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Effect of Beetroot Extract on Colour and Sensory Quality of Flavoured Milk

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ABSTRACT

In the dairy industry, most of the colouring agents used are artificial in nature which are reported to cause harmful effects when consumed in higher doses. Colour extraction from natural sources is always safe and beneficial. Beetroot is a root vegetable and its juice and extracts are used as traditional medicine, food colorant and additive to cosmetics. Present study was conducted to investigate the effect of beetroot extract on colour and sensory quality of flavoured milk. After addition of beetroot extract, it was found that the sensory score of beetroot flavoured milk was higher than control flavoured milk. Viscosity of beetroot flavoured milk was slightly higher than control flavoured milk. Sensory score and pH of beetroot flavoured milk decreased during storage at refrigeration temperature. It was concluded that addition of beetroot extract gave good colour and appearance to the flavoured milk and there was no adverse effect on body and texture, flavor and overall acceptability of flavoured milk.

Key word: *Beetroot, Flavoured milk, Sensory properties, Colour, Shelf Life*

INTRODUCTION

Colour is the main feature of food, which determines the latter's appeal to the consumers. It is the first characteristic to be noticed and is one of the main ways of visually assessing a food before it is consumed. The perceived colour provides an indication of the expected taste of food; hence food colors are used extensively. According to number of research works, the synthetic colours are harmful to consumer, especially those used in food[17]. The natural colouring agents are helpful to prevent several diseases and disorders in human beings because of their antimicrobials and antioxidant property. So, it is better to use natural colour as a food colouring agent instead of synthetic colour. Beetroot is a vegetable, and its juice and extracts also used as traditional medicine, food colorant and additive to cosmetics[6,18].

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Red beetroot extract is widely used as a natural colorant in many dairy products, beverages, candies and meat products (cooked, smoked, semi-dry or fermented sausages)[2,3,12]. Gasztonyi analysed five red beet varieties (Bonel, Nero, Favorit, Rubin and Detroit) in terms of their pigment composition[5]. In all cases, the major red-violet pigments were betanin, isobetanin, betanidin and isobetanidin, and the major yellow components were vulgaxanthin I and vulgaxanthin II. In addition to their red color, beetroot juice contains a high level antioxidants[21], as well as many other health promoting compounds such as potassium, magnesium, folic acid, iron, phosphorus, calcium and soluble fibre. Beetroot juice is a rich source of a number of polyphenolic compounds[8,14]. It contains several desirable biological activities, including antioxidant, antiinflammatory, hepatoprotective, and antitumor properties[4,7,20]. Present study was conducted to investigate the effect of beetroot extract on colour and sensory quality of flavoured milk.

MATERIALS AND METHODS

Extraction of beetroot extract: Medium sized beetroots were cleaned with water and peeled using a peeler. They were then shredded into small shreds using an SS shredder. About 80 g of the shredded beetroot was taken in a grinder and added with 20 ml acidic solution (0.2 g citric acid + 0.1 g ascorbic acid was dissolved in 100 ml pasteurized water), ground for 4-5 min and the pulp taken in a muslin cloth, pressed manually and the extract collected in a separate container. This beetroot colour extract (BCE) was used in flavoured milk.

Preparation of beetroot flavoured milk: Cow milk was filtered and standardized to 3% fat and 8.5% SNF. Granular sugar @ 7% and beetroot colour extract (BCE) @ 1, 2, 3, 4 and 5 ml per 500 ml of milk were added and mixed thoroughly. The milk was then homogenized at 60°C and pasteurized at 80°C/no hold, cooled to 4-5°C. Strawberry flavor @ 2-3 drops per 500ml milk was added and mixed thoroughly. This flavoured milk was packaged in LDPE pouches and stored at refrigerated temperature.

Sensory evaluation: Samples were evaluated for sensory characteristics like color and appearance, body and texture, flavor and overall acceptability on a 9-pont Hedonic scale[11].

Viscosity of milk: Kinematic viscosity of sample was determined at about 10°C using Ostwald capillary glass viscometer by the method described for general liquids[15].

Colour measurement: Colour of the samples was measured by Scanner-Adobe Photoshop method[19].

pH: pH of sample was determined by dipping the electrode of pH meter (Servewell Instruments, Bangalore) directly into the product at 27°C.

Statistical analysis

Data of sensory and colour analyses obtained in the study were subjected to statistical analysis by one way ANOVA using MS-Excel package version 2007.The differences among treatments were measured at 5% level of significance.

