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Effect of addition of inulin on chemical, organoleptic, microbiological and rheological properties of *Peda*

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Abstract

The objective of this study was to examine the effect of inulin on chemical, organoleptic, microbial and rheological properties of *peda*. It is observed that addition of inulin content in *peda* up to 7% level in *khoa* had significantly ($P < 0.05$) decreases moisture, fat, protein, total carbohydrates content in *peda* whereas, ash, fiber, total solids content increases significantly ($P < 0.05$) as compare to control. It was observed that addition of inulin had significant ($P < 0.05$) effect on body and texture as compare to flavour, color and appearance, sweetness and overall acceptability of the *peda*. In respect to the microbiological properties, increasing the level of inulin decreases the Total Plate Count and Yeast and Mould count in *peda*. Incorporation of inulin influenced the rheological properties of *peda*. As the level of inulin increases it significantly ($P < 0.05$) increases the hardness, cohesiveness, gumminess and chewiness of *peda* as compare to control whereas, adhesiveness and springiness decreases. Our results suggest that inulin can be added into *peda* up to 7% without affecting its overall quality characteristics.

Keywords: *Peda*, inulin, rheological, organoleptic, microbial

Introduction

Peda is an indigenous, *khoa* based, heat desiccated milk sweet prepared from either cow milk, buffalo milk or the combination their of. *Peda* is prepared by heating a mixture of *khoa* and sugar until the desired granular, hard texture and flavour develops. *Peda* is highly nutritious *khoa* based sweet as it contains milk solids plus sugar and other additives. The quantity of *peda* produced in India exceeds than other *khoa* based sweets (Mahadevan, 1991) [15]. Currently, dietary fiber is considered as a key ingredient for improving human health and the attention towards dietary fiber enriched foods has been intensified manifolds due to its health promoting properties. Inulin is a storage carbohydrate in plants, having fructose moieties joined by α -(2-1) D fructosyl linkages and is resistant to digestion in the human small intestine due to the a configuration of anomeric C-2 but it can be fermented in large intestine. Almost 90% of the inulin passes to the colon and digested by bacteria present there (Shoib *et al.*, 2016). Due to its ability to act as a dietary fiber and its bifidogenic nature, inulin may represent a functional food ingredient in a health context (Karimi *et al.*, 2015) [14]. The importance of dietary fibers in the diet has been recognized now days. Dietary fibers can provide a multitude of functional properties when they are incorporated in food systems. Thus, fibers addition contributes to the modification and improvement of the texture, sensory characteristics and shelf-life of foods due to their water-binding capacity, gel forming ability, fat mimetic, anti-sticking, anti-clumping, texturising and thickening effects (Thebaudin *et al.*, 1997; Yangilar, 2013; Dello *et al.*, 2004) [21, 22, 23]. Dietary fiber have beneficial physiological effect like improved laxation, attenuation of blood cholesterol, attenuation of post prandial blood glucose, influence of immune function, fermentability and production of SCFAS (short chain fatty acids), decreasing of intestinal transits time, increasing of stool bulk (EU, 2008) [5]. They have technical functionality relating to texture, as well as nutritional functionality relating to health (Ramirez *et al.*, 2010; Ajila and Prasada Rao, 2013) [16, 2]. Milk and milk products considered as a vehicle for dietary fiber would not only take care of their own role in human health but could also enhance the heath fullness of the diet as a whole. Hence considering the benefits of supplementation of fiber in the diet; with respect to its nutritional, medicinal value and technological properties. It is decided to study the effect of addition of inulin on chemical, organoleptic, microbiological and rheological properties of *peda*.

Materials and Method

Treatment Details

Inulin powder was added at different levels viz., 1, 3, 5 and 7 percent on the basis of *khoa* in T₁, T₂, T₃ and T₄ treatments respectively before addition of powdered sugar in *peda* preparation. The control (T₀) *peda* was prepared without addition of inulin powder.

