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RESEARCH PAPER

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Effect of different particle sizes of jaggery powder on storability

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ABSTRACT

The investigations were carried out to study the effect of different particle size and packaging materials on storability of jaggery powder on the basis of changes in chemical composition and organoleptic characteristics. Jaggery powder of three different grades *viz.*, coarse (0.500 -0.708 mm), medium (0.351 - 0.420 mm) and fine (0.211 - 0.296 mm) were prepared and packed in 100 gauge polyethylene bag. The samples were stored at room temperature for the period of 6 months. In order to optimize the particle size of jaggery powder, the changes in chemical composition and organoleptic properties were evaluated during storage. The results revealed that change in chemical composition was lower in case of coarse jaggery powder. The coarse jaggery powder having particle size in the range 0.500 – 0.078 mm) was found more acceptable among all other powder sizes after storage period of six months in terms of its chemical properties and organoleptic characteristics.

KEY WORDS : Jaggery, Powder, Storability, Particle size

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INTRODUCTION

Jaggery is one of the most important sweeteners in India. Jaggery (also known as *gur*) is a traditional unrefined non-centrifugal sugar consumed in Asia, Africa, Latin America, and the Caribbean (Nevkar *et al.*, 2005). It is a concentrated product of cane juice without separation of the molasses and crystals, and can vary from golden brown to dark brown in color. It contains up to 50% sucrose, up to 20% invert sugars with some other insoluble matter such as ash, proteins and bagasse fibers (Ghosh and Agrawal, 1983). It is directly consumed by human and used in animal feed mixtures. Jaggery is a natural sweetener made by the concentration of sugarcane juice prepared without the use of any chemicals (Singh, 1985). Jaggery has great nutritive and medicinal value. Jaggery purifies the blood, prevents the rheumatic afflictions and disorders of bile and process properties of higher order (Sahu and Paul, 1998; Sahu and Saxena, 1994). Jaggery contains proteins, vitamins and minerals, which are essential constituents for the body. It is also a potent source of iron and copper (Beguin, 1978). Jaggery is an energy food that is said to purify blood, regulate liver function and keep the body healthy. It has also been prescribed in various diseases like jaundice, breathlessness and kidney problems (Veldhuyzen-van, 1999).

Jaggery industry is the dominant decentralized cottage industry of India, which meets about 40 to 50% sweetener requirement of Indian population. About one third to one half jaggery produced needs to be stored every year (Singh, 1985). Jaggery is usually available in the market in the form of one or half kg block. However, these blocks are not feasible for transportation and retailing. The loss of jaggery during storage ranged from 7 to 25% depending upon storage conditions (Shinde *et al.*, 1981). Hence, in present investigation, efforts were made to convert jaggery into different particle sizes and further prepared jaggery powder was analyzed for its physicochemical and organoleptic characteristics during storage for the period of 6 months.

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MATERIALS AND METHODS

The present research work entitled "effect of

different particle size of jaggery powder on storability" was carried out in Department of Agricultural Process Engineering, M.P.K.V, Rahuri during the year 2005-06.

Experimental analysis:

The Jaggery (var. CO92005) was procured from Regional Sugarcane and Jaggery Research Station, Kolhapur. It was free from impurities, light brown in color, grainy structure and uniform size. The pieces of solid jaggery were shed dried under controlled temperature of 27^0C till external surface becomes slightly rough and losses its smoothness. Size reduction was done by hammer (the beater of hammers mill that rotates in closed steel chamber at 3000 rpm and forces the ground through a screen of 18 meshes). The jaggery powder obtained was analyzed for its properties and quality. Three sizes of powder jaggery (*i.e.* course, medium and fine) were obtained on the basis of sieve analysis of jaggery powder. The powder jaggery properties *viz.,* sieve analysis (Rathnayake, 2005), fineness modules (Smith, 1978) and uniformity index (Sahay and Singh, 2001) were determined. Average particle size was calculated using equation (Sahay and Singh, 2001).

$$\text{Average particle size} = 0.135 \times (1.336)^{FM}$$

Packaging and storage of jaggery powder:

Jaggery powder (course, medium and fine) were further packed in 100 gauge polyethylene bags. These samples were further stored at room temperature (27^0C) in M.P.K.V., Rahuri.

Physicochemical properties:

The physicochemical properties *viz.,* reducing sugar, non reducing sugar, pH, colour and moisture content of jaggery powder were determined by using standard methods (AOAC, 1995). Colour of jaggery solution was measured on Klet summerson photoelectric colourimeter using green filter.

Organoleptic evaluation:

Organoleptic evaluation was carried out every month during storage. A panel of 10 judges using Nine-point hedonic scale judges the colour, taste, texture, flavour and overall acceptability of samples. Method given by Amerine *et al.* (1965) was used for sensory evaluation.

● RESULTS AND DISCUSSION ●

The results obtained from the present investigation as well as well as relevant discussion have been presented under following heads :

Chemical composition of jaggery powder:

The chemical composition of jaggery powder (var. Co 92005) was determined and presented in Table 1. The moisture content, pH and colour found were 1.2 per cent, 6.6 and 0.18 per cent, respectively. The reducing sugar and non-reducing sugar obtained were 8.51 per cent and 78.56 per cent, respectively.

Table 1: Chemical composition of jaggery powder

Properties	Value
Moisture content, %	1.20
pH	6.60
Reducing sugar, %	8.51
Non-reducing sugar, %	78.56
Colour	0.18

Grading of jaggery powder

The sieve analysis of jaggery powder for fineness modulus, size (average particle diameter) and uniformity index was done and data are tabulated in Table 2.

