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VC Kedaree

Department of Animal
Biotechnology, College of
Agricultural Biotechnology,
Loni, Tal. Rahata, Dist.
Ahmednagar, Maharashtra,
India

SD Nalkar

Department of Animal
Biotechnology, College of
Agricultural Biotechnology,
Loni, Tal. Rahata, Dist.
Ahmednagar, Maharashtra,
India

VV Sansare

Department of Animal
Biotechnology, College of
Agricultural Biotechnology,
Loni, Tal. Rahata, Dist.
Ahmednagar, Maharashtra,
India

Preparation of shrikhand with incorporation of pineapple powder

VC Kedaree, SD Nalkar and VV Sansare

Abstract

The present study was carried out using different levels of pineapple powder with a view to optimize the process for its manufacture and to study its chemical, sensory and microbiological qualities. Initially the preliminary trials were conducted by blending of different levels of pineapple powder @ 0, 1, 2 and 3 % in the pineapple shrikhand with 35% sugar to finalize the experimental treatments. Experimental pineapple shrikhand samples were analyzed for sensory, chemical and microbiological qualities. It was observed that pineapple shrikhand samples under different treatments showed significant differences for total solid, fat, protein, ash, acidity and moisture content. The values were ranged from 49.90 to 47.86 %, 14.83 to 14.40%, 12.75 to 12.46%, 1.188 to 1.148%, 1.450 to 1.410%, and 52.15 to 50.06%, respectively. Total solids, Fat, Protein, Ash, Acidity and Moisture contents differed significantly among the different types of shrikhand with pineapple powder. Significant difference was observed within the smell and taste score and the body and texture score of different types of shrikhand. In case of sensory evaluation, colour and appearance and overall acceptability found to be significant over the other treatments. The microbial results indicate the SPC count was among the different treatments. Overall, the shrikhand was acceptable at 1st day because the count was within the acceptable limit. The yeast and mould and coliform count was not detected up to 15 days. The high microbial load may be due to inadequate cleaning or aseptic condition. Hence, it is recommended that the aseptic condition should be maintained during product preparation. So, it was suggested that shrikhand could be prepared successfully by adding different proportion of pineapple powder. It was suggested to incorporate pineapple powder @ 3 % which showed better overall acceptability and result among the all treatments.

Keywords: Shrikhand, pineapple powder, body and texture, color and appearance, sensory evaluation, microbial evaluation

Introduction

Shrikhand is one the most popular fermented milk products for taste and therapeutic value. Shrikhand contains appreciable amount of milk protein and phospholipids and is obtained by lactic acid fermentation through the action of *Lactobacillus bulgaricus*, *Streptococcus lactic*, *Streptococcus diacetylactis*, *Lactobacillus citrovoroum* and *Streptococcus thermophilus*.

Shrikhand is one of the important fermented milk products which derive its name from the Sanskrit word "Shikharani" meaning a curd prepared with added sugar, flavoring agents (cardamom and Saffron), fruits and nuts. It is popular in western part, especially in Maharashtra, Gujarat and Karnataka. Shrikhand is known for its high nutritive, characteristic flavor, 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 disease due to its low fat and sugar contents. (More *et al.*, 2017)^[10].

Indias market potential and current growth rate of traditional dairy products is unparalleled and all set to boom further under the technology of mass production. 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, desiccation and fermentation. Indian fermented milk products utilize 7% of total milk produced and mainly includes three product dahi, shrikhand (sweetened concentrated curd) and lassi which may be considered the western equivalent to yogurt, quarg and stirred yogurt, respectively.

Fermented milk products constitute a vital component of the human diet in many regions of the world. In the Indian sub-continent such products are also classified as "indigenous milk products" like dahi (curd), lassi, shrikhand etc. which are prominent in people's diet. Shrikhand is the indigenous fermented milk product prepared by the fermentation of milk by using known strain of lactic acid bacteria.

Corresponding Author:

VC Kedaree

Department of Animal
Biotechnology, College of
Agricultural Biotechnology,
Loni, Tal. Rahata, Dist.
Ahmednagar, Maharashtra,
India

Shrikhand is extensively used as a sweet dish after meals. It is also used as a festive sweet in India. Sugar is added as additive to the Shrikhand to enhance taste and does not have any preservative effect. Other natural additives like dried fruits are added to the shrikhand to enhance flavor. Shrikhand is traditionally made at home in western India.

