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Impact of Storage on Quality of Jaggery Produced in Mandya District

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Abstract

An investigation was carried out to assess the status of jaggery storage at house hold and jaggry making units and grading. Commercial samples of jaggery produced in Mandya district were used for the study. About two kg samples of six forms of jaggery (n = 18) were stored in air tight plastic containers and LDPE covers for a period of five months. Moisture content ranged between 3.6 to 8.3%. Porosity ranged between 4.50 to 16.78 cc/100 ml and hardness of jaggery differed according to the form of jaggery. The sucrose content was least in pellet form jaggery while other forms were at par with each other. Reducing sugar content in bar jiggery was significantly higher compared with cube jaggery. The reducing sugar content ranged between 4.70 to 8.84% in fresh jaggery. Cube form and ball form jaggery were well accepted by the panelists (n = 11) due to their size, color and texture followed by bucket form and other types. All the respondents used deferent containers for storage of jaggery on small scale. Majority (48%) of respondents stored jaggery in aluminum and steel boxes followed by plastic boxes (33%), sugarcane trash (10%), earthen pots (5%) and polythene bags (4%) and the period of storage ranged from one week to six months. There was reduction in NR values of all forms of jaggery samples. Pellets jaggery deteriorated most in its quality after storage. It may be concluded that storage methods was in line with the scientific knowledge base. The end users were following correct practices of storage. There was significant change in the quality of jaggery after storage. Therefore, jaggery with good shelf life is the need of day. The problem of grading is indeed difficult because of the wide variations in its quality and also its complex chemical composition.
Key words : Storage, Impact, Jaggery, Quality.

Nutritional and medicinal potential of jaggery is of considerable value for majority of population living in rural and urban India. Jaggery industry has been the most ancient and important cottage industry. The production of jaggery is seasonal, therefore its preservation and storage becomes essential. Jaggery made from immature, over ripe, diseased, lodge or frost affected canes have high reducing sugars content, low yield and poor keeping quality jaggery (1, 2). Good quality jaggery could be prepared by cane harvesting at the age of 14 month (3). Packaging of jaggery is crucial during storage and large scale storage during monsoon poses serious problems. High moisture content promotes growth of microbes which brings about compositional changes and eventually leads to undesirable changes in color, aroma and flavor (4, 5). Consumption of such jaggery has been reported to produce toxic effects on human health (6). Therefore, an investigation was carried out to study the effect of storage materials and their impact on quality of jaggery and to assess the status of jaggery storage at house hold and jaggery making units and grading.

Methods

Commercial samples of jaggery produced in Mandya district were used for the study. About two kg samples of six forms of jaggery (n = 18) such as, bucket form, cube form, ball form (unde), pellets (goli), cake form (kurikalacchu) and bar form and laboratory prepared control jaggery were used for storage study. Samples were stored in air tight plastic containers and LDPE covers for a period of five months. The samples were subjected to sensory and physico-chemical analysis for sucrose, reducing sugar and ash content using standard methods for fresh and stored jaggery samples. Information from 41 households and 20 jaggery units on storage methods for jaggery was obtained using pre-tested schedules to obtain best storage material for jaggery and grading of jaggery was done using net rendement values (NR = sucrose (%)–[RS% + (3.5 × Ash %)]. Suitable statistical tests were applied to analyze the data.

Table 1. Physico-chemical and storage properties in commercial samples jaggery. *$P < 0.05$. NS, Non-significant.

Forms of jaggery	Moisture (%)	Porosity (cc/100g)	Hardness (kg/cm^2	Dirt and impurities (%)	Before storage Sucrose (%)	Before storage Reducing sugars (%)	After storage Sucrose (%)	After storage Reducing sugars (%)	Ash (%)
Bucket	6.95	16.67	6.07	3.05	83.54	8.05	74.50	11.05	4.89
Ball (unde)	3.98	15.33	4.25	2.20	83.75	5.53	75.37	10.49	3.41
Cube	6.72	16.78	4.62	2.37	83.10	4.70	75.37	10.73	4.01
Pellets (goli)	7.32	7.62	2.51	3.55	78.39	6.04	67.04	12.10	3.92
Cake (kurikalacchu)	8.45	7.67	4.61	3.95	83.29	5.72	73.26	11.42	4.39
Bar	8.83	4.50	2.10	2.03	82.41	8.84	74.11	15.24	3.90
Control	3.61	10.75	7.64	1.90	84.57	4.84	72.54	9.31	3.25
Mean	6.55	11.33	4.54	2.72	82.72	6.25	73.17	11.48	3.97
F value	*	*	*	NS	*	*	*	*	NS
SE ±	0.2575	0.5431	0.2726	-	0.7672	0.2176	0.8959	0.2331	-
CD	0.7813	1.6476	0.827	-	2.327	0.6599	2.718	0.7071	-
CV (%)	2.86	7.81	4.91	6.14	2.135	2.263	3.29	1.43	7.17

