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Standardization of Krishna Tulsi (*Ocimum tenuiflorum*) Enriched Jaggery and Quality Analysis

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Abstract

Jaggery is the natural sweetener available in solid, liquid and powder form. The micronutrients which are present in jaggery has many nutritional and medicinal properties. Jaggery has proved itself better as compared to white sugar. The objective of the study was standardization of krishna tulsi (*Ocimum tenuiflorum*) enriched jaggery and its quality analysis. In the current study, jaggery enriched in two forms using tulsi powder and aqueous extraction. Sugarcane variety VCF0517 was selected for jaggery preparation and herbs were added at the concentration of 1.0, 1.5 and 2.0 per cent and subjected for physical parameters and sensory evaluation. Best accepted enriched jaggery was subjected to chemical and mineral estimation. Results showed that concentration at 2.0 per cent found to be best accepted in both the methods with respect to appearance, color, texture, taste, flavour and overall acceptability. pH range between 6.15 to 7.09 while the moisture content in jaggery enriched with tulsi powder (5.74 to 6.46) and aqueous extraction of tulsi (6.09 to 6.46), whereas cutting strength of the enriched jaggery with tulsi powder (9.71 to 10.73 kg /cm^2) found to be lower when compared to control (25.61) and aqueous extraction of tulsi (16.66 to 21.20 kg /cm^2). Color parameters such as $L^* a^* b^*$ values lightness, redness and yellowness found to be lower in jaggery enriched with tulsi powder compared to control and aqueous extraction. Mineral composition found to be higher in enriched jaggery with tulsi powder such as calcium (158 mg), magnesium (145 mg), iron (11.95 mg) and phosphorus (44 mg). Findings concluded that jaggery enriched with *Ocimum tenuiflorum* powder found to be best accepted for the general health and nutritional benefits.

Keywords : Herbal jaggery, *Ocimum tenuiflorum*, Aqueous extraction, Mineral composition

Jaggery is pure, wholesome, unrefined and traditional sweetener from sugarcane. Compared to sugar it is having good amount of minerals like calcium and phosphorus. More than 70 per cent of the total world jaggery production is from India (Anonymous, 2002). In rural India jaggery has wider acceptability. Now even in the urban elite group shifting from refined sugar to jaggery. According to WHO guidelines adults and children reduce their daily intake of free sugars to less than 10 per cent of their total energy intake. At present, 24.5 per cent of the cane produced in India is being utilized for producing jaggery (Hirpara *et al.,* 2020). Out of the total jaggery production in India, about 80 per cent of jaggery is prepared in solid form and the remaining 20 per cent is prepared in liquid and granular form. Jaggery can be added with different natural flavouring components and nutritive ingredient (Nath *et al.,* 2015). *E. cardamomum*-fortified jaggery was prepared and substitute for regular jaggery with value added health benefits (Nayaka *et al.,* 2019). Scientific production of herbal jaggery will encourage this cottage industry and provide a healthy alternative to white sugar. Hence, the current research was aimed to study the development of herbal jaggery enriched with *Ocimum tenuiflorum* and its quality analysis.

Material and Methods

Procurement of Raw Materials

For the preparation of tulsi based herbal jaggery, sugar cane variety VCF0517 was used and procured from V. C. Farm, Mandya. For addition of Krishna tulsi or Holy basil (*Ocimum tenuiflorum*) was selected for preparation of herbal jaggery and

procured from Department of Horticulture, UAS, GKVK, Bengaluru.

For the development of herbal jaggery the tulsi was used in two different forms such as, herbal powder then (fresh tulsi leaves were taken and dried using tray drier at temperature 45 ^{0}C, then ground to fine powder) and aqueous extraction of tulsi (200 g of fresh leaves with 50 ml of distilled water. The extract is subjected to 10,000 rpm for 10 minutes and supernatant was collected).