Pineapple (*Ananas comosus*) is one of the most important commercial fruit crops in the world. It is known as the queen of fruits due to its excellent flavour and taste. Pineapple is the third most important tropical fruit in the world after Banana and Citrus. Pineapples are consumed or served fresh, cooked, juiced and can be preserved. Mature fruit contains 14% of sugar; a protein digesting enzyme, bromelin, and good amount of citric acid, malic acid, vitamin A and B.

Pineapple is a wonderful tropical fruit having exceptional juiciness, vibrant tropical flavor and immense health benefits. Pineapple contains considerable amount of calcium, potassium, vitamin C, carbohydrates, crude fiber, water and different minerals that is good for the digestive system and helps in maintaining ideal weight and balanced nutrition. Pineapple is a common fruit in Bangladesh and it has minimal fat and sodium. It contains 10-25 mg of vitamin. Pineapple composition has been investigated mainly in the edible portion. Considering the health benefits of pineapple and shrikhand in human diet it is proposed to carry out the present investigation in combination.

Materials and Methods

The research was conducted in Department of Animal Biotechnology, College of Agricultural Biotechnology, Loni. Commercial grade clean, white crystalline cane-sugar and pineapple powder were procured from local market of Loni, Tal. Rahata, Dist- Ahmednagar.

In this phase, the following different levels of pineapple in shrikhand were studied.

T₀ - Control (without addition of pineapple powder) and 35% sugar.

T₁ - Shrikhand prepared from 99% Chakka, 1% pineapple powder and 35% sugar.

T₂ -Shrikhand prepared from 98% Chakka, 2% pineapple powder and 35% sugar.

T₃ -Shrikhand prepared from 97% Chakka, 3% pineapple powder and 35% sugar.

Preliminary trials were conducted to find out the blending ability of pineapple powder with Shrikhand to have proper body and texture. After trying different levels of pineapple powder the above proportion were finalized for the study.

Physico-Chemical Analysis

The total solid content of milk, pineapple and chakka were determined by gravimetric method as per IS: 1479 (part II), 1961^[8]. The fat content was determined by using standard Gerber method as described in IS: 1224 (part II), 1977. The protein content was determined by estimating the per cent nitrogen by Micro-kjeldhal method as recommended in IS: 1479 (part II), 1961^[8]. The per cent nitrogen was multiplied by 6.38 to find out protein percentage in shrikhand. Per cent ash content was determined by the method described in A.O.A.C., 1975. Per cent moisture content was determined by gravimetric method as per IS: 1479 (part II) 1961^[8]. The acidity of shrikhand expressed as per cent lactic acid was determined by the method described in IS: 1479 (part I), 1960^[7].

Sensory Evaluation

The fresh sample of shrikhand were evaluated organoleptically by nine point hedonic scale for various quality attributes such as general appearance, body, texture and flavour by panel of 8-10 judges. The experimental samples were served to the judges at 7°C. The panelists were instructed to rate each sample on 9 point hedonic scale. They were provided hedonic scale score cards for evaluating the quality of product as described in IS: 6273 (part-II) 1971^[5].

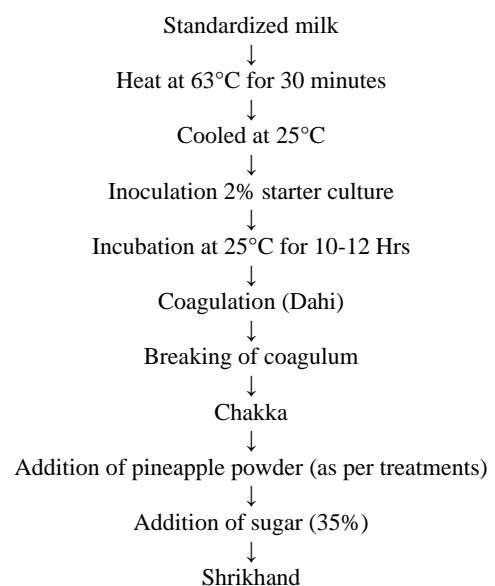
Microbiological Analysis

All the treatment samples of pineapple shrikhand along with control sample were stored at 4°C and analysed for different microbial parameters such as standard plate count, coli form count, yeast and mould count by adopting standard procedure as given by (Dubey and Maheshwari, 2004) throughout the storage period.

