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Quality evaluation of kandi pedha sold in Satara city

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Abstract
The objective of the present study were to study sensory, physico-chemical and microbial quality of the kandi pedha sold in Satara city. Initially, the shops of kandi pedha was being sold in Satara city were surveyed for their locations. Based on information, the shops were selected randomly for collection of samples. Total 15 samples of kandi pedha from different shops were collected and brought to the laboratory for further evaluation. Entire data of the experiment have been analysed and interpreted.
Wide variation were observed in sensory score for flavour (7.70±0.17 to 8.03±0.03), body and texture (7.90±0.20 to 8.20±0.15), colour and appearance (7.20±0.61 to 8.03±0.23) and overall acceptability (7.68±0.38 to 8.20±0.24). The physico-chemical characteristics also revealed wide variation for moisture (12.61±0.09 to 14.30±0.18), fat (16.42±0.03 to 18.21±0.02), protein (12.81±0.09 to 14.32±0.04), reducing sugar (14.50±0.05 to 17.40±0.31), non-reducing sugar (34.19±0.30 to 38.35±0.29), total sugar (50.92±0.10 to 53.21±0.17), ash (2.91±0.01 to 3.12±0.03), acidity (0.43±0.01 to 0.57±0.01) and pH (6.73±0.03 to 6.8±0.05). The variations were also observed in microbial counts for standard plate count (3978±0.9 cfu/g to 5219±1.0 cfu/g), yeast and mould count (27.9±0.4 cfu/g to 52.8±1.9 cfu/g) and coliform count (25.2±0.4 cfu/g to 50.7±1.5 cfu/g/).
It was concluded that the kandi pedha brand S_3 showed highest score in terms of flavour, body and texture and overall acceptability and brand S_5 showed highest score in terms of colour and appearance among all five brands marketed in Satara city. The brand S_3 showed lowest standard plate count and yeast and mould count, which is best for consumption. The samples of kandi pedha brands analysed for different parameter follows the minimum and maximum legal standards as prescribed by FSSAI 2006. All kandi pedha brands marketed in Satara city fulfilled the minimum legal standards given by BIS and FSSAI (2006) in respect of microbial standards.

Keywords: Kandi pedha, physico-chemical, microbial

Introduction
Pedha is an indigenous khoa based heat desiccate milk sweet prepared by heating mixer of khoa and sugar with addition of natural or artificial colour and flavour until the desired characteristics texture and flavour develops (Kavita et al. 2015) [23]. Pedha is highly nutritious product as it contains almost all milk solids, sugar and other additives. Pedha is more popular than all other khoa based sweets. Pedha is characterized by caramelized flavour and popular due to their pleasant taste among the Indian traditional sweets. Several varieties of pedha are sold in the market; Mathura pedha in Uttar Pradesh are brown, small and round in shape, has caramel flavour and a long keeping quality. In Gujrat and western part of the country, white pedhas are preferred, which are usually made from buffalo milk. Certain other varieties of pedha like Elaichi pedha, Malai pedha, Keshar pedha, Rajkot pedha etc. are also found in the markets of different parts of the India. There are different types of famous pedha brands recognized by locality or producer. A few examples from Maharashtra are Chitale, Ghodake and Kaka halwai pedha. Some of co-operative dairies i.e. Gokul, Warna, Hutatma, Krushna, Katraj, Dudh Pandhari has produced their own pedhas. Similarly Kandi pedha from Satara is recognized for its brown colour and caramelized flavour and in Ahmednagar city (M.S.), Rajur pedha is famous for its flavour.
There are mainly two types of pedha one is white pedha and other is brown pedha. Kandi pedha is brown colored pedha which originated and famous in Satara district. Kandi pedha has special importance in various celebrations like inaugural functions, to celebrate success, weddings, etc. in Satara district. It available in round and smooth textured. Kandi pedha comes in two different flavours, cardamom (original flavour) and kesar (saffron). Technique of making kandi pedha is different than other pedha making techniques. Kandhi pedha is originated in Satara district and name of pedha is originated from its kand making style. Kand making is style of double frying of khoa to change its color and turns it into brown color khoa.

