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Development of functional shrikhand incorporated with orange peel extracts and its sensory evaluation

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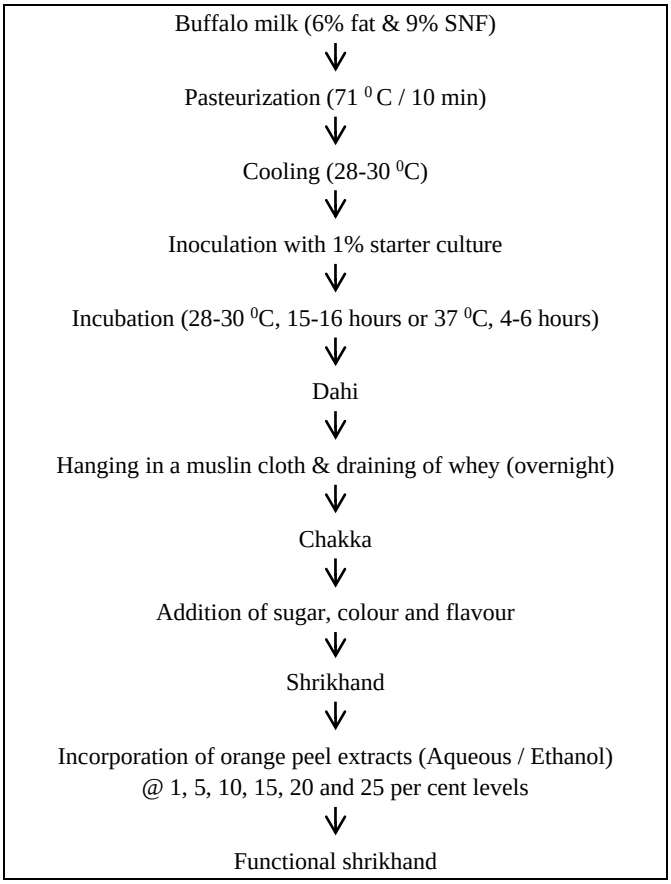
Abstract
Functional shrikhand was prepared by incorporating aqueous and ethanol extracts of fresh, dried orange fruit peels at different concentrations. Based on the sensory evaluation, the functional shrikhand incorporated with 20 per cent aqueous and 15 per cent ethanol extracts of fresh and dried orange fruit peels were found to be the best compared to the control. It was concluded that aqueous extracts (20 per cent) of fruit peels incorporated shrikhand can be introduced as value added functional dairy product in human diet.

Keywords: Functional shrikhand, orange peel extract, sensory evaluation

Introduction
The nutritional advantages associated with consumption of the dairy based foods are unparallel and always have been an integral part of our rich cultural heritage. India's market potential and current growth rate of traditional dairy products is set to boom further under the technology of mass production. An estimated 50 to 55 per cent of the milk produced in India is converted into a variety of traditional milk products (Aneja *et al.*, 2002) [2]. Indian traditional fermented milk products utilize 7 per cent of total milk produced (Bhardwaj, 2013) [3]. Shrikhand, an indigenous fermented milk product is a semi soft, sweetish sour, whole milk product prepared from lactic acid fermented curd. The curd is partially strained through muslin cloth to remove the whey, which produces a solid mass called chakka, the basic ingredient for shrikhand (De, 1980) [5].
Fruits and vegetable processing in India generates substantial quantity of wastes, which are abundant source of antioxidant polyphenols, minerals, dietary fibers and phenolics. Use of these wastes as a source of polyphenols and antioxidants may have considerable economic benefit to the food processors. Therefore a cheap, efficient and environmentally sound utilization of these wastes is needed (Singh and Immanuel, 2014) [12]. Citrus fruits are important horticultural crops and are mainly used by juice processing industries, while, the peels are generally wasted which contain more bioactive compounds, such as phenolics, flavanones, flavonoids, limonoids and fibre (Kumar *et al.*, 2011) [7].
There is also a need to find diverse technologies to add value to the dairy products. Thus, supplementation of fruit peel extracts would add value to the shrikhand not only in terms of variety but also enhance the healthfulness by increasing the antioxidant activity and total phenolic content in the developed product. The technological packages for such food products also encourage the efficient utilization of fruit industry wastes.
Since, fruit peel extract incorporated dairy product like shrikhand is a new effort and there was very minimal study, a research was proposed to develop functional shrikhand incorporating fresh and dried orange peel extracts at different levels.

Materials and Methods
The buffalo milk with 6 % fat and 9 % SNF were used for this study. Fresh orange fruits were purchased and the fruit peel extracts (aqueous or ethanol) were prepared as per the standard procedure (Singh and Immanuel, 2014) [12].
Fresh or dried orange peel extracts were added at different levels (1, 5, 10, 15, 20 and 25 per cent) in shrikhand for functional shrikhand preparation (De, 1980) [5]. The shrikhand prepared without extract was used as control and compared with the functional shrikhand.

