Physicochemical and Microbiological Examination of Food Preservation Strategies of Indian Dishes Kalan and Gulab Jamun

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ABSTRACT

Background: The curd curry commonly known as kalan in Kerala and Gulab Jamun has been chosen in the present work which is relevant in accordance with its usage with common man. Kalan possesses a normal shelf of two days at normal temperature and room conditions. The present work attempted to preserve the product for two weeks or more at room temperature by applying canning technique. The shelf life of Kalan was proved to be enhanced to two more weeks with proper canning. Kalan is prepared in the laboratory and was packed in sterile bottles which were then sterilized by dipping in sterile hot water for thirty minutes. This process impairs the product sufficient sterility to enhance the preserving quality considerably. The product has been found unchanged in its flavor and taste after the expected expiry period. In the preparation of Gulab jamun, drying and frying strategies facilitates the removal of most of the contaminants and hence the product presented as sterile. The sugar syrup provides further preservation. This technique for preservation can thus become effective. The work presented an attempt that has been made to study the effect of processing/preservation technique.

Methods: Canning technique was applied as a preservation strategy to the product kalan and addition of sugar syrup presented to be the preservation technique for gulab jamun. Both were considered as the natural way of preservation rather than utilizing any artificial strategies or additions. The shelf life of the same was studied in detail under physiological, biochemical and microbiological parameters.

Result: The two food preservation techniques studied in this project are proved to impart better shelf life to the particular type of dairy based products without the addition of any preservative chemicals.

Key words: Canning, Drying, Gulab jamun, Kalan, Preservation.

INTRODUCTION

Developing countries shows importance for preserved foods as this century specialized with many modern techniques of packing of food items. Several processing techniques were there which are depended upon type of packing and period of storage (Banerjee, 1997). Many factors are assessed for designing the type of processing and packaging that made the food item safe for consumption and acceptable for customers (Rao, 2001).

There are several types of canning processes. Some of the milk products like processed cheese, butter oil, milk powder are preserved for sufficiently long period by canning procedure. Basic strategy in canning practice includes placing food in sealable containers, closing, heating and cooling. This method was being practiced since early 1800’s. Canned foods form a significant part of their diet in advanced nations. The containers generally preferred for most heat processed food are in cans. Glass jars are easy to clean, corrosion free and transparent and the product is visible to the consumer and some prefer products packed in containers. Glass containers have non corrosive property which was utilized for packing certain food products safely.

Fast foods or ready to serve food items or products possesses shorter shelf life. Their preserving quality can be improved by canning procedures. The shelf life of such products under normal conditions may be one or two days. But the shelf life can be increased to two months or more under suitable packing conditions. Kalan (Curd curry) is an acidic food. The heat of the containers and some holding time before cooling, the closed container renders Sterility and it’s commercially accepted. This time of canning was explained as hot pack or hot fill. Immersing in hot water for a sufficient period of time will enhance the shelf life of the filled cans. (Sukumar.de, 2003).

Sugar as a preservative strategy had been and has been practiced by people for some kind of food usually for sweets. Some of the indigenous milk products were prepared in sugar either crystalline or in syrup form. Sugar provides sweetens to the food product and performs antimicrobial activity by osmosis. Foods can be stored either in sugar syrup or in crystallized form where the food to be stored is cooked in sugar till the point of crystallization. Sugar acts...
by drawing out water from the bacteria and other microorganisms, which either kills the bacteria or inhibits their growth. Sugar reduces the water activity as well as it performs reverse osmosis and thus sugar acts as a food preservative.

Indian confectionary possesses khoa as one of its classic raw material. It is made by the slow evaporation of milk in open kettles with constant stirring. The moisture content is more than thirty percent and its stability was limited to 2-4 days. Gulab Jamun is usually prepared by deep frying of khoa balls and immersing it in sugar syrup of desired consistency. The Gulab jamun is balls of protein starch with the interstitial space with sugar syrup. Gulab Jamun available in Indian market is semi preserved and therefore its microbial status is an important factor in its utilization. Even though high sugar and low moisture content never favors microbial growth, there is still the danger of water absorption due to improper pack. Khoa is found to contain many pathogens. Proper hygienic practices are to be observed to prepare safe products for an effective utilization and consumer appraisal.

