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Standardization and nutritional evaluation of organic jaggery based muffins

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Abstract
The present study was conducted for formulating muffin with substitution of sugar with non-organic jaggery and organic jaggery in different formulation and nutritional analysis of selected and accepted muffins. In little millet jaggery based muffins, 100 per cent non-organic jaggery and 120 per cent organic jaggery was selected and accepted. On futher evaluation the overall acceptability was 8.38 ± 0.73 and 7.73 ± 0.89 for sugar based and non-organic based little millet muffin respectively. However at 120 per cent of organic jaggery the level of incorporation, acceptability was higher and had an acceptability index of 81.98. The findings revealed that, among the two types of jaggery, calcium and potassium was higher in non- organic (268.45 mg/100g, 354.7 mg/100g) while phosphorus was higher in organic jaggery (181.5 mg/100g) based little millet muffin. Iron content did not vary between the two types of jaggery (2.5 and 2.6 mg/100 g).Both little millet jaggery muffins were accepted.

Keywords: organic-jaggery, chemical composition, muffins

1. Introduction
An organic food is free of synthetic additives like pesticides, chemical fertilizers and also contains less heavy metal. Jaggery is a natural traditional sweetener, made by concentrating the extracted sugarcane juice. Jaggery been widely used in parts of India, Africa, Latin America, Japan etc. and is technically known as Non Centrifugal Sugar (Walter, 2012) [4].

The awareness among the general public regarding the organic food products has been catching up fast. Consumers are opting more for organic food products due to higher health consciousness. Higher the demand, higher is the supply of new varieties of organic food. Thus giving scope to develop new products with organic value. Bakery products are one of the areas which require higher diversification in organic food products. There is higher potential to develop bakery products with organic ingredients, which can enhance the qualitative and quantitative factors of the food product, hence the study was undertaken with the objective of development and characteristics of organic jaggery based muffins.

2. Material and Methods
The basic ingredients for preparation of muffins were purchased from local market. Organic jaggery certified by organic board was purchased. Standardized procedure of Bakery unit, UAS, Dharwad was followed for the preparation of muffin. Fat and powdered sugars were creamed and slowly egg was added creamed till it mixes well. Flour was mixed to the cream and dough was put to the small paper cups. Muffin was baked for 30 min at 220 ^{0}C. Standardization of jaggery based muffin was carried out by replacing sugar with non-organic and organic jaggery by 0, 80, 100 and 120 per cent.

The value added muffins were evaluated for organoleptic attributes using 9 point hedonic scale by a panel of 20 semi-trained judges from Department of Food Science and Nutrition, College of Home Science, UAS, Dharwad. Nutrient composition of control and most acceptable -little millet-jaggery cookies were analyzed on moisture free basis in triplicates employing standard procedures (Anon., 1990) [1].

Each selected developed value added cookies were analyzed in triplicate. Moisture, fat, protein, ash, and minerals were estimated by AOAC (1990) method. The crude fibre in developed muffins was analysed by the procedure given by AOAC (1990). While total carbohydrate content by difference method. The energy content of value added muffins was computed by summing up the values obtained by multiplying the values with Atwater constants for carbohydrates, crude fat and protein with the 4, 9 and 4, respectively. Dietary fiber content of all the cookies and muffins was analyzed by enzymatic-gravimetric method (Asp *et al*., 1983) [2]. Iron, phosphorous and potassium were analyzed by Atomic Absorption Spectrophotometer (AAS). Calcium was determined by precipitating it as calcium oxalate and titrating the solution of oxalate in dilute H_2SO_4 against standard $KMnO_4$ (Anon., 1990) [1]. Obtained experimental values were analyzed by analysis of variance (ANOVA) and student's t test for comparisons. SPSS software (version 16.0) was used to analyze the data.

3. Result
The little millet muffin with 20:80 refined flour: little millet flour with sugar was varied with different proportions of jaggery replacing sugar, keeping the other ingredients like flour, butter, curds and essence constant(table 1). The muffins

with different variations were subjected for organoleptic evaluations Table 2 indicates that the muffin with non-organic jaggery at 100 per cent incorporation was on par with little millet muffins with sugar. The overall acceptability was 8.38 ± 0.73 and 7.73 ± 0.89 for sugar based and non-organic based little millet muffin respectively. Hence this proportion was selected for further evaluation.

