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## Physico-chemical, sensory and textural characteristics white (Doodh) Peda sold in saurashtra region of Gujarat state

Subhash Prasad, Kunal K Ahuja and Tanmay Hazra

### Abstract

The present study was conducted to evaluate the physico-chemical, sensory and textural characteristics of white (doodh) peda sourced from eight different cities in saurashtra region of Gujarat State. Average percentage of moisture, fat and protein of white (doodh) peda were; 17.56±1.62, 18.58±2.23, 12.72±1.37 respectively. Average sensory score (max. 9) of Color & Appearance, Body & Texture, Sweetness, Flavour and Overall acceptability of white(doodh) peda were 8.10±0.19, 7.99±0.30, 7.94±0.37, 8.03±0.25, 8.07±0.19 respectively. Average values of Lightness (L\*), redness (a\*), and yellowness (b\*) of white(doodh) peda were 73.17±4.29, -2.41±0.50, 20.92±1.30 respectively. Average values of C\*, WI, BI and YI white (doodh) were 21.06, 65.89, 30.24, 40.84 respectively. Average value of Hardness (g), Adhesiveness (g.sec), Springiness, Cohesiveness, Gumminess (g), Chewiness (g) and Resilience of white (doodh) peda were 3023±545, -8.53±4.45, 0.17±0.02, 0.16±0.02, 480.68±91.30, 81.25±23.75, 0.039±0.001 respectively.

**Keywords:** Peda (Khoa), Physico-chemical quality, color index, hardness, lightness

### 1. Introduction

India is emerging as a largest dairy market of 21st century in world. The dairy industry in India is crucial to the socioeconomic development of the nation and is a significant part of the rural economy. According to data from Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), milk production was 209.96 million tons (MT) during 2020-21. India accounted for 21 percent of the global output. About 55% of milk produced is used for product manufacture and 45% is consumed as liquid milk. Out of 55% milk used for products manufacture, about 40% is used for manufacture of Indian traditional dairy products. By this, we can understand that huge market potential exists for traditional dairy products (TDPs). In India, Gujarat is one of the developed states and historically a frontrunner in milk production activities. With an annual milk production of 15.29 MT during 2020–21, it ranked fourth in the country accounting for about 8% share.

Milk confections are very popular in the Indian subcontinent. These items are made from khoa/mawa, which is the base material for the sweets like gulabjamun, kalajamun, burfi, kalakand, Milk Cake, Peda, Rabri, Khurchan, Basundi, Pantua, Kunda and Lalmohan. Bal Mithai, Phirni, Peda, Malaipoori, Lal Peda, Dharwad Peda, and Thirattupal are region-specific locally available sweets in various parts of India that people prefer for their distinct taste and texture (Aggarwal *et al.*, 2018) [1].

Khoa is highly nutritious food having 90 per cent digestibility coefficient of proteins and 69 per cent biological value (Balasubramanian *et al.*, 1955) [5]. Peda is indigenous khoa-based heat desiccated milk sweet made by heating a khoa and sugar mixer with natural and/or artificial colour and flavour until the desired texture and flavour develops (Kavita *et al.*, 2015) [15]. Buffalo milk is preferred over cow and goat milks for peda preparation because it produces a soft and uniform body with a smooth, compact, and homogeneous texture (Kamle *et al.*, 2015). Because peda contains less moisture, it has a longer shelf life. Peda has a coarse grainy texture and is whitish yellow in colour. Chemical composition, body and texture, appearance, and microbial quality all contribute to its quality (Gavhane *et al.*, 2014) [11]. The amount of peda produced in India far outnumbers that of any other indigenous milk-based sweet (Aneja *et al.* 2002) [3].