Preparation of Herbal Jaggery

Ocimum tenuiflorum enriched jaggery was prepared by using the method described by Jaggery Park, V. C. Farm, Mandya. Tulsi dried powder and aqueous extraction were taken at different concentrations (1.0, 1.5 and 2.0%) and were added to sugarcane juice extracted from sugarcane variety VCF0517 and pH was adjusted to 6.5 using milk of lime [Ca (OH)2]. The juice was initially boiled for 10 min and the scum formed during boiling was completely removed. Finally, the juice was heated and concentrated to thick syrup until the temperature reaches 118 ^{0}C. The scum formed after subsequent boiling was completely removed. The syrup was cooled and transferred to moulds. Jaggery prepared without addition of tulsi served as control. All the samples were stored at ambient temperature in an open container for further analysis (Fig. 1).

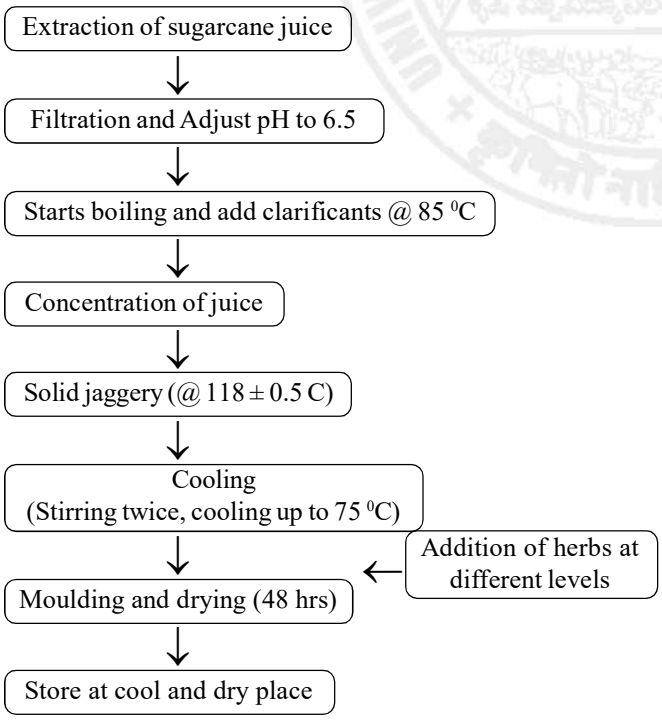

Fig. 1 : Flow chart of jaggery preparation

Fig. 2 ; Development of herbal jaggery enriched with tulsi powder at concentration of 1.0, 1.5 and 2.0 per cent

Fig. 3 : Development of herbal jaggery enriched with aqueous extraction of tulsi at concentration of 1.0, 1.5 and 2.0 per cent

Estimation of Physical Parameters

Enrichment of jaggery with tulsi powder and aqueous extraction of tulsi samples was subjected to physical properties such as, pH and moisture using AOAC (2005), color (Terdal *et al*., 2013), hardness and insoluble solids were analyzed. Sensory evaluation was done using 9-point hedonic scale (Shobha *et al.,* 2019).

Physico-Chemical Properties of Best Accepted Herbal Jaggery

By correlating physical properties and sensory evaluation of the best accepted herbal jaggery, was subjected to chemical parameters such as total sugars, reducing sugar, sucrose and quantification of minerals such as calcium, iron, magnesium and phosphorous was analyzed. Suitable statistical tool was used.

Physical parameter of jaggery enriched with tulsi powder and aqueous extraction of tulsi at the concentration of 1.0, 1.5 and 2.0 per cent depicted

