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Characterization of market samples of milk beverage: *Thandai*

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Abstract

Thandai is a well-known region specific traditional milk-based beverage popular in Rajasthan and certain other Northern states of India. It is served in summer and relished as a delicacy during festive season in India. This drink is prepared with combination of nuts including almond and seeds of watermelon, muskmelon, pumpkin and cucumber along with certain flavoring additives such as saffron and cardamom. *Thandai* is easily digestible, highly refreshing, thirst quenching, appetizing and nutritionally far superior to many synthetic and aerated drinks. Besides fulfilling satiety value, the ingredients used in preparation of this beverage have also been medicinally proven. Being a traditional Indian drink, International and national level research work and the literature pertaining to the same is not available. Thus, the present study was undertaken to investigate and characterize the quality of commercially available *thandai* in terms of sensory, physico-chemical and microbiological attributes. Significant ($p < 0.01$) differences amongst the market samples were noticed in terms of quality.

Keywords: *Thandai*, flavored milk, ready to serve, beverage, optimization

1. Introduction

Water is an essential life supporting element. It secures a crucial position for regulating a broad range of vital functions in human body. Thirst is the sensation experienced by body when it becomes dehydrated. Thus, beverages took the lead in overcoming the craving for fluids. With intensification in income scales, health consciousness as well as in food connoisseurs, legion of people have diversified from plain water and milk into variant drinks. Therefore, this scenario resulted into the availability of various traditional drinks on the shelves of supermarkets, either in RTS form, or in easy to constitute form. These kinds of beverages emerged as the apple of eye for almost all age groups. The diversification comprises, beverages made from fruits (fruit-based beverages; RTS, nectar, cordial squash), flavored milk beverages (vanilla, chocolate, strawberry etc) and fermented beverages (cultured buttermilk; sweetened, salted or plain) that has given the wide array of choice to modern consumer to choose product of their choice. These beverages are easily digestible, highly refreshing, thirst quenching, appetizing and nutrient rich as well as helps in fulfilling satiety value. Since, good nutrition plays a fundamental role in adequate growth and development of body during childhood as well as maintains and protects body from both infectious and non-communal diseases in adulthood respectively; hence on this account such health packed drinks have superseded much over synthetic and caloric drinks and have acquired higher consumer ratings. According to a research conducted by Tetra Pak, seven out of ten biggest markets for flavoured milk are in developing countries, while nations like India will drive massive growth of this product. Flavoured milk is world's second most popular liquid dairy product after white milk and its consumption is forecast to increase in India at a CAGR of 20% during 2015 -2020 (Anon, 2015) [2]. At present, flavoured milk dominates the dairy beverages segment contributing 60% (in value) to the branded dairy beverages consumed. Amid copious variegated drinks available, nutty flavored drink named *thandai* is a one of the hitherto undocumented regional specific traditional dairy based beverage of India with negligible information accessible about the product composition or its characteristics.

This drink is especially popular in Rajasthan and also in few other northern states of India, during the festive season. It is a drink prepared with a mixture of almonds, fennel seeds (obtained from *Foeniculum vulgare*), *khus khus* (white poppy seeds obtained from *Papaver somniferum*), pepper, cardamom, saffron, milk and sugar and is served chilled, with some

other optional ingredients. Also, Madaan *et al.* (1984) [18] recommended the use of cucurbit seeds for *thandai* preparation. Additionally, this famous dry nut cum milk-based beverage is traditionally prepared as an offering to Lord Shiva during the festival called *Mahashivaratri* in India and is often mixed with 'bhanga' (edible form of *Cannabis sativa*, also known as Hemp plant) to make an intoxicating drink. *Thandai* is quite popular in North-India, especially in hot season. This thirst-quencher beverage is tasty, cooling and highly refreshing.

As on now, only few brands are available commercially. Also, the consistency of different brands of the product available in the market is not same. Both powder and liquid consistency concentrates of the product are available in the market with a wide variety of differences in their end quality prepared thereof. Therefore, to characterize the market samples, present study was undertaken at Department of Dairy Technology, College of Dairy Science and Technology, Guru Angad Dev Veterinary and Animal Sciences University.

