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J Srinivas
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Jessie Suneetha W
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

K Uma Maheswari
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

B Anila Kumari
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

S Suchiritha Devi
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

N Krishnaiah
Department of Veterinary Public Health & Epidemiology, College of Veterinary Science, P.V. Narasimha Rao Telangana Veterinary University, Rajendranagar, Hyderabad, Telangana, India

Correspondence
Jessie Suneetha W
Department of Foods & Nutrition, Post Graduate & Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Nutritional analysis of value added Shrikhand

J Srinivas, Jessie Suneetha W, K Uma Maheswari, B Anila Kumari, S Suchiritha Devi and N Krishnaiah

Abstract
Shrikhand is a semi-soft, sweetish-sour milk product prepared from lactic fermented curd. Value added shrikhand was developed by incorporation of whey protein concentrate and beetroot powder at 3 and 0.5% respectively. This addition resulted in decrease of moisture by 3.57% whereas ash (21.3%), fat (8.0%), carbohydrates (4.4%) and energy (5.5%) showed an increase. There was neither significant increase nor decrease in the protein content.
The titratable acidity in both control and value added shrikhand was low on the day zero and increased by 21st day of storage by 12.2% and 26.1%. The total milk solids content of control and value added shrikhand increased by 4.1% and 2.5% respectively. The reducing sugars content of control and value added shrikhand increased by 30.77% and 38.33% respectively during storage. The pH for control changed from 5.6 to 3.9 and in value added shrikhand from 5.7 to 4.1 at day 0 to 21.

Keywords: Fermented products, value added shrikhand, shelf life of shrikhand, beetroot powder, whey protein concentrate.

Introduction
Indigenous dairy products have played an important role in socio-economic life of Indians since times immemorial accounting for over 90% of dairy products consumed (Singh, 2007) [21]. Milk products are prepared to increase the shelf life and preserve its nutritive value as milk is the most perishable product (Harper and Richard, 2008) [12]. Fermented milk products have therapeutic, anti-choleterolemic and anti-carcigenic properties since antiquity (Boghra and Mathur, 2000) [8]. Preservation of milk using fermentation with lactic acid bacteria is one of the oldest and efficient methods to preserve milk with its valuable nutrients as it's a 'probiotic' product (Kongo and Malcata, 2016) [15].
Shrikhand is a semi-soft, sweetish-sour milk product prepared from lactic fermented curd (Singh *et al.*, 2014) [22]. The name shrikhand is derived name from the Sanskrit word "Shikharani" meaning a curd prepared with added sugar, flavouring agents like saffron, fruits and nuts. It is popular in western India and is very refreshing particularly during summer months and is recommended for people with as it have (Swapna and Chavannavar, 2013) [25]. The consumption of shrikhand was reported to be effective in treatment of many diseases like diarrhea, acidity and gastro enteritis (Patel and Schauen, 1997) [17].

Material and Methods
Value addition to WPC added shrikhand with beet root powder: The 3% WPC shrikhand added with 0.5% beet root powder was found to be most acceptable with pleasant flavor, smooth texture and glossy surface appearance without any free wheying off (Srinivas, *et. al.*, 2016) [24].
Colour quality of the samples was estimated by using Hunter lab calorimeter (Hunter Lab, 2013) [13]. Proximate analysis was carried to the control and value added shrikhand as per the procedures followed by standard AOAC methods. Moisture, ash and protein (AOAC, 2005) [4-7], fat (AOAC, 1997) [2], carbohydrate and energy (AOAC, 1980) [1], tritrable acidity of the shrikhand (AOAC, 2000) [3], total milk solids (AOAC, 2005) [4-7] and reducing sugars by Fehling's method (AOAC, 2000) [3] were used.

Results and Discussion
The shrikhand samples were analyzed for the colour quality and proximate properties which included moisture, ash, protein, fat, carbohydrate and energy content.

Colour analysis of shrikhand: Color scores of the standardized shrikhand were presented as L*, a* and b* values in the Table 1.

Generally the L* value ranges from 0 to 100 indicating luminance or lightness component along with two chromatic components, a* component from green to red and the b* component from blue to yellow. The L*a*b* units are often used in food research studies to determine the uniform distribution of colors as L*a*b* units are very close to human perception of colour.

The colour is important as it improves the visual appeal of the food product to which it is added (Meena, 2013) [16]. The colour of the WPC and beet root powder added to shrikhand was analysed. The value added shrikhand was red in color as beetroot contains anthocyanins and other colored components. The colour values ΔL, Δa and Δb for control and SWB samples are shown in Table 1.

Table 1: Colour analysis of shrikhand

Shrikhand	ΔL	Δa	Δb
Control	46.45^{a}±0.92	10.75^{a}±1.15	6.16^{a}±0.50
SWB	62.96^{b}±3.30	13.17^{b}±1.43	6.99^{b}±0.38
Mean	54.71	11.96	6.58
S.E	1.71	0.92	0.34
C.D	4.19	2.26	0.82
C.V (%)	4.43	10.90	7.24

Note: Values are expressed as mean ± standard deviation of three determinations.