Flow diagram for the preparation of functional Shrikhand



Sensory evaluation of control and functional shrikhand was carried out using 9- point hedonic scale (Amerine *et al.*, 1965) [1]. All the samples were appropriately coded before subjected for sensory evaluation. The data obtained were tabulated and subjected to statistical analysis as per the procedure adopted by Snedecor and Cochran (1994) [13].

Results and Discussion

Sensory evaluation of functional shrikhand incorporated with aqueous extracts of orange peels at different levels

Table 1 shows the mean sensory scores of colour and appearance, flavour, sweetness, body and texture and overall acceptability of the control as well as functional shrikhand incorporated with aqueous extracts of fresh and dried orange fruit peels (FOAE and DOAE) at various levels viz. 1,5, 10,15, 20 and 25 per cent (Figure 1).

From the Table 1, statistical analysis revealed that colour and appearance, flavour, sweetness, body and texture and overall acceptability (mean ± SE) scores of control and aqueous extracts of fresh and dried orange peel incorporated functional shrikhand (FOAE and DOAE) differed highly significant ($P \leq 0.01$).

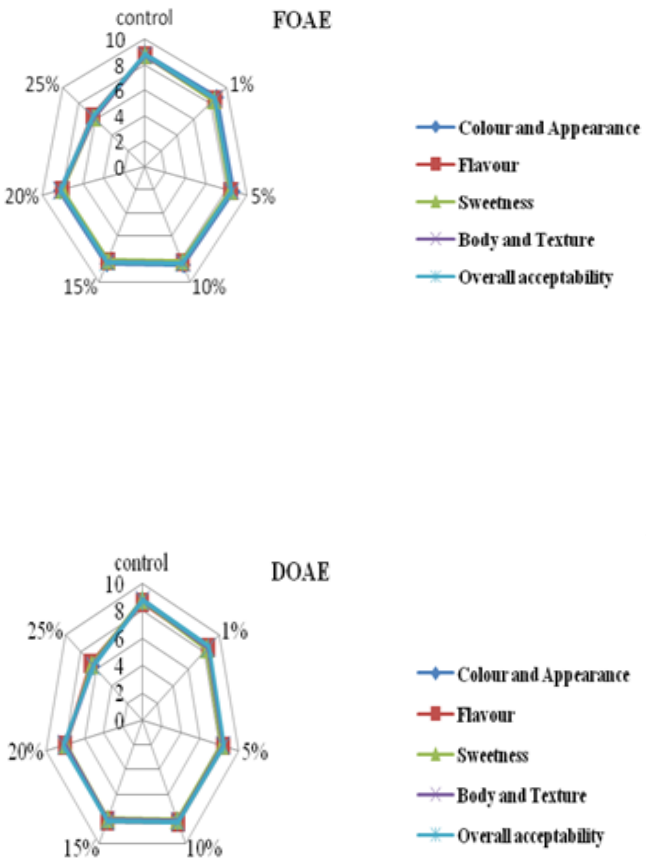
The colour and appearance, flavour, sweetness and overall acceptability scores of orange fruit peel aqueous extract incorporated functional shrikhand were reduced, as the inclusion level increased from 1 to 25 per cent. As there was a drastic reduction in sensory score at 25 per cent level, which was not accepted by the sensory panel, the aqueous extracts of fresh and dried orange fruit peels could be incorporated up to 20 per cent level in shrikhand. This result was in close resemblance with the finding of Nigam *et al.* (2009) [9], Kumar *et al.* (2011) [7], Narayanan and Lingam (2013) [8], Bhoyar *et al.*, 2014 and Singh and Paswan (2015) who analyzed sensory evaluation of functional shrikhand.

Regarding the scores of body and texture, there was no significant difference between 15 and 20 per cent incorporation levels. These result were supported by the observation of Narayanan and Lingam (2013) [8] who observed that the body and texture of shrikhand was significantly ($P<0.01$) affected due to blending of banana pulp at 20 percent level. Likewise, El-Said *et al.*, 2014 [6] also revealed that increasing the percentage of the added pomegranate peel extracts resulted in decrease in the viscosity of the stirred yoghurt, there by affected the body and texture.

