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# Effect of whey based Antimicrobial Edible Coating on the Shelf-Life of Paneer

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**ABSTRACT:** Paneer is a heat-acid coagulated milk product with a short storage-life of one day at room temperature and six days at refrigerated condition. Shelf-life of paneer can be increased by coating it with edible coatings. The edible coating under study was prepared using condensed whey (45 per cent total solids) to which 4 per cent glycerol was added as plasticizer. Both lactic acid (20 per cent and 25 per cent) and potassium sorbate solutions (20 per cent and 25 per cent) were added to the coating at 10 per cent and 12 per cent levels. Paneer samples were coated with each treatment coating and packaged in LDPE pouches and stored at room temperature. Results of microbiological and sensory analysis of samples showed that shelf life of paneer samples coated with coatings containing 25 per cent concentrated lactic acid and potassium sorbate solutions added at levels of 12 per cent and 10 per cent were extended up to 4 days and 3 days respectively. The sample coated with coating containing 20 per cent lactic acid and 20 per cent potassium sorbate solutions added at 12 per cent level of condensed whey taken, gave a shelf-life of 2 days at room temperature.

**KEYWORDS:** Paneer, whey, edible coatings, shelf-life.

## I. INTRODUCTION

Paneer is a popular indigenous milk product prepared by heat acid coagulation of cow or buffalo milk or a combination of thereof using citric acid or lactic acid or sour milk as the coagulating agent. India produces around three lakh tones of paneer annually, which implies, that almost five percent of total milk produced in the country is converted into paneer (Makhal and Sen, 2001). This traditional value-added dairy product contains around twenty six percent of milk fat, sixteen percent of protein, two percent of lactose and one point five to two percent minerals which makes it highly nutritious. Because of its favourably rich calcium and protein content, paneer is highly advisable for people suffering from diabetes and tooth decay, growing children and pregnant women (Chopra and Mamtani, 1995). However, the availability of paneer in the Indian market is limited due to its poor shelf-life (Kanawjia and Singh, 2000). Paneer can be stored for only a day at room temperature and for about six days under refrigerated condition without deteriorating its chemical and microbiological quality.

Through the years, scientists and researchers have made several attempts to increase its shelf-life. And some of them have found to be effective in extending the products' shelf-life to a certain limit. Low temperature storage, dehydration, sterilization, vacuum packaging are some of the physical methods employed to increase the storage-life of paneer. Chemical treatments like use of antioxidants, benzoic acid, sorbic acid, potassium sorbate and dipping of paneer cubes in brine solution are also found to achieve the similar results.

Use of edible films and coatings is another emerging technique put into use for successful increase in the storage life of various products. "Edible films are defined as a thin layer of material which can be consumed and provides a barrier to moisture, oxygen and solute movement for the food" while "Edible coatings are a particular form of film designed for application directly onto the surface of target materials; they are normally regarded as part of the final product" (Han 2002). They have received considerable attention in recent years because of their advantages over synthetic films. The main advantage of edible films over traditional synthetics is that they can be consumed with the packaged products. Seydim and Sarikus (2006) reported that milk protein based edible coatings are excellent oxygen, lipid, and aroma barriers. Whey based edible films and coatings are transparent, flavourless, tasteless and flexible materials. Whey is obtained as a by-product during the preparation of chhana, paneer, cheese and casein. It is estimated that India produces roughly around three million tones of whey annually, which contains substantial amount of nutrients ie about two lakh

tones of milk nutrients (Naik *et al.*, 2009). Much of this whey is not utilized, and it creates serious pollution and waste disposal problems. Ozdemir and Floros (2008) suggested that the development of whey based edible films and coatings can aid in effective utilization of whey, improve the nutritional value of foods and prolong the shelf-life. Addition of antimicrobial agents like lactic acid and antifungal agents like potassium sorbate to this coating is expected to further ensure food safety and extension of shelf-life by reducing (or even preventing) growth of pathogenic and spoilage microorganisms.

## II. MATERIALS AND METHODS

### Procurement of raw materials

Buffalo milk for the preparation of paneer was procured from Kerala Veterinary and Animal Sciences University Dairy Plant, Mannuthy. Whey was obtained as the by-product during preparation of paneer. Citric acid, glycerol, lactic acid and potassium sorbate were purchased from Nice chemicals, Thrissur. Plate count agar, Violet red bile agar and Potato dextrose agar used for microbiological studies were purchased from Himedia, Mumbai.

### Preparation of paneer

Buffalo milk was heated to 90°C with no holding and cooled to 70°C. The milk was then coagulated by addition of one per cent citric acid solution at 70°C. The citric acid was added slowly to milk with continuous and consistent agitation till clear whey separated out. When coagulation was complete, stirring was stopped and curd was allowed to settle down for 5 minutes, then the whey was drained out using a muslin cloth. The curd was collected and filled in hoop (25 cm x 25cm) lined with a strong and clean muslin cloth. The hoop had square frame with its top open. Then pressure was applied on the top of the hoop by placing a weight of 1.5kg/cm<sup>2</sup> for 20 minutes. The paneer block was then cooled and immersed in chilled water for one hour for texturization.