2. Materials and Methods

2.1 Characterization of commercial samples of *Thandai*:

2.1.1 Material for market survey

Five best renowned commercial samples of *thandai* concentrate, in liquid form, were procured from the domestic market. The brands selected for the study were Paris, Hitkary, Haldiram, Mishrambu and Sheetal. Ready to use, UHT treated homogenized toned milk processed by Amul was taken from local market for the preparation of *thandai* from market samples.

2.1.2 Chemicals

The chemicals used in the investigation of various physicochemical and microbiological parameters were analytical grade reagents (AR).

2.1.3 Preparation of *Thandai* from market samples (as directed by manufacturer on the label)

Paris Kesaria Thandai (referred as A): Take 40 ml. of Paris Kesaria *Thandai* with 100 ml. of pre-boiled milk.

Hitkary Sandali Kesaria Thandai (referred as B): Mix one part of concentrate in three parts of milk.

Haldiram Kesaria Thandai (referred as C): Mix one part of concentrate in four parts of chilled (pre-boiled) milk.

Sheetal Thandai Kesar Badam Pista (referred as D): Mix one part of concentrate to four parts of pre-boiled milk.

Mishrambu Premium Thandai Dry Nut Syrup (referred as E): Mix five parts of chilled milk to one part of concentrate.

2.1.4 Sensory Evaluation

The parameter adjudicating and characterizing procedures were finalized from the flavor profile method (Keane, 1992) [14]. The work done on sensory lexicons by Adhikari *et al.* (2011) [1], Chawla *et al.* (2014) [5], Civille *et al.* (2010) [6], Thompson *et al.* (2009) [23] and Drake *et al.* (2010) [8] was thoroughly studied and a wide range of descriptive attributes, highly regarded for *thandai* were chosen. A total of 17 descriptors were selected under 4 heads. These included color and appearance, flavor, mouth feel and overall acceptability. A detailed sensory analysis was carried out for the market samples on descriptive type 100-point scale. On the scale, 0 was verbally anchored as nil, 25 as slight, 50 as moderate, 75 as definite and 100 as extreme. The scale selected was quite broad; enough to encompass the full range of parameter intensities and had enough discrete points to pick up all the small differences in intensity between the samples. A panel of

scientists (n= 7) working at College of Dairy Science and Technology, evaluated the samples.

2.1.5 Physico-chemical analysis

Different standard procedures were adopted to deeply analyze the market samples for various physico chemical attributes such as protein, fat, moisture and sugars (IS 1981) [11]. Along with this, ash and acidity was also analyzed (AOAC 1995) [3]. Color of the samples was analyzed by the instrumental method prescribed by Bindu *et al.* (2007) [4] using a color reader CR10 (Konica Minolta). The color attributes were observed in three categories i.e.; lightness (L), redness (a) and yellowness (b). Lightness (ranging from 0 to 100, in which 0 depicts black and 100 depicts white), redness (ranging from -60 to +60, where -60 depicts green and +60 depicts red) and yellowness (ranging from -60 to +60, where -60 depicts blue and +60 depicts yellow). Dietary fiber of *thandai* samples was evaluated by using a dietary fiber kit obtained from M/s Sigma – Aldrich Chemicals, U.S.A., following the method prescribed by (AOAC 1995) [3]. All assays were carried out in triplicates and distilled water was used throughout the testing to enhance accuracy in results.

2.1.6 Microbiological analysis

The market samples were evaluated for the microbial safety. In this, SPC count, Yeast and Mould count as well as Coli form count was investigated as per the standard procedures (IS 1981) [11]. The sample was drawn aseptically for microbial assay to obtain error free results. All the materials such as Petri plates, conical flasks, tips used for auto-pipettes were sterilized in hot air oven and agar solutions were sterilized at 121 °C at 15 psi for 15 minutes. The plating procedure was conducted in a laminar flow with well-maintained sterile environment. All the assays were carried out in triplicates at specific dilutions. UHT treated tetra packed milk was taken for the preparation of market samples to avoid false microbial counts entering the samples through milk.

