ECRONICON OPEN ACCESS

EC NUTRITION
Research Article

Technological Characteristics of Some Nigerians' Sorghum Grain Varieties

Diarra M[1]*, Bouhari M[2], and Idakwo PY[2]

[1]Rural Economy Institute, Food Technology Laboratory of Sotuba, Bamako, Mali

[2]University of Maiduguri, Department of Food Science and Technology, Nigeria

***Corresponding Author**: Diarra M, Rural Economy Institute, Food Technology Laboratory of Sotuba, Bamako, Mali.

Received: November 02, 2016; **Published:** November 10, 2016

Abstract

Five Nigerians' sorghum varieties, Borno kamouanza, Chakalari red, Chakalari white, Kaura and Masakwa adjama, were characterized for their dehulling loss, yield of dehulling, dehulling performance, milling yield, milling performance and flour particles sizes. An Indian dehuller, NAVIN No 1 HULLER, MADRAS, type ENGLEBERG) and a plate mill (1A. DELMAR GRINDING MILL, type plates) were used following, the traditional standard operating conditions of millers, that consisted of running the dehuller or the grinder without a prior adjustment between the size of the grains and the gap between the blades of the dehuller or that between the plates of the grinder and the grains. The dehulling time was recorded using a stop watch.

The results of dehulling showed that the highest dehulling loss (40%) was obtained with Chakalari white whereas the lowest (20.55%) was observed with Masakwa adjama. Consequently, the highest (79.45%) and the lowest (60.00) dehulling yields were obtained with Masakwa adjama and Chakalari white, respectively. The highest (24.00 kg/h) dehulling performance was observed with Borno kamouanza whereas, the lowest (9.99 kg/h), was obtained with Kaura. The highest milling yield (96.25%) and the lowest (85.50%) were seen with Chakalari red and Chakalari white, respectively. The highest milling performance (57.75%) was obtained with Chakalari red while Kaura had the lowest of 27.99%. The particles sizes of most of the flour from the different sorghum varieties ranged between 250 and 500 μm.

Keywords: *Technological; Characteristics; Nigerian; Sorghum; Varieties*

Introduction

Dehulling and milling are two important stages or primary operations of cereals as sorghum, millet and maize, processing. Dehulling consists of removing the external layer or pericarp of the grain and also part of the germ in some cases [1]. The protein, mineral and vitamin contents of the grain are reduced through dehulling. However, products' digestibility is improved because of the partial elimination of polyphenols and phytic acids which reduce proteins and other nutriments bioavailability [2].

Milling is intended to reduce the grain in fine particles, semolina or flour depending on their sizes. The dehulling and milling behavior of the grain varies with variety but also with the method and the machines utilized. Several methods including, manual one using mortars and pestles [3] and mechanical, utilizing machines as ENGELBERG dehullers and mills, are used for dehulling and milling [4]. Knowledge of cereal grain variety dehulling and milling behavior enables guiding not only, food processors in their choices of variety in terms of products to be produced, but also breeders, with regard to factors in the grains, to be improved.

Materials and Methods

Materials

The five sorghum grain varieties investigated, Borno kamouanza, Chakalari red, Chakalari white, Kaura and Masakwa adjama, were obtained from Maiduguri Monday Market, in Nigeria. Other materials utilized included, a metallic tray, a local sieve and a winnow for grains cleaning. Also, were used, a scale of 50 kg, SHELL motor oil and gas-oil, an Indian dehuller, NANIN No 1 HULLER, MADARS, type ENGLEBERG, and a hammer mill, 1A DELMAR GRINDING MILL.

Method

Dehulling

Three (3) Kg in triplicate of clean grains of each of the 5 sorghum grain varieties, Borno kamouanza, Chakalari red, Chakalari white, Kaura and Masakwa adjama, were weighed and conditioned with 600 ml of water and fed directly to the feeder of the dehuller. The machine was operated by a local miller following the local practice of dehulling. This practice consisted of draining the grains towards the dehulling chamber with a piece of stick and operating the machine without an adjustment between the size of the grains and the gap between the blades and the rotor. The dehulling time was recorded using a stop watch whereas, its loss, yield, and performance were determined using the formulas (1), (2) and (3), respectively below:

Formula (1): (%) DHL = (B- A) / B x 100 [5].

