



American Journal of
Food Technology

ISSN 1557-4571



Academic
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Effect of Apple Pulp and *Celosia argentea* on the Quality Characteristics of Shrikhand

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ABSTRACT

A study was conducted to evaluate the effect of apple pulp on the quality characteristics of Shrikhand. Various levels of apple pulp viz. 0, 10, 20 and 30 percent were used in the preparation of Shrikhand replacing chakka in the formulation. Further the use of dried '*Celosia argentea*' (flower part only) as a colouring agent in the preparation of the Shrikhand containing optimum level of the apple pulp was explored. The protein, fat and ash percent of the Shrikhand decreased significantly ($p < 0.05$) whereas moisture content increased significantly ($p < 0.05$) with increasing level of apple pulp. On the basis of various sensory parameters, Shrikhand containing 20% apple pulp and dried '*Celosia argentea*' flower was selected as optimum. The product was further packed in polystyrene cups and stored under refrigerated conditions at $4 \pm 1^\circ\text{C}$ for a period of three weeks. The mean scores of all the sensory parameters decreased significantly ($p < 0.05$) with storage. Total plate count and psychrophilic count increased significantly ($p < 0.05$) whereas coliforms were not detected throughout the period of storage. Thiobarbituric acid reacting substances (TBARS) values also increased significantly ($p < 0.05$) with storage period. The product was acceptable for a period of three weeks under refrigerated conditions.

Key words: Shrikhand, Apple pulp, '*Celosia argentea*', physicochemical parameters, sensory attributes, storage

INTRODUCTION

India's market potential and current growth rate of traditional dairy products is unparalleled and all set to boom further under the technology of mass production. This market is the largest in value after liquid milk and is estimated at US \$3 billion in India and US \$1 billion in North America alone (Aneja *et al.*, 2002). An estimated 50 to 55% of the milk produced in India is converted into a variety of traditional milk products, using processes such as coagulation (heat and/or acid), desiccation and fermentation (Aneja *et al.*, 2002). Indian fermented milk products utilize 7% of total milk produced (Aneja *et al.*, 2002) and mainly includes three product dahi (curd), shrikhand (sweetened concentrated curd) and lassi (stirred curd) which may be considered the Western equivalent to yogurt, quarg and stirred yogurt, respectively (Sarkar, 2008).

Dairy products are likely to remain important dietary components because of their nutritional value, flavor and texture. There will continue to be a demand for traditional, high quality dairy products, despite increasing competition from non-dairy based products (Rathore *et al.*, 2007).

Demand for yogurt has increased considerably in the last decade (Saavedra *et al.*, 2004), especially in the United Kingdom (Kowalska *et al.*, 2000) and United States (Sivak, 2000), owing to yogurt's nutritional and therapeutic benefits (Sarkar and Misra, 2002; Foda *et al.*, 2007). The increase in the consumption of yoghurt in United States is attributed to the addition of fruits, flavours and sweeteners to plain yoghurt (Osundahunsi *et al.*, 2007). Recently, yogurt has become a popular vehicle for the incorporation of probiotic cultures such as *Bifidobacterium bifidum* and *Lactobacillus acidophilus* for improved health and nutrition (Sarkar, 2008). Yoghurt is highly nutritious and easily digestible as compared to milk (Athar *et al.*, 2000). People who don't drink milk because they cannot digest lactose; consume yoghurt which contains less lactose (Khalifa *et al.*, 2010; Sanful, 2009).

Shrikhand is an indigenous semi-soft whole milk product prepared using chakka (strained dahi/curd). The curd (dahi) is partially strained through a cloth to remove the whey and thus produce solid mass called chakka. Chakka is finely mixed with sugar and flavouring agents. It is sweetish-sour in taste. Typically shrikhand constitutes 39.0% moisture and 61.0% of total solids of which 10.0% is fat, 11.5% proteins, 78.0% carbohydrates and 0.5% ash, on a dry matter basis with a pH of about 4.2-4.4 (Kulkarni *et al.*, 2006; Boghra and Mathur, 2000). Shrikhand is very much popular in western part of the country due to its high nutritive, characteristics flavour, taste, palatable nature and possible therapeutic value. It is very refreshing particularly during summer months. It can be recommended as health food for specific patients suffering from obesity and cardiovascular diseases due to its low fat and sugar contents. It has the nutritive goodness of fermented milk products.