2.3 Statistical Analysis

The result were compiled in Microsoft excel (Microsoft office 2016). All the data collected was expressed as mean \pm standard deviation from three independent samples. The data obtained during the present investigation was subjected to one-way analysis of variance (ANOVA) and Duncan's multiple range tests using Statistical Analysis System (SAS) version 9.3.8 (SAS Inc., Cary, NC, USA). Similar statistical analysis has been reported by Youn *et al.* (2016) [25].

3. Result and Discussion

3.1 Characterization of market samples

3.1.1 Sensory Analysis

Sensory evaluation is a complex approach and involves visual, auditory, olfactory and gustation responses. These are appraised with the five basic human sense organs. The detailed sensory score card (Table1) was carefully studied to get an insight into the quantitative analysis of market samples. The color and appearance head included two descriptors namely milkier appearance and light brown to pistachio green color. These two attributes influence food appreciation and quality. Consumers have subjective standards for the acceptable range and preferred optima for these attributes (Maynard *et al.* 1965) [19]. The average scores for milkier appearance and color varied from 40-62.85 and 40.85-65 respectively among all five market samples. Since, flavor is made up of several attributes including basic tastes, flavor aromatics and feelings (Adhikari *et al.* 2011) [1].

Thandai is also a blend of various flavors and there exists wide variation among these intensities as per processing materials and methods used. The flavor head included aromas such as cocoa, cardamom, almond /saffron /pistachio, malty, sandal, cooked as well as from milk fat, sweetness and combination of nuts respectively. The average scores for cocoa aroma, cardamom aroma, almond/saffron/pistachio aroma, malty aroma, sandal aroma, aroma from milk fat and combination of nuts ranged from 11.57-29.0, 42.85-64.85, 58.57-73, 8-23.57, 9.42-24.57, 26.14-37.28 and 32.85-51.71, respectively. Statistically, no significant difference among the above-mentioned attributes was observed for the five commercial samples through sensory scores. But, the scores from cooked aroma and sweetness varied significantly ($p < 0.05$) amongst the five classes of samples. The cooked aroma of sample B was observed close to nil with an average score of 5 whereas, sample A received scores close to slight cooked aroma with average score value 20.71. The other three samples i.e.; C, D, E recorded intermediate cooked flavor within nil and slight range. The sweetness of sample A was found definite with average score of 80.42 whereas, in sample E sweetness was found close to moderate range with average score of 62.14, respectively.

Furthermore, the descriptors under mouth feel head were smooth, coarse, grainy/ presence of particulates, watery and rich with their average scores as 37.85-51.42, 24.28-39.42, 20.71-43.71, 22.85-55.42, 25.28-47.57, respectively. The watery mouthfeel varied significantly ($p < 0.05$) among all five commercial samples. Sample B was recorded slight watery whereas sample E was recorded as moderately watery. With through evaluation of average sensory scores of milkfat aroma, watery mouth feel and rich mouth feel, one can also predict the effectiveness of sensory procedure evolved in this study. Rich mouth feel is closely linked with milk fat. The taste, smell, mouth feel, and hedonic properties of fat all contribute to the popular concept of fat "taste" (Drewnowski 1997) [9]. Also, an inverse relation between rich mouth feel and watery mouth feel scores was observed. The overall acceptability scores ranged from 44.28-59, respectively. Sample E fetched maximum mean scores (59.0) for overall acceptability amongst all the market samples of *thandai*.