Table 1: Incorporation of non-organic and organic jaggery in little millet muffins

Variations	Sugar (g)	Non-organic jiggery (g)	Organic jaggery (g)
I	100	0	0
II	20	80	80
III	-	100	100
IV	-	120	120

Table 2: Sensory profile of little millet muffin with non-organic jiggery

Variation	Sugar :Jaggery	Appearance	Color	Flavor	Taste	Texture	Overall acceptability	Acceptability index
1	100:0	8.58 ± 0.6^{a}	8.52 ± 0.66^{a}	8.32 ± 0.87^{a}	8.35 ± 0.73^{a}	8.26 ± 0.86^{a}	8.38 ± 0.73^{a}	93.35
2	20:80	6.94 ± 1.01^{c}	6.94 ± 0.8 1^{c}	7.17 ± 1.02^{c}	7.23 ± 0.98^{c}	7.26 ± 0.70^{c}	7.14 ± 0.74^{c}	79.03
3	0:100	7.91 ± 1.08^{ab}	7.91 ± 0.96^{ab}	7.58 ± 0.98^{b}	7.67 ± 0.97^{b}	7.61 ± 1.01^{b}	7.73 ± 0.89^{ab}	85.94
4	0:120	7.70 ± 0.75^{b}	7.58 ± 0.85^{b}	7.35 ± 0.73^{c}	7.64 ± 0.88^{b}	7.41 ± 0.82^{c}	7.50 ± 0.74^{c}	83.66
F		19.86	21.52	10.34	8.97	8.95	14.92	
S. Em. ±		0.15	0.14	0.16	0.16	0.15	0.14	
CD		0.43**	0.40**	0.44**	0.43**	0.41**	0.38**	

Values are expressed as mean ± SD of triplicate
**the values are significantly different at p≤0.01,
*the values are significantly different at p≤0.05, NS-Non-significant,
The same superscript letters within a column are not significantly different.

With regard to organic jaggery incorporated muffin, the acceptability was significantly less compared to control ($p < 0.05$). Among the various levels of incorporation of organic jaggery, substitution at 0:120 levels scored higher and hence this was selected for further evaluation. The scores for appearance, colour, flavor, taste, texture, and overall acceptability decreased with increase in organic jaggrey substituted muffins. However at 120 per cent level of incorporation the acceptability was higher and had an acceptability index of 81.98 (Table 3).

Table 3: Sensory profile of little millet muffin with organic jiggery

Variation	Sugar : Jaggery	Appearance	Color	Flavor	Taste	Texture	Overall acceptability	Acceptability index
1	100:0	8.60 ± 0.65^{a}	8.51 ± 0.71^{a}	8.33 ± 0.91^{a}	8.36 ± 0.86^{a}	8.18 ± 0.97^{a}	8.57 ± 0.65^{a}	93.61
2	20:80	7.57 ± 1.06^{b}	7.20 ± 0.93^{b}	7.30 ± 0.88^{b}	7.40 ± 0.91^{b}	7.39 ± 1.01^{b}	7.30 ± 0.85^{b}	81.77
3	0:100	6.93 ± 1.16^{c}	6.81 ± 1.04^{c}	6.96 ± 0.71^{c}	7.03 ± 1.01^{c}	6.96 ± 0.88^{c}	6.90 ± 0.78^{c}	77.01
4	0:120	7.53 ± 0.93^{b}	7.30 ± 0.9^{b}	7.39 ± 0.64^{b}	7.39 ± 0.86^{b}	7.27 ± 0.9^{b}	7.39 ± 0.82^{b}	81.98
F		10.06	11.36	10.74	6.35	4.11	15.92	
S. Em. ±		0.20	0.19	0.16	0.19	0.20	0.16	
CD		0.55**	0.52**	0.45**	0.52**	0.55**	0.44**	

Values are expressed as mean ± SD of triplicate
**the values are significantly different at p≤0.01,
*the values are significantly different at p≤0.05, NS-Non-significant.
The same superscript letters within a column are not significantly different.

Table 4 shows the nutrient content of little millet muffins with sugars, non-organic and organic jaggery. Energy, moisture and fat (444.57, 19.42 and 25.10 g/100 g) was found to be higher in case of organic jaggery incorporated little millet muffins, while it had lower carbohydrates compared to the other two types. Non-organic jaggery based little millet muffins had significantly lower ($p < 0.0\ 5$ %) levels of total ash content (0.46 g/100 g). Protein, crude fiber and dietary fiber did not vary significantly between the three types of muffins.