This kand making style is known by some people who migrate to Satara city and prepared pedha by making kand and then it became popular all over district and all over Maharashtra by name of kandi pedha. Also some people told British people unable to pronounce kand which made by local people and they were called it as candy and it became pronounced as kandi by local ones. Now a days, the consumers are becoming more health conscious and there is a wide variation in chemical, textural and sensory profile between the market samples, which may be due to variation in method of preparation and varying levels of sugar and moisture.

Materials and Methods

The present investigation entitled, "Quality evaluation of Kandi pedha sold in Satara city", was undertaken in the laboratory of Department of Animal Husbandry and Dairy Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra).

Materials

All the glassware's *viz*., petriplates, bacteriological pipette, test tubes, glass beakers, conical flasks etc. used were Borosil made laboratory glassware's, they were cleaned and sterilized properly before their use. An Electronic named precision balance of citizen make capacity 300g was used for weighing samples and chemicals throughout analysis of kandhi pedha samples. Autoclave was used for sterilization of bacteriological media, glasswares, etc. BOD incubator was used for incubation. Lab Hosp made Laboratory hot air oven was used to determine the moisture content in the Kandi pedha samples. A colony counter with magnifying lens and hand operated tally counter was used for counting colonies, developed by microorganisms. Laminar air flow an instrument manufactured by Envair clean air equipment, Pune was used for microbiological work.

Microbiological media- For the analysis of standard plate count, coliform count and yeast and mould count media viz., Nutrient Agar (NA), Violet Red Bile Agar (VRBA) and Potato Dextruse Agar (PDA) were prepared in the laboratory and used for microbiological examination Kandi pedha samples.

Methods

Fresh five samples *of* kandi pedha were collected from various sweet mart shops of Satara city, in the polythene bags sterilized with sodium hypochloride solution. These samples were brought to laboratory in normal temperature and analysed for their sensory, chemical and microbial quality.

Sensory evaluation of Kandi pedha

The sensory evaluation of kandi pedha was carried out by adopting 9 point hedonic scale developed by Gupta (1976) [14] with the help of 5 semi-trained judges from the department of Animal husbandry and Dairy science, food science. The samples were analyzed for their sensory attributes *viz*; colour and appearance, flavor, body and texture, and overall acceptability.

Chemical analysis

Moisture content of Kandi pedha was determined by standard procedure as described by (Anonymous, 1959) [1]. Fat content of Kandi pedha samples was determined by Gerbers method described in ISI: 1224 (part II) 1977 [20]. The semi-microkjeldahl method given by Menefee and Overman (1940) [30] was used for determination of total protein with slight modification. The reducing sugars were estimated by Lane and Eynon method (1923) with slight modification suggested by Ranganna (1986) [42]. Non-Reducing sugar were determined by subtracting reducing sugars from total sugars. Total ash content of Kandi pedha sample was determined by method given by IS; 18 Part (XI) (1981) [21].

Statistical Analysis

The data obtained in the present investigation was tabulated and analyzed statistically by using completely randomized design (CRD) as per the Panse and Sukhatme (1985) [35].

Results and Discussion

Sensory evaluation of Market samples of Kandhi Pedha

Colour and appearance

The analysis of colour and appearance revealed that samples S_5 were superior over other treatments with highest score of 8.03±0.23 (Table 1). While the other samples had non-significant difference in colour and appearance of Kandhi Pedha samples, out of the five samples S_1 recorded lowest score of 7.20±0.61. It may be due to blackish color observed to double fried khoa. These similar findings reported by Rajaraman *et al.* (2018) [40]. They observed that treatment P_1 found highly significant over other treatments, whereas no significant difference was observed between P_2, P_3, P_4, P_5, and P_6. The colour and appearance tend to vary based on the source of milk, the amount of sugar added and also time milk heating.