3.1.2 Physico-chemical Composition

The physico-chemical attributes varied significantly ($p < 0.01$) among all five commercial brands. The average scores for fat, protein, reducing and total sugars varied within the range (in percent) of 2.92- 3.29, 2.74- 3.18, 4.65- 4.86 and 12.85-17.30, respectively (Table 2). Dadgostar *et al.* (2013) [7] found similar results for various commercially available milk-based drinks. Water serves as a medium for solution and colloidal suspension for the other components present in milk (Mohammad *et al.* 2008). Moisture content was found highest in sample A followed by samples D, C, B and was observed lowest in sample E. Average moisture content varied from 79.93-82.24 (in percent). Okyere *et al.* (2014) [21] reported similar readings in tiger nut milk. Sugars can be found naturally in foods, including fruits and dairy products, in addition to those sugars that are added to foods during processing and added sugars are sugars that are not naturally found in the food product and are added during the production of the food (Erickson and Salvin 2015) [10]. The average reducing sugars were 4.65, 4.75, 4.81, 4.70, and 4.86 for samples A, B, C, D, and E respectively. Furthermore, the average ash content of sample B was significantly ($p < 0.01$) low i.e.; 0.71 while that of sample E it was found significantly

($p < 0.01$) high i.e.; 0.91 respectively. Similar results were found by Javaid *et al.* (2009) [12] and Mohammad *et al.* (2008) in commercial milk samples. The fat content of sample E was significantly ($p < 0.01$) low while sample D had significantly ($p < 0.01$) high fat content. Whereas, the protein content of sample C was significantly ($p < 0.01$) and sample B had significantly ($p < 0.01$) high protein content. Javaid *et al.* (2009) [12] reported similar variations in protein and fat content in market milk samples. The fiber content had wide variations ranging from as low as 0.002% to as high as 2.77% for sample C and E respectively. Fiber is not present in milk and milk products. It is a component of cell wall of fruits, vegetables, grains and seeds (Lunn and Buriss 2007) [17]. Consumption of fiber rich food products reduces or prevents many health problems such as obesity, gastrointestinal disorders, hypertension and so on. Fiber enriched milk drink contained 1.5% of fiber (Lummela *et al.* 2009) [16]. The color attributes were observed in three categories i.e.; lightness (L), redness (a) and yellowness (b).

Lightness (ranging from 0 to 100, in which 0 depicts black and 100 depicts white), redness (ranging from -60 to +60, where -60 depicts green and +60 depicts red) and yellowness (ranging from -60 to +60, where -60 depicts blue and +60 depicts yellow). The instrumental color attributes were analyzed and found to be varied significantly ($p < 0.01$). Lightness ranged from as low as 54.26 to as high as 76.81. The lowest value of lightness was 54.26 as observed in sample D and it was similar to the upper range observed by Yanes *et al.* 2002 [24] in chocolate milk beverage, suggesting that the sample D being similar to chocolate milk beverage in lightness parameter. This dark color may be attributed to presence of nuts like almonds and caramelization reaction of various ingredients present within decoction. Redness ranged from minimum of -3 to maximum of 2.67. Sample C and E were comparable in redness values. As well as yellowness ranged from 14.43 to 34.68, respectively. However, values of acidity among all commercial samples varied significantly ($p < 0.01$) from 0.47 to 0.53 percent lactic acid. Values obtained after analysis were in close relation with the studies undertaken by Kumar and Kumar (2016) [15] on *lassi* (probiotic buttermilk).

3.1.3 Microbiological Analysis

The samples prepared from various brands of *thandai* showed significantly ($p < 0.01$) high amounts of bacteria (Table 3), represented through standard plate count (SPC), yeast and molds and coli form. The counts were calculated as log cfu/ml. Samples A and B showed significantly ($p < 0.01$) high amounts of SPC i.e.; 6.67 and 7.71 log cfu/ml respectively. The possible reasons for such high number of bacterial growth can be post processing contamination, unhygienic practices employed during manufacture and poor-quality packaging systems. The yeast and mold counts varied significantly ($p < 0.01$) from as low as 2.41 log cfu/ml to as high as 3.95 log cfu/ml for samples C and A respectively. The yeast and mold count are indicators of some type of fungal growth, so possible reason of such high levels may be due to high sugar content in the concentrate (Sperber and Doyle 2009) [22]. The coli form count of the samples prepared from various market concentrates ranged from 2.10 to 2.93 log cfu/ml. Though, sample A, B, D and E had high range of coliforms but statistically non-significant from sample C. Coli forms are indicator organisms of unhygienic practices as well as fecal contaminations (Kagkli *et al.* 2007) [13]. Thus, such high range is definitely a matter of concern according to consumer health and welfare point of view.