TABLE 1

Physical parameters of jaggery enriched with tulsi powder and aqueous extraction

Parameter	pH	Moisture (%)	Hardness (Kg/cm^2)	Insoluble solid
Tulsi powder				
Control	7.09 ± 0.01	6.46 ± 0.05	25.61 ± 0.64	2.01 ± 0.10
PT1	6.23 ± 0.03	5.70 ± 0.07	10.73 ± 0.70	1.45 ± 0.13
PT 2	6.17 ± 0.01	5.85 ± 0.10	9.90 ± 0.10	1.90 ± 0.55
PT 3	6.16 ± 0.01	5.94 ± 0.01	9.71 ± 0.36	2.50 ± 0.55
F value	*	*	*	*
SEm±	0.09	0.08	2.03	0.11
CD @ 5 %	0.11	0.13	0.97	0.15
Aqueous extraction of tulsi				
Control	7.09 ± 0.01	6.46 ± 0.05	25.61 ± 0.64	2.01 ± 0.10
AT 1	6.15 ± 0.01	6.09 ± 0.07	16.66 ± 0.56	1.75 ± 0.03
AT 2	6.15 ± 0.01	6.18 ± 0.05	20.47 ± 0.22	1.94 ± 0.03
AT 3	6.18 ± 0.01	6.49 ± 0.08	21.20 ± 0.34	1.96 ± 0.10
F value	*	*	*	*
SEm±	0.09	0.05	0.96	0.05
CD @ 5 %	0.12	0.13	0.89	0.30

*PT1, PT2 and PT3 are concentration of tulsi powder (PT) at 1.0, 1.5 and 2.0 per cent
*AT1, AT2 and AT3 are aqueous extraction of tulsi (AT) at 1.0, 1.5 and 2.0 per cent
*Significant at *p- 0.05* (5%)

in Table 1. pH is the most important factor that affects the clarification process. It plays an important role in the stability and storage quality of the jaggery (Mandal *et al.,* 2013). The control jaggery had to be higher pH (7.09) when compared with enriched jaggery ranged between 6.15 to 6.23. In addition, moisture percentage is an important parameter to determine the quality, stability and shelf-life of foods during storage. Moisture content of jaggery ranged between 5.94 to 6.46. The results found to be similar with Guerra and Mujica (2010). The hardness of the jaggery was lower in the jaggery enriched with tulsi powder sample (9.71 to 10.73 Kg / cm^2) compared to aqueous extraction of tulsi (16.66

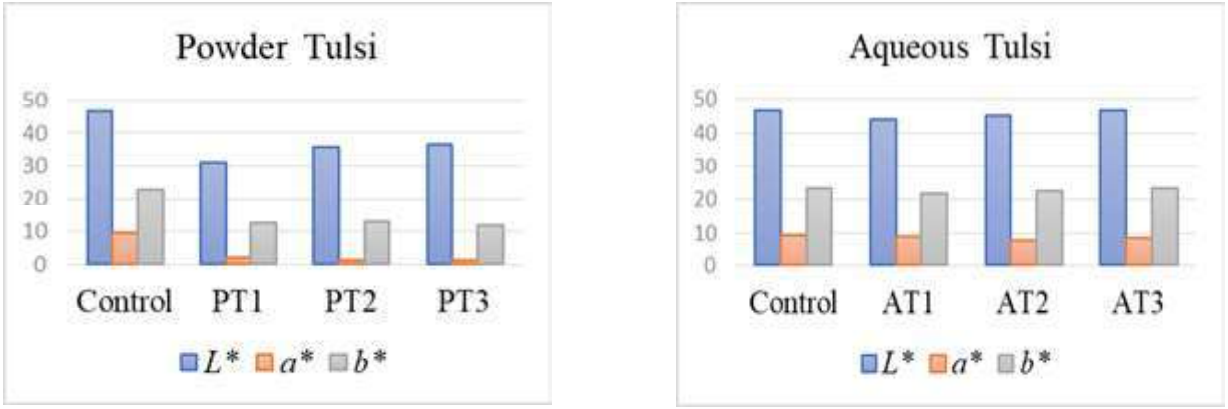

Fig. 4 : Color values of jaggery with tulsi powder and aqueous tulsi extraction at different concentration

TABLE 2

Mean Sensory score for enriched jaggery with tulsi powder and aqueous tulsi extraction

