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Studies on chemical and microbial qualities of *basundi* stored under retort packaging

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Abstract

In this investigation attempts were made to evaluate the chemical and microbial qualities of *basundi* under retort packaging. The Retort processed *basundi* samples were compared with the non-retort processed *basundi* stored at 37 °C and 5 °C for about 35 days and observed the chemical and microbial qualities of product at 5 days interval. The retort processed *basundi* during storage time all the samples in various treatments showed marginal decrease in fat, protein, lactose, total sugar, pH and increase in sucrose, total solid, ash, FFA and acidity during storage for both the treatments of retort processed pouches were stored at 37 °C and 5 °C. The microbial evaluation of the samples indicated that, the retort processed sample stored at 37 °C was commercially sterile up to 35th day of storage. However, the *basundi* without retort processing and stored at 37 °C and 5 °C was shown drastic change in the microbial load and unacceptable because of microbial spoilage. Obtained results were leads to conclude that, the retort processing of *basundi* and stored at 37 °C can enhance the shelf life up to 35th day of storage.

Keywords: *Basundi*, chemical analysis, microbial analysis, retort packaging, shelf life

Introduction

Basundi is one of the heat desiccated indigenous dairy product, popular in western part of India, mostly in Maharashtra and Gujarat. The market value of product depends upon a relative creamy consistency, white to light brown colour, sweetish caramel aroma and soft textured flakes uniformly distributed throughout the product mass (Patange *et al.*, 2006) [20]. It has high nutritive and food value owing to the concentration of milk to 2 to 2.5 fold and presence of sugar at high level. Sugar serves as a preservative apart from adding to the rich taste of *basundi*. Traditionally *basundi* is prepared from buffalo milk which is concentrated along with the scrapping and agitating, to about 2 fold by slow boiling in open kettle. Sugar at the rate of 6 to 7 per cent of milk added at the last stage of concentration followed by optional addition of flavours and nuts. The product is cooled and served chilled (Pal and Raju, 2007) [18].

The in-packet sterilization can be archived in cans, jars, tubs and pouches. Sterilization of food is differing than that of retort packaging. Retort packaging may be defined as a process for preservation of a food in which food is sealed before cooking for long-term un-refrigerated storage. This packaging has largely influence on the shelf life of food products.

Material and Methods

Material

Buffalo milk was obtained from Dairy farm, RCSM College of Agriculture, Kolhapur. Cane sugar was procured from local market of Kolhapur city. An iron karahi was used for preparation of *basundi*. Stirrer used for stirring-cum scrapping the milk during preparation of *basundi*. L.P.G. gas was used as heating media. Cream separator was used for separation of cream and skim milk for standardization. Retort pouch procured from Modern Scientific Store, Karnal, Haryana. All glasswares used were of Borosil make for analytical work. Electronic weighing balance capacity 3000g was used for weighing during the course of investigation. Refrigerator used to kept samples. Sealing machine used for sealing the pouches. Autoclave used to sterilize the pouch (retorting). Digital pH meter was used for measuring pH during the period of investigation. All the chemicals required for analytical work was used of Analytical Reagent (AR) and Guaranteed Reagent (GR) grade manufactured by Merk, India Ltd/Glaxo India Ltd.

Methodology

Basundi was prepared as per the procedure, given by Aneja *et al.* (2002) [3]. Initially buffalo milk was standardized to 6 per cent fat by Pearson square method (De, 1980) [5]. The standardized milk was then allowed to boil in Karahi. During boiling milk was continuously stirred and scrapped to avoid burning till the concentration reaches to 2:1. Followed by addition of sugar, which was 6 per cent of milk taken. The heating was continued for few minutes. Prepared *basundi* was allowed to cool down at room temperature. Prepared *Basundi* was hot filled to around 100 ml in retortable pouches using funnel. The pouches were sealed properly using a sealing machine with 3 mm seal width. The air tight sealed retortable pouches was kept in autoclave at 121 °C for 15 min. These sealed pouches were retorted in autoclave at 121 °C for 15 min. and stored as per treatments and compared with non-retorting.

The treatments were as follows

T₁: Basundi stored at refrigerated temperature without retort packaging.

T₂: Basundi stored at refrigerated temperature with retort packaging.

T₃: Basundi stored at room temperature without retort packaging.

T₄: Basundi stored at room temperature with retort packaging. Each sample of *basundi* was evaluated further to chemical and microbial analysis at 5 days interval during storage.