RESULTS AND DISCUSSION

Effect of beetroot colour extract (BCE) on sensory quality of flavoured milk: The beetroot colour extract (BCE) was added to milk before pasteurization. The levels added were 1, 2, 3, 4 and 5 ml BCE per 500 ml milk. The sensory evaluation results showed that BCE produced a pleasing pink color in the flavoured milk. The pink color was attributed to the pigments of betalain and betanine present in BCE. From Table-1, it can be seen that color and appearance scores of flavoured milk increased as the BCE level increased, but only up to 4 ml level. Score increased from 6.96 for control flavoured milk to 7.84 for beetroot flavoured milk, when 4 ml BCE was added. When 5 ml was added there was no further improvement in the color and appearance. The color addition had a cascading effect on all other attributes. The body and texture scores of beetroot flavored milk increased from 7.38 to 7.60, it may be due to slightly higher viscosity of beetroot

flavoured milk. Flavor scores of beetroot flavoured milk also increased from 7.45 to 7.74, which may be due to natural flavour of beetroot. Overall scores also increased from 7.10 for control to 7.90 for beetroot flavoured milk, by the addition of 4 ml BCE. Though use of 5 ml BCE imparted pink colour, there was no much further improvement in the sensory quality of flavoured milk. So, 4 ml BCE in 500 ml flavoured milk was chosen for further studies. The effect of addition of BCE on all the sensory attributes was statistically significant ($P<0.05$).

Effect of addition of BCE on the viscosity of flavoured milk: The viscosity values of control flavoured milk and 4 ml BCE added beetroot flavoured milk are shown in Table-2. It may be seen that in all the trials, the viscosity of BCE added flavoured milk was slightly higher than that of control flavoured milk. The viscosity of control flavoured milk varied from 1.70 – 1.75 cS whereas that of BCE added flavoured milk varied from 1.81 – 1.91 cS. BCE had less total solids than milk, yet slight increase in viscosity of milk may be attributed to acidic nature of the extract added. Labropoulos reported viscosity of pasteurized cow milk as 1.9 to 2.0 cP[10]. It is known that even a slight increase in acidity of milk may enhance its viscosity[9].

Stability of beetroot colour in flavoured milk during storage at refrigeration temperature: The colour intensity of beetroot flavoured milk was quantified in terms of Red (R), Green (G), Blue (B) and Luminosity (L) values as measured by Scanner-Adobe Photoshop method. It may be seen that R, G and B proportions changed during storage of flavoured milk at refrigeration temperature as per the changes in the overall colour caused by BCE addition. The initial values of R, G and B were 234.7, 190.04 and 196.74, respectively which changed to 241.1, 199.11and 201.17 at the end of 11 days storage (Table-3). The L values were 204.2, 206.6, 204.9, 209.0, 205.3, 202.2 and 211.9, respectively at storage intervals of 0, 2, 5, 7, 9, 10 and 11 days. These values indicated that there was not much change in the lightness / darkness of the colour during storage. The same was the observation with R, G and B values also. The colour almost remained the same throughout the storage period of 11 days. This is because of low temperature of storage. There are no reports of changes in colour of flavoured milk or market milk during storage. However, Popov-Raljic reported that L* value of UHT milk decreased during storage at ambient temperature (20±5°C) [16]. This was attributed to Maillard browning.

Effect of storage on pH of flavoured milk: pH of flavoured milk decreased during storage period. In control flavoured milk the decrease was from 6.72 to 6.22 towards the end of storage whereas in case of beetroot flavoured milk the decrease was from 6.77 to 6.18 (Table-4). Similar result was also reported by Mohyuddin *et al.*[13] and Arora *et al.*[1].

Effect of storage on sensory score of beetroot flavoured milk at refrigeration temperature:

Flavoured milk was packaged in LDPE pouch and stored at refrigeration temperature and evaluated for changes in sensory quality. The data of sensory scores is shown in Table-5. It can be seen from the table that the colour and appearance score of beetroot flavoured milk decreased slightly from 8.31 to 8.19 on 11th day which is not statistically different from the initial score (Table-5). This shows that the beetroot colour was stable at the storage temperature during storage. The body and texture scores during storage varied from 7.95 to 7.13 at the end of storage, which was significantly less than the zero day score. These scores indicated that on 11th day, there was whey separation hence the score significantly reduced. Flavour scores gradually decreased during storage. The score on zero day was 8.03 which decreased to 8.01, 7.97, 7.96 and 7.77 on 4, 6, 8 and 10 days, respectively. These scores were statistically similar ($P>0.05$). But on 11th day the score significantly reduced to 5.85. This is because of development of acidic flavour. This is reflected in overall acceptability score which also significantly reduced to unacceptable level (5.77). Mohyuddin *et al.*[13] reported that sensory score of a milk drink decreased during storage period at refrigeration temperature.

