according to the region. The test Asida was done with the method used in western Sudan: the water was boiled, a reasonable ajeen (fermented dough) was added with continuous stirring with (mufraka, a special wood stick) until the dough is well cooked. In a personal communication [11] described the test of how to know that the Asida was well cooked by emerging the mufraka into the Asida and pick it out, if the Asida held in mufraka became elastic and stuck to the mufraka, then it is said to be well cooked. After that a hand full of flour was gradually

added and mixed thoroughly until a homogenized paste was developed with the preferred thickness. The Asida cooking test was performed by using the western Sudan method. When cooked, stiff porridge should not spread when dropped into cold water, but rather should retain its shape. This is sometimes used as a test for doneness [7].

G. Panel Test:

Twenty judges were selected and trained to be qualified for sensory evaluation. The panelists were given a hedonic questionnaire to test texture, color, taste, and general acceptability of coded samples of Asida, using scale of 1 to 5 points (1 = poor, 2 = fair, 3 = good, 4 = very good and 5 = excellent). **Statistical Analysis** Each sample was analyzed in triplicate and the figures were then averaged. Data were compared using analysis of variance (ANOVA), [12].

III. RESULTS AND DISCUSSION

A. Grain and Flour Quality:

The 90 seconds decortication resulted in 86.35, 84.5 and 82 % recovery for, Hageen, Tabat and Feteriea respectively, these results suggest that the hardness is strongly correlated to percent recovery and consequently on the milling yield. The three research sorghum grains are categorized to hard (Hageen), intermediate (Tabat) and soft (Fetarita). These results are not far from the range of recovery reported by [13], who reported the range between 63.8 and 84.5%. Milling quality of the cultivars under research is shown in Table 1, The milling moisture losses for Tabat and Hageen cultivar ranged between 3 and 3.51% with average of 3.35 % which indicates no great variations; but when Feterita cultivar is compared a significant difference was detected may be due to the softness of the grain which has less resistant to milling action. However Tabat flour milled on roller mill showed the finest flour followed by Hageen and Feterita respectively. No great variation in Ash content detected except Tabat milled on the plate mill which showed the least ash content among the flours of all cultivars.

B. Flour Blend:

The results showed that there was very narrow range of blending wheat flour with sorghum to produce Asida (7- 16%). The optimum blend was found to be 10 % wheat flour and 90 % sorghum flour.

C. Asia (Porridge Quality):

The porridge is consumed immediately or after short time after cooking. The first sensation of Asida is the sight, therefore the color is a significant parameter of evaluation Asida just like any other food stuff; as it is eaten by fingers the texture has a great share in evaluating its quality, regarding Asida, taste came last as evaluating quality parameter according to panelists.

TABLE1: THE SORGHUM FLOUR SPECIFICATION

Entry	Moisture losses	Granulation %throu180 µm	Ash content
TS	3.39	91.39	1.30
HS	3.42	91.68	1.26
TP	3.51	91.53	0.88
HP	3.46	91.51	1.18
TR	3.00	97.40	1.31
HR	3.34	94.50	1.29
FS	2.28	93.95	1.44
FP	2.34	93.72	1.39

T = Tabat; H = Hageen; F = Feterita; S = Stone mill; P = Plate mill; R = Roller mill

Asida made from flour extracted from grains with different hardness and different milling methods were subjected to sensory evaluation by a panel of 20 tasters. The mean score for color, texture, taste and overall acceptability are presented in Table 2. according to panel testers there were no significant differences at ($p < 0.05$) detected between the overall acceptability of Tabat milled on roller mill, decorticated Tabat milled on plate and stone mills, this group of flours produced the best Asida quality, followed by decorticated Hageen milled on plate mill, and Hageen milled on roller mill,

respectively. The least overall acceptance was evaluated as Feterita milled on stone mill followed by Feterita milled on plate mill, its red color is revealing undesirable sensory attributes. These findings reveal a positive relation between Asida quality and milling method: color and fineness this finding is in agreement with [14], who reported that texture varied considerably among the porridges, caused by differences in the meal particle sizes. Among all types of flour used for Asida making, Tabat milled on plate mill produced the best Asida color followed by Tabat milled on stone mill and on roller mill respectively. While Asida made from Feterita flour milled on stone mill was rated as the poorest Asida color followed by the same grain milled on plate mill and Hageen flour milled on stone mill. However, Asida color results exhibited wide variations between grain cultivars and milling methods Tabat cultivar which produced a significantly better Asida color than all other cultivars indicates that the grain color is strongly affects consumer's preference. The best rated Asida texture was made from Tabat flour milled on roller mill followed by Feterita milled on stone mill. While the least rated texture was Asida made from Hageen flour milled on plate mill. These results suggest a strong negative relation between Asida texture and grain hardness and a positive relation between flour particle size and Asida texture. However, it was reported that the sensory attributes of sorghum products are influenced mainly by the physico-chemical properties of the grain [15] and the milling process used to produce the flour or meal [16], [17]. Furthermore the research observed that the texture of Asida made from hard grain (Hageen) deteriorated with time after cooking, though it has scored high points of texture sensory evaluation. The positive relationship between porridge texture corroborates the finding of [18], who found that hard grains produce firmer porridge. Asida taste showed the least variation among the evaluated quality parameters, decorticated Tabat milled on stone mill was rated the best, followed by Tabat milled on roller mill. This result indicates that the milling method affect the taste. This finding is in harmony with the finding of [16], [17] and [15], who correlated the sorghum flour products with the grain characteristics and milling method.

TABLE II: ORGANOLEPTIC EVALUATION OF ASIDA

Entry	Color	Texture	Taste	Overall. Acceptability
TS	4.62 ^a	4.13 ^a	4.55 ^a	4.43 ^a
HS	4.11 ^b	4.04 ^b	3.79 ^c	3.98 ^b
TP	4.71 ^a	4.00 ^a	4.14 ^b	4.28 ^a
HP	4.30 ^b	4.00 ^b	3.82 ^c	4.04 ^b
T R	4.54 ^{a,b}	4.33 ^a	4.50 ^a	4.46 ^a
H R	3.87 ^c	4.06 ^b	4.00 ^b	3.98 ^b
FS	1.83 ^e	4.18 ^a	4.00 ^b	3.34 ^d
FP	2.01 ^e	4.00 ^{a,b}	3.91 ^{bc}	3.31 ^d

T = Tabat; H = Hageen; F = Feterita; S = Stone mill; P = Plate mill; R = Roller mill

Means within a column followed by the same letter are not significantly different ($P < 0.05$).

IV. CONCLUSION AND RECOMMENDATIONS

Blend to produce the best Asida quality as the study suggests is 10 % wheat flour and 90 % sorghum flour. Asida color and texture results exhibited wide variations between grain cultivars and milling methods. This finding reveals a positive a relation between Asida and milling qualities namely color and fineness. Unexpectedly taste showed the least variation among the evaluated quality parameters. However Tabat milled on stone mill gives the best Asida, followed by Tabat milled on roller mill; though Feterita gave the best texture Asida, it was not the favorite for consumers due to its red color. Therefore the research recommends Tabat cultivar milled on stone or roller mill as the best cultivar for Asida making among the test cultivars.

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