Preparation of *peda*

For preparation of control *peda* and experimental *peda* buffalo milk was procured from the Dairy Unit, Department of Animal Husbandry and Dairy Science, college of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. This milk was standardized to 6 per cent fat before preparation of *khoa*. *Peda* was prepared according to the method given by Dharampal, (1998) [4] Process flow chart for the preparation of *peda* is given in Figure 1.

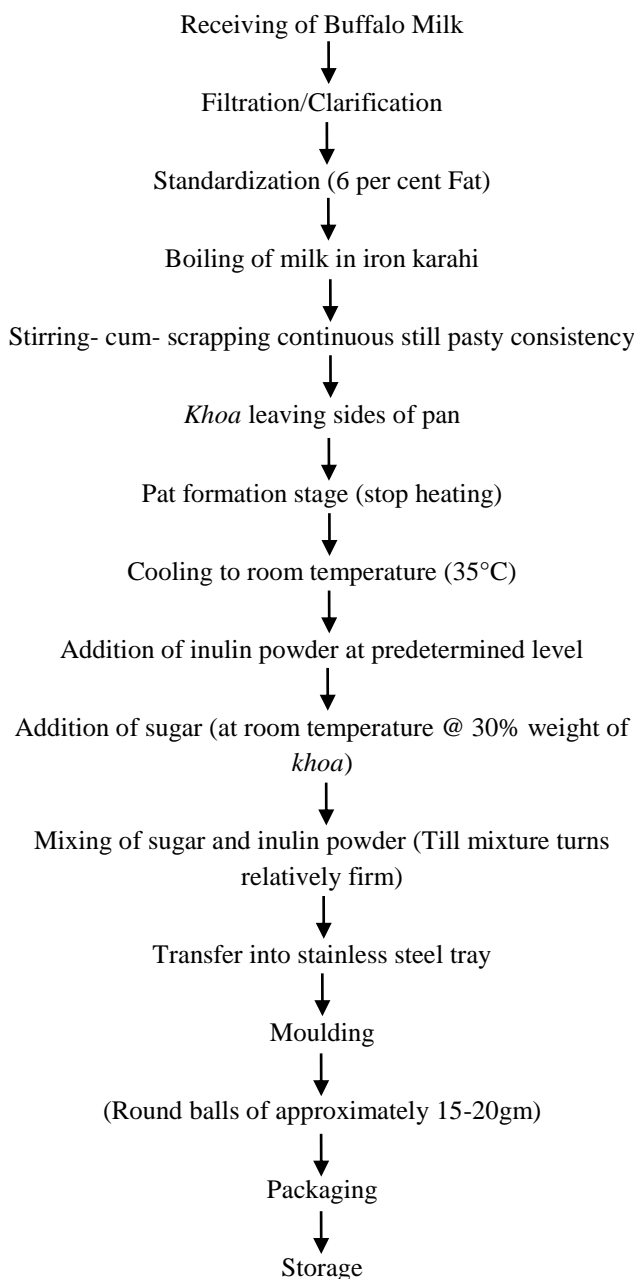


Fig 1: Flow-chart for preparation of *peda* blended with inulin fiber

Chemicals

The readymade edible inulin powder was procured from HERBSPRO INDIAN PVT. Ltd, Flat No. - 6-3-1093, 701 a,

vv vintage, Boulevard Rajbhavan Road, Hyderabad- 500082. The chemicals used in this study for chemical analysis and microbial study were of analytical grade.

Chemical Analysis

The *peda* blended with inulin and without inulin (control) were chemically analyzed for moisture as per procedure described by ISI: 2785 (1964) [12], fat by ISI: 1224 (part II) (1977) [10], protein as per the procedure described in ISI: (1981) [11], ash by ISI: 1547 (1985), total solids estimated as per the procedure described in ISI: (1981) [11], carbohydrate were determined by subtraction method and dietary fiber were estimated as per the method described in AOAC method (1975) [1].