**MATERIALS AND METHODS**

**Ingredients chosen for Kalan**

Curd-1.5L, Sugar-25gm, Salt-15gm, Chilli powder-8gm, Turmeric powder-2gm, Pulp-500gm.

**Procedure in the preparation**

Curd and Pulp were added and mixed together which was further mixed with desired quantity of chilli and turmeric powders. Sugar was added and the mixture was heated till boil and was cooled to -80°C. Salt was added and filled in sterile bottles. The bottles were immersed in hot water at temperature in between 65-75°C and were sealed.

**Ingredients chosen for Gulab Jamun**

Khoa-850gm, Maida-98gm, Baking powder-1.4tsp, Sugar-2.8kg, Water-2.8kg, Ghee-1000gm.

**Procedure for Gulab Jamun preparation**

Sugar and water were boiled together to make sugar syrup. The khoa was weighed in a clean and dry SS tray. Immediately the tray was placed in ice water. The dough was made by addition of maida and baking powder with proper kneading. It was mixed by placing it above ice water to prevent fat oozing out of it. The same was made as small balls. The balls were deep fried in ghee without cracking till the outside become moderately brown and was placed in sugar syrup and transferred to clean and dry bottles for seal.

**Analysis Conducted for Gulab Jamun**

**Sugar of balls**

A little of sugar syrup was taken and its temperature was adjusted to 20°C. Sugar syrup was placed on brix meter and observed through the lens. The scale showed the brix of the syrup.

**Sugar of Concentrate by Brix Method**

**Step 1**

Forty gram of sample was taken in 100ml beaker and distilled water was added at 95°C to dissolve it. A stirring rode was used for the same. This was transferred to a 250ml conical flask with distilled water at 65°C. A maximum volume of 150ml was maintained. 6ml of ammonia solution was added and kept for 15 minutes. Acetic acid was added to neutralize the above solution which was tested with litmus paper to the appropriate. Xinc acetate and Potassium ferricyanide solution was added in 12.5ml quantities and mixed and made up to 250ml with distilled water and were mixed well and filtered using ordinary filter paper.

**Step 2**

Filtrate of 2.5 ml c was transferred to 100ml standard flask and to it, 25ml distilled water was added 6ml of 6.34N HCl solution was added along with the same. The system were kept in water bath at 65±3°C for 30 minutes. Entire apparatus was cooled to room temperature and was neutralized with NaOH solution. The system was made up to 100ml called as solution A2.

**Step 3**

A1 1.25ml was taken in a 250ml standard flask. The same was diluted to 250ml with distilled water. The solution was taken in a burette. Fehlings solution A and Fehling’s solution B was pipette into the conical flask 5ml each. The same apparatus was kept over a Bunsen burner and 20ml of solution from burette was added. The system was allowed to boil. Solution added from burette till color of titration turned reddish brown. 1ml of methylene blue solution was added. Titration was continued till one drop caused change of color to colorless.

**Step 4**

Solution A2 25ml was taken in 250ml flask. The same was diluted to 250ml with distilled water. The solution was taken in a burette. Fehlings solution A and Fehling’s solution B was pipette into the conical flask 5ml each. The same apparatus was kept over a Bunsen burner and 20ml of solution from burette was added. The system was allowed to boil. Solution added from burette till color of titration turned reddish brown. 1ml of methylene blue solution was added. Titration was continued till one drop caused change of color to colorless.

**General Physicochemical assay for both the food products**

**Total solids**

Lunder, 1971

Weight of an SS dish was recorded (W1) after dried in an oven. The sample was added on to the vessel and weight was calculated (W2). The entire system was dried in an oven at 105°C for 2hours. The weight was calculated (W3).

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\text{Total solids} = \left(\frac{W3-W1}{W2-W1}\right) \times 100
\]

**Analysis of the moisture content**

\[
\text{% of moisture} = \left(\frac{W2-W3}{W2-W1}\right) \times 100
\]
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pH -using Basic pH Paper
The pH of the product was noted by dipping a pH paper in the Kalan and by comparing the color change with standard chart.

Studies for shelf life
The product was stored and it was checked every 5 days. Organoleptic tests such as smell, color, taste, flavor and odor were tested at the time of opening of the product.