Results and Discussion

Physico-Chemical and Storage Properties in Commercial Samples of Jaggery

Table 1 reveals the physico-chemical and storage properties in commercial samples of jaggery. Among the physical properties of jaggery viz. moisture, porosity, hardness, dirt and impurities were analyzed. Moisture content ranged between 3.6 to 8.3%. Control jaggery and ball form had significantly lower moisture content than other forms of jaggery. Porosity ranged between 4.50 to 16.78 cc/100 ml bar form jaggery had significantly lower pore space when compared with cube, bucket and ball form. Hardness of jaggery differed according to the form of jaggery. Control jaggery had harder texture followed by bucket form. Pellets and bar form jaggery had soft texture. The hardness of jaggery ranged between 2.1 to 7.6 kg/cm^2. Control jaggery had lesser dirt and impurities than the rest, and there was no significant difference between other forms of jaggery

Table 2. Mean sensory scores of commercial samples of jaggery. Five point scales were : 5-excellent, 1-least acceptable. * $P < 0.05$, NS, Non-significant.

Forms of jaggery	Appearance	Texture	Flavor	Taste	Over all acceptability
Bucket	3.91	3.72	3.54	3.45	3.72
Ball	4.18	4.00	3.64	3.45	3.81
Cube	4.36	3.91	3.64	3.90	3.91
Pellets (goli)	3.45	3.54	3.45	3.63	3.63
Cake (Kurikalacchu)	3.27	3.00	3.27	3.18	3.18
Bar	3.91	3.45	3.72	3.72	3.54
Control	2.27	2.90	3.45	3.45	3.54
F value	8	2.168	0.299	0.690	0.935
SE ±	0.225	0.287	0.278	0.282	0.245
CD	0.624	0.795	0.771^{NS}	0.783^{NS}	0.679^{NS}

With respect to quality of jaggery, sucrose, reducing sugar and ash content are important quality parameters that were analyzed in seven forms of jaggery. The sucrose content was least in pellet form jaggery while other forms were at par with each other. Reducing sugar content in bar jaggery was significantly higher compared with cube jaggery. The reducing sugar content ranged between 4.70 to 8.84% in fresh jaggery. Irrespective of storage materials, sucrose content of the stored jaggery samples had significantly decreased in all forms of jaggery and there was a significant increase in reducing sugar content after storage for five months. No changes were observed due to storage with respect to ash content. Reducing sugar plays an important role in determining the quality of jaggery. The higher reducing sugar in jaggery was reported to cause discoloration and changes in texture. These results are in line with the study of Mungare et al. (7). For better storability, jaggery should be high in non-reducing sugar (above 80%), lower in reducing sugar (below 10%) and in salts (below 0.3%) and should not have more than 5% moisture content (8). However, upon storage, jaggery samples deteriorated and many of

Table 3. Consumer response towards perceived changes upon storage of jaggery (n =41).

Sensory altributes	Impro-ves	Remains same	Wor-sens	Characteristic Changes
Appearance (color)	3	8	30	Turns darker (17) Discolors (13)
Texture	-	6	35	Sticky (24) Softens (24)
Flavor	-	8	33	Fruity/Rotten (5)
Teste	-	10	31	Sour (28) Bitter (3)
Over all acceptability	3	4	34	

the changes could be attributed to increase in moisture content. For storage purpose jaggery should have higher sugar content (above 80%), low in reducing sugars (below 10%) and salts (below 0.3% Ca and 0.1% Mg) and should not have more than 5% moisture content (8).