Table 1: Effect of addition of BCE as colouring agent on the sensory scores of flavoured milk

ml BCE per 500 ml milk	Color and appearance	Body and texture	Flavor	Overall acceptability
0 (Control)	6.96^{a}±0.49	7.38^{a}±0.58	7.45^{ab}±0.46	7.10^{a}±0.41
1	7.02^{a}±0.49	7.40^{ab}±0.56	7.43^{a}±0.50	7.23^{ab}±0.35
2	7.28^{b}±0.46	7.42^{ab}±0.56	7.48^{abc}±0.47	7.38^{b}±0.36
3	7.58^{c}±0.50	7.51^{ab}±0.49	7.61^{bcd}±0.36	7.64^{c}±0.33
4	7.84^{d}±0.45	7.60^{b}±0.49	7.74^{d}±0.42	7.90^{d}±0.40
5	7.57^{c}±0.55	7.54^{ab}±0.55	7.62^{cd}±0.38	7.54^{c}±0.51

Note: BCE - beetroot colour extract; all scores on 9 – point Hedonic scale; scores with different superscripts in a column are significantly different from each other ($p<0.05$)

Table 2: Effect of addition of BCE as colouring agent on the viscosity of flavoured milk

Trial No.	Viscosity of milk (cS)*	
	Control flavoured milk	Beetroot flavoured milk#
1	**1.74**	**1.91**
2	**1.73**	**1.91**
3	**1.75**	**1.90**
4	**1.70**	**1.81**
5	**1.73**	**1.86**

Note: BCE - beetroot colour extract; * Measured at 10-11°C; # Flavoured milk added with 4 ml BCE (beetroot colour extract) per 500 ml milk

Table 3: Effect of storage on colour parameters* of BCE added flavoured milk# at refrigeration temperature

Days	Luminosity	Red	Green	Blue
0	204.2^{a}±9.6	234.7^{a}±14.5	190.04^{a}±7.2	196.74^{a}±11.2
2	206.6^{a}±10.5	238.1^{a}±10.3	192.58^{a}±11.9	196.43^{a}±7.7
5	204.9^{a}±7.4	235.7^{a}±5.2	191.31^{a}±9.5	194.11^{a}±6.9
7	209.0^{a}±9.4	241.1^{a}±6.6	194.54^{a}±10.7	199.28^{a}±10.9
9	205.3^{a}±8.5	237.7^{a}±5.4	191.11^{a}±9.8	193.94^{a}±9.9
10	202.2^{a}±12.4	233.8^{a}±9.5	188.28^{a}±14.0	190.65^{a}±13.0
11	211.9^{a}±7.5	241.1^{a}±6.6	199.11^{a}±9.3	201.17^{a}±6.9

Note: BCE - beetroot colour extract * Measured under RGBL mode on a scale of 0-255; values with different superscripts in a column are significantly different from each other ($p<0.05$); # Flavoured milk added with 4 ml BCE (beetroot colour extract) per 500 ml milk

Table 4: Effect of storage on pH of flavoured milk# at refrigeration temperature

Days	Control flavoured milk	Beetroot flavoured milk
0	6.72	6.77
2	6.71	6.86
4	6.67	6.84
6	6.51	6.68
8	6.49	6.62
9	6.46	6.60
10	6.29	6.57
11	6.22	6.18

Note: # Flavoured milk added with 4 ml BCE (beetroot colour extract) per 500 ml milk

Table 5: Effect of storage on sensory score of BCE added flavoured milk[#] at refrigeration temperature

Days	Colour and appearance	Body and texture	Flavour	Overall acceptability
0	8.31^{a}±0.26	7.95^{b} ±0.13	8.03^{b} ±0.18	8.21^{b} ±0.32
2	8.27^{a}± 0.36	7.93^{b} ±0.31	8.03^{b} ±0.18	8.21^{b} ±0.32
4	8.23^{a}±0.38	7.91^{b} ±0.25	8.01^{b} ±0.16	8.19^{cb} ±0.30
6	8.23^{a} ±0.38	7.89^{b}±0.27	7.97^{b} ±0.23	8.13^{bc}±0.30
8	8.21^{a} ±0.37	7.89^{b} ±0.27	7.96^{b} ±0.33	8.08^{bc}±0.37
10	8.21^{a}±0.37	7.89^{b} ±0.27	7.77^{b} ±0.22	7.83^{b} ±0.29
11	8.19^{a} ±0.37	7.13^{a}±0.60	5.85^{a}±1.14	5.77^{a}±1.05

Note: BCE - beetroot colour extract; all scores on 9 – point Hedonic scale; scores with different superscripts in a column are significantly different from each other ($p<0.05$); [#] Flavoured milk added with 4 ml BCE (beetroot colour extract) per 500 ml milk

CONCLUSION

It was concluded that the BCE addition gave good colour and appearance to the flavoured milk as well as there was no adverse effect on body and texture, flavor and overall acceptability of flavoured milk. The colour showed stability during the period of shelf life of the dairy product.

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