Table 1: Sensory analysis scores of market samples of *thandai* on 100 point descriptive scale.

Attributes	A Sample	B Sample	C Sample	D Sample	E Sample
Milkier	40.00 ^a ± 10.85	50.57 ^a ± 13.03	62.85 ^a ± 7.10	54.85 ^a ± 8.24	58.00 ^a ± 9.50
Color: Light brown to Pistachio green	40.85 ^a ± 15.44	50.28 ^a ± 14.28	46.71 ^a ± 7.84	42.85 ^a ± 10.89	65.00 ^a ± 9.58
Cocoa aroma	17.85 ^a ± 14.13	11.57 ^a ± 7.25	14.85 ^a ± 14.20	18.42 ^a ± 14.02	29.00 ^a ± 12.98
Cardamom aroma	62.71 ^a ± 15.61	42.85 ^a ± 10.22	59.85 ^a ± 15.25	50.57 ^a ± 16.23	64.85 ^a ± 7.94
Almond/Saffron/ Pistachio aroma	73.00 ^a ± 8.95	59.71 ^a ± 8.11	60.42 ^a ± 8.69	58.57 ^a ± 11.31	64.00 ^a ± 7.27
Cooked aroma	20.71 ^a ± 5.16	5.00 ^b ± 3.45	10.57 ^{ba} ± 5.63	4.14 ^b ± 3.52	15.42 ^{ba} ± 6.10
Malty aroma	20.28 ^a ± 8.59	19.28 ^a ± 7.98	23.57 ^a ± 9.11	8.00 ^a ± 7.05	13.28 ^a ± 7.11
Milk fat	31.14 ^a ± 8.01	34.71 ^a ± 10.98	37.28 ^a ± 5.35	26.14 ^a ± 4.22	33.42 ^a ± 5.78
Sweet	80.42 ^a ± 6.61	79.14 ^{ba} ± 6.12	77.85 ^{ba} ± 4.83	76.00 ^{ba} ± 5.54	62.14 ^b ± 4.75
Sandal	24.57 ^a ± 13.96	12.42 ^a ± 4.96	9.42 ^a ± 4.33	21.85 ^a ± 13.72	17.14 ^a ± 9.87
Combination of Several Nuts	51.71 ^a ± 15.97	34 ^a ± 11.02	34.28 ^a ± 12.52	32.85 ^a ± 15.11	33.57 ^a ± 12.98
Smooth	48.42 ^a ± 6.99	44.57 ^a ± 10.80	43.57 ^a ± 8.60	51.42 ^a ± 7.77	37.85 ^a ± 5.31
Coarse	34.57 ^a ± 15.08	28.42 ^a ± 13.71	35.57 ^a ± 12.47	39.42 ^a ± 9.02	24.28 ^a ± 11.20
Grainy/Presence of Particulates	24.00 ^a ± 12.27	32.00 ^a ± 12.59	43.71 ^a ± 9.31	20.71 ^a ± 8.36	37.71 ^a ± 11.22
Watery	27.71 ^{ba} ± 12.44	22.85 ^b ± 10.59	27.42 ^{ba} ± 5.68	44.14 ^{ba} ± 8.86	55.42 ^a ± 8.10
Rich	39.85 ^a ± 11.72	47.57 ^a ± 12.30	45.57 ^a ± 10.21	25.28 ^a ± 10.80	36.71 ^a ± 10.91
Overall Acceptability	48.00 ^a ± 7.74	45.57 ^a ± 8.04	52.57 ^a ± 8.63	44.28 ^a ± 7.51	59.00 ^a ± 6.22

Values are in Mean±SD

Values bearing ^{a, b, ba} within a row vary significantly ($p \leq 0.05$)

A Sample= Paris, B Sample = Hitkary, C Sample = Haldiram, D Sample = Sheetal, E Sample= Mishrambu

Table 2: Physico-chemical analysis of market samples of *thandai*.

