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Preparation of Peanut Flour based *Thabdi Peda*

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ABSTRACT

Background: Peanut plays an important role in the diet of human as it is rich source of edible oil, protein, minerals and vitamins. Peanut is a leguminous crop which is also known as poor man's nut due to availability of different nutrients at low price. Peanut flour after oil extraction can be successfully utilized in preparing different nutritionally enriched products such as peanut bars, peanut chocolates, peanut cookies, peanut candy, peanut biscuits, peanut pasta, *etc*. Milk is very important part of Indian diet. India is the largest producer of milk. In the milk based sweets, *Thabdi Peda* is most popular due to its distinguished colour, texture and caramel taste. Therefore, the current study was undertaken to incorporate peanut flour in *Thabdi Peda* to make it more nutritious.

Methods: The effect of sugar and peanut flour on the textural properties of *Peda* was investigated using a two-factor, five-level central composite rotatable design (CCRD) with a quadratic model. Different textural and nutritional properties were recorded to optimize the proportion of sugar and peanut flour.

Result: From the study, it was concluded that the nutritious *Thabdi Peda* could be prepared with 10% sugar and 17.04% peanut flour proportion by utilising standard process of manufacturing.

Key words: Optimization, Peanut flour, Response surface methodology, Sugar, *Thabdi Peda*.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is one of the most important cash crops of India. It belongs to the family (*Fabaceae*) of bean/legume. Peanut is also known as 'groundnut', 'earthnut', 'monkey nut', 'pinda', 'manillanut' and 'goobers' (Woodroof, 1983). During the year 2020-21, the production of peanut was 6.70 million tonnes in India with 14 per cent worldwide share. India was ranked second in the production after China with 17.99 million tonnes and 36 per cent share at the global (Anonymous., 2022).

Peanut is now being used to produce different food varieties like snacks, protein-enriched products, beverages, extruded products, fortified bakery products, desserts, *etc*. (Rustom *et al*., 1996). Peanut after extraction of oil can also be utilised in preparing value added products like soups, cookies, curries, *etc*. due to the nature of emulsification (Tate *et al*., 1990).

On the other side, milk is an important dairy product of India. Presently, India is the largest producer of milk in the world. In the year 2019-20, it is estimated that India produces about 198.44 million tonnes of milk. Making khoa uses approximately 5.5% of the total amount of milk produced in India (Bandyopadhyay *et al*., 2006; Chauhan and Dodeja, 2019). The quantity of *Peda* produced from milk and consumed in India is higher than the other indigenous milk based sweets. Amongst these, *Thabdi Peda* is more popular because of its distinguished colour, caramel taste, texture and longer shelf life (Patel *et al*., 2012).

In India, peanut flour is used to develop a range of low-cost food formulations, including malted food, multifunctional food, fortified flour and high-protein cookies (Bassey *et al*., 2013).

The pleasant aroma, nutty flavour and smooth texture of roasted peanut has found great reception. Positive impact of peanut on human health is reported as per the previous studies. Therefore, peanut is exploited as betterment of highly nutritious food products and it is also used to treat severe child malnutrition (Patel, 1996; Briend, 2001). Consumers in India are becoming more health conscious and seeking for healthier food due to the rise in disposable income, level of education and nutritional understanding (Patil *et al*., 2022).

Therefore, an addition of peanut flour in preparing sweet was felt beneficial to the human health. There is an opportunity to add peanut flour in *Thabdi Peda* to get delicious and nutritionally enriched product. Commercial value of peanut flour after extraction of oil is very less. Incorporation of defatted peanut flour in *Thabdi Peda* would be beneficial to farmers to get higher price of peanut with the commercial application of peanut flour.

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MATERIALS AND METHODS

The current study was carried out at the Department of Processing and Food Engineering, College of Agricultural Engineering and Technology, Junagadh Agricultural University, Junagadh (Gujarat, India) during the year 2021-22.

Raw materials

Pasteurised whole buffalo milk was procured from Cattle Breeding Farm of Junagadh Agricultural University, Junagadh. Sugar (Madhur sugar; Shree Renuka Sugars Limited) was used as a sweetener which was purchased from local market of Junagadh. Different equipment *viz*., Gas stove, Stainless Steel karahi (open pan), Palta, Plate, *etc*. were used to prepare the *Peda*.

Partially defatted peanut kernel splits of GG-20 variety were obtained from the local market. The peanut kernel splits were roasted at 130°C for 60 min as recommended by Dhamsaniya and Patel (2013) using mini tray dryer oven (Macro Scientific Works PVT. LTD., Model: MSW-214). Roasted peanut kernel splits were cooled at room temperature followed by grinding in mixer grinder (Bajaj Electricals Limited, Model: FX11 600 Watts Food Processor). After that, sieving (22 mesh sieve size) was carried out to obtain the Roasted Partially Defatted Peanut Flour (RPDPF).