Analytical methods

Physico-chemical Analysis of *Basundi* under retort packaging

The fat content of the *basundi* was determined By Mojonnier method by Chaudhury (1959) [4]. For determination of protein the formal titration method described by Aneja *et al.* (2002) [3]. The lactose of *basundi* was estimated by Lane-Eynon's method given in IS: 1479 (Part-II) 1961. Total sugar of *basundi* was determined as per Lane-Eynon's method given in IS: 1479 (Part-II) 1961. The total ash content was determined as per the method described in AOAC (1995) [1]. Total solids was determined as per method given in: IS 1479 (Part- II), 1961. Free Fatty Acids (FFA) content of *basundi* samples was determined by the method suggested by Deeth and Fitz-Gerald (1975) [6]. The titratable acidity of *basundi* sample was determined as per procedure stated in IS: 1479 (Part-I) 1960. pH was measured by (A.O.A.C. 1995) [1].

Microbial analysis

Standard plate count (SPC) was determined by (IS 5402: 1969). Yeast and mould was determined by (IS 5403:1999: Reaffirmed 2005). The coli form count of the samples of *basundi* was determined as per the Procedure described in IS: 5404, (1995)

Statistical Analysis

The research data analyzed in respect of Completely Randomized Design (CRD) with equal replications (Snedecor and Cochran, 1994). Replications – Five Treatment – Four.

Results and Discussion

Storage related changes in physico-chemical attributes of *basundi* under retort packaging

Fat

The minimal fat percentage (10.77) was recorded in sample T₃ and maximum fat percentage (10.86) was recorded in sample T₄ on 5th day of storage. The samples T₁, T₂ and T₄ were found to be at par to each other. While sample T₃ was on par over the all other treatments. For the sample preserved under treatment T₂ there was a gradual reduction in fat percentage and it was 10.96, 10.84, 10.77, 10.54, 10.34, 10.10, 9.84 and 9.66 per cent on 0, 5, 10, 15, 20, 25 and 30th day of storage period, respectively. The average fat percentage were found to be 10.97, 10.86, 10.77, 10.54, 10.32, 10.07, 9.77, 9.63 and 9.48 in case of *basundi* treated with T₄ on 0, 5, 10, 15, 20, 25, 30 and 35th day of storage respectively. Treatment T₂ and T₄ were at par to each other throughout the storage period. Decrease in fat content during storage might be due to, the increased in rancidity and lipolytic activity which was in consonance with decrease in fat content. Observations in present study corroborate with those reported by Mohammedali *et al.* (2013) [16].

Protein

Protein content was decreased as storage period increased, accordance with the data pertained, it was found that, on the day of preparation of samples were found to be non-significant. Despite slow but steady decrease in protein contents in T₂ and T₄ was non-significantly differed at P<0.05 throughout the storage period protein might have undergone through denaturation. Similar findings were also reported by Navajeevan and Rao (2005) [17] in *Kunda*.

Lactose

The lactose content of *basundi* decreased as storage period increased, accordance with the data obtained T₂ and T₄ does not showed marked difference. *Basundi* stored under T₂ and T₄ showed marginal variation in lactose content from 8.19 to 7.50 and from 8.18 to 7.40 per cent, respectively. The lactose content decreased drastically during storage from 8.14 to 5.92 per cent in T₁ within 20 days of storage and from 8.18 to 5.87 per cent in T₃ within 5 days of storage. The decreasing trend in lactose as a function of storage period might be due to occurrence of millard reaction. Despite slow but steady decrease in lactose contents in T₂ and T₄ these values are not statistically significant ($p < 0.05$). This corroborates with previous studies by Gaucher *et al.* (2008) [8].

Sucrose

The treatments T₂ and T₄ showed marginal variation in sucrose content from 15.67 to 15.99 per cent up to 35th day and 15.69 to 16.08 per cent up to 40th day respectively. There was non-significant difference between T₂ and T₄ up to storage of storage period of 35 days. The sucrose content in *basundi* was increased during storage from 15.68 to 16.70 per cent in T₁ within 20 days of storage and from 15.68 to 16.71 per cent in T₃ within 5 days of storage. Probably the enzymatic activities might be responsible for the increased sucrose content in the *basundi* during storage present study corroborate with those reported by Gaikwad and Hembade (2011) [7].