In Saurashtra region of Gujarat, three varieties of peda was popular i.e. Doodh (doodh) peda, Thabdi (brown) peda and Kesar (Yellow) Peda. White (Doodh) peda is the common variety

and is popular all over India and characterized as a circular slightly flattened ball with low moisture content and white to creamy white in colour and smooth texture. Thabdi (brown) Pedas are heat desiccated indigenous milk sweets that are manufactured and sold in large quantities in the Saurashtra region of Gujarat State (Patel *et al.* 2012) [20]. Kesar (Yellow) Pedas are milk-based, flattened-round confections with saffron flavor and color.

Thirty two (32) doodh (white) pedas samples were collected from Saurashtra region of Gujarat over a period of one year. Utmost care was taken to transport the samples to the college laboratory in a hygienic manner at optimum temperature by using appropriate insulated containers. The samples were appropriately labelled to maintain the privacy of the source. The samples were maintained at room temperature before analysis of different attributes

## 2. Materials and Methods

### 2.1 Collection area of white (doodh) pedas samples

The market white (doodh) pedas samples were collected from four popular sweet shops of eight cities i.e. Amreli (CT-1), Bhavnagar (CT-2), Rajkot (CT-3), Junagadh (CT-4), Porbandar (CT-5), Dwarka (CT-6), Jamnagar (CT-7) and Botad (CT-8) of Saurashtra region of Gujarat state. The collected pedas samples are immediately packed in cardboard boxes. The cardboard boxes were packed and sealed in polyethylene bags to prevent gain or loss of moisture during transport. The samples were stored at room temperature before analysis of different quality parameters. In collected samples also records supplementary data like sampling date, type of package used, packaging material of samples, date of manufacture of samples and best before date of samples.

### 2.2 Chemical analysis

Moisture content of pedas was estimated by drying method as per BIS: SP18, Part XI (1981). The total fat content was determined by Gerber method (at sulphuric acid solution concentration 87%) describe in IS 1224 (part II) 1977. Protein content was estimated by the semi-micro kjeldahl's method as modified by Arora *et al.* (1991) [1].

### 2.3 Sensory quality analysis

The sensory quality of pedas was done by a group of 7 judges (i.e. faculty member) of College of Dairy Science Amreli on a 9-point hedonic scale (1= disliked extremely, 2=disliked very much, 3=disliked moderately, 4=disliked slightly, 5=neither liked nor disliked, 6=liked slightly, 7=liked moderately, 8=liked very much, 9=liked extremely), developed by Amerine *et al.* (1965). The judges were also requested to give criticism for each attribute of the samples. The samples for evaluation were coded appropriately during sensory evaluation.

### 2.4 Estimation of Colour value and Colour index of white (Doodh) Pedas

Color of pedas is evaluated using colorimeter model name color Flex EZ in CIE  $L^*a^*b^*$  scale with illuminants D65 (6500K, spectral distribution of mid-day sun) and  $10^\circ$  angle of observation. Parameter  $L^*$  takes (0-50 score) dark and (50-100 score) light. The parameter  $a^*$  takes positive values for reddish colors and negative values for the greenish ones, whereas  $b^*$  takes positive values for yellowish colors and negative values for the bluish ones (Leon *et al.*, 2006). CIE

system was more sensitive to the variation of  $b^*$ .

**2.4.1. Chroma ( $C^*$ ) is:** The quantitative attribute of colorfulness, used to determine the degree of difference of a hue in comparison to a grey color with the same lightness. The higher the Chroma values, the higher is the color intensity of samples perceived by humans (Bermúdez-Aguirre *et al.*, 2009) [6].

$$C^* = (a^{*2} + b^{*2})^{0.5} \text{-----(1)}$$

**2.4.2. Whiteness index (WI):** Indicates the degree of whiteness and mathematically combines lightness and yellow-blue into a single term. It is widely measured using the following equation according to Vargás *et al.* (2018) [23].