Physico-chemical Attributes	A Sample	B Sample	C Sample	D Sample	E Sample
Moisture %	82.24 ^a ± 0.65	80.24 ^{dc} ± 0.04	80.51 ^c ± 0.01	81.43 ^b ± 0.01	79.93 ^d ± 0.01
Fat %	3.07 ^{cb} ± 0.01	3.1 ^b ± 0.01	3.02 ^c ± 0.09	3.29 ^a ± 0.01	2.92 ^d ± 0.01
Protein %	2.91 ^b ± 0.04	3.18 ^a ± 0.05	2.74 ^c ± 0.01	3.09 ^a ± 0.10	2.84 ^{cb} ± 0.09
Reducing Sugars%	4.65 ^e ± 0.01	4.75 ^c ± 0.02	4.81 ^b ± 0.01	4.70 ^d ± 0.02	4.86 ^a ± 0.01
Total Sugars %	12.85 ^e ± 0.01	14.06 ^c ± 0.02	15.51 ^b ± 0.01	13.23 ^d ± 0.02	17.30 ^a ± 0.02
Ash %	0.86 ^b ± 0.01	0.71 ^d ± 0.02	0.8 ^c ± 0.03	0.83 ^{cb} ± 0.02	0.91 ^a ± 0.01
Acidity %	0.53 ^a ± 0.01	0.49 ^{ba} ± 0.05	0.47 ^b ± 0.01	0.48 ^{ba} ± 0.01	0.47 ^b ± 0.01
Fiber Content %	0.22 ^b ± 0.03	0.003 ^c ± 0.001	0.002 ^c ± 0.001	0.005 ^c ± 0.002	2.77 ^a ± 0.23
Color					
Lightness(L)	75.86 ^a ± 1.50	76.81 ^a ± 0.34	69.73 ^b ± 0.05	54.26 ^d ± 0.05	67.73 ^c ± 0.05
Redness (a)	2.5 ^c ± 0.37	2.67 ^{cb} ± 0.25	-3 ^b ± 0.1	-1.43 ^d ± 0.05	-3.7 ^a ± 0.05
Yellowness (b)	34.68 ^a ± 0.20	30.82 ^b ± 0.32	24.16 ^d ± 0.05	14.43 ^c ± 0.05	28.13 ^c ± 0.05

Values are in Mean±SD

Values bearing ^{a, b, c, d, e} within a row vary significantly ($p \leq 0.01$)

A Sample= Paris, B Sample = Hitkary, C Sample = Haldiram, D Sample = Sheetal, E Sample= Mishrambu

Table 3: Microbiological analysis of market samples of *thandai*

Character Log cfu/ml	A Sample	B Sample	C Sample	D Sample	E Sample
Standard Plate Count	6.67 ^b ± 0.01	7.71 ^a ± 0.01	2.73 ^c ± 0.15	3.06 ^d ± 0.05	3.67 ^c ± 0.02
Yeast and Mold	3.95 ^a ± 0.02	3.19 ^b ± 0.04	2.41 ^c ± 0.10	2.63 ^d ± 0.05	2.91 ^c ± 0.06
Coli forms	2.93 ^a ± 0.02	2.80 ^a ± 0.18	2.10 ^b ± 0.17	2.80 ^a ± 0.03	2.87 ^a ± 0.06

Values are in Mean±SD

Values bearing ^{a, b, c, d, e} within a row vary significantly ($p \leq 0.01$)

A Sample= Paris, B Sample = Hitkary, C Sample= Haldiram, D Sample = Sheetal, E Sample= Mishrambu

4. Conclusion

Thandai is the hitherto undocumented regional specific traditional dairy based beverage of India. The market survey of the commercial liquid concentrate of *thandai* was carried out. Huge variations in the quality among all five samples as well as differences and difficulties arising from preparation of these concentrates were noticed. However, Haldiram brand (sample C) was found sensorily most acceptable. The physico-chemical and microbiological analysis of the market samples also revealed statistically significant ($p \leq 0.01$) variations in all attributes. Considering all the facts, there is an urgent need to standardize RTS beverage to eliminate possible variation in the product.

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