Total sugar

It was revealed from data that, the treatments T₂ and T₄ showed marginal variation in total sugar from 23.85 to 22.03 per cent and 23.85 to 21.87 per cent respectively. The total sugar decreased drastically during storage from 23.82 to 22.79 per cent in T₁ within 20th day of storage and from 23.86 per cent to 23.21 per cent in T₃ within 5th day of storage. Decreased in total sugar content of *basundi* in retort processed pouches were lowered than that of without retort processed pouches might be due to, the decreasing rate of lactose was more than, that of increasing rate of sucrose content during storage due to microbial activities in non-retort processed pouches. This trend has been also reported by Gaikwad and Hembade (2011)^[7].

Ash

The ash content of *basundi* samples treated with treatments T₁, T₂, T₃ and T₄ was increased as storage period increased. The *basundi* stored under T₂ and T₄ showed the marginal increase in ash from 1.56 to 1.86 per cent up to 35th day and 1.54 to 1.85 per cent up to 40th day respectively, which were non significant throughout storage period. The ash increased drastically during storage from 1.49 to 1.86 per cent in T₁ within 20 days of storage and from 1.49 to 1.74 per cent in T₃ within 5 days of storage. The ash content of retort processed *basundi* was lesser as compared with, without retort processed *basundi* during storage. The increased in ash content might be due to increase in minerals by enzymatic and microbial activities, observations of present study agreed with those reported.

Total solid

Samples T₂ and T₄ showed marginal increase in total solid (%) from 40.02 to 40.52 up to 35th day of storage and 40.03 to 40.50 up to 40th day of storage respectively. There was no much difference between T₂ and T₄ up to storage period of 35 days. The total solid increases drastically during storage from 40.04 to 40.49 per cent in T₁ within 20 days of storage and from 40.04 to 40.19 per cent in T₃ within 5 days of storage. The increased in total solids might be due to, increase in ash content and other minerals during storage period. The observations present study corroborates with those reported by Navajeevan and Rao (2005)^[17] in Kunda.

Free Fatty Acid (FFA)

The FFA content increased gradually during storage in T₂ and T₄ *basundi* samples. The FFA content of *basundi* samples showed marginal variation from 0.59 to 2.02 µeq/ml in case of T₂ up to 35th day and 0.59 to 2.05 µeq/ml in case of T₄ during period of 40 days storage at 5 °C and 37 °C

respectively. The FFA values changes significantly from 0.58 to 1.97 µeq/ml in case of T₁ at the end of 20th days of storage at 5 °C and 0.60 to 1.58 in case of T₃ at the end of 5th day of storage at 37 °C. Increased lipolysis in terms of FFA was reported in heat desiccated dairy products like Burfi (Palit, 1998)^[19] and Rabri (Acharya, 2003)^[2]. There may be possibility of slow hydrolysis of milk fat in *Basundi* during storage leading to a release of FFA.

Acidity

For T₂ and T₄ treated *basundi* had recorded marginal variation in acidity from 0.40 to 0.67 (% LA) and 0.40 to 0.69 (% LA) respectively. Treatment T₂ and T₄ does not showed remarkable difference throughout storage period of 35 days. Acidity also increased in retort processed *basundi* similar result was also observed by Navajeevan and Rao, (2005)^[17] in *Kunda*. The increase in acidity could also be due to the action of microorganisms as well as production of organic acids during processing and storage. Similar results were also reported by Goyal and Srinivasan (1989)^[9].

pH

It was observed that, the pH showed a decreasing trend on storage for both, with retort and without retort processed *basundi*. Samples T₂ and T₄ showed marginal variation in pH from 6.30 to 5.84 and 6.30 to 5.78, respectively. There was no marked difference between T₂ and T₄ throughout storage period. The pH decreased significantly during storage from 6.58 to 5.66 in T₁ within 20 days of storage and from 6.56 to 5.45 in T₃ within 5 days of storage. This decrease in pH could be attributed to the maillard reaction, taking place during storage leading to the production of organic acids. Similar drop in pH of sterilized kheer during storage has also been reported by Jha *et al.* (2011)^[15].

Microbiological quality of *basundi*

It was observed from the data obtained of microbial quality, standard plate count was nil for the samples processed at T₂ and T₄ up to 35 days of storage at 5°C and 37°C respectively. While in T₁ and T₃ SPC count was observed from 1st day of storage. In case of treatment T₂ and T₄, no Coliform Count, Yeast and molds count were observed in the first 30 days of storage but counts were observed at 35th day of storage. So it can be observed that there is no considerable increase in the microbial counts during storage indicating sterilization effect by the retort processing. The results reflected commercial sterility of *basundi* subjected to retort processing. The results are in agreement with the results of Raghvendra and Pagote (2006)^[22].