$$WI = 100 - [(100 - L^*)^2 + a^{*2} + b^{*2}]^{0.5} \text{-----(2)}$$

**2.4.3. Browning index (BI)** is defined as brown color purity and is one of the most common indicators of browning in food products containing sugar. The BI is calculated using the following expression (Erbay & Koca, 2015) [8]

$$BI = 100 \left( \frac{a^* + 1.75L^*}{\frac{5.645L^* + a^* - 3.012b^*}{0.17}} \right) \text{-----(3)}$$

**2.4.4. Yellowing index (YI):** Is used as a color measurement related to browning index.

$$YI = 142.86 b^*/L^* \text{-----(4)}$$

Color difference can be measured as total color difference ( $\Delta E^*$ ). Total color difference indicates the magnitude of color difference between any two samples using the following equation (Fernandez-Avila *et al.* 2017) [9]

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2} \text{-----(5)}$$

Two colors can be distinguished by the human eye depending on their total color difference: ( $\Delta E^* < 1$ ) color differences that could not be perceptible to the human eye, ( $1 < \Delta E^* < 3$ ) minor color differences that could be perceptible to the human eye, and ( $\Delta E^* > 3$ ) color differences that could be perceptible to the human eye (Quintanilla *et al.* 2019) [21].

### 2.5 To evaluate the textural properties of Pedas

Samples were cut into 25.4 mm x 25.4 mm sizes and Texture Profile Analysis (TPA) of Pedas was conducted using Texture Analyser (model TA XT Plus, Stable Micro Systems Ltd., UK), fitted with 50 kg load cell. 75 mm compression plate was used for texture profile analysis of samples. The product was subjected to compressive force by probe up to the distance of 10 mm twice. A two-bite test force distance compression curve was obtained and from the resulting. Force-time curves, numerical values of pedas sample height, hardness, adhesiveness, springiness, cohesiveness, gumminess and chewiness of the different pedas samples obtained using the Exponent software (version 6.0.16.0) at temperature approximately  $25^\circ\text{C}$ . Five cubic samples of pedas were used for each experimental under study and the average value of these readings was reported. The textural characteristics of the pedas samples were directly displayed on the monitor of the computer as graph (Load vs. time i.e. g vs. s) as well as

derived values in tabular form.

## 2.6 Statistical analysis

Data obtained for Peda samples were statistically analyzed employing one way ANOVA using SPSS software, to know the variations in samples between white (doodh) peda of different cities.

## 3. Results and Discussions

The Results obtained from the present study on chemical

composition (*viz* Fat, moisture, and protein), sensory characteristics, colour and textural properties of doodh (white) peda of market samples founded in depicted in Tables 1.

### 3.1 Chemical composition

The average compositional composition (i.e. moisture, fat, protein) of eight cities market doodh (white) peda were chemically analyzed of different samples as shown in Table 1-5.

**Table 1:** Average chemical composition of white (doodh) peda of eight different cities

City	%Moisture	% Fat	% Protein
CT-1	18.68 ±1.08	20.33± 0.56	13.20±0.85
CT-2	15.72±0.45	17.33±1.04	13.55±0.53
CT-3	17.33±0.78	18.00±2.83	11.54±1.03
CT-4	16.33±0.55	22.00±2.94	12.55±1.83
CT-5	17.88±2.06	17.33±0.47	12.08±1.70
CT-6	17.58±2.06	17.65±2.02	12.50±1.00
CT-7	18.54±1.80	18.55±1.27	13.48±1.72
CT-8	18.45±1.54	17.50±0.58	12.90±1.60
Overall mean (%) of market doodh peda	17.56 ±1.62	18.58±2.23	12.72±1.37

Mean ± SE, n=4

Average moisture (%) ranges of market doodh (white) peda were found 15.72±0.45 to 18.68 ±1.08. Overall mean of moisture (%) of market doodh (white) peda was estimated 17.56±1.62. The variation in the moisture content might be mainly due to the difference in method of manufacture, amount of sugar added. Average fat (%) ranges of market doodh (white) peda were found 17.33±1.04 to 22.00±2.94. Overall mean of fat (%) of market doodh(white) peda was estimated 18.58±2.23. The difference in the fat content of peda samples might be attributed to the variation in the type of milk used (buffalo/cow), skim milk powder, maida, butter and fat content. Average protein (%) ranges of market doodh (white) peda were found 11.54±1.03 to 13.55±0.53. Patel