Statistical Analysis

For present investigation RBD i.e. Randomised Block Design was employed using three replications. The data were tabulated and analysed according to Snedecor and Cochran (1994)^[12].

Flow chart for preparation of Pineapple shrikhand



Results and discussion

Table 1: Chemical analysis of buffalo milk, curd and pineapple powder

Sr. No.	Constituents	Buffalo milk (%)	Chakka	Pineapple powder
1	Total Solid	15.78	30.94	96.34
2	Fat	6.12	14.84	0.62
3	Protein	3.90	12.76	2.84
4	Ash	0.76	0.82	2.42
5	Acidity	0.14	1.46	0.54

These observations indicate that the buffalo milk used in the present investigation was of good quality. Chakka used for shrikhand preparation had on an average fat content 14.84 per cent, acidity 1.46 per cent, protein 12.76 per cent and total solids 30.94 per cent.

Table 2: Effect of different levels of pineapple on total solids of shrikhand

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	47.92	47.88	47.78	47.84	47.855 ^d	0.05172
T ₁	48.57	48.66	48.58	48.59	48.60 ^c	0.035355
T ₂	49.1	49.34	49.26	49.18	49.22 ^b	0.089443
T ₃	49.88	49.8	49.94	49.96	49.895 ^a	0.062249

It was observed that the total solid content showed gradual increase with the increase in level of pineapple powder. This simultaneous increase from T₀ to T₃ may be due to high amount of total solid content of pineapple powder (96.34) than buffalo milk (15.78), chakka (30.94). The highest total solid content was noticed at T₃ i.e. shrikhand blended with 3% pineapple powder, while the lowest total solid content was observed at T₀ i.e. shrikhand without pineapple powder. Treatment T₃ was found to be significantly superior over the treatments T₂, T₁ and T₀, respectively.

Table 3: Effect of different levels of pineapple powder on fat content of pineapple shrikhand (Per cent)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	14.84	14.8	14.82	14.84	14.825 ^a	0.016583
T ₁	14.7	14.72	14.7	14.7	14.705 ^b	0.00866
T ₂	14.55	14.52	14.54	14.52	14.5325 ^c	0.01299
T ₃	14.41	14.42	14.38	14.4	14.4025 ^d	0.01479

Blending with pineapple powder had significantly affected the fat content of shrikhand. It was observed that blending of pineapple powder decrease the fat content of shrikhand. The declining trend of fat content of shrikhand can be attributed to the fact that the fat content of pineapple powder is much lower (0.62 per cent) than that of milk and chakka. Besides, obvious reason is that as the level of pineapple powder increased, there was reduction in amount of milk and chakka on added percentage basis.

The average fat content of pineapple shrikhand was 14.62 per cent. The highest fat content in shrikhand (14.825) was observed in (T₀) i.e. shrikhand without pineapple powder and the lowest (14.4025 per cent) at 3 per cent level of pineapple powder (T₃). Treatment T₀ was found to be significantly superior over the treatments T₁, T₂ and T₃, respectively.

Table 4: Effect of different levels of pineapple powder on protein content of pineapple shrikhand (per cent)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	12.76	12.72	12.76	12.74	12.745 ^a	0.016583
T ₁	12.66	12.62	12.68	12.68	12.66 ^b	0.024495
T ₂	12.56	12.58	12.56	12.58	12.57 ^c	0.01
T ₃	12.47	12.45	12.44	12.48	12.46 ^d	0.015811

Variation in protein content was significant. The average protein content of shrikhand was 12.745, 12.66, 12.57 and 12.46 per cent for T₀, T₁, T₂ and T₃, respectively. The highest level (12.745 per cent) of protein content was noticed at treatment T₀ i.e. without pineapple powder, lowest (12.46 per cent) at T₃ i.e. 3% pineapple powder.

It was observed that the protein content showed gradual decrease in shrikhand with the increase in level of pineapple powder. The simultaneous decrease from T₀ to T₃ may be due to high amount of protein content of pineapple powder (2.84 per cent). Treatment T₀ found significantly different than the T₁ and T₂ and T₃. All treatment found significantly different of 5% level of significance.

