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Studies on physicochemical properties and extraction of starch from sorghum bicolor L. Hybrids

MaliN.B[1], Jadhav B.A[1], More D.R[1] and Salve R.V[2]

[1]Department of Food Trade and Business Management, College of Food Technology, M. A. U. Parbhani.

[2]Department of Food Science and Technology, MGM, College of Food Technology, Aurangabad (MS) India.

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ABSTRACT

In the present investigation attempts have been made to isolate sorghum starch (Sorghum bicolor L. moench) using genotype CSH-25, PMS 8AXKR196, PMS 71AXKR354 at optimum conditions. The genotypes CSH-25, PMS 8AXKR196 and PMS 71AXKR354 are sorghum hybrids and could be exploited for preparation of sorghum starch and among these three CSH-25 was found to be highest starch yielding hybrid. The yield of starch obtained from all these hybrids is to be satisfactory and these hybrids can be extensively used for commercial production of starch .This starch can be used for various purposes such as stabilization, thickening, syrup preparation, extraction of bioethanol which can be used as fuel with gasoline etc.

Introduction

Cereal grains comprise the largest single food group in the diet. These are used (in developed, developing and under developed countries) as a primary source of calories. India has the largest (32.30%) area under sorghum cultivation in the world and ranks second in production after U S.A. Sorghum is used both as food and feed due to its carbohydrate content and starch is the principle component in it.

The protein-polysacchande complexes exhibit better functional properties than that of protein and polysaccharide alone. (Schmitt et.al., 1998). The protein-polysaccharide complex formation seems to be promising to improve protein functionality. (John and Shastn, 1998). Food starches are usually used in protein hydrolysate-based nutritional products such as hypoallergenic infant formulas mainly as emulsion stabilizers

Materials and Methods

Sorghum grains of three cultivars CSH-25, PMS 8AXKR196, PMS 71AXKR354, were collected from Sorghum Research Station, Marathwada Agricultural University Parbhani. The chemicals used in the investigation were of analytical grade.

Physical properties of sorghum grains

Thousand grain weight

Thousand grain weights indicate the fullness of the grains and size of grains. In triplicate, 1000 grains were counted and accurately weighed. The average weight of 1000 kernels in grams was reported.

True density

True density was determined by Toluene Displacement Method, known weight (50g) of grains were taken in 100 ml fractionally graduated measuring cylinder containing a fixed volume (100 ml) of Toluene or kerosene and the increase in volume was noted and results were expressed in g/ml.

Bulk density

Bulk density was determined by using a 100 ml measuring cylinder and by taking the weight of 50 grains/volume of 50 grains and reported as g/ml

$$\text{Bulk density} = \frac{\text{Mass of sample}}{\text{Volume of same mass of sample}}$$

Grain hardness: Grain hardness was measured by estimating breaking strength of individual grains in kg of average pressure applied in a Hardson's grain hardness tester. Angle of repose: Angle of repose was determined by pouring grains on an elevated smooth surface of a fixed diameter (8.33cm) to form a regular heap and the maximum height of cone was measured by scale. Angle of repose was calculated as $\tan^{-1}$ (height/radius)

Angle of repose = $\tan^{-1}$ (h/r); where h= height of heap and r = radius of heap

Porosity: Porosity was calculated in percentage by using formula,

$$\text{Porosity percent} = \frac{\text{Density - Bulk density}}{\text{Density}} \times 100$$

Grain size: Grain size was determined by measuring Length (L), Width (W) and Thickness (T) of 10 randomly selected by using a vernier caliper with an accuracy of 0.02 mm. Triplicate reading were taken and average size was calculated in mm by using formula,

$$\text{Size} = (\text{Length} \times \text{width} \times \text{thickness})^{1/3}$$

Sphericity: Sphericity was determined by using the formula,

$$\text{Sphericity} = \frac{\text{Size}}{\text{Largest dimension}}$$

Largest dimension

Chemical composition of sorghum grains: The moisture content, protein, lipid, carbohydrate ash was determined by the standard method of A.O.A.C (1990).

Tele:

E-mail addresses: rahul.salve03@gmail.com

Results and Discussions

Physical characteristics of sorghum grains

Physical properties of sorghum grains were determined and the results are given in the table 1.

The hybrid CSH-25 showed higher 1000 kernel wt i.e. 24.5gm which gives an idea about its percent yield. Colour was found to be creamy white in hybrids CSH-25 whereas creamy yellow for PMS 71AXKR354 and PMS 8AXKR196. Similar results were reported by Kulkarni *et .al*. (2000). The angle of repose was found to be higher for hybrid PMS 8AXKR196 Which gives an idea about intergrain friction. Similar results were reported by Wankhede et.al (1977).

The bulk density, true density, hardness, porosity and size of the grain were found to be high in CSH-25 as compared to PMS 71AXKR354 & PMS 8AXKR196. These results are in agreement with the results of Simonyan K.J.*et al*. (2007).

Chemical characteristics of sorghum grains

The grains were analyzed for their proximate chemical composition and the data presented in table 2

The chemical composition showed that hybrid PMS 71AXKR354 was highest in moisture content (10.00%) than CSH-25(9.80%) and PMS 8AXKR196 (9.20%). These results were found to be comparable with the results of Deshpande, M. S (1983). Hybrid CSH-25 was found to contain highest protein (9.05%) and total carbohydrates (73.00%). These results were found that the fat, reducing sugar and crude fiber was highest in CSH-25 (1.55%) where as the percent ash was found to be highest in PMS 71AXKR 354 (2.30) .These results were found to be comparable with the results of Kulkarni *et.al* (2000).

Yield of starch

Data presented in table 3 shows that the percent starch recovery was observed highest in CSH-25 i.e. 68.5, hybrid PMS 8AXKR196 yielded 61.22 and PMS 71AXKR354 yielded 59.42 percent starch. These results are in well agreement with the results of Wankhede et.al (1989),

Conclusion

From the above experiment it was concluded that the genotype CSH-25 was found to be highest starch yielding hybrid. The yield of starch obtained from all these hybrids is to be satisfactory and these hybrids can be extensively used for commercial production of starch.

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Table 1. Physical properties of sorghum grains

Sr.No No.^	Parameters	Hybrids		
		CSH -25	PMS 8AXKR196	PMS 71AXKR354
1	1000 kernel wt (gm)	24.5	24.33	24.00
2	Colour -	2.5y8/2	2.5Y8/4	2.5Y8/4
3	True density (g/ml)	1.30	1.25	1.29
4	Bulk density (g/ml)	0.24	0.230	0.22
5	Angle of repose (degrees)	25.40	24.50	20.22
6	Hardness (kg)	7.60	7.53	7.05
7	Porosity (%)	81.00	80.5	79
8	Size (mm)	3.00	2.9	2.85
9	Sphericity (mm)	0.92	0.93	0.93

The values represent the average of 3 determinations.

Table 2. Chemical composition of sorghum grains

Sr. No.	Parameters	Hybrids		
		CSH -25	PMS 8AXKR196	PMS 71AXKR354
1	Moisture (%)	9.80	9.20	10.00
2	Protein (%)	9.05	9.00	8.02
3	Fat (%)	1.55	1.03	1.02
4	Ash (%)	1.55	1.62	2.30
5	Total CH_2O (%)	73.00	66.50	63.0
6	Reducing sugar	0.70	0.55	0.35
7	Crude fibre (%)	02.05	163	1.20

The values represent the average of 3 determinations

Table 3. Yield of starch

HYBRIDS	PERCENT STARCH
CSH -25	68.50
PMS 8AXKR19	61.22
PMS 71AXKR3	59.43