(1996) [19] collected market sample of *pedha* from 5 different cities *viz.*, Ahmedabad, Anand, Boroda, Rajkot and Surat and proximate composition of *pedha* in respect of moisture, fat, protein content varied from 8.68 to 16.52, 14.92 to 23.92 and 13.17 to 15.80 per cent, respectively could be comparable to this results.

### 3.2 Sensory qualities/scores of white (Doodh) Peda

The average Sensory qualities score (i.e. Color and Appearance, Body and Texture, Sweetness, Flavour and Overall acceptability) of eight city market doodh (white) peda were evaluated of different samples as shown in Table 2.

**Table 2:** Average sensory score of different market white (doodh) peda samples

City	Color and Appearance	Body and Texture	Sweetness	Flavour	Overall acceptability
CT-1	8.13±0.21	8.14±0.25	8.14±0.32	8.21±0.13	8.16±0.14
CT-2	8.00±0.28	7.71±0.18	7.64±0.34	7.79±0.21	7.86±0.19
CT-3	8.14±0.09	7.85±0.43	7.64±0.24	7.88±0.22	8.02±0.09
CT-4	8.06±0.25	8.14±0.32	8.07±0.31	8.14±0.23	8.20±0.18
CT-5	8.13±0.10	8.14±0.06	8.14±0.13	8.21±0.30	8.15±0.21
CT-6	8.03±0.24	7.71±0.35	7.64±0.15	7.79±0.06	7.86±0.14
CT-7	8.13±0.15	8.14±0.16	8.42±0.30	8.04±0.23	8.16±0.09
CT-8	8.24±0.20	8.12±0.19	7.85±0.31	8.17± 0.12	8.13±0.21
Overall Avg. value	8.10± 0.19	7.99±0.30	7.94±0.37	8.03±0.25	8.07±0.19

Mean ± SE, n=4

Average colour and appearance score ranging of market doodh (white) peda were found 8.00±0.28 to 8.24±0.20. Overall mean of colour and appearance score of market doodh (white) peda was estimated 8.10±0.19. Difference in the color & appearance score might be due to wide variation in raw material and additive, amount of sugar based maillard. Sharma *et al.*, (2001) [3] recorded that increase in fat percentage in khoa resulted in improvement in its colour.

Average body and texture score ranging of market doodh (white) peda were found 7.71±0.35 to 8.14±0.32. Overall mean of body and texture score of market doodh(white) peda was estimated 7.99±0.30. It might be due to wide variation in chemical composition particularly fat and sugar levels. These

findings agreed with the result of Londhe and Pal (2008) [17], who reported that significant effect on the body and texture score of brown peda with increase in the level of fat in milk and sugar, but to a certain extent and Kavita *et al.*, (2015) [15], who also concluded that there is highly significant difference among all the samples.

Average sweetness score ranging of market doodh (white) peda were found 7.64±0.34 to 8.42±0.30. Overall mean of sweetness score of market doodh (white) peda was estimated 7.94±0.37. The mean sweetness value was highly significantly among the samples. The highest sweetness in this peda samples might be and time of desiccation, composition of base material. The reports also suggested by

Desale *et al.*, (2007) [11] studied the effect of compositional variables on the quality of peda.

Average flavour score ranging of market doodh (white) peda were found 7.79±0.21 to 8.21±0.30. Overall mean of flavour score of market doodh (white) peda was estimated 8.03±0.25.