Dahi is the most popular cultured milk product of Indo-Pakistan (Soomro *et al.*, 2003) and for some individuals; it has a definite therapeutic value, especially who suffer from some stomach and intestinal disorders (Nahar *et al.*, 2007; Younus *et al.*, 2002). Dahi has been suggested to activate the nonspecific immune system and protects against enteric infections caused by *Shigella dysenteria* in mice (Singh and Kansal, 2003), inhibited angiotensin I in rats and reduced systolic blood pressure in hypertensive humans (Ashar and Chand, 2004a, b) and Subramanian *et al.* (2005) mentioned that ingestion of shrikhand by albino mice induced an increase in IgG, indicating an improvement in the immune system. Dahi may be capable of exhibiting anticarcinogenic activity due to the increase of conjugated linoleic acid contents (0.5-1.0%) during its manufacture (Sarkar 2008, Aneja and Murthi, 1990). Ingestion of dahi for two days induced a 21-fold increase in *b*-galactosidase activity in mice (Singh and Kansal, 2003).

Some workers have attempted to improve the sensory and nutritive characteristics of Shrikhand by adding fruit pulp. Nigam *et al.* (2009) have studied the effect of papaya pulp on the quality characteristics of Shrikhand.

The Apple (*Malus x malus*) is one of leading fruits which is grown in temperate regions of the world. Its beautiful appearance, crispy flesh, pleasant flavour and sweet taste attract the consumers (Ali *et al.*, 2004; Nour *et al.*, 2010). The sweet aroma of the apples is contributed to sugars, organic acids and phenolic compounds it contain (Petkovsek *et al.*, 2009). It contains numerous organic and inorganic compounds and micro and macro biogenic elements such as sugars, acids, pectin, tannins, starch, cellulose, vitamins, enzymes and phyto-hormones with major chemical elements being nitrogen, phosphorus, potassium, calcium, sulphur, iron and magnesium (Nour *et al.*, 2010).

The therapeutic value of apple is well known for different illnesses and is good for the treatment of anaemia, dysentery, heart disease, kidney stones and promotes vigour and vitality. It

determines the absorption of gastric secretions, the elimination of toxins and has diuretic effect (Nour *et al.*, 2010; Suni *et al.*, 2000).

Apples contain a large concentration of flavonoids, as well as a variety of other phytochemicals (Lee *et al.*, 2003). Apples and especially apple peels, have been found to have a potent antioxidant activity and can greatly inhibit the growth of liver cancer and colon cancer cells (Nour *et al.*, 2010; Boyer and Liu, 2004; Lee *et al.*, 2003). Malic acid is the predominant organic acid in apple fruits (Campeanu *et al.*, 2009) that maintains the liver in a healthy condition and also helps in digestion process (Nour *et al.*, 2010). Consumers are becoming more interested in the content of the health-promoting compounds in fruit because of their antioxidant activity (Robards *et al.*, 1999).

Shrikhand is often prepared by adding saffron to enhance its colour and appearance and flavour. Present study explores the use of dried flower of the Amaranthaceae family i.e., *Celosia argentea* as a colouring agent in the preparation of Shrikhand. The dried flower part of the plant *Celosia argentea* can be also be explored as a colouring agent in various other milk products like flavoured milks. Thus present study was envisaged to study the effect of apple pulp and *Celosia argentea* (dried flower part) on the quality characteristics of Shrikhand.