Experimental design

To investigate the combined effect of two independent variables, namely sugar (X_1) and peanut flour (X_2) on various response variables, a two-factor, five-level Central composite rotatable design (CCRD) with a quadratic model was used.

Thabdi Peda preparation

The *Thabdi Peda* were prepared with varying sugar proportion (6-10%) and peanut flour (5-20%) on weight basis of milk following the standard procedure recommended by Modha *et al.* (2015). The pasteurised buffalo milk was taken in Stainless steel karahi (open pan) to prepare the *Peda*. Milk was heated in the open pan to concentrate. After first boiling, sugar (6-10% w/w of milk) was added at the temperature of 97°C and stirring was done by SS palta. The concentration process was continued until the pre-pat formation stage. At this stage, the gas stove was turned to low flame to prevent burning of material. Whole mass was kept undisturbed for some time until the milk was coagulated and converted into the granular mass. The heating was continued with low flame to get desired texture, desiccation for moisture evaporation and development of distinguished colour and flavour. After this, it was allowed to cool at the room temperature. The peanut flour (5-20% w/w of milk) was added to the concentrate at about 50°C temperature to get homogenized product. After completely cooling of the product at room temperature, manual formation of peanut flour based *Thabdi Peda* was carried out.

Determination of textural and nutritional characteristics

Textural characteristics *viz*., hardness, springiness and cohesiveness were determined by Texture Analyser (TA.XT plus) using Exponent Lite (Stable Micro Systems, UK) software (Kondiba, 2006).

The true protein content was estimated as per the method suggested by Sadasivam and Manickam (1996). The important minerals *viz*., iron and zinc content were evaluated by Microwave Plasma-Atomic Emission Spectrometer (Agilent 4200 MP-AES, Agilent Technologies) while the phosphorus was determined by the method of nitro vanadomolybdate and UV-Visible spectrophotometer (Thermo Scientific Evolution 201).

Sensory evaluation

Sensory evaluation was conducted for all the samples of peanut flour based *Thabdi Peda*. The sensory evaluation was carried out using hedonic rating scale (1 being extremely disliked, 5 being neither liked nor disliked and 9 being extremely liked). A group of semi-trained panellists assigned score on hedonic scale based on their perceptions of the samples' taste, texture, colour and appearance, odour and overall acceptability (Ranganna, 2000).

Statistical analysis

Response Surface Methodology (RSM) was used to estimate the quality of *Peda* by the effect of independent variables on various responses. Central composite rotatable design (CCRD) with two factors and five centre points was used (Myers and Montgomery, 2000) to design the experiment. Design Expert software (11.1.2.0) was used to create the response surface curves for each response parameter.

RESULTS AND DISCUSSION

Texture of peanut flour based *Thabdi peda*

The different treatment combinations of peanut flour based *Thabdi Peda* were subjected to evaluate the textural properties *viz*., hardness, springiness and cohesiveness as shown in Table 1. Different textural properties of peanut flour based *Thabdi Peda* were analysed using analysis of variance (ANOVA) and regression coefficients for response surface quadratic models as given in Table 2.

Effect on hardness of *Peda*

The hardness of peanut flour based *Thabdi Peda* was obtained in the range of 17.24-36.31 kg_f depending upon the varying proportion of sugar and peanut flour as given in Table 1. The regression analysis and ANOVA results for the hardness of peanut flour based *Thabdi Peda* is presented in the Table 2. The linear effect of sugar and peanut flour was indicated positively significant at $p<0.05$ and $p<0.001$, respectively on hardness. The quadratic effects of both the ingredients on hardness were found positive and highly significant ($p<0.01$). The interaction effect between sugar and peanut flour was found to be negatively significant ($p<0.05$) on hardness of *Peda*. The empirical relation between the hardness of peanut flour based *Thabdi Peda* and the test variables in coded units, was obtained as under:

Hardness of *Peda* =

$$20.03 + 1.70\ X_1 + 5.36\ X_2 - 3.05\ X_1X_2 + 3.71\ X_1^2 + 3.54\ X_2^2$$

Where,

X_1 and X_2= Sugar and peanut flour proportion, respectively.