Sensory Evaluation of Commercial Samples of Jaggery

Seven forms of fresh jaggery samples were orgnoleptically evaluated for sensory attributes like appearance, texture, flavor, taste and over all acceptability (Table 2). Cube form and ball form jaggery were well accepted by the panelists (n = 11) due to their size, color and texture followed by bucket form and other types (9). There was discoloration in pellets and bar form jaggery after one month of storage. Majority of jaggery samples discolored and textural changes after three months of storage. Cube form jaggery maintained its color and texture even after storage. There were no changes observed with respect to taste after storage. The organoleptic evaluation revealed the deterioration of color and change in texture among stored samples (Table 3). The surface area of jaggery has an important bearing on drying, storage quality and market value (1). In the present study, many changes associated with increase in moisture content were observed in both chemical and sensory characteristics. Similar studies have been conducted by Pandey and Kulshreshtha (10) and their results are similar to the present study.

Storage of Jaggery at Households and Jaggery Making Units

Information on practices followed for storage of jaggery at households and jaggery making units is presented in Figure 1. All the respondents used different containers for storage of jaggery on small scale. Majority (48%) of respondents stored jaggery in aluminum and steel boxes followed by plastic boxes (33%), sugarcane trash (10%), earthen pots (5%) and polythene bags (4%) and the period of storage ranged from one week to six months.

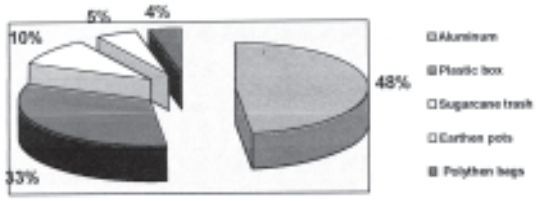

Figure 1. Practices followed by households (n = 41) for storage of jaggery.

Grading of Jaggery

Samples of jaggery were graded before and after storage employing theNR values (1). The range of NR values was from 58.37 to 68.35. Sucrose, reducing sugar and ash content of jaggery were taken into account while calculating the NR values. There was reduction in NR values of all forms of jaggery samples. Ball form and control jaggery were graded A_1 with excellent quality when they were fresh. After storage for five months, these two forms of jaggery fell into B grade with medium quality. Pellet jaggery deteriorated most in its quality after storage. However, no changes in grades were observed in bucket, ball cube and control samples of jaggery. Whereas pellets, cake and bar form jaggeries fell into poorer quality with C grades after storage (Table 4). The problem of grading is indeed difficult because of the wide variations in its quality and also its complex chemical composition. Each merchant has his own idea about the classification of jaggery. The grades, as understood at present in different markets, have no relation with one another and the superior grade of one market may be even inferior in other market. Preference of people for jaggery varies from place to place (11). A wide range of regional preferences have also been reported.

Conclusion

Nutritional and medicinal potential of jaggery is

Table 4. Grading of jaggery based on NR value. Ref. Roy (1).

Form of jaggery	No of samples	Before storage NR values	Grades	Quality	Afrer storage NR values	Grades	Quality
Bucket	3	58.57	B	Medium	46.34	B	Medium
Ball (unde)	3	66.28	A_1	Excellent	53.00	B	Medium
Cube	3	64.36	A_2	Good	50.60	B	Medium
Pellets	3	58.63	B	Medium	41.22	C	Poor
Cake (kurikalacchu)	3	62.20	A_2	Good	46.47	B	Medium
Bar	3	59.88	B	Medium	45.22	B	Medium
Control	3	68.35	A_1	Excellent	51.85	B	Medium

of considerable value for majority of population living in rural and urban India. The production of jaggery is seasonal, therefore its preservation and storage becomes essential. In the present study, control jaggery and ball form had significantly lower moisture content than other forms of jaggery and proved better for storage. Irrespective of storage material, quality parameters of jaggery were affected by the duration of storage. Among different forms of jaggery cube form and ball form jaggery were well accepted by the panelists due to their size, color and texture. All the respondents used deferent containers for storage of jaggery on small scale. It may be concluded that storage methods were in line with the scientific knowledge base. The end users were following correct practices of storage. There was reduction in NR values of all forms of jaggery samples after storage hence had impact on grading parameters. There was significant change in the quality of jaggery after storage. Therefore, jaggery with good shelf life is the need of day. The problem of grading is indeed difficult because of the wide variations in its quality and also its complex chemical composition.

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