Means within the same column followed by a common letter do not significantly differ at $p \leq 0.05$

Control: chakka with 40% sugar

SWB: control with 3% WPC and 0.5% beet root powder

The maximum colour change for shrikhand was observed in L* value followed by a* and b* with respect to control sample and was significant at $p<0.05$.

Moisture: The moisture content of control shrikhand was 50.32% and the minimum moisture content was observed for value added shrikhand with 48.52%. The value added shrikhand showed 3.57% decrease in moisture content in comparison with control sample with significant difference ($p<0.05$) as the bound water may have been taken by the value added ingredients.

Ash: The ash content was 0.81% and 0.98% for the control and value added products respectively. The results indicated that ash content showed a significant difference ($p<0.05$) between the products. The ash content increased by 21.3% of value added shrikhand in comparison with control due to the addition of WPC and beet root powder.

Fat: The results obtained showed that the fat content was 7.95% and 8.58% in control and value added product. An increase of 8.0% was observed in the value added shrikhand and significant difference at $p<0.05$ was observed.

Protein: The protein content was 8.39% and 8.78% for the control and value added product respectively. There was no significant increase in the protein content between the two samples.

Carbohydrates: The carbohydrate content was 30.86% for control and 32.22% for sample. An increase of 4.4% was observed in the value added shrikhand.

Energy: The energy content was 228.60 Kcal/100g for control and 241.27 Kcal/100g for the value added sample. Addition of WPC and beet root powder showed an increase of 5.5% in the energy content.

Changes in the nutritional quality characteristics of value added shrikhand during storage: The shrikhand samples were analyzed during storage for the proximate properties which includes moisture, ash, protein, fat, carbohydrate and energy content and the percentage change during storage were presented in Figure 1.

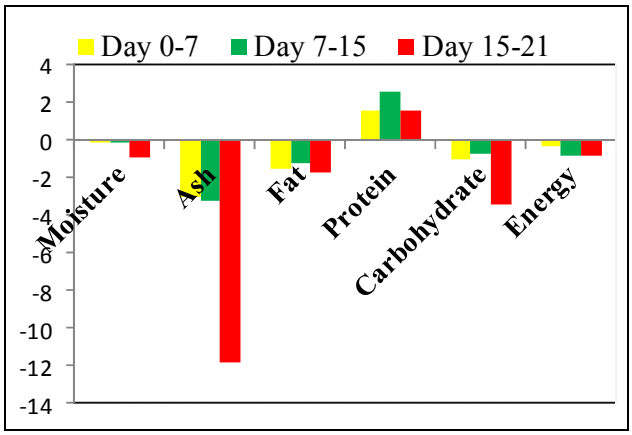

Fig 1: Percentage change in nutritional quality characteristics of value added shrikhand

The moisture content in the control and value added shrikhand showed a decrease of 0.38% during storage. The ash results revealed that there was 12.3% and 17.6% decrease in mean ash content of control and value added shrikhand respectively during storage. The fat content showed a decrease of 4.9% and 4.3% in the control and value added shrikhand respectively during storage. The protein content increased by 5.85% control and value added shrikhand.

The carbohydrate content decreased by 3.45% and 5.15% for control and value added shrikhand respectively during storage. The addition of WPC and beet root powder showed an increase of 5.5% in the energy content of the value added shrikhand when compared to control on day zero. But on storage, the energy content of control shrikhand decreased by 2.4% and 1.92% in value added shrikhand.

Minor quality characteristics of value added shrikhand: The minor attributes which may also affect the nutritional properties were titratable acidity, total solids and reducing sugars.

Table 2: Minor attributes of value added shrikhand during storage

Treatment	Day	Control	SWB	Mean	CD
Tritrable acidity (%)	0	0.82^{a}±0.01	0.88^{b}±0.01	0.850	0.023
	7	0.84^{a}±0.01	0.92^{b}±0.01	0.885	0.014
	15	0.88^{a}±0.01	0.97^{b}±0.01	0.928	0.018
	21	0.92^{a}±0.01	1.11^{b}±0.01	1.016	0.030
Total milk solids (%)	0	60.20^{a}±0.05	62.69^{b}±0.17	61.452	0.287
	7	61.07^{a}±0.02	63.11^{b}±0.03	62.093	0.058

	15	62.11[a]±0.01	63.52[b]±0.01	62.814	0.034
	21	62.60[a]±0.01	64.15[b]±0.03	63.372	0.050
Reducing sugars (%)	0	2.21[a]±0.02	2.53[b]±0.04	2.373	0.082
	7	2.33[a]±0.01	2.97[b]±0.01	2.653	0.034
	15	2.52[a]±0.01	3.34[b]±0.01	2.934	0.030
	21	2.89[a]±0.01	3.50[b]±0.01	3.120	0.030
pH	0	5.6[a]±0.01	5.7[b]±0.01	5.650	0.011
	7	5.1[a]±0.01	5.3[b]±0.01	5.200	0.013
	15	4.7[a]±0.01	4.8[b]±0.01	4.750	0.010
	21	3.9[a]±0.01	4.1[b]±0.01	4.000	0.012