Table 4: Nutrient content of little millet muffin sugar, non-organic and organic jaggery per 100 gram

Little millet muffin	Energy (Kcal)	Moisture (%)	Protein (g)	Fat (g)	Ash (g)	Crude fiber (g)	Carbohydrates (g)	Dietary fiber (g)
Sugar	415.60 ± 5.30^{c}	15.90 ± 0.17^{b}	17.03 ± 0.45^{b}	16.50 ± 0.25^{b}	0.70 ± 0.30^{a}	0.62 ± 0.34^{b}	49.81 ± 0.42^{a}	3.21 ± 0.28^{b}
Non-organic jaggery	427.10 ± 1.01^{b}	16.33 ± 0.46^{b}	16.16 ± 1.8^{b}	18.90 ± 0.10^{b}	0.46 ± 0.10^{b}	0.61 ± 0.38^{b}	48.10 ± 2.60^{a}	3.20 ± 0.20^{b}
Organic-jaggery	444.57 ± 6.05^{a}	19.42 ± 0.19^{a}	15.18 ± 1.02^{b}	25.10 ± 3.00^{a}	0.73 ± 0.40^{a}	0.62 ± 0.27^{b}	39.50 ± 2.50^{b}	2.91 ± 0.08^{b}
F	28.79	39.72	1.59	19.41	14.38	0.001	2.05	19.27
S.Em.±	2.71	0.30	0.73	1.00	1.00	0.19	0.11	1.24
C.D.	54.05**	1.05**	NS	3.47**	0.13**	NS	0.41**	NS

Values are expressed as mean ± SD of triplicate
**the values are significantly different at p≤0.01,
*the values are significantly different at p≤0.05, NS-Non-significant
The same superscript letters within a Column are not significantly different.

When the little millet muffins were analyzed for specific minerals, it was found that all the estimated minerals calcium, iron, potassium and phosphorus were significantly higher in jaggery muffins when compared to little millet muffins with sugar. Among the two types of jaggery, calcium and potassium was higher in non- organic (268.45 mg/100g, 354.7 mg/100g) while phosphorus was higher organic jaggery (181.5 mg/100g) based little millet muffin. Iron content did not vary between the two types of jaggery (2.5 and 2.6 mg/100 g) (Table 5).

Table 5: Mineral content of little millet muffin with sugar, non-organic and organic jaggery per 100 gram

Muffins	Calcium (mg)	Iron (mg)	Potassium (mg)	Phosphorus (mg)
Sugar	30.60 ± 1.3^{c}	1.2 ± 0.17^{b}	140.25 ± 0.66^{c}	18.9 ± 0.5^{c}
Non-organic jaggery	268.45 ± 1.7^{a}	2.5 ± 0.12^{a}	354.7 ± 1.01^{a}	163 ± 0.50^{a}
Organic jaggery	252.59 ± 1.7^{b}	2.6 ± 0.13^{a}	306.7 ± 0.85^{b}	181.5 ± 0.45^{b}
F value	626.08	12.95	379.06	486.90
S.Em. ±	0.94	0.08	0.49	0.28
C.D.	5.81*	0.73**	6.33*	4.41*

Values are expressed as mean ± SD of triplicate

**the values are significantly different at $p \leq 0.01$,

*the values are significantly different at $p \leq 0.05$, NS-Non-significant.

The same superscript letters within a coloum are not significantly different.

4. Discussion

Compared to sugar either non-organic jaggery or organic jaggery tasted less sweet, as expressed by judges, hence higher amount of incorporation was explored. The little millet muffins with sugar and with different levels of non-organic jaggery when subjected to organoleptic evaluations revealed that 100 per cent replacement scored on par with control for appearance, colour and overall acceptability. Taste, flavor, texture scored lesser, but was higher than 80 and 120 per cent levels. Hence this was selected for further analysis. In case of organic jaggery, 120 per cent level scored higher than the other variations hence opted for further evaluations. The non-organic jaggery was more crystalline compared to organic and the colour of the jaggery was darker and less sweet.

The specific mineral composition indicated all are higher in jaggery muffins compared to sugar muffins. Jaggery is rich in minerals like calcium, phosphorus, potassium, magnesium, iron unlike sugar which is devoid of most of the micro-nutrients (Nath *et al.,* 2015) [3]. Calcium and potassium were higher in non-organic jaggery muffin while iron and phosphorus were higher in organic jaggery muffin which could be due to added during production process.

5. Conclusion

From the study it was be concluded that, in little millet muffin the sugar can be totally replacement with jaggery. In case of non-organic jaggery and addition of 100 per cent in case of organic jaggery 120 per cent was acceptable. The scores for appearance, colour, flavor, taste, texture, and overall acceptability decreased with increase in organic jaggrey substituted muffins. However at 120 per cent level of incorporation the acceptability was higher and had an acceptability index of 81.98. The muffins with jaggery was high in mineral content compared to little millet muffin with sugar.

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