Body and texture

The body and texture is the main parameter as far as the consumer appeal is concerned. It revealed that the mean body and texture score of Kandhi Pedha for the samples S_1, S_2, S_3, S_4 and S_5 was 8.20±0.15, 8.07±0.06, 8.20±0.15, 7.90±0.20 and 7.97±0.03, respectively. Highest score 8.20±0.15 observed for samples S_1 and S_3 while the lowest score for S_4 (7.90±0.20). It was observed that less moisture in Pedha resulted in harder body and rough texture, However, Pedha with medium sugar, optimum moisture and high fat were excellent in body and texture.

The results recorded in present investigation for body and textural score were comparable with Mahadeven (1991) [27].

Flavour

The flavour of any food product is the most important attributes as far as consumers liking is concerned and Kandhi Pedha is not an exception to it. Table 1 shows the mean sensory scores. It was observed from the Table 1 that the sample S_2 has highest sensory score and at par with sample S_3 among the other samples because it contain optimum Elaichi flavour and sample S_5 has lowest sensory score because it contain low sugar.

Table 1: Sensory evaluation of market samples of *Kandhi* Pedha

Treatment	Sensory attributes			
	Colour and appearance	Body and texture	Flavour	Overall acceptability
S_1	$7.20^{d\pm}0.61$	$8.20^{a}\pm0.15$	$7.80^{b}\pm0.43$	$7.68^{d}\pm0.38$
S_2	$7.80^{bc\pm}0.41$	$8.07^{b}\pm0.06$	$8.03^{a}\pm0.03$	$7.99^{b}\pm0.18$
S_3	$7.87^{b\pm}0.18$	$8.20^{a}\pm0.15$	$8.00^{a}\pm0.00$	$8.20^{a}\pm0.24$
S_4	$7.80^{bc\pm}0.20$	$7.90^{d}\pm0.20$	$7.87^{b}\pm0.18$	$7.85^{bc}\pm0.13$
S_5	$8.03^{a\pm}0.23$	$7.97^{c}\pm0.03$	$7.70^{c}\pm0.17$	$7.86^{bc}\pm0.14$
SE(m)	0.37	0.14	0.23	0.24
CD (p<0.05)	1.16	0.43	0.71	0.75

*Means±SE with different superscript indicates the value were statistically significant (p<0.05) within the column.

Overall acceptability

With respect to the overall acceptability of the different samples of Kandhi Pedha, S_1 was awarded lowest score of 7.68±0.38, while S_3 was awarded highest score of 8.20±0.24. The sample S_3 was found superior over the other treatments.

Rajaraman *et al.* (2018) [40] were found that the treatment P_1 was highly significant over other treatments whereas no significant difference was observed between P_2, P_3, P_4, P_5 and P_6.

Physico-chemical constituents of market samples of Kandhi Pedha samples

The physico-chemical aspects like moisture, fat, protein, reducing sugar, non-reducing sugar, total sugar, total ash, pH and acidity of Kandhi Pedha samples were determined.

Moisture

The moisture content of the sample S_1 (14.30±0.18%) was slightly higher than that of the other samples. It was observed from the Table 2 that the moisture content of all the Kandhi Pedha samples were differed significantly while sample S_2 and S_4 were at par with each other. The range of moisture observed in sample was in between 12.61±0.09 to 14.30±0.18. The variation in the moisture content might be mainly due to the difference in method of manufacture, extent of desiccation, amount of sugar added, difference in chemical composition of base material used.

These findings are similar with Patel *et al.* (2006) [38] who investigated five Pedha samples from the different cities of Gujrat state for chemical attributes and reported significant differences in moisture content. Keerthi *et al.* (2018) [24], revealed that the moisture content of laboratory Pedha sample was slightly higher than that of the market sample. The moisture content of all the Pedha samples was differed significantly.