The response surface curve for the variation in the hardness of peanut flour based *Thabdi Peda* as a function of sugar (X_1) and peanut flour (X_2) is shown in Fig 1(a). It shows the interactive effect of sugar and peanut flour on the hardness of peanut flour based *Thabdi Peda*. The decrease in hardness was observed as the sugar decreased up to 7.07% and peanut flour up to 7.03% as indicated in the Fig 1(a). The hardness at this combination was proposed to be decreased up to 16.68 kg_f. It could be noted that the hardness was increased with further increase in sugar and peanut flour. The increment might be due to replacement of moisture by sugar and peanut flour. Similar trend was reported by Panghal *et al.* (2018) while studying the effect of processing parameters on quality of sugar snap cookies. Srikanth *et al*. (2017) have also observed increase in hardness of Aloe vera juice incorporated *Peda* as compared to control *Peda*.

Effect on springiness of *Peda*

The springiness was found in the range of 0.101-0.191 mm depending with varying proportion of sugar and peanut flour as given in Table 1. The linear effect of peanut flour and the quadratic effect of sugar were found to be negatively significant at 1% and 5% level, respectively. Whereas, the linear effect of sugar, quadratic effect of peanut flour and

Table 1: Experiment values of different textural properties of peanut flour based *Thabdi Peda.*

Experimental	Independent variable		Responses		
Runs	Sugar (%)	Peanut flour (%)	Hardness(kgf)	Springiness(mm)	Cohesiveness
1	8.00	12.50	19.45	0.161	0.151
2	8.00	5.00	19.09	0.191	0.194
3	9.41	17.80	30.06	0.138	0.139
4	8.00	12.50	22.63	0.155	0.155
5	6.00	12.50	25.72	0.152	0.144
6	9.41	7.20	26.90	0.146	0.173
7	10.00	12.50	30.34	0.125	0.162
8	8.00	20.00	36.31	0.101	0.122
9	8.00	12.50	17.85	0.178	0.156
10	6.59	17.80	32.62	0.121	0.138
11	8.00	12.50	18.05	0.181	0.157
12	8.00	12.50	22.19	0.156	0.153
13	6.59	7.20	17.24	0.180	0.179

Table 2: Analysis of variance (ANOVA) and regression coefficients for response surface quadratic model of different textural properties of peanut flour based *Thabdi Peda.*

Source	Hardness (kgf)	Springiness (mm)	Cohesiveness
Intercept	20.03	0.1662	0.1544
		Linear terms	
Sugar (X_1)	1.70*	-0.0069 ^{NS}	0.0026 ^{NS}
Peanut flour (X_2)	5.36***	-0.043**	-0.0221***
		Interaction terms	
X_1X_2	-3.05*	0.0128 ^{NS}	0.0018 ^{NS}
		Quadratic terms	
X_1^2	3.71**	-0.0128*	-0.0003 ^{NS}
X_2^2	3.54**	-0.0091 ^{NS}	0.0022 ^{NS}
		Indicators for model fitting	
R^2	0.9429	0.8630	0.9446
Adj-R^2	0.9021	0.7651	0.9050
Pred-R^2	0.8304	0.4296	0.6363
Adeq Precision	13.0509	8.5325	15.8750
F-value	23.13	8.82	23.87
Lack of fit	NS	NS	12.18
C.V. %	8.08	8.42	3.72

***Extremely significant at p<0.001; **Highly significant at p<0.01; *Significant at p<0.05; NS= Non-significant.

the interaction effect of both the parameters were found non-significant on springiness of *Peda*. The empirical relationship for springiness was obtained as under:

Springiness of *Peda* =

$$0.1662 - 0.0069\ X_1 - 0.043\ X_2 + 0.0128\ X_1X_2 - 0.0128\ X_1^2 - 0.0091\ X_2^2$$

Where,

X_1 and X_2= Coded factors of sugar and peanut flour, respectively.

The increase in springiness was observed as the sugar proportion decreased up to 6.62% and peanut flour up to 5.00% as indicated in the Fig 1(b). The springiness at this combination was proposed to be increased up to 0.194 mm. Upon further rise in peanut flour springiness was found to be decreased.

Effect on cohesiveness of *Peda*

The cohesiveness of *Thabdi Peda* were obtained in the range of 0.122–0.194 depending upon the sugar and peanut flour content as given in Table 1. The variation in sugar content was not found significant. But, the effect of varying peanut flour in *Thabdi Peda* was extremely significant ($p<0.001$). Also, the interaction and quadratic effect of varying both the variables were non-significant. The empirical relation for the cohesiveness of peanut flour based *Thabdi Peda* was obtained as under:

Cohesiveness of *Peda* =

$$0.1544 + 0.0026\ X_1 - 0.0221\ X_2 + 0.0018\ X_1X_2 - 0.0003\ X_1^2 + 0.0022X_2^2$$

Where,

X_1 and X_2= Coded factors of sugar and peanut flour, respectively.