Table 1: Sensory evaluation of functional shrikhand incorporated with aqueous extracts of orange peels at different levels (Mean[#] ± SE)

Sensory Attributes	Inclusion level (%)	Types of functional shrikhand	
		FOAE	DOAE
Colour and Appearance	Control	8.83±0.02 [c]	8.72±0.07 [c]
	1	8.73±0.12 [c]	8.50±0.21 [c]
	5	8.63±0.11 [c]	8.42±0.11 [b]
	10	8.48±0.11 [b]	8.25±0.12 [b]
	15	8.38±0.11 [b]	8.23±0.12 [b]
	20	8.28±0.11 [b]	8.05±0.11 [b]
	25	6.28±0.14 [a]	6.33±0.23 [a]
F value		104.75**	45.42**
Flavour	Control	8.72±0.04 [c]	8.65±0.08 [c]
	1	8.47±0.20 [b]	8.52±0.06 [c]
	5	8.37±0.20 [b]	8.40±0.06 [b]
	10	8.27±0.20 [b]	8.28±0.07 [b]
	15	8.17±0.20 [b]	8.15±0.08 [b]
	20	8.10±0.21 [b]	8.05±0.08 [b]
	25	6.37±0.18 [a]	6.68±0.35 [a]
F value		28.84**	31.58**
Sweetness	Control	8.75±0.02 [d]	8.78±0.06 [d]
	1	8.38±0.07 [c]	8.35±0.09 [c]
	5	8.27±0.07 [c]	8.24±0.09 [b]
	10	8.16±0.08 [b]	8.12±0.09 [b]
	15	8.07±0.08 [b]	8.00±0.10 [b]
	20	8.01±0.07 [b]	7.92±0.10 [b]
	25	6.20±0.14 [a]	6.50±0.18 [a]
F value		163.36**	69.28**
Body and Texture	Control	8.73±0.04 [d]	8.80±0.04 [d]
	1	8.57±0.06 [c]	8.48±0.04 [c]
	5	8.47±0.06 [b]	8.38±0.04 [b]
	10	8.34±0.06 [b]	8.25±0.03 [b]
	15	8.25±0.06 [b]	8.15±0.03 [b]
	20	8.25±0.06 [b]	8.08±0.04 [b]
	25	6.22±0.07 [a]	6.43±0.20 [a]
F value		347.97**	136.91**
Overall Acceptability	Control	8.78±0.02 [c]	8.77±0.06 [c]
	1	8.61±0.10 [c]	8.56±0.10 [b]
	5	8.51±0.10 [b]	8.44±0.10 [b]
	10	8.37±0.09 [b]	8.30±0.08 [b]
	15	8.30±0.07 [b]	8.22±0.09 [b]
	20	8.25±0.06 [b]	8.18±0.08 [b]
	25	6.32±0.23 [a]	6.38±0.39 [a]
F value		85.45**	35.18**

Fig. 1



[#] Mean of six observations

Means bearing different superscripts in a same column differ significantly (p<0.01) for each sensory attributes

** Highly Significant

Sensory evaluation of functional shrikhand incorporated with ethanol extracts of orange peels at different levels

Table 2 shows the sensory scores (mean± SE) of colour and appearance, flavour, sweetness, body and texture and overall acceptability of control as well as functional shrikhand incorporated with ethanol extracts of fresh and dried orange peels (FOEE and DOEE) at various levels viz.1, 5, 10, 15 and 20% (Figure 2).

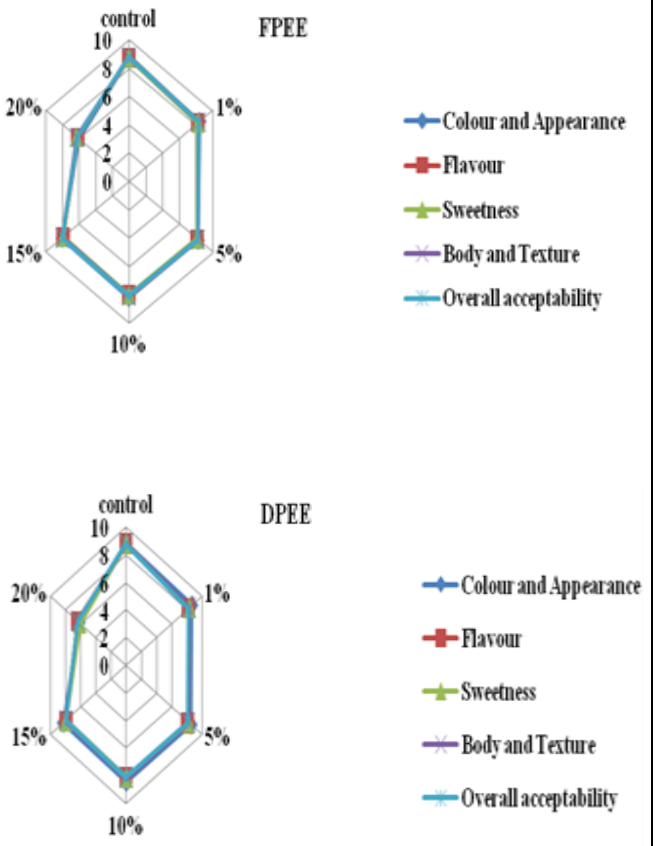
The variations in colour and appearance, flavour, sweetness, body and texture and over all acceptability scores were observed to be statistically highly significant due to the effect of addition of orange peel extracts to the shrikhand. The scores showed decreasing trend with increase in addition of extracts levels compared to that of control. As the reduction in score at 20 per cent level was not accepted, it was concluded that ethanol extracts of fresh and dried orange fruit peels could be incorporated up to 15 per cent level in shrikhand.