Table 1: Data* obtained for different chemical properties in retort processed *basundi* stored under room temperature during storage period.

| Chemical properties | Storage period (Days) | | | | | | | | |
|----------------------------|-----------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| Fat (%) | 10.97±0.01 | 10.86±0.01 | 10.86±0.01 | 10.54±0.02 | 10.32±0.02 | 10.07±0.02 | 9.77±0.02 | 9.63±0.02 | 9.48±0.01 |
| Protein (%) | 7.60±0.05 | 7.24±0.02 | 7.00±0.05 | 6.77±0.05 | 6.56±0.04 | 6.36±0.04 | 6.18±0.04 | 6.06±0.03 | 5.95±0.02 |
| Lactose (%) | 8.18±0.07 | 7.98±0.04 | 7.91±0.06 | 7.80±0.05 | 7.67±0.05 | 7.60±0.06 | 7.52±0.04 | 7.46±0.02 | 7.40±0.01 |
| Sucrose (%) | 15.69±0.01 | 15.69±0.01 | 15.78±0.01 | 15.81±0.01 | 15.88±0.01 | 15.93±0.01 | 15.93±0.01 | 16.00±0.01 | 16.08±0.01 |
| Total Sugar (%) | 23.85±0.05 | 23.39±0.05 | 22.77±0.05 | 22.77±0.05 | 22.46±0.04 | 22.46±0.04 | 22.24±0.04 | 22.10±0.04 | 21.87±0.03 |
| Ash (%) | 1.54±0.04 | 1.57±0.02 | 1.57±0.02 | 1.64±0.01 | 1.69±0.01 | 1.6±0.01 | 1.78±0.01 | 1.81±0.01 | 1.85±0.01 |
| Total Solids (%) | 40.03±0.01 | 40.05±0.01 | 40.11±0.01 | 40.16±0.01 | 40.24±0.01 | 40.30±0.01 | 40.39±0.01 | 40.46±0.01 | 40.50±0.01 |
| Free Fatty Acids (µeq/ml) | 0.59±0.02 | 0.59±0.02 | 1.48±0.03 | 1.68±0.01 | 1.85±0.02 | 1.97±0.01 | 1.97±0.01 | 2.00±0.01 | 2.05±0.01 |
| Acidity (% of Lactic Acid) | 0.40±0.01 | 0.44±0.01 | 0.46±0.01 | 0.47±0.01 | 0.52±0.01 | 0.54±0.01 | 0.60±0.01 | 0.66±0.01 | 0.69±0.01 |
| pH | 6.30±0.02 | 6.18±0.02 | 6.11±0.01 | 6.06±0.01 | 6.00±0.02 | 5.92±0.01 | 5.87±0.01 | 5.81±0.01 | 5.78±0.01 |

(* mean± SE of five replications of treatment T₄)

Table 2: Changes in microbial (CFU) quality in retort processed *basundi* during storage

| Treatments | | Storage period (Days) | | | | | | | | |
|----------------|-----|-----------------------|---------------------|--------------------|--------------------|---------------------|-----|-----|-----|-----|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| T ₁ | SPC | 67×10 ² | 89×10 ² | 48×10 ³ | 91×10 ³ | 62×10 ⁴ | - | - | - | - |
| | YMC | 3 | 31 | 148 | 1300 | 1960 | - | - | - | - |
| | CC | Nil | 8 | 52 | 105 | 1.4×10 ² | - | - | - | - |
| T ₂ | SPC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | - |
| | YMC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | 1 | - |
| | CC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | - |
| T ₃ | SPC | 69×10 ² | 5.3×10 ⁵ | - | - | - | - | - | - | - |
| | YMC | 3 | 21400 | - | - | - | - | - | - | - |
| | CC | Nil | 21 | - | - | - | - | - | - | - |
| T ₄ | SPC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| | YMC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | 2 |
| | CC | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | 1 |

(Note = - Indicated that the product has been spoiled, SPC: Standard plate count, YMC: Yeast and mould count, CC: Coliform count)

Conclusion

The *basundi* were content, fat 9.63 per cent, protein 6.06 per cent, lactose 7.46 per cent, sucrose 16.00 per cent, total sugar 22.10 per cent, ash 1.81 per cent, total solid 40.24 per cent, FFA 2.00 µeq/ml, acidity 0.66 (LA%) and pH 5.81 in the retort processed *basundi* stored at 37°C. Microbial evaluation indicated that the sample of retort processed *basundi* stored at 37°C was found to be commercially sterile.

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