The increase in cohesiveness was observed as the sugar increased up to 8.25% and peanut flour up to 5.00% as indicated in the Fig 1(c). The cohesiveness at this combination could be increased up to 0.190. Cohesiveness was decreased with increase in peanut flour proportion in *Thabdi Peda*. It might be possible due to the textural difference between the *Thabdi Peda* and peanut flour based *Thabdi Peda*.

Nutritional properties of peanut flour based *Thabdi peda*

The nutritional characteristics of peanut flour based *Thabdi Peda* was compared with the traditional *Thabdi Peda*. The data are presented in Table 3. From the table, it could be noted that the protein content along with iron and zinc was remarkably increased in the peanut flour based *Thabdi Peda*. Hence, the peanut flour based *Thabdi Peda* are found more nutritious than the traditional *Thabdi Peda*.

Overall acceptability of peanut flour based *Thabdi peda*

The textural properties of peanut flour based *Thabdi Peda* was found slight inferior than the traditional *Peda* as shown

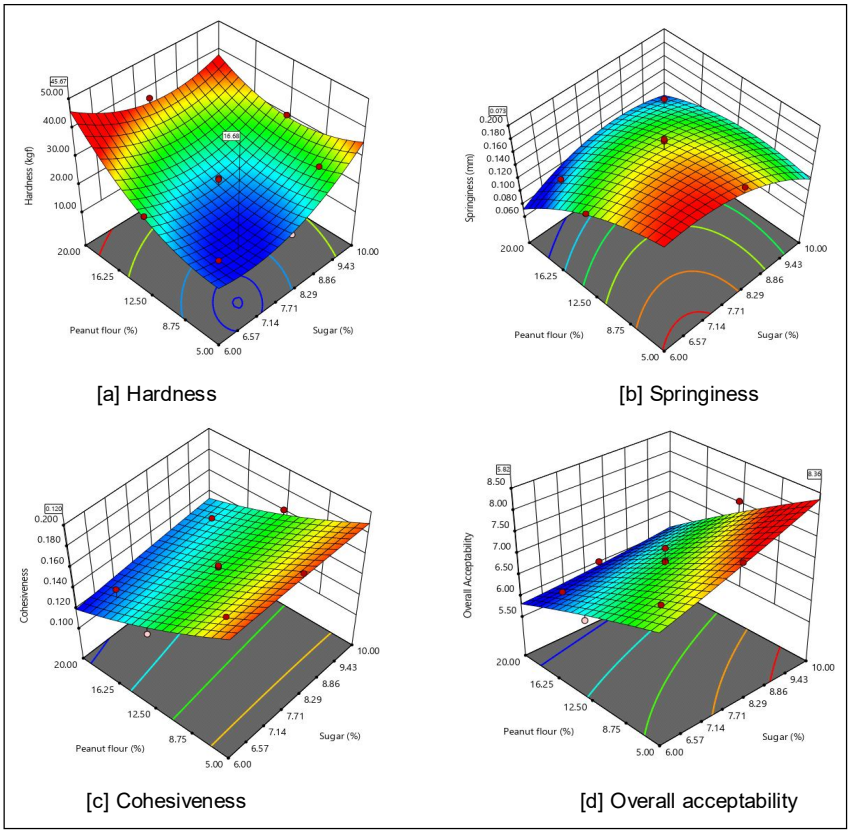

Fig 1: Effect of sugar and peanut flour on textural and organoleptic quality of *Thabdi Peda*.

Table 3: Comparison of nutrients in peanut flour based *Thabdi Peda* with traditional *Thabdi Peda*.

Composition	Peanut flour based *Thabdi Peda*	Traditional *Thabdi Peda*	Deviation (%)
		Nutritional properties	
True protein (%)	21.20	14.84	42.86
Iron (mg/100 g)	56.14	11.30	396.81
Zinc (mg/100 g)	2.49	1.32	88.64

in Fig 1(d). But, it was not disliked by the panellists during the organoleptic test as overall acceptability was obtained more than 6.0 score. Similar trend in overall acceptability was also observed by Gavhane *et al*. (2014) while increasing the proportion of ginger powder in *Peda*.

CONCLUSION

Peanut flour based *Thabdi Peda* was successfully prepared and composition was optimized using CCRD design under RSM. On the basis of textural and nutritional properties, the peanut flour based *Thabdi Peda* prepared from 10% sugar and 17.04% peanut flour was found highly acceptable over other treatments with the desirability of 0.90%.

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Conflict of interest: None.

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