Organoleptic Evaluation

The organoleptic attributes of *peda* were analyzed in terms of its flavour, color and appearance, body and texture, sweetness and overall acceptability by a semi-trained panel consisting of ten members from the Department of Animal Husbandry and Dairy Science and College of Food Technology, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani using nine point hedonic scale (Gupta 1976) [7]. (1 = dislike extremely; 9 = like extremely). Sensory evaluation was done at room temperature.

Microbial Analysis

Microbiological parameters were determined by using standard procedure for Total Plate Count by method cited in IS: 5550 (1970) using Nutrient Agar as Medium, Yeast and Mould count by method cited in IS: 5550 (1970) using Potato Dextrose Agar as Medium and Coliform count by method cited in IS: 5550 (1970) using Violet Red Bile Agar (VRBA) as medium.

Texture Profile Analysis (TPA)

TPA of inulin added *peda* samples and control samples were performed using the Texture Analyser TA.XT plus, Exponent Lite (Stable Micro Systems) available at College of Food Technology, VNMKV, Parbhani. TPA was performed to characterize the hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness of the product. The *peda* sample was cut into 2×2×1 cm³ size pieces. The samples which were maintained at 25°C and subjected to monoaxial compression of 10 mm height. The force distance curve was obtained for a two bite compression cycle with the test speed of 1mm/s and trigger force of 10 g.

Statistical Analysis

All the data were expressed as mean ± Standard error of mean calculated from four replications of experiment by using Completely Randomized Block Design (CRBD). One way analysis of variance (ANOVA) was applied to measure the test for significance as described by Steel and Torrie (1980) [18].

Results and Discussion

Effect of addition of inulin fiber on chemical composition of *peda*

The effect of different levels of inulin on chemical properties viz., Moisture, fat, protein, total carbohydrates, ash, fiber and total solids of *peda* was shown in Table 1. There was significant (P<0.05) decrease in moisture, fat, protein and total carbohydrate content of *peda* was observed with increasing the level of inulin. The control *peda* had significantly (P<0.05) higher moisture, fat, protein and total

carbohydrate content than all experimental *peda* samples. The decreasing moisture content could be due to utilization of water by inulin in gel formation. The results recorded in present investigation where comparable with Syed and Ghosh (2017) reported that increasing level of inulin in processed cheese decreases moisture, fat, protein content of the processed cheese. Increased level of inulin in *peda* results in

significantly ($P < 0.05$) increasing the ash, fiber and Total solid content of *peda*. The ash, fiber and total solid content of *peda* blended with 7 per cent inulin were found highest. The findings of present study where similar with Suvera *et al.*, (2017) [19] reported that ash, fiber and total solid content in *shrikhand* increases with increase in addition of inulin.

Table 1: Effect of addition of inulin fiber on chemical composition of *peda*

Chemical Constituent	Treatment					CD (P < 0.05)
	T ₀	T ₁	T ₂	T ₃	T ₄	
Moisture	18.20 ± 0.020 ^a	17.86 ± 0.047 ^b	17.57 ± 0.026 ^c	17.31 ± 0.032 ^d	17.00 ± 0.029 ^e	0.0803
Fat	18.40 ± 0.020 ^a	18.31 ± 0.021 ^b	18.12 ± 0.025 ^c	17.80 ± 0.027 ^d	17.30 ± 0.021 ^e	0.0692
Protein	14.52 ± 0.025 ^a	14.43 ± 0.023 ^b	14.31 ± 0.025 ^c	14.18 ± 0.027 ^d	14.03 ± 0.026 ^e	0.076
Total Carbohydrate	46.25 ± 0.058 ^a	45.76 ± 0.043 ^b	44.36 ± 0.091 ^c	42.95 ± 0.071 ^d	41.78 ± 0.064 ^e	0.2030
Ash	2.64 ± 0.017 ^a	2.71 ± 0.019 ^b	2.83 ± 0.020 ^c	3.03 ± 0.022 ^d	3.28 ± 0.025 ^e	0.0619
Fiber	0.00 ± 0.000 ^a	0.94 ± 0.020 ^b	2.81 ± 0.017 ^c	4.72 ± 0.029 ^d	6.63 ± 0.021 ^e	0.0599
Total Solid	81.41 ± 0.038 ^a	81.88 ± 0.028 ^b	82.30 ± 0.038 ^c	82.64 ± 0.035 ^d	82.96 ± 0.039 ^e	0.1082