This result was in close agreement with the finding of Para *et al.* (2014) [10], who revealed that shrikhand containing orange and chiku pulps combination at 14% level was selected as optimum on the basis of various sensory parameters. The observations were also in accordance with the finding of Singh and Immanuel (2014) [12] who reported that paneer samples prepared with the addition of natural antioxidant extracts from peels of pomegranate, orange and lemon were acceptable at 2% level of inclusion and had greater ability to prevent peroxide formation. The results were also in close resemblance with the findings of El-Said *et al.* (2014) [6], who revealed that increasing the percentage of the added pomegranate peel extracts (5 to 35%) resulted in decrease in the sensory score of the stirred yoghurt, there by affected the sweetness.

Table 2: Sensory evaluation of functional shrikhand incorporated with ethanol extracts of fruit peels at different levels (Mean[#] ± SE)

Sensory Attributes	Inclusion level (%)	Types of functional shrikhand	
		FOEE	DOEE
Colour and Appearance	Control	8.78±0.02 [b]	8.80±0.00 [c]
	1	8.55±0.08 [b]	8.52±0.10 [b]
	5	8.42±0.08 [b]	8.42±0.10 [b]
	10	8.32±0.08 [b]	8.32±0.11 [b]
	15	8.17±0.10 [b]	8.22±0.14 [b]
	20	6.57±0.54 [a]	6.17±0.17 [a]
F value		15.25**	88.75**
Flavour	Control	8.78±0.02 [c]	8.83±0.02 [c]
	1	8.30±0.10 [b]	8.25±0.09 [b]
	5	8.21±0.08 [b]	8.15±0.09 [b]
	10	8.07±0.12 [b]	8.08±0.08 [b]
	15	8.01±0.13 [b]	8.00±0.07 [b]
	20	6.15±0.10 [a]	6.27±0.27 [a]
Fvalue		112.70**	58.26**
Sweetness	Control	8.78±0.02 [c]	8.71±0.08 [c]
	1	8.37±0.10 [b]	8.21±0.06 [b]
	5	8.27±0.10 [b]	8.14±0.06 [b]
	10	8.17±0.10 [b]	8.05±0.07 [b]
	15	8.07±0.10 [b]	8.01±0.07 [b]
	20	6.00±0.21 [a]	6.33.±0.33 [a]
F value		87.76**	38.18**
Body and Texture	Control	8.78±0.02 [c]	8.81±0.01 [c]
	1	8.47±0.03 [b]	8.59±0.06 [b]
	5	8.43±0.08 [b]	8.49±0.06 [b]
	10	8.32±0.08 [b]	8.36±0.05 [b]
	15	8.20±0.06 [b]	8.18±0.05 [b]
	20	6.38±0.29 [a]	6.33±0.33 [a]
F value		54.83**	51.38**
Overall Acceptability	Control	8.78±0.02 [c]	8.79±0.01 [c]
	1	8.23±0.07 [b]	8.33±0.21 [b]
	5	8.14±0.07 [b]	8.26±0.21 [b]
	10	8.03±0.07 [b]	8.13±0.19 [b]
	15	8.00±0.07 [b]	8.01±0.19 [b]
	20	6.37±0.29 [a]	6.18±0.18 [a]
F value		49.13**	31.89**

Fig. 2



[#] Mean of six observations
Means bearing different superscripts in a same column differ significantly (p<0.01) for each sensory attributes
** Highly Significant.

Conclusion

Shrikhand is an indigenous fermented milk product of pasty consistency with slight sweetish sour taste, made from chakka. Thus, supplementation of fruit peel extracts would add value to the shrikhand not only in terms of variety but also enhance healthfulness. The technological packages for such food products also encourage the efficient utilization of fruit industry wastes. Among the different treatments, the functional shrikhand incorporated with 20 per cent aqueous (FOAE and DOAE) and 15 per cent ethanol (FOEE and DOEE) extracts of fresh and dried fruit peels of orange were found to be the best when compared to control, based on the sensory evaluation. It was concluded that aqueous extracts (20 per cent) of fruit peels incorporated shrikhand can be introduced as value added functional dairy product in human diet.

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