Where:

(%) DHL = Percent Dehulling loss

B = Initial weight of whole grain

A = Final weight of dehulled grain

Formula (2): (%) DHY = A/B x 100

Where:

(%) DHY = Percent Dehulling Yield

Formula (3): DHP = (A x 3600 sec.) / T

Where:

DHP (kg/hr.) = Dehulling Performance

A = Final weight of dehulled grain

T = Dehulling time of the initial whole grains

Grinding

Two (2) kg, in triplicate, of clean grain of each of the five afore mentioned sorghum grain varieties, were weighed, and fed directly to the hopper of the grinder. The machine was operated following the local, standard operating conditions that is, conveying sometimes the grains in the chopper with a piece of stick to speed up their transit to the grinding chamber, adjusting the feed trap to the grinding chamber with fingers, and manually loosening or tightening the plates according to the desired fineness of the flour. The grinding time was recorded using a stop watch, while its yield and performance were determined using the formulas (1) and (2), respectively below:

Formula (1): (%) GY = B / A x 100

Where:

(%) GY = Percent Grinding Yield

A = Weight of dehulled grains fed into the grinder

B = Weight of flour

Formula (2): GP = B x 3600 sec. / T

Where:

GP (kg/hr.) = Grinding Performance

B = Weight of flour

T = Grinding time of the dehulled grain

Flour Particles Size Determination

Hundred (100) g of each of the 5 sorghum grain varieties, flour were sieved for 10 min through a set of sieve mesh of 4000, 2000, 1000, 500, 250, 125, and 63 µm successively. The percentage of flour that does not pass through each sieve was measured and the mean particle size G50 which, corresponds to the sieve mesh that retains 50% of the flour, determined.

Statistical Analyses

The statistical analysis was carried out using the Statistics Package for Social Sciences (SPSS) version 16. All the values expressed in percentage were obtained using the frequencies under the descriptive statistics.

Results and Discussion

Dehulling

Table 1 presents the dehulling characteristics data of the sorghum grain varieties investigated. The highest dehulling loss (40.00%) and the lowest (20.55%) were found with Chakalari white and Masakwa adjama, respectively. This range is comparable to the value (32.5%) reported for ENGLEBERG rice milling loss [6]. With regard to the dehulling yield, the highest value, 79.45%, was obtained with Masakwa adjama while Chakalari white had the lowest of 60.00%. Apart from Chakalari white, the dehulling yield of the five sorghum varieties used was ≥ 70%, value reported for ENGELBERG Dehuller [4], The highest dehulling performance (24.00%) and the lowest (9.99%), were obtained with Borno kamouanza and Kaura, respectively. All the five sorghum grain varieties had a dehulling performance far below that (60 - 100 kg/h) reported for ENGLEBERG Dehuller [4]. This could be due to the repeatedly coming of the dehuller belt, during the milling, which will lengthen the dehulling time, thereby reduce the performance;

Sorghum Grain Variety	Dehulling Loss (%)	Dehulling Yield (%)	Dehulling Performance Kg/hr	Dehulling Performance Kg/hr/hp.
Borno kamouanza	30,00	70.00	24.00*	3.00
Chakalari red	26.11	73.8	14.38	1.80
Chakalari white	40.00*	60.00*	10.84	1.36
Kaura	28.89	71.11	9.99*	1.25
Masakwa adjama	20.55*	79.45*	22.20	2.78

Table 1: *Dehulling Characteristics of Sorghum Grain Varieties.*
Values are means of 3 determinations.

Grinding

The grinding results are shown in (Table 2). Chakalari red had the highest grinding yield of 96.25% whereas, the lowest (85.50%) was found with Chakalari white. The grinding yield obtained with the equipment was ≥ 85.50% with all the five sorghum grain varieties. These values are above the average accepted performance (≥ 70%) for machine. With regard to the grinding rate, the highest (7.22 kg/hr/hp.) and the lowest (3.50 kg/hr/hp.), were obtained with Chakalari red and Kaura, respectively. These values are far below the one (25 kg/hr/hp.) [4], These discrepancies between the actual results and the ones reported are probably due to the lack of adjustment of the gap between the grinder plates which results in incomplete milling. Also, may have contributed the formation of a paste which, adheres to the plates and is not evacuated.