Fat

After the investigation, it was observed that there was significant difference in Kandhi Pedha samples between the five treatments. The fat content of S_1, S_2, S_3, S_4, S_5 samples are 17.44±0.11, 16.96±0.02, 18.21±0.02, 16.42±0.03, 16.68±0.18, respectively. The fat content of S_3 was significantly more than other shops samples. The difference in the fat content of Kandhi Pedha samples might be attributed to the variation in the type of milk used and their fat content, amount of sugar added and duration of desiccation.

The present study was similar with Tilekar (2007) [51] who reported the significant difference in fat content in Pedha samples collected from Renowed hotellers and Ordinary hotellers. Kavitha *et al.* (2015) [23], concluded that there were significant difference was found between the laboratory and market made Pedha samples.

Table 2: Physico-chemical constituents of market samples of Kandhi Pedha

Treatment	Physico-chemical constituents			
	Moisture (%)	Fat (%)	Protein (%)	Reducing sugar (%)
S_1	$14.30^{a}\pm0.18$	$17.44^{b}\pm0.11$	$12.81^{b}\pm0.09$	$14.50^{c}\pm0.05$
S_2	$12.61^{d}\pm0.09$	$16.96^{c}\pm0.02$	$14.32^{a}\pm0.04$	$17.40^{a}\pm0.31$
S_3	$13.60^{b}\pm0.11$	$18.21^{a}\pm0.02$	$14.10^{a}\pm0.21$	$15.79^{b}\pm0.09$
S_4	$12.88^{cd}\pm0.13$	$16.42^{d}\pm0.03$	$13.98^{a}\pm0.22$	$15.37^{b}\pm0.26$
S_5	$13.33^{bc}\pm0.25$	$16.68^{cd}\pm0.18$	$14.01^{a}\pm0.09$	$16.73^{a}\pm0.20$
SE (m)	0.16	0.09	0.19	0.21
CD (p<0.05)	0.52	0.31	0.60	0.66

Treatment	Physico-chemical constituents				
	Non-reducing sugar (%)	Total sugar (%)	Ash (%)	Acidity (%)	pH
S_1	$38.35^{a}\pm0.29$	$52.85^{a}\pm0.31$	$3.11^{a}\pm0.09$	$0.43^{d}\pm0.01$	$6.8^{a}\pm0.05$
S_2	$34.49^{c}\pm0.14$	$51.89^{b}\pm0.29$	$3.11^{a}\pm0.01$	$0.49^{c}\pm0.00$	$6.8^{a}\pm0.05$
S_3	$35.23^{b}\pm0.07$	$51.02^{c}\pm0.15$	$2.91^{c}\pm0.01$	$0.53^{b}\pm0.00$	$6.76^{b}\pm0.06$
S_4	$37.84^{a}\pm0.09$	$53.21^{a}\pm0.17$	$3.07^{ab}\pm0.03$	$0.57^{a}\pm0.01$	$6.73^{c}\pm0.03$
S_5	$34.19^{c}\pm0.30$	$50.92^{c}\pm0.10$	$3.12^{a}\pm0.03$	$0.57^{a}\pm0.01$	$6.76^{b}\pm0.03$
SE (m)	0.20	0.22	0.04	0.01	0.05
CD (P<0.05)	0.65	0.70	0.15	0.03	0.16

*Means±SE with different superscript indicates the value were statistically significant (p<0.05) within the column.

Protein

The statistical analysis of the findings revealed that the sample S_1 is significantly superior over rest samples of kandi pedha. Whereas, no significant difference was observed between S_2, S_3, S_4 and S_5 samples. The highest protein content was observed for the sample S_2 (14.32±0.04%).

These findings were in close agreement with Keerthi *et al.* (2018), they reported the highest protein content in laboratory made Pedha samples as 16.80. They found highly significant difference over other market samples. Rajaraman *et al.* (2018) [40] revealed highly significant difference between the different commercial samples of Pedha. Sharma *et al.* (2019) [47] was found that significant difference in protein content of Pedha samples manufactured by using various compositions of ingredients.