Variation	Appearance	Color	Texture	Flavour	Taste	Overall Acceptability
Tulsi Powder						
Control	7.00	6.96	6.83	7.06	7.26	7.36
PT1	6.83	6.16	7.13	7.10	7.56	7.53
PT2	7.46	7.20	7.71	7.63	7.70	8.00
PT3	8.80	8.24	8.76	8.10	8.10	8.00
F Value	*	*	*	*	*	*
SEm±	0.053	0.203	0.051	0.044	0.033	0.033
CD @ 5 %	0.109	0.414	0.105	0.091	0.069	0.069
Aqueous extraction of tulsi						
Control	7.00	6.96	6.83	7.06	7.26	7.36
AT1	7.02	8.59	8.54	8.54	8.36	8.55
AT2	7.77	8.85	8.50	8.77	8.36	8.65
AT3	8.15	8.84	8.00	8.81	8.95	8.71
F Value	NS	NS	*	*	*	*
SEm±	-	-	0.240	0.169	0.183	0.087
CD @ 5 %	-	-	0.720	0.507	0.549	0.261

TABLE 3

Biochemical and mineral composition of best accepted herbal jaggery

Parameter	Control	PT3	AT3
Total sugars (g/100g)	85.53	82.30	84.51
Reducing sugars (g/100g)	7.45	7.71	6.46
Sucrose (g/100g)	76.86	73.69	75.45
Magnesium (mg/100g)	123	145	113
Iron (mg/100g)	10	11.95	10.95
Calcium (mg/100g)	106	158	110
Phosphorous (mg/100g)	38	44	39

to 21.20 Kg / cm^2) and control jaggery (25.61 Kg / cm^2). This was due to addition of herbs in the jaggery preparation. The Insoluble solids of enriched jaggery ranged between 1.45 to 2.50 with different concentration. Significant differnce was found between the tretaments with respect to physical parameters. In both varities of enriched jaggery.

Color has been the primary factor in accessing the quality of the jaggery and in India it is used as the criteria for the classification of jaggery. Fig. 4 depicted the color parameters of enriched jaggery at different concentration. It showed lower values for the lightness ranged between 31.22 to 35.46 when it was compared with aqueous extraction of tulsi (43.82 to 46.65) and control (46.77). The aqueous extraction of tulsi and control sample showed higher color properties with higher *L**, *a** and *b** values as compared to tulsi powder enriched jaggery. The difference in the color parameter may be attributed due to addition of tulsi powder.

Table 2 depicts mean sensory score for jaggery enriched with tulsi powder and aqueous extraction. Based on sensory attributes the significant difference was found among the treatments and concentration of 2.0 per cent and found to be best accepted in both enriched jaggery with tulsi powder aqueous extraction of tulsi. Vinuta *et al.* (2015) observed that

texture, hardness, chewiness and spicy attributes enhanced in dose dependent *Z. officinale* enrichment.

Chemical and mineral composition of best accepted herbal jaggery enriched with tulsi powder and aqueous extraction of tulsi is depicted in Table 3. Total sugars, reducing sugar and sucrose content was found to be similar with control sample. Enriched jaggery with tulsi powder aids mineral composition such as, magnesium (1145 mg), iron (11.95 mg), calcium (158 mg) and phosphorus (44mg) . When compare to aqueous extraction of tulsi and control. It may be due to climatic condition and variety of sugarcane used for preparation of jaggery. Mineral composition of jaggery found to be lower reported by (Hirpara *et al.,* 2020) and (Rao *et al.,* 2012) compared to present study.

From the study, it can be concluded that jaggery enriched with tulsi powder and aqueous extraction of tulsi of at 2.0 per cent level was best accepted with having good amount of mineral composition in powder tulsi jaggery compared with control and aqueous extraction of tulsi. The consumers are conscious of health and demanding newer products. Hence, enriched jaggery has higher medicinal and nutritive values as compared to other sweeteners, easily available to the rural people and is highly recommendable by health experts. Also, jaggery is associated with number of health benefits, which makes it a better choice than sugar.

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