Note: Values are expressed as mean ± standard deviation of three determinations.
Means within the same column followed by a common letter do not significantly differ at p≤ 0.05
Control: chakka with 40% sugar
SWB: control + 3% WPC+ 0.5 % beet root powder

On the day of storage, the acidity content was 0.82% and 0.88% for the control and value added product respectively. There was an increase of 7.3% in the titratable acidity in the value added shrikhand. The total milk solids content was 60.20% and 62.69% for the control and value added product respectively. An increase of 4.1% acidity was observed in the value added shrikhand. The reducing sugars content was 2.21% and 2.53% in the control and the sample. An increase of 14.5% was seen in the value added shrikhand was seen.

The percentage change during storage minor attributes like titratable acidity, total solids and reducing sugars is shown in Table 2. The titratable acidity in both control and value added shrikhand was low on the day zero and increased by 21st day of storage by 12.2% and 26.1%. The total milk solids content of control shrikhand increased by 4.1% and in value added shrikhand by 2.5%. The reducing sugars content of control and value added shrikhand increased by 30.77% and 38.33% respectively during storage. The pH for control changed from 5.6 to 3.9 and in value added shrikhand from 5.7 to 4.1 at day 0 to 21.

The reducing sugar contents in all cases were found to increase with decrease in sucrose levels may be due to breakdown of sucrose during storage and finally samples became unacceptable for consumption (Sharma *and* Zariwala, 1980) [20]. Moreover the continued storage of shrikhand at 5 ± 1^0 C further revealed that fresh shrikhand was having 2.96% reducing sugar which increased to 3.39% during 5 day storage and finally reached to 4.70% in 35 days storage. This trend did indicate that there was comparatively less reduction in sucrose during short period of storage and substantial decrease was noticed at longer duration storage (Khurana and Kanawjia, 2007) [14].

This gradual increase in titratable acidity with the storage period was due to the conversion of lactose into lactic acid and other organic acids by the starter cultures along with a fall in pH of shrikhand (Ghatak and Dutta, 1998) [11]. The lactose content of shrikhand was dependent on the extent of lactose degradation and moisture content of shrikhand (Boghra and Mathur, 2000) [8] and similar result in pH for shrikhand during storage at 5±1ºC were reported by Reddy *et al*. (1984) [18].

The storage study of replacement of sugar with stevia powder in shrikhand revealed that there was an increased microbial load and decrease in fat, protein, ash and moisture content in both the control and experimental sample after 21 days of storage period (Rolly, 2014) [19].

Sonawane, *et al*., (2007) [23] report that the addition of sugar to shrikhand at levels 30 and 40% with strawberry pulp at 10, 15 and 20% on weight basis of chakka showed a decrease in moisture content during storage period. The acidity of shrikhand increased as pulp level increased when samples were stored at room temperature.

The sensory properties of shrikhand blended with banana pulp at 10, 20 and 30% were analysed and the sample with the 20% incorporation of banana pulp showed no significant difference in sensory attributes up to 14 days in comparison with other two samples (Narayanan and Lingam, 2013).

David (2015) [10] prepared herbal shrikhand by incorporating aqueous basil extract @ 1%, 2%, 3% and 4% and evaluated the various physico-chemical, organoleptic and microbiological parameters. The physico-chemical analysis results showed that treatment of basil @ 4% was best accepted and had maximum moisture, protein, ash content, antioxidant activity and acidity while the control sample had maximum total solids, fat content and pH. Jamun enriched shrikhand contained 12.78% jamun pulp powder and 30.66% sugar was developed by Chandra and Vinod (2015) [9]. The jamun pulp powder showed maximum influence on colour, flavour and overall acceptability where as the sugar concentration greatly affected the sweetness, body and texture.

Singh *et al.,* (2014) [22] evaluated microbial content of soy fortified shrikhand containing soymilk of 45% and cane sugar of 30.0%. This sample was considered most suitable formulation for with highly palatability with permissible microbial count.

Conclusion

In conclusion, the value addition resulted in decrease of moisture by 3.57% whereas ash (21.3%), fat (8.0%), carbohydrates (4.4%) and energy (5.5%) increased. There was neither significant increase nor decrease in the protein content.

The titratable acidity and pH in both control and value added shrikhand increased may be due to the conversion of lactose to lactic acid. The total milk solids content of control and value added shrikhand increased by 4.1% and 2.5% respectively. The reducing sugars content of control and value added shrikhand increased by 30.77% and 38.33% respectively during storage. The increase in the nutritional quality parameters may be due to the loss of moisture from the stored product.

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