Reducing sugar

The data depicted in Table 2 reveals that sample S_2 content higher reducing sugar (17.40±0.31) which was significantly superior over other samples. While the sample S_5 reported close observation with S_2 (16.73±0.20). The range of reducing sugar observed in between 14.50±0.05 to 17.40±0.31 per cent.

Non-reducing sugar

Table 2 showed that S_5 recorded lower non reducing sugar content (34.19±0.30) which showed close agreement with S_2 (34.49) and found significantly superior over other samples. The range of non-reducing sugar samples was in between the 34.19±0.30 to 38.35±0.29.

Total sugar

The total sugar content of Kandhi Pedha samples from five samples shows significant difference. Table 2 revealed that the average total sugar content in Kandhi Pedha samples were from 50.92±0.10 (S_5) to 53.21±0.17(S_4).

These results were closely similar with Keerthi *et al.* (2018) [24] reported that the total sugar content of market pedha samples ranged from 47.78 to 51.35 per cent. Singh *et al.* (2021) [50] they found the significant difference in both reducing and non-reducing sugar content between laboratory and marked made Pedha samples.

Ash

The ash content of Kandhi Pedha sample was higher for S_5 (3.12±0.03) as compared with other samples i.e. S_1 (3.11±0.09), S_2 (3.11±0.01), S_3 (2.91±0.01) and S_4 (3.07±0.03).

These findings were similar with Rajorhia and Srinivasan (1979) [41], who studied that the ash contents in khoa samples also showed fairly wide variations. The type of milk used, extent of desiccation and addition of adulterants would cause such disparity. Keerthi *et al.* (2018) [24] was reported that the ash content of market Pedha samples was higher for the T_2 and T_4 (3.117) when compared with other samples T_1 (2.909) and T_3 (2.757). Sharma *et al.* (2019) [47] reported that significant difference in ash content of Pedha samples manufactured by using various compositions of ingredients.

Acidity

The acidity (%LA) of Kandhi pedha were ranged from 0.43±0.01 to 0.57±0.01 per cent. S_1 samples showed have acidity i.e. 0.43±0.01% while sample S_4 showed higher acidity i.e. 0.57±0.01 per cent. Sample S_4 and S_5 were found significantly high value over other samples.

Keerthi *et al.* (2018) [24] found significant difference in the acidity between laboratory made Pedha and marked Pedha. Singh *et al.* (2021) [50] reported the acidity of market Pedha sample 0.43 per cent which was lower over the laboratory Pedha sample 0.45 per cent.

pH

In case of pH all the samples showed significant difference between them. Table 2 revealed that the relation between acidity and pH were inversely proportional to each other. This was the result of use of milk with different acidity or amount of sugar added and degree of heat treatment used during its preparation.

The data found to be close agreement with Kavitha *et al.* (2015) [23] they found significant difference in the acidity of Pedha samples. Malarkannan and Somaimuthu (2017) [28] were found non-significant difference in pH between all the Pedha samples of various composition.

Microbial analysis of Kandhi Pedha samples

Five samples of Kandhi Pedha were collected from the different five Kandhi Pedha shops in Satara city, for there microbiological analysis for standard plate count, yeast and mould count and coliform count. The reported results are placed in the below table.

Standard Plate Count (SPC)

The data presented in Table 3 showed that SPC were ranged from 3978±0.9 cfu/g to 5219±1.0 cfu/g. The Kandhi Pedha from sample S_2 were reported highest SPC (5219±1.0 cfu/g), which was significantly differed from the sample S_1 and S_3.

The higher SPC indicates the inferior microbiological quality of Kandhi Pedha. This may due to the using of poorly handled milk and Kandhi Pedha during their production and post-production stages.

Ravindrakumar *et al.* (1997) [44] and Ray *et al.* (1998) [45] reported higher than the values observed in the present investigation. Tilekar (2007) [51] was reported the similar standard plate count in the analysed samples of Pedha from renowed hotellers of ahmednagar city. Singh *et al.* (2021) [50] were reported the SPC of market Pedha sample 5.63 log cfu/g which was higher over the laboratory Pedha sample 3.63 log cfu/g.