Microbiology (Yadav et al, 1993)
Standard plate count
The SPC was conducted for the approximate estimation of total number of bacteria in milk and milk products under standard conditions and with standard protocol.

Determination of coli form count
The samples after serial dilution were aseptically transferred to Petri dishes. The violet red agar medium was added. The plates were distributed for the uniform distribution of the media and are then solidified. A second thin layer was added and allowed to solidify. The same was then incubated at 37°C for 24 hours. The colonies were counted after incubation.

Determination of yeast and mould
After the transfer of serially diluted media under aseptic conditions to Petri dishes, a few drops of sterile tartaric acid was added. The PDA medium was cooled to -45°C and poured on to the plates. After rotation, the plates were allowed for solidification and the same was incubated at 22°C for 4-5 days.

RESULTS AND DISCUSSION
Kalan - physicochemical parameter analysis
Slight variation in total solids (Table 1) could not bring about any remarkable changes in the body and texture of the product. Since such type of products is not usually tried in industrial scale, a model recipe was not available to replicate. However we had tried to maintain ingredient concentration in that particular level because the curry had the average composition was the same in all cases, the total solid level was maintained at 82% level in all cases (Table 2). The brix value changed in accordance with the heat treatment given during its preparation.

Organoleptic tests such as smell, color, taste, flavor and odor were tested at the time of opening of the product. The characteristic taste of acidic, sweet, hot and spicy ingredients of kalan. The body and texture of curd curry was satisfactory in all cases. The product remained unaltered on organoleptic evaluation throughout the experimental period. The curd used was always having an acidity of about 1% lactic acid and the additional ingredients could not affect the pH of the product. The lower pH is inhibitory to most of the bacteria (Table 1). Further due to added salt and sugar the water activity becomes lower (Frazier, 2004). These factors are not favorable for the proliferation of bacteria. Hence the significance of bacteria like organisms in moderately preserved product become insignificant. But yeast and mould could be favored by the low pH; low salt and low sugar content of the product because of the mixed taste of the acidic, sweet, hot and spicy ingredients of kalan. Such products are unique and was being used by the people of Kerala from ancient times.

Gulab Jamun-Physicochemical parameter analysis
The Gulab jamun was prepared according to a recipe given in “outlines of dairy technology” (Sukumar De, 2003). Hence the composition was the same in all cases, the total solid level was maintained at 82% level in all cases (Table 2). The brix value changed in accordance with the heat treatment given during its preparation.

Sugar content of the balls was determined by Lane and Eyons method. The sugar % of balls shows similar value in the trials. Actually the balls absorb only low quantity of the sugar syrup. Hence the balls are not so sweet and are to be consumed along with other sugar groups.

Microbiology of Kalan
As mentioned earlier bacteria plays no significant role in the spoilage of kalan. The SPC of the product was so negligible to cause any undesirable change in the finished product. The coliform trial was also nil in all the trials. The yeast and mould count which could only be expected to bring about an undesirable fermentative change in the finished product was also nil in all the trials (Table 3). Hence the product was almost safe on microbiological considerations. However the product showed deterioration within two days after opening due to fungal growth.

Consumer appraisal
The body and texture of curd curry was satisfactory in all cases. We have observed that the characteristic taste of the product remained unaltered on organoleptic evaluation (Fig 1-6) throughout the experimental period.

Microbioogy of Gulab Jamun
The coli form count was nil in all the trials. That proves the hygienic practice adopted throughout the production and packaging of Gulab jamun was satisfactory. The SPC was negligible (Table 4). The product was preserved in sugar syrup of adequate strength so as to hinder any type of spoilage.

Table 1: Analysis of physicochemical parameters that influences the quality of food product Kalan (Curd Curry).
| Total solids | pH | Moisture | OLT |
|--------------|----|----------|-----|
| 14%          | 4  | 86%      | Good for three weeks |
| 16%          | 3.5| 84%      | Good for three weeks |
| 16.5%        | 3.8| 84.5%    | Good for three weeks |

Table 2: Analysis of physicochemical parameters that influences the quality of food product Gulab Jamun. (Lunder, T, L, 1971). (IDF, 1931).
| Total solids | Moisture | Sugar syrup brix | Sugar of balls % | OLT |
|--------------|----------|------------------|------------------|-----|
| 82           | 18%      | 61               | 23.4             | Good for two weeks |
| 82           | 18%      | 63               | 21.3             | Good for two weeks |
| 82           | 18%      | 60               | 23.0             | Good for two weeks |
bacterial growth. This assures safety of bacterial spoilage. Yeast and mould was also nil in all trials. The moisture content of the product can expect to fever only fungal growth but fungal contamination could be observed only after opening the package. Even then the high concentration of the sugar syrup was found to impart protection to the product.