Average overall acceptability score ranging of market doodh (white) peda were found 7.86±0.19 to 8.20±0.18. Overall mean of overall acceptability score of market doodh (white) peda was estimated 8.07±0.19. Difference in the overall acceptability might be due to wide variation in color & appearance, body & texture, flavor, Sweetness and also variation in chemical composition of market peda samples.

**Table 3:** Average Colour Value (in L\*,a\* & b\* scale) of market peda samples

City	L*	a*	b*
CT-1	73.13±5.90	-2.12±0.12	19.49± 0.57
CT-2	64.60±1.72	-3.33±0.87	21.02±1.02
CT-3	78.13±1.05	-2.43±0.22	22.15±1.06
CT-4	74.13±1.71	-2.19±0.30	20.36±0.71
CT-5	74.12±0.79	-2.32±0.29	20.26±1.07
CT-6	72.89±1.44	-2.38±0.29	20.88±0.75
CT-7	73.25±1.88	-2.16±0.10	20.54±0.97
CT-8	75.13±2.00	-2.33±0.19	22.65±1.37
Overall mean of market peda	73.17±4.29	-2.41±0.50	20.92±1.30

Mean± SE, n=4

L\* value represents degree of whiteness, (0-50 score) dark and (50-100 score) light. Positive a\* values represent redness. A negative a\* values represents degree of greenness. Positive b\* values represents degree of yellowness. The range of L\*, a\* and b\* of doodh peda were found of 64.60±1.72 to 78.13±1.05, -3.33±0.87 to -2.12±0.12 and 17.76 to 18.82. Overall mean value of L\*, a\* and b\* of doodh (white) peda were found of 73.17±4.29, -2.41±0.50 and 20.92±1.30 respectively.

### 3.4 Color index

The Colour Indexes (Chroma value, Whiteness index, Browning index and yellowing index) of white (doodh) peda were calculated by above formulae as shown in Table 7.

### 3.3 Colour values and colour index of white (doodh) peda

Colour has been constantly one of the major consumer's criteria for judging the quality of dairy product. The colour scanning machine was used to objectively quantify the difference in colour attributes of peda samples. The results obtained of market doodh peda samples from the colorimeter gives three values in term of L\*, a\* and b\* depicted in Tables 3. The Average Colour Value (In L\*,a\* & b\* scale) of eight cities doodh (white) peda were objectively evaluated by colorimeter among the different samples as shown in Table 3.

**Table 4:** Average Colour value Chroma(C\*), WI, BI and YI of market peda of eight cities

Peda variety	C*	WI	BI	YI
Doodh	21.06	65.89	30.24	40.84

Average value of C\* (chroma), WI (Whiteness index), BI (Browning index) and YI (Yellowing index) of doodh peda were 21.06, 65.89, 30.34 and 40.84 respectively.

### 3.5 Textural attributes of white (doodh) peda

The Textural attributes (i.e. Hardness, Adhesiveness, Springiness, Cohesiveness, Gumminess and Chewiness) of four different shops of all eight cities white (doodh) were evaluated of different samples as shown in Table 5.

**Table 5:** Average rheological attributes of peda samples from different city of Saurashtra region of Gujarat State.

City	Hardness (g)	Adhesiveness (g.sec)	Springiness	Cohesiveness	Gumminess (g)	Chewiness (g)
CT-1	2661±65	-6.98±0.97	.161±.002	.139±.005	415±24	66.7±1.5
CT-2	2716± 208	-6.97±0.36	.161±.004	.154±.007	415±15	67.2±2.0
CT-3	3764± 130	-18.09±7.38	.185±.007	.176±.006	526±13	117.0±25.1
CT-4	3831± 102	-8.09±1.59	.186±.010	.176±.010	626±89	117.3±12.5
CT-5	2461± 109	-6.78±0.46	.158±.011	.140±.004	420±9	64.8±3.3
CT-6	2618± 164	-6.92±0.43	.159±.016	.148±.005	418±2	66.2±2.3
CT-7	2685± 92	-6.82±0.79	.165±.031	.142±.009	422±14	65.3±1.3
CT-8	3450± 98	-7.58±1.98	.176±.010	.165±.016	602±15	85.4±2.8
Overall mean	3023±545	-8.53±4.45	0.17±0.02	0.16±0.02	481±91	81.3±23.8