Values are Mean ± Standard Error Value with different superscript are significantly differed at $P < 0.05$

Effect of addition of inulin fiber on the sensory attributes of *peda*

The effect of varying levels of inulin on sensory attributes viz., Flavour, color and appearance, body and texture, sweetness and overall acceptability of *peda* was shown in Table 2. Inulin powder in *peda* (T₂) secure significantly ($P < 0.05$) highest score for flavour as compare to other treatments. There was significant ($P < 0.05$) decrease in body and texture score. Highest score was recorded for T₀ whereas lowest for T₄. Significantly ($P < 0.05$) lowest score was obtained for T₄ in respect to color and appearance of *peda* prepared with 7 per cent inulin powder. The color and appearance score was highest in control (T₀) *peda* which

decreases with increasing the level of inulin with non significant effect up to 6 per cent level. The sweetness score for *peda* decreased from T₀ to T₄. Significant ($P < 0.05$) decrease in sweetness score was observed in T₂, T₃ and T₄ as compared to (T₀) control *peda*. Significant ($P < 0.05$) increase in overall acceptability score was observed. Highest score for overall acceptability was obtained for T₀ as compared to other treatments of experimental *peda*. The results were comparable to those of Suvera *et al.*, (2017) [19] reported non significantly decrease in flavor, color and appearance, body and texture and overall acceptability score with increasing level of inulin in *shrikhand*.

Table 2: Effect of addition of inulin fiber on sensory attributes of *peda*

Treatment	Sensory Attributes				
	Flavor	Color and Appearance	Body and Texture	Sweetness	Overall Acceptability
T ₀	8.63 ± 0.051 ^a	8.42 ± 0.069 ^a	8.89 ± 0.064 ^a	8.72 ± 0.061 ^a	8.67 ± 0.029 ^a
T ₁	8.40 ± 0.076 ^b	8.26 ± 0.074 ^{ab}	8.57 ± 0.066 ^b	8.58 ± 0.090 ^{ab}	8.46 ± 0.058 ^b
T ₂	8.88 ± 0.045 ^c	8.04 ± 0.097 ^{bc}	8.23 ± 0.127 ^c	8.36 ± 0.101 ^b	8.38 ± 0.033 ^b
T ₃	8.24 ± 0.069 ^b	7.79 ± 0.096 ^c	7.81 ± 0.101 ^d	7.99 ± 0.106 ^c	7.96 ± 0.052 ^c
T ₄	7.98 ± 0.088 ^d	7.52 ± 0.065 ^d	7.19 ± 0.100 ^e	7.35 ± 0.099 ^d	7.51 ± 0.038 ^d
CD P < 0.05	0.2037	0.246	0.2848	0.2796	0.1308

Values are Mean ± Standard Error Value with different superscript are significantly differed at $P < 0.05$

Effect of addition of inulin fiber on microbiological properties of *peda*

The effect of varying levels of inulin on Total Plate Count, Yeast and Mould count, Coliform count) of *peda* was shown in Table 3. The decreasing trend was observed in Total Plate Count. In respect of Total Plate Count significantly ($P < 0.05$) lowest count was observed for T₄ and highest score for control (T₀). Significant ($P < 0.05$) decrease is observed in respect of Total Plate Count in T₃ and T₄. Yeast and Mould

count decreased from T₀ to T₄. Significant ($P < 0.05$) decrease was observed in Yeast and Mould count for T₄. The Total Plate Count and Yeast and Mould count of *peda* was decreased with decreasing the moisture content as the level of inulin in *peda* increases. Coliform in any dairy product indicate the hygienic condition maintained during production and packaging. All the experimental *peda* samples were free from coliform count. The results are in accordance with Gavhane *et al.*, (2015) [6].