Based on sieve analysis the jaggery powder was graded into three grades *viz*., coarse, medium and fine. The particle sizes of 0.500 – 0.708, 0.351 – 0.420 and 0.211 – 0.296 mm were considered coarse, medium and fine, respectively. The fineness modulus, average particle diameter and uniformity index found were 4.14, 0.45, and 5:2:3, respectively. Similar studies were done by Rathnayake (2005) for rice products.

Table 2 : Sieve analysis of jaggery powder

Grading	Size (mm)	Fineness modulus	Average particle size (mm)	Uniformity index
Coarse	0.500 – 0.708			
Medium	0.351 – 0.420	4.14	0.45	5:2:3
Fine	0.211 – 0.296			

Effect of particle size on chemical properties of jaggery powder:

The data of effect of particle size of jaggery powder during storage on moisture content, pH, reducing sugar, non reducing sugar and colour of jaggery powder are depicted in Table 3. The results revealed that moisture content of jaggery powder significantly increased during the storage period. This may be due to the high water vapour transmission rate of 100 guage polyethylene bags due to which there was increase in moisture content of jaggery powder. The moisture content of jaggery powder ranged from 1.20 to 1.74 per cent. Maximum moisture

Table 3 : Effect of particle size and storage on physic-chemical properties of jaggery powder

Sr. No.	Particulars	Particle size	Storage period (methods)						
			0	1	2	3	4	5	6
1.	Moisture	Fine	1.20	1.23	1.28	1.35	1.51	1.65	1.74
		Medium	1.20	1.20	1.26	1.32	1.47	1.60	1.68
		Coarse	1.20	1.20	1.24	1.29	1.43	1.55	1.62
2.	pH	Fine	6.60	6.60	6.59	6.59	6.58	6.54	6.50
		Medium	6.60	6.60	6.58	6.58	6.57	6.53	6.49
		Coarse	6.60	6.60	6.57	6.57	6.56	6.52	6.48
3.	Reducing sugar	Fine	8.51	8.51	8.51	8.52	8.53	8.54	8.56
		Medium	8.51	8.51	8.51	8.52	8.53	8.55	8.57
		Coarse	8.51	8.51	8.51	8.53	8.54	8.56	8.58
4.	Non reducing sugar	Fine	78.56	78.56	78.56	78.55	78.54	78.53	78.53
		Medium	78.56	78.56	78.56	78.55	78.53	78.52	78.52
		Coarse	78.56	78.56	78.55	78.54	78.52	78.51	78.50
5.	Colour	Fine	0.18	0.19	0.21	0.22	0.24	0.26	0.27
		Medium	0.18	0.20	0.21	0.23	0.25	0.27	0.28
		Coarse	0.18	0.21	0.22	0.24	0.26	0.28	0.29

* Each value is average of 5 determinations

was observed in case of fine jaggery powder stored for 6 months while minimum water absorption after 6 months of storage was observed in coarse particle sized jaggery powder. On the basis of moisture, it could be concluded that particle size is inversely related to moisture absorption in jaggery powder. The pH of samples varied from 6.60 to 6.48. pH of sample found to be reversibly related to storage period. pH decreased with increase in storage period and increased in particle size. The decrease in pH during storage may be due to change in chemical properties which are affected by storage conditions.

The reducing sugar content of jaggery powder found to increase with increase in storage period and particle size. While, non reducing sugar decreased with increase in storage period and particle size. The colour of sample found to be maximum in case of coarse particle size which increased with increase in storage period.

Effect of particle size and storage on organoleptic properties of jaggery powder:

The data on sensory attributes *viz.*, colour, taste, texture, flavour and overall acceptability of jaggery powder is plotted and shown in Fig. 1. The results revealed that there were no changes on taste with different particle sizes. However, colour and textural properties of jaggery powder changed drastically with increase in size of particles.

The overall acceptability was ranged from 7.6 to 8.4 for all the particle sizes (Fig. 1). The overall acceptability was found to be maximum in case of coarse powder (8.4), followed by medium (8.1) and minimum overall

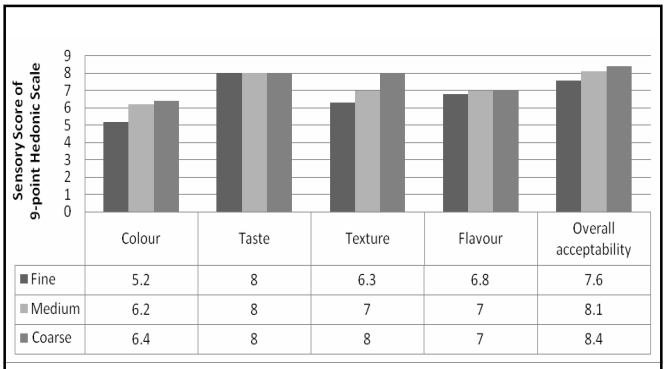

Fig. 1: Organoleptic evaluation of jaggery powder

acceptability was seen in case of fine powder (7.6). On the basis of data generated on organoleptic evaluation, it could be predicted that coarse powder was found more acceptable compared to medium and fine powder with respect to organoleptic characteristics.

Conclusion:

– Jaggery powder was found to contain 1.20% moisture, 6.60 pH, 8.51% reducing sugar and 78.56% non reducing sugar. The colour of prepared jaggery powder found to be 0.18.

– The particle size significantly affected the chemical properties of jaggery. With increase in particle size, moisture, reducing sugar and colour of jaggery increased while pH and non reducing sugar content was found to decrease.

– Organoleptic evaluation of samples after 6 months of storage reported best quality of coarse particle size

followed by medium and fine jaggery powder.

In all, it could be concluded that jaggery powder with coarse particle size (0.500 – 0.708 mm) found to desirable amongst all the samples in terms of its physico-chemical properties and organoleptic evaluation.

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