MATERIALS AND METHODS

Preparation of Shrikhand: Fresh buffalo milk was procured from local market of Jammu in 2010 and standardized at 4% fat and 9% SNF (Solid not fat). Dahi was procured from local market and used as culture. Milk was boiled and then cooled down at 28° C and inoculated by the previous day dahi at the rate of 1.5% and incubated at 28-30°C for 10-12 h until a firm coagulum was formed. Coagulum was then crushed and was transferred to a double muslin cloth and hung for expulsion of whey for 8-10 h in refrigerated conditions (4±1°C). The semi solid chakka obtained after drainage of whey was used as the base for Shrikhand. Based on the various preliminary trials the level of sugar was adjusted at 40%. The sugar was converted to powder in mixer-grinder before use and the mixture was well kneaded for uniform mixing. Shrikhand was prepared by using different levels of apple pulp viz. 10, 20 and 30% replacing chakka in the formulation. Shrikhand prepared without apple pulp served control and was compared with the treatments.

Colouring agent: Traditionally dried flower part of *Celosia argentea* is used as a colouring agent in various meat products of Jammu and Kashmir. One percent solution of *Celosia argentea* of initial milk taken was used as a natural colouring agent in the product. The solution was made by mixing 10 g of dried *Celosia flowers* with 1000 g of milk. The mixture was kept as such for soaking for two hours and than boiled for two minutes. The mixture was thereafter filtered through double muslin cloth and used in the preparation of dahi.

Sensory evaluation: The sensory evaluation of the product was carried for attributes, namely appearance and colour, flavour, juiciness, body and texture, sweetness and the overall acceptability of fresh and stored samples by a panel of seven trained members composed of scientists and research scholars of the division based on a 8-point hedonic scale, wherein 8 denoted “extremely desirable” and 1 denoted extremely undesirable (Semman *et al.*, 1987). The product was cooled to the refrigeration temperature (4±1°C) and coded samples were prepared and served cold to the panelists. Panelists were seated in a room free of noise and odours and suitably illuminated. Water was provided for oral rinsing between the samples.

Analytical procedures: The pH was determined by the method of Keller *et al.* (1974) using a digital meter (Systronics Digital pH Meter 803, serial No. 603). The moisture, protein, fat and ash content was determined as per the manual of methods of analysis of foods (Lab Manual 1, 2005). Thiobarbituric acid reacting substances value during storage was determined using the method described by Witte *et al.* (1970). Microbiological profile viz. total plate count, psychrophilic count, yeast and mould count and coliform count in the samples were determined by method described by APHA (1984) using vertical laminar flow (Thermo Electron Corporation, D-63505 Langensfeld, Robert Boschstr.1, Germany). Readymade media procured from Hi-Media Laboratories Pvt. Ltd. were used for the analysis.

Refrigerated storage: On the basis of various sensory parameters, Shrikhand containing 20% apple pulp and dried *Celosia argentea* flower was selected as optimum. The optimum product was further packed in polystyrene cups and stored under refrigerated conditions at 4±1°C for a period of three weeks.

Statistical analysis: Means and standard errors were calculated for different parameters. Factorial design of experiment was followed. Analysis of variance was performed by Snedecor and Cochran (1980). In significant effects, least significant differences were calculated at appropriate level of significance for a pair wise comparison of treatment means.

RESULTS

Proximate composition: The mean values of various proximate parameters of Shrikhand containing 0, 10, 20 and 30% of apple pulp are presented in Table 1. The mean moisture values of Shrikhand ranged from 50.47% to 55.48%. A significantly ($p < 0.05$) increasing trend was observed with increasing level of the apple pulp. The mean moisture percent of control samples (50.47%) was significantly lower than 10% (52.88%), 20% (53.53%) and 30% (55.48%) samples. The mean moisture percentage of 10 and 20% samples were comparable to each other. **The mean moisture percentage of 10 and 20% samples were comparable to each other.** The mean protein values of Shrikhand ranged from 3.17 to 6.25%. A significantly ($p < 0.05$) decreasing trend was observed with increasing level of the apple pulp. The mean fat percentage values of Shrikhand ranged from 8.24 to 11.16%. A significantly ($p < 0.05$) decreasing trend was observed with increasing level of the apple pulp. The mean ash percentage values of Shrikhand ranged from 0.25 to 0.59%. A significantly ($p < 0.05$) decreasing trend was also observed with increasing level of the apple pulp.