Sorghum Grain Variety	Grinding Yield (%)	Grinding Performance (Kg /hr)	Grinding Performance (Kg/hr/hp.)
Borno kamouanza	93.75	32.94	4.12
Chakalari red	96.25*	57.75*	7.22
Chakalari white	85.50*	43.30	5.41
Kaura	91.25	27.99*	3.50
Masakwa adjama	92.50	29.01	3.63

***Table 2**: Grinding Characteristics of Sorghum Grain Varieties.*
Values are means of 3 determinations.

Flour Particles Size

Table 3 presents the particles size of the flour from the different sorghum grain varieties. Masakwa Adjama had the highest particles size of 500 µm at 63.56% whereas, the lowest (250 µm at 52.78%) was found with Borno kamouanza. These values agree with those of the dehulling yield, where Masakwa adjama had the highest of 79.45% and Borno kamouanza 70.00% after that of 60.00% of Chakalari white. In fact, the harder the grain, the greater the dehulling yield.

Sorghum variety	Sieve diameter (µm)							
	4000	2000	1000	500	250	125	63	< 63
	Flour weight retained on sieve (g)							
Borno kamouanza	0.00	0.00	0.42	39.28	52.78*	6.40	1.18	0.00
Chakalari red	0.00	0.06	0.34	48.44*	43.66	6.04	1.10	0.02
Chakalari white	0.00	0.00	0.36	61.88*	28.44	6.68	1.86	0.16
Kaura	0.00	0.00	0.34	8.64	62.62**	21.92	5.08	1.06
Masakwa adjama	0.00	0.02	0.70	63.56**	28.18	5.56	1.26	0.08

***Table 3:** Flour Particle Size of Sorghum Grain Varieties.*
Values are means of three determinations.

It can be concluded that adjusting the gap between the blades and the nerved cylinder in an ENGLEBERG Dehuller as well as that between the plates of a grinder, in terms of the grain size, is a must. A lack or a bad adjustment of this gap will result in: a breakage of the big grains and the non-dehulling of the small ones, therefore a reduction of the dehulling rate; incomplete milling; formation of a paste which adheres to the plates and is not evacuated, consequently a loss in grinding rate or performance. It can be concluded that adjusting the gap between the blades and the nerved cylinder in an ENGLEBERG Dehuller as well as that between the plates of a grinder, in terms of the grain size, is a must. A lack or a bad adjustment of this gap will result in: a breakage of the big grains and the non-dehulling of the small ones, therefore a reduction of the dehulling rate; incomplete milling; formation of a paste which adheres to the plates and is not evacuated, consequently a loss in grinding rate or performance.

Bibliography

1. Kent N L. "Technology of cereal. An introduction for students of Agriculture and Food Science, 3rd ed". *Pergamon Press Ltd, Oxford UK* (1983).

2. Nkama I and Ikwele M C. "Assessment of food quality of millet grain. In Pearl millet in Nigeria Agriculture; Production; Utilization and Research Priorities. Proceedings of the Pre-season National Coordination and Planning Meeting of the National Coordinated Research Program on Pearl Millet". *Lake Chad Research Institute Maiduguri* (1998).

3. Natural Resources Institute (NRI). "Sorghum post-harvest operations". Food Security Department (2007).

4. François M. "From grain to flour. Dehulling and Grinding of Cereals in West Africa". *Rural and Agricultural Cooperation Technical Center (CTA) Wageningen* (1989).

5. Gomez M I., *et al*. "Manual of Laboratory Procedures for Quality Evaluation of Sorghum and Pearl Millet. *ICRISAT (International Crops Research Institute for the Semi-Arid Tropics)* (1997).

6. Nkama I. "Cereal grains and grain legume products. Unpublished data". *Department of Food Science and Technology, University of Maiduguri* (2009).

Volume 5 Issue 5 November 2016