Table 3: Microbial analysis of market samples of *Kandhi* Pedha

Treatment	Microbial Properties		
	Standard Plate Count (cfu/g)	Yeast and mould count (cfu/g)	Coliform count (cfu/g)
S_1	4424^{b}±1.4	33.2^{c}±1.5	34.6^{b}±1.5
S_2	5219^{a}±1.0	47.6^{b}±1.5	50.7^{a}±1.5
S_3	3978^{c}±0.9	27.9^{d}±0.4	25.2^{c}±0.4
S_4	5082^{a}±0.8	52.8^{a}±1.9	49.5^{a}±1.9
S_5	5174^{a}±0.5	47.8^{b}±0.9	46.2^{a}±0.9
SE (m)	1.00	0.13	0.22
CD (P<0.05)	3.16	0.43	0.71

*Means±SE with different superscript indicates the value were statistically significant (p<0.05) within the column.

Yeast and Mould Count (YMC)

Yeast and Mould are the important group of microorganisms. In India spoilage of dairy products occurred mostly due to the growth of yeast and moulds. The prevailing tropical climate and high humidity mainly causes the growth of yeast and moulds observed in the dairy products. Table 3 showed that yeasts and mould counts of Kandhi Pedha ranges from 27.9±0.4 cfu/g to 52.8±1.9 cfu/g. The sample S_4 reported higher yeast and mould count i.e.52.8±1.9 cfu/g which is significantly higher than other samples. While sample S_3 indicating lower YMC. This might be due to the hygienic handling and processing of the product.

Dwarkanath and Srikanta (1977) [8] and Patel (1996) [37] reported higher values than the values observed in the present investigation. Tilekar (2007) [51] was reported the similar yeast and moulds count in the analysed samples of Pedha from renowed hotellers of ahmednagar city. Singh *et al.* (2021) [50] reported the YMC of market Pedha sample 3.66 log cfu/g which was higher over the laboratory Pedha sample 2.36 log cfu/g.

Coliform Count

The difference in coliform count of kandi pedha samples could be due to uncleaned hands of workers, poor quality of milk, unhygienic conditions of manufacturing unit, inferior quality of material used and post processing contamination.

Table 4.16 showed that coliform counts of Kandhi Pedha ranges from 25.2±0.4 cfu/g to 50.7±1.5 cfu/g. The sample S_2 reported higher coliform count i.e. 50.7±1.5 cfu/g which is significantly higher than other samples. While sample S_3 indicating lower coliform count. This might be due to the hygienic handling and processing of the product.

The results were correlated with Grewal and Tiwari (1990) [13] whom found higher coliform contamination in market samples when compared with laboratory samples. Singh *et al.* (2021) [50] reported the coliform count of market Pedha sample 4.09 log cfu/g which was higher over the laboratory Pedha sample 1.50 log cfu/g.

Conclusions

1. Sample S_3 found significantly superior over all other samples in flavor, body and texture and overall acceptability. Sample S_5 found superior over all other samples in colour and appearance.
2. Sample S_1 showed higher percentage of moisture i. e. 14.30±0.18 per cent, fat percent found higher in 18.21±0.02 per cent in analysed sample S_3, sample S_2 found superior over all the other samples in case of protein content. In case of sugar contents, sample S_2 found significantly superior with 17.40±0.31 per cent reducing sugar and sample S_1 reported significant difference with higher non reducing sugar content i.e. 38.35±0.29 per cent. Sample S_4 showed higher total sugar content.
3. Sample S_3 reported lower Standard plate count (SPC), Yeast and mould count (YMC) and coliform count i.e. 3978±0.9 cfu/g, 27.9±0.4 cfu/g and 25.2±0.4 cfu/g respectively. Therefore, sample S_3 showed less occurrence of microbial load in storage condition. Hence, due to less occurrence of microbial load S_3 has best quality for storage and consumption.

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