Table 5: Effect of different levels of pineapple powder on ash content of pineapple shrikhand (per cent)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	1.15	1.13	1.16	1.15	1.1475 ^c	0.010897
T ₁	1.16	1.14	1.16	1.16	1.155 ^c	0.00866
T ₂	1.18	1.16	1.18	1.18	1.175 ^b	0.00866
T ₃	1.19	1.19	1.18	1.19	1.1875 ^a	0.00433

It was observed that the ash content showed gradual increase with increase in level of pineapple powder. The simultaneous increase from T₀ to T₃ may be due to total amount of ash content of pineapple powder (2.42). The lowest ash content was observed at T₀ i.e. shrikhand without pineapple powder, while the highest ash content was observed at T₃ i.e. shrikhand with 3% pineapple powder (1.1875). Treatment T₃ found significantly different than the other treatments whereas treatment T₀ found at par the treatment T₁.

Table 6: Effect of different levels of pineapple powder on acidity of pineapple shrikhand (per cent)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	1.46	1.44	1.45	1.45	1.45 ^a	0.007071
T ₁	1.46	1.44	1.44	1.45	1.4475 ^a	0.008292
T ₂	1.44	1.42	1.42	1.42	1.425 ^b	0.00866
T ₃	1.44	1.4	1.4	1.4	1.41 ^c	0.017321

Variation in acidity of pineapple shrikhand was found to be significant. It was observed that the acidity showed gradual decrease with the increase in level of pineapple powder. This simultaneous decrease from T₀ to T₃ may be due to low amount of acidity of pineapple powder (1.41). The lowest acidity was noticed at T₃ i.e. shrikhand blended with 3% pineapple powder, while the highest acidity was observed at T₀ i.e. shrikhand without pineapple powder. Treatment T₀ found significantly different than T₂ and T₃ treatments whereas treatment T₁ found at par with treatment T₀.

Table 7: Effect of different levels of pineapple powder on moisture content of pineapple shrikhand (per cent)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	52.08	52.12	52.22	52.16	52.145 ^a	0.05172
T ₁	51.43	51.34	51.42	51.41	51.40 ^{bc}	0.035355
T ₂	50.09	50.66	50.74	50.82	50.5775 ^c	0.287087
T ₃	50.12	50.02	50.06	50.04	50.06 ^d	0.037417

The lowest level of moisture content was noticed at treatment T₃ i.e. 3% pineapple powder, highest (52.145 percent) at T₀ i.e. without pineapple powder. It was observed that the moisture content showed gradual decrease in shrikhand with the increase in level of pineapple powder. The simultaneous decrease from T₀ to T₃ may be due to low amount of moisture content of pineapple powder (3.66 per cent). Treatment T₀ was found to be significantly superior over the treatments T₁, T₂ and T₃, respectively.

Sensory evaluation of pineapple shrikhand

Table 8: Score for Colour and appearance of pineapple shrikhand (out of nine)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	7.17	7.36	7.06	6.92	7.1275 ^c	0.160838
T ₁	7.7	7.82	8.08	8.05	7.9125 ^b	0.158647
T ₂	8.21	7.28	8.22	8.22	7.9825 ^{ab}	0.405609
T ₃	8.72	7.82	8.88	8.65	8.5175 ^a	0.411241

Score for colour and appearance was increased and sometimes decreased due to addition of pineapple powder. The highest score (8.5175) was observed for treatment T₃ i.e. shrikhand blended with 3% pineapple powder and this highest score may be due to its peculiar slightly greenish colour and appearance which was liked most by the judges. Lowest score (7.1275) was observed for treatment T₀ i.e. shrikhand blended without pineapple powder. The lowest score may be due to its white colour which was not accepted by judges. Treatment T₃ was found to be significantly superior over the treatments T₀, T₁ and T₂, respectively.

Table 9: Score for body and texture of pineapple shrikhand (out of nine)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	7.32	7.16	7.33	7.17	7.245 ^d	0.080156
T ₁	7.7	7.97	8.1	7.81	7.895 ^c	0.152398
T ₂	8.3	8.28	8.16	8.38	8.28 ^b	0.07874
T ₃	8.66	8.69	8.74	8.79	8.72 ^a	0.049497

Shrikhand prepared from T₃ level recorded highest score. (8.72) followed by T₂ (8.28). The sensory score increased at T₃ i.e. 3 per cent level pineapple powder. Treatment T₃ was found to be significantly superior over the treatments T₁, T₂ and T₀, respectively.