Sensory attributes: The mean values of various sensory parameters of Shrikhand containing 0, 10, 20 and 30% of apple pulp are presented in Table 2. Table revealed that apple pulp had a

Table 1: Proximate composition of shrikhand containing different levels of apple pulp. (Mean±SE)*

Parameters (%)	Level of apple incorporated (%)			
	0	10	20	30
Moisture	50.47±0.46 ^a	52.88±0.04 ^b	53.53±0.07 ^b	55.48±0.08 ^c
Protein	6.25±0.11 ^a	5.16±0.10 ^b	4.18±0.12 ^c	3.17±0.09 ^d
Fat	11.16±0.07 ^a	10.52±0.24 ^b	9.29±0.11 ^c	8.24±0.09 ^d
Ash	0.59±0.07 ^a	0.45±0.01 ^b	0.38±0.02 ^b	0.25±0.01 ^c

*Mean±SE with different superscripts in a row differs significantly ($p < 0.05$), n = 6 for each treatment

Table 2: Sensory attributes of shrikhand containing different levels of apple pulp. (Mean± SE)*

Sensory attributes	Level of apple incorporated (%)			
	0	10	20	30
Colour and appearance	7.09±0.12	7.05±0.10	7.00±0.11	6.98±0.10
Flavour	6.45±0.10 ^a	6.63±0.09 ^{ab}	6.93±0.10 ^b	6.86±0.10 ^b
Juiciness	6.43±0.14 ^a	6.74±0.11 ^{ab}	6.84±0.09 ^b	7.03±0.09 ^b
Body and texture	7.02±0.10 ^a	6.93±0.09 ^{ab}	6.63±0.12 ^{ab}	6.52±0.16 ^b
Overall acceptability	7.12±0.10 ^a	6.93±0.09 ^a	6.64±0.12 ^{ab}	6.53±0.12 ^b

*Mean±SE with different superscripts in a row differs significantly (p<0.05). Mean values are scores on 8 point descriptive scale where 1- extremely poor and 8- extremely desirable, n = 21 for each treatment

Table 3: Effect of *Celosia argentea* on the sensory attributes of shrikhand. (Mean±SE)*

Sensory attributes	Level of apple incorporated (%)		
	0 (without celosia)	20 (with celosia)	20 (without celosia)
Colour and appearance	6.71±0.10 ^a	7.12±0.09 ^b	6.69±0.11 ^a
Flavour	6.47±0.09 ^a	6.98±0.09 ^b	6.95±0.10 ^b
Juiciness	6.49±0.12 ^a	6.97±0.10 ^b	6.94±0.09 ^b
Body and texture	7.00±0.10	6.78±0.10	6.76±0.11
Overall acceptability	6.88±0.10 ^a	7.10±0.09 ^b	6.74±0.10 ^a

*Mean±SE with different superscripts in a row differs significantly (p<0.05). Mean values are scores on 8 point descriptive scale where 1- extremely poor and 8- extremely desirable, n = 21 for each treatment

significant (p<0.05) influence on flavour, juiciness, body and texture and overall acceptability. The mean values of colour and appearance scores of Shrikhand ranged from 6.98 to 7.09. The appearance scores showed a declined trend with increase in apple pulp, though the decline was non-significant (p>0.05). The scores of flavour as well as juiciness showed a significantly (p<0.05) increasing trend with increasing level of apple pulp. The mean flavour scores ranged from 6.45 to 6.86 whereas mean juiciness scores ranged from 6.43 to 7.03. The mean flavour and juiciness scores of control samples (6.45, 6.43) were comparable with samples containing 10% apple pulp (6.63, 6.74) whereas all other values were comparable to each other. The mean body and texture and overall acceptability scores showed a similar trend and decreased significantly (p>0.05) with increasing levels of apple pulp. The mean scores of body and texture and overall acceptability ranged from 6.52 to 7.02 and 6.53 to 7.12 respectively. The mean score of control samples was comparable with the scores of samples containing 10% and 20% level of apple pulp whereas it was significantly (p>0.05) higher than samples containing 30% apple pulp.