Table 3: Effect of addition of inulin fiber on microbiological properties of *peda*

Treatment	Microbiological Properties	
	Total Plate Count cfu X 10 ³ / gm	Yeast and Mould Count cfu / gm
T ₀	10 ± 0.408 ^a	7 ± 0.816 ^a
T ₁	9 ± 0.913 ^{ab}	6 ± 0.408 ^{ab}
T ₂	7 ± 0.707 ^b	5 ± 0.913 ^{bc}
T ₃	4 ± 0.408 ^c	3 ± 0.408 ^c
T ₄	3 ± 0.913 ^c	2 ± 0.577 ^d
CD P < 0.05	2.131	3.686

Values are Mean ± Standard Error Value with different superscript are significantly differed at $P < 0.05$

Effect of addition of inulin fiber on the rheological properties of *peda*

The effect of varying levels of inulin on rheological properties viz., Hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness of *peda* was shown in Table 4. There was significant ($P < 0.05$) increase in hardness, cohesiveness, gumminess and chewiness. Significant ($P < 0.05$) increase in hardness was observed in T_2 , T_3 and T_4 as compared to control (T_0) *peda*. In respect of cohesiveness, gumminess and chewiness of *peda* significant ($P < 0.05$)

increasing trend was observed in T_1 , T_2 , T_3 and T_4 with increasing inulin addition up to 7% level. Whereas, decreasing trend was observed in respect of adhesiveness and springiness. For adhesiveness significantly ($P < 0.05$) lowest score was observed in T_3 and T_4 as compared to control T_0 *peda* and non-significant effect was observed up to 3% addition of inulin in *peda*. Non-significant effect was observed for springiness with addition of inulin up to 5% level in *peda*. The results are in accordance with Jain *et al.*, (2012)^[13].

Table 4: Effect of addition of inulin fiber on rheological properties of *peda*

Treatment	Hardness (Kg)	Cohesiveness	Adhesiveness (Kg.sec)	Springiness (mm)	Gumminess (Kg.sec)	Chewiness (Kg.sec)
T_0	0.410 ± 0.037^a	1.085 ± 0.010^a	0.010 ± 0.004^a	1.860 ± 0.009^a	0.448 ± 0.042^a	0.833 ± 0.082^a
T_1	0.453 ± 0.024^{ab}	1.300 ± 0.017^b	0.015 ± 0.003^a	1.825 ± 0.021^{ab}	0.590 ± 0.039^b	1.083 ± 0.066^b
T_2	0.523 ± 0.017^b	2.258 ± 0.017^c	0.035 ± 0.006^b	1.778 ± 0.014^{bc}	1.178 ± 0.029^c	2.093 ± 0.056^c
T_3	0.893 ± 0.012^c	3.110 ± 0.015^d	0.053 ± 0.009^b	1.758 ± 0.009^c	2.775 ± 0.024^d	4.878 ± 0.054^d
T_4	1.015 ± 0.021^d	4.375 ± 0.019^e	0.078 ± 0.009^c	1.753 ± 0.026^c	4.440 ± 0.080^e	7.778 ± 0.122^e
CD $P < 0.05$	0.072	0.048	0.021	0.052	0.143	0.243

Values are Mean \pm Standard Error Value with different superscript are significantly differed at $P < 0.05$

Conclusions

Inulin was added to *peda* as a source of soluble fiber, its addition upto 7 per cent significantly reduces the moisture, fat, protein, total carbohydrate whereas, ash, fiber and total solid content of *peda* significantly increases. It also showed that control *peda* scored highest score for all sensory attributes except flavour. Inulin powder in *peda* secure highest score for flavour. Addition of inulin progressively increased hardness, cohesiveness, gumminess, chewiness and decreased adhesiveness and springiness toward higher level of incorporation. Total Plate Count, Yeast and Mould count of *peda* decreases towards higher level of incorporation of inulin. Thus it can be concluded that inulin could be successfully incorporated in *peda* up to 7 per cent without adversely affecting the sensory as well as nutritional quality of finished product.

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