Mean± SE, n=4

Hardness is the most frequently evaluated characteristic in determining the texture of peda. Hardness of peda depends upon various factors including moisture content and mineral content. This variation might be due to the variation in chemical composition of the peda, amount of sugar added and extent of desiccating. The results obtained of market doodh peda were ranging from 2461±109 (g) to 3831± 102 (g). Adhesiveness is related to the sensory stickiness and indicated by a negative peak following the first peak. The results obtained of Adhesiveness values of market doodh peda were

ranging from -6.78±0.46 (g.sec) to -18.09±7.38 (g.sec). Rasane *et al.* (2012) reported that average values of adhesiveness of market yellow *pedha* 0.30 to 60.00. Springiness is height that the food recovers during the time that elapses between the end of the first bite and the start of the second bite. The results obtained of Springiness value of market doodh peda were ranging from 0.158±0.011 to 0.186±.010. Cohesiveness is the ratio of area under the second bite curve before reversal compression to that under the first bite curve. The results obtained of cohesiveness value of

market doodh peda were ranging from  $0.139\pm 0.005$  to  $0.176\pm 0.010$ . Rasane *et al.* (2012) reported that average values of Cohesiveness of market yellow *pedha* 0.21 to 0.44. Gumminess is related to energy required for disintegrate semi-solid food product to a state ready for swallowing. The results obtained of Gumminess of market doodh peda were ranging from  $418\pm 2$  (g) to  $626\pm 89$  (g). Chewiness is related to energy required for masticating a solid food product to make it ready for swallowing. The results obtained of Chewiness of market doodh peda were ranging from  $64.8\pm 3.3$  (g) to  $117.3\pm 12.5$  (g).

#### 4. Conclusions

Total 32 different samples of white (doodh) Peda were collected from eight different cities of saurashtra region of Gujarat and chemical, sensory, colour and textural characteristics analysis. Following data was found.

Average percentage of moisture, fat and protein of doodh peda were;  $17.56\pm 1.62$ ,  $18.58\pm 2.23$ ,  $12.72\pm 1.37$  respectively. In sensory attribute score: Average sensory score (max. 9) of Color & Appearance, Body & Texture, Sweetness, Flavour and Overall acceptability of doodh peda were  $8.10\pm 0.19$ ,  $7.99\pm 0.30$ ,  $7.94\pm 0.37$ ,  $8.03\pm 0.25$ ,  $8.07\pm 0.19$  respectively. Average values of Lightness (L\*), redness (a\*), and yellowness (b\*) of doodh peda were  $73.17\pm 4.29$ ,  $-2.41\pm 0.50$ ,  $20.92\pm 1$  respectively. Average values of C\*, WI, BI and YI of doodh peda were 21.06, 65.89, 30.24, 40.84 respectively. Average value of Hardness (g), Adhesiveness (g.sec), Springiness, Cohesiveness, Gumminess (g), Chewiness (g) and Resilience of doodh peda were  $3023\pm 545$ ,  $-8.53\pm 4.45$ ,  $0.17\pm 0.02$ ,  $0.16\pm 0.02$ ,  $481\pm 91$ ,  $81.3\pm 23.8$ ,  $0.039\pm 0.001$  respectively.

They concluded that there is a wide variation in chemical, textural and sensory profile between the cities, which may be due to variation in method of preparation and varying levels of sugar and moisture content. However, little investigation has been carried out to evaluate the sensory and physico-chemical qualities of Doodh peda sold in Saurashtra region of Gujarat state. The present study was thus carried out to evaluate the sensory and physico-chemical qualities of Doodh peda samples collected from Saurashtra region of Gujarat state.

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