The mean values of various sensory parameters of Shrikhand containing *Celosia argentea* and 0 and 20% apple pulp are presented in Table 3. A significant (p>0.05) influence of *Celosia argentea* was seen on the colour and appearance and overall acceptability of the product. The samples containing *Celosia argentea* showed a significantly (p>0.05) higher colour and appearance (7.12) and overall acceptability (7.10) scores than control samples (6.71, 6.88) and samples containing 20% apple pulp (6.69, 6.74).

Microbiological and physico-chemical parameters: The mean values of various microbiological and physico-chemical characteristics of aerobically packaged shrikhand with optimum level of apple pulp and *Celosia argentea* and control are presented in Table 4. Mean

Table 4: Effect of refrigerated storage on microbiological and physico-chemical characteristics of aerobically packaged shrikhand. (Mean±SE)*

Treatments	Storage period (days)			
	0	7	14	21
Total plate count (log cfu g⁻¹)				
C (0%)	1.44±0.07 ^A	1.78±0.04 ^B	1.98±0.04 ^B	2.42±0.01 ^C
SC (20%)	1.41±0.08 ^A	1.75±0.04 ^B	1.95±0.03 ^B	2.39 ±0.02 ^C
Psychrophilic count (log cfu g⁻¹)				
C (0%)	Not detected	1.38±0.06 ^A	1.77±0.06 ^B	1.87±0.04 ^B
SC (20%)	Not detected	1.31±0.04 ^A	1.74±0.05 ^B	1.85±0.04 ^B
Coliform count (log cfu g⁻¹)				
C (0%)	Not detected	Not detected	Not detected	Not detected
SC (20%)	Not detected	Not detected	Not detected	Not detected
TBA (mg malonaldehyde kg⁻¹)				
C (0%)	0.32±0.02 ^{Aa}	0.44±0.01 ^{Ba}	0.67±0.02 ^{Ca}	0.78±0.01 ^{Ca}
SC (20%)	0.30±0.02 ^{Aa}	0.36±0.01 ^{Ab}	0.49±0.01 ^{Bb}	0.59±0.02 ^{Bb}

*Mean±SE with different superscripts in a row wise (upper case alphabet) and column wise (lower case) differ significantly (p<0.05), n: 6 for each treatment, C: Control shrikhand without Celosia and apple pulp, SC: Shrikhand with 20% apple pulp and dried *Celosia argentea*

values of total plate count (log cfu g⁻¹) showed a significantly (p>0.05) increasing trend with increasing storage days. The mean values ranged from 1.44 to 2.42 cfu g⁻¹ for control samples and from 1.41 to 2.39 cfu g⁻¹ for samples containing 20% apple pulp and *Celosia argentea*. Mean values of psychrophilic count (log cfu g⁻¹) also showed a significantly (p>0.05) increasing trend with increasing storage days however, the counts were not detected on the 0th day of storage. The mean values ranged from 1.38 to 1.87 cfu g⁻¹ for control samples and from 1.31 to 1.85 cfu g⁻¹ for samples containing 20% apple pulp and *Celosia argentea*. Coliforms were not detected throughout the period of storage.

The mean values of Thiobarbituric Acid Reacting Substances (TBARS) showed a significantly (p>0.05) increasing trend with storage days. The mean values ranged from 0.32 to 0.78 mg malonaldehyde kg⁻¹ for control samples and from 0.30 to 0.59 mg malonaldehyde kg⁻¹ for treatment samples. Furthermore, mean values of treatment samples on 7th, 14th and 21th day of storage were significantly lower than the control samples respectively.

Sensory parameters: The mean values of various sensory parameters of aerobically packaged shrikhand with optimum level of apple pulp and *Celosia argentea* and control are presented in Table 5. A significant effect of storage was observed on all the sensory parameters. The mean values of colour and appearance showed a significantly (p>0.05) decreasing trend with increasing storage days for both control as well as treatment samples. The scores ranged from 6.72 to 5.52 for control samples and from 7.21 to 5.95 for treatment samples. The colour and appearance scores of treatment samples were significantly (p>0.05) higher than control samples on all days of storage.