**Consumer appraisal**

The organoleptic characteristics remained unaltered during the shelf life period of the two weeks at room temperature as examined.

The utilization of Sugar and Sugar substitutes were predicted by response surface methodology has been depicted for the preservation of Gulab jamun (Chetana et al, 2004). The processing conditions like temperature, 

**Table 3:** Coliform and yeast and mould count in food product Kalan after application of preservation strategies.

| Coliforms | SPC | Yeast and Mould |
|-----------|-----|-----------------|
| Nil       | Nil | Nil             |
| -         | 3   | -               |
| -         | 2.5 | -               |

**Table 4:** Coliform and yeast and mould count in food product Gulab Jamun after application of preservation strategies.

| Coliforms | SPC | Yeast and Mould |
|-----------|-----|-----------------|
| Nil       | 3.5 | Nil             |
| -         | 9.5 | -               |
| -         | 7   | -               |

![Fig 1: Sensory evaluation score card for Kalan-A.](image)

![Fig 2: Sensory evaluation score card for Kalan B.](image)

![Fig 3: Sensory evaluation score card for Kalan C.](image)
sugar strength, duration of soaking will influence the stability of the product as indicated in researches. The kalan usualy prepared by standard preservation technique including canning and through it the shelf life can be increased two to three weeks. Sugar was the main component that acted as preservative in the preparation for gulab jamun. The sugar composition of the syrup affected the ascorbic acid retention specially on air drying tenure. The stability of the color during frozen storage with maltose have showed much more significant effects.

CONCLUSION
Kalan usually prepared at home or for common functions has a maximum shelf life of two days at normal temperature. By the application of canning technique to the product, the shelf life has been considerably increased within the period of our experiment. We could found out that the shelf life may be extended to one month at room temperature. It can be expected to have a shelf life of not less than one year under refrigeration. The canning technique invariably proved to increase the shelf life without affecting the product quality. The method is simple and can be applied for the preservation of many products.

Gulab Jamun applied the technique of preservation in sugar syrup. Keeping the quality of ghee fried khoa balls can also be expected to be less than two days at normal temperature. When they are immersed in sugar syrup, their keeping quality has considerably improved. We had observed the product after two weeks. It has been noticed that the organoleptic characteristics have not at all adversely
affected after two weeks. On the other hand, we think that the palatability and flavor have been improved after two weeks. Thus sugar has contributed to enhancement of keeping quality. The food preservation technique studied here proved to impart a better shelf life to the particular types of dairy products without the addition of any particular chemicals.

REFERENCES
Banerjee, A.K. (1997). Process for commercial products. In. Dairy India, 5th edition. Published by P.R Gupta, New Delhi: 387.
Frazier, W.C. and West off, D.C. (2004). Gas Production in milk Food microbiology, fourth edition. Tata McGraw Hill Publishing Company Limited. New Delhi.
IDF. consumption statistics for milk and milk products. (1981). Bulletin of International Dairy Federation, 79, IDF Document 131.
Lunder, T.L. (1971). Simplified procedure for determining fat and total solids by Mojonnier method. Journal of Dairy Science. 54(5): 737-739.
Ramakrishna Chethana, Balaraman, M., Sunki, R. (2004). Process Optimization of Gulab Jamun, an traditional Indian Sweet, using sugar substitutes. European Food Research and Technology. 219(4): 386-392.
Rao, K.H. (2001). Prospects and challenges for India dairy Industries to export dairy products. Indian Journal of Dairy Technology and Biosciences. 14(2): 72-78.
Sukumar.de, market milk. (2003). Outline of Dairy Technology. Oxford university press New Delhi: 14-15.b.
Yadav, J.S., Grover, S. and Batish, V.K. (1993). Fermented milks. A comprehensive dairy Microbiology. New Delhi India. 423-571.