Table 10: Score for flavour of pineapple shrikhand (out of nine)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	7.06	7.14	7.12	6.99	7.0775 ^d	0.05847
T ₁	7.87	8.05	7.94	7.93	7.9475 ^c	0.064952
T ₂	8.17	8.39	8.59	8.55	8.425 ^b	0.165151
T ₃	8.93	8.87	8.84	8.86	8.875 ^a	0.033541

Shrikhand prepared from T₃ level recorded highest score for flavour (8.875) followed by T₂ (8.425), T₁ (7.9475) and T₀ (7.0775). The sensory score increased at T₃ i.e. 3 per cent level pineapple powder. Treatment T₃ was found to be significantly superior over the treatments T₂, T₁ and T₀, respectively.

Table 11: Score for consistency of pineapple shrikhand (Out of nine)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	7.29	7.31	7.57	8.44	7.6525 ^c	0.467888
T ₁	7.72	7.8	7.99	7.8	7.8275 ^{bc}	0.099342
T ₂	8.28	8.28	7.92	8.29	8.1925 ^b	0.157381
T ₃	8.61	8.75	8.81	8.82	8.7475 ^a	0.083778

Shrikhand prepared from T₃ level recorded highest score for flavour (8.7475) followed by T₂ (8.1925), T₁ (7.8475) and T₀ (7.6525). The sensory score increased at T₃ i.e. 3 per cent level of pineapple powder. Treatment T₃ was found to be significantly superior over the treatments T₂, T₁ and T₀, respectively.

Table 12: Score for overall acceptability of pineapple shrikhand (out of nine)

Particulars	R ₁	R ₂	R ₃	R ₄	Average	S.D.
T ₀	7.21	7.24	7.27	7.13	7.213125 ^d	0.052481
T ₁	7.7475	7.91	8.0275	7.8975	7.895625 ^c	0.099426
T ₂	8.24	8.3075	8.2225	8.36	8.2825 ^b	0.054858
T ₃	8.73	8.7825	8.8175	8.78	8.7775 ^a	0.031175

Shrikhand prepared from 3 per cent pineapple powder scored highest score (8.7775), followed by shrikhand prepared from

2% per cent pineapple powder (8.2825), and 1% pineapple powder (7.895625). On the basis of results obtained, amongst different levels of pineapple powder T₃ (3 per cent pineapple powder) treatment was found more acceptable for blending.

The results of overall acceptability scores thus indicate that lowest score was noticed for shrikhand blended without pineapple powder. Treatment T₃ found significantly different than the treatments T₀, T₁ and T₂. All the treatments found significantly different from each other at 5% level of significance.

Changes in microbial qualities of Pineapple shrikhand during storage

Standard plate count

It was observed that standard plate counts of pineapple shrikhand increased with increase in storage period for samples stored at room temperature of 4°C. The SPC of all the treatments were not detected at 7th day of storage period. However, it was increase at 7th day and 15th days of storage. As per the result, all the SPC count was within the acceptable limit up to 15th day.

Yeast and mould count

A yeast and mould count of fresh shrikhand was not detected upto 15th days of preservation at 4^o C.

Coli form count

The coliform count was not detected in all the treatments such as T₀, T₁, T₂ and T₃ from 1st to 15th days of storage.

Production of cost

The cost of pineapple shrikhand production blended with pineapple powder was worked out by considering the prevailing retail cost of ingredients only. Data indicated the cost of ingredients only and other cost factors remains constant for all treatments and were not accounted for cost estimation. Cost of ingredients increased with the increase in the level of pineapple powder. The yield of pineapple shrikhand shows inclining trend, with the increase in the level of pineapple powder, which resulted in increasing cost of production on weight basis.

The highest cost (T₃) was recorded in case of pineapple shrikhand blended with 3 per cent pineapple powder, while lower cost (T₀) recorded in case of shrikhand without pineapple powder. It was observed that the cost of pineapple shrikhand was increased with the increase in the level of pineapple powder flavour. The production cost of most acceptable level (T₃) was Rs- 131.44/kg.

Conclusion

From the results of the present investigation, it may be concluded that pineapple powder could be successfully utilized for the development of shrikhand. The most acceptable level of shrikhand can be prepared by using 3 per cent pineapple powder. The pineapple powder had a positive effect on flavor acceptability and its consumption. On the basis of microbial analysis it may be concluded that the product is acceptable upto 15th day of storage.

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