The mean scores of flavour, body and texture and sweetness also showed a significantly (p>0.05) decreasing trend with increasing storage days for both control as well as treatment samples. The scores ranged from 7.10 to 5.85, 7.10 to 5.85 and 7.00 to 5.88 for control samples and from 7.13 to 5.98, 7.00 to 5.74 and 7.03 to 5.95 for treatment samples respectively.

The mean scores of overall acceptability also showed a significantly (p>0.05) decreasing trend with increasing storage days for both control as well as treatment samples. The scores ranged from

Table 5: Effect of refrigerated storage on sensory attributes of aerobically packaged *shrikhand*. (Mean±SE)*

Treatments	Storage period (days)			
	0	7	14	21
Colour and appearance				
C (0%)	6.72±0.10 ^{Aa}	6.43±0.11 ^{ABa}	6.18±0.10 ^{Ba}	5.52±0.09 ^{Ca}
SC (20%)	7.21±0.11 ^{Ab}	6.85±0.10 ^{ABb}	6.54±0.10 ^{Bb}	5.95±0.10 ^{Cb}
Flavour				
C (0%)	7.10±0.12 ^A	6.84±0.10 ^{AB}	6.63±0.10 ^B	5.85±0.10 ^C
SC (20%)	7.13±0.11 ^A	6.87±0.11 ^{AB}	6.68±0.11 ^B	5.98±0.10 ^C
Body and Texture				
C (0%)	7.10±0.09 ^A	6.74±0.11 ^B	6.51±0.09 ^B	5.85±0.11 ^C
SC (20%)	7.00±0.09 ^A	6.63±0.10 ^B	6.45±0.09 ^B	5.74± 0.10 ^C
Sweetness				
C (0%)	7.00±0.11 ^A	6.81±0.10 ^A	6.48±0.11 ^B	5.88±0.10 ^C
SC (20%)	7.03±0.10 ^A	6.87±0.11 ^A	6.54±0.10 ^B	5.95±0.10 ^C
Overall acceptability				
C (0%)	6.78±0.11 ^{Aa}	6.49±0.10 ^{ABa}	6.19±0.10 ^{Ba}	5.62±0.11 ^{Ca}
SC (20%)	7.12±0.11 ^{Ab}	6.88±0.11 ^{ABb}	6.53±0.09 ^{Bb}	5.92±0.10 ^{Cb}

*Mean±SE with different superscripts in a row wise (upper case alphabet) and column wise (lower case) differ significantly (p<0.05), n: 21 for each treatment. C: Control shrikhand without Celosia and apple pulp, SC: Shrikhand with 20% apple pulp and *Celosia argentea*

6.78 to 5.62 for control samples and from 7.12 to 5.92 for treatment samples. Further the overall acceptability scores of treatment samples were significantly (p>0.05) higher than control samples on all days of storage.

DISCUSSION

Proximate composition: The mean moisture values of Shrikhand showed a significantly (p<0.05) increasing trend with increasing level of the apple pulp. This may be due to the higher moisture content of apple pulp in comparison to the chakka. A significantly (p<0.05) decreasing trend was observed in the protein, fat and ash content of *Shrikhand* with increasing level of the apple pulp. The probable reason may be due to the lower protein, fat and ash content of the apple pulp in comparison to the chakka. Similar results were obtained by Desai *et al.* (1994) who prepared yoghurt by using different types of fruit's. Comparable results were also found by Vagdalkar *et al.* (2002) who prepared shrikhand by using different levels of cocoa powder and papaya pulp separately. Nigam *et al.* (2009) also reported the similar findings by incorporating papaya pulp in the Shrikhand.

Sensory attributes: Apple pulp had a significant (p<0.05) influence on flavour, juiciness, body and texture and overall acceptability of the Shrikhand. The colour and appearance scores showed a declined trend with increase in apple pulp, though the decline was non-significant (p>0.05). Flavour and juiciness of Shrikhand showed a similar pattern. The scores showed a significantly (p<0.05) increasing trend with increasing level of apple pulp. The mean flavour and juiciness scores of control samples were comparable with samples containing 10% apple pulp whereas all other values were comparable to each other. The mean body and texture and overall acceptability scores showed a similar trend and decreased significantly (p>0.05) with increasing levels of apple pulp. The mean score of control samples was comparable with the scores of samples containing 10% and 20% level of apple pulp whereas it was significantly (p>0.05) higher than samples containing 30% apple pulp. Nigam *et al.* (2009) studied incorporation of papaya pulp in the manufacture of

Shrikhand and reported a similar decline in the sensory attributes of the product with the increasing level of incorporation.

Furthermore, a significant ($p>0.05$) influence of *Celosia argentea* was seen on the colour and appearance and overall acceptability of the product. The samples containing *Celosia argentea* showed a significantly ($p>0.05$) higher colour and appearance and overall acceptability scores than control samples and samples containing 20% apple pulp without *Celosia argentea*. Based on various sensory attributes and physico-chemical parameters, product containing 20% apple pulp and *Celosia argentea* was selected as optimum and the product was aerobically packaged and stored for a period of three weeks for further studies.

Microbiological and physico-chemical parameters: Mean values of total plate count ($\log \text{cfu g}^{-1}$) showed a significantly ($p>0.05$) increasing trend with increasing storage days. Jain (2003) observed a similar increase in total plate count while studying the microbiological quality of milk nuggets at refrigeration temperature. Bhat *et al.* (2010) also reported the similar results during the refrigerated storage of dietetic Kashmiri saffron phirne from reconstituted skim milk. Mean values of psychrophilic count ($\log \text{cfu g}^{-1}$) also showed a significantly ($p>0.05$) increasing trend with increasing storage days however, the counts were not detected on the 0th day of storage. Jain (2003) and Bhat *et al.* (2010) also reported the similar results. Coliforms were not detected throughout the period of storage. Bhat *et al.* (2010) also reported zero coliform count of dietetic Kashmiri saffron phirne during the refrigerated storage.

The mean values of Thiobarbituric Acid Reacting Substances (TBARS) showed a significantly ($p>0.05$) increasing trend with storage days. However, mean values of treatment samples on 7th, 14th and 21th day of storage were significantly lower than the control samples respectively. It may be due to the antioxidant effects of apple pulp and *Celosia argentea*.

All the changes in the quality of Shrikhand during refrigerated storage were within the limits of acceptability.

Sensory parameters: A significant effect of storage was observed on all the sensory parameters. The mean values of colour and appearance showed a significantly ($p>0.05$) decreasing trend with increasing storage days for both control as well as treatment samples. The colour and appearance scores of treatment samples were significantly ($p>0.05$) higher than control samples on all days of storage. The mean scores of flavour, body and texture and sweetness also showed a significantly ($p>0.05$) decreasing trend with increasing storage days for both control as well as treatment samples. The mean scores of overall acceptability also showed a significantly ($p>0.05$) decreasing trend with increasing storage days for both control as well as treatment samples. Further the overall acceptability scores of treatment samples were significantly ($p>0.05$) higher than control samples on all days of storage. Patel *et al.* (1993) reported that the overall acceptability score of chakka decreased with increase in storage period due to deterioration of flavour. Jain (2003), Nigam *et al.* (2009) and Bhat *et al.* (2010) also reported similar decline in the sensory parameters of various dairy products during refrigerated storage.

CONCLUSIONS

Apple pulp was successfully utilized in the preparation of *Shrikhand* without adversely affecting the quality of the product. The product prepared with 20% apple pulp and *Celosia argentea* was selected as optimum on the basis of various sensory and physico-chemical parameters. The product developed could be stored for a period of three weeks under refrigeration temperature ($4\pm 1^\circ\text{C}$) without deterioration in the quality of the product.

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