### Preparation of edible coating

Whey obtained was condensed to approximately 8:1 concentration using vacuum evaporator (Anhydro, Lab E 1688) at 70°C with a vacuum of 70 cm Hg. Slightly over condensed whey was diluted with plain whey to get 45per cent total solids in the standardized condensed whey. To the standardized condensed whey, glycerol was added as plasticizer at four per cent level. This coating mixture was then subjected to magnetic stirring for an hour followed by heating in a water bath at 80°C for 20 minutes and then cooled to room temperature.

Solutions of concentrations 20per cent and 25per cent of both lactic acid and potassium sorbate were prepared and each of these concentrations were added to the cooled coating mixture at levels of 10per cent and 12per cent of the coating mixture taken.

### Coating onto paneer samples

Paneer was cut into uniform pieces of and was dipped into the coating solution. Care was taken to ensure that the coating had uniformly spread onto the sample surface. The samples were then dried at room temperature for an hour and later packed into pre-sterilized LDPE pouches followed by storage at ambient conditions (30±1°C).

### Microbiological analysis

Coated samples were subjected to microbiological evaluation by enumerating the total viable count, coliform count and yeast and mould counts during each day of storage at room temperature (IS: 1224, 1981).

### Sensory evaluation

The paneer samples were evaluated organoleptically for different quality attributes like flavour, body and texture, colour and appearance and overall acceptability by a trained panel of judges comprising of five members. A nine point hedonic scale score card was used for evaluation.

### Statistical Analysis

The data generated for microbial analysis was statistically analysed using one way ANOVA and post hoc analysis done using Duncan's test for more than three treatments. Pair wise comparison was done using independent t-test for two treatments. The changes in sensory attributes were statistically evaluated using principle of Kruskal Wallis test. All the statistical analysis was performed using SPSS version 21.

## III. RESULTS

The samples coated with 20per cent antimicrobial concentration at 12per cent level (T<sub>2</sub>), 25per cent antimicrobial concentration at 10per cent (T<sub>3</sub>) and 25per cent antimicrobial concentration at 12per cent levels (T<sub>4</sub>) gave an extended storage life compared to the control sample (T<sub>1</sub>) when stored at ambient conditions. Hence paneer samples coated with these coatings were subjected to microbial and sensory analysis. The results of the effects of different treatment coatings on microbial and sensory attributes of paneer are given in Table 1 and Table 2 respectively.

**Table1:** Effect of different treatment coatings on the microbiological attributes of paneer when stored at room temperature.

| A              | SPC count ( $\log_{10}\text{cfu/g}$ )            |                        |                         |                        |           |         |
|----------------|--------------------------------------------------|------------------------|-------------------------|------------------------|-----------|---------|
| No of days     | 0                                                | 1                      | 2                       | 3                      | 4         | 5       |
| T <sub>1</sub> | 2.45±0.03 <sup>a</sup>                           | 3.67±0.02 <sup>a</sup> | spoiled                 | spoiled                | spoiled   | spoiled |
| T <sub>2</sub> | 2.28±0.06 <sup>b</sup>                           | 3.61±0.03 <sup>a</sup> | 3.59±0.17 <sup>a</sup>  | spoiled                | spoiled   | spoiled |
| T <sub>3</sub> | 2.05±0.05 <sup>c</sup>                           | 2.38±0.05 <sup>b</sup> | 2.62±0.04 <sup>b</sup>  | 3.45±0.06 <sup>a</sup> | spoiled   | spoiled |
| T <sub>4</sub> | 2.00±0.00 <sup>c</sup>                           | 2.33±0.03 <sup>b</sup> | 2.59±0.03 <sup>b</sup>  | 3.05±0.05 <sup>b</sup> | 3.66±0.03 | spoiled |
| F value        | 23.62**                                          | 425.104**              | 24.708**                | -                      | -         | -       |
| t value        | -                                                | -                      | -                       | 5.197**                | -         | -       |
| B              | Coliform count ( $\log_{10}\text{cfu/g}$ )       |                        |                         |                        |           |         |
| No of days     | 0                                                | 1                      | 2                       | 3                      | 4         | 5       |
| T <sub>1</sub> | 1.75±0.15                                        | 2.76±0.09              | spoiled                 | spoiled                | spoiled   | spoiled |
| T <sub>2</sub> | Nil                                              | 2.45±0.09              | 2.63±0.03 <sup>a</sup>  | spoiled                | spoiled   | spoiled |
| T <sub>3</sub> | Nil                                              | Nil                    | 2.10±0.10 <sup>b</sup>  | 2.56±0.04              | spoiled   | spoiled |
| T <sub>4</sub> | Nil                                              | Nil                    | Nil                     | 1.86±0.30              | 2.37±0.34 | spoiled |
| t value        | -                                                | 2.401 <sup>ns</sup>    | 5.07**                  | 2.253 <sup>ns</sup>    | -         | -       |
| C              | Yeast and mold count ( $\log_{10}\text{cfu/g}$ ) |                        |                         |                        |           |         |
| No of days     | 0                                                | 1                      | 2                       | 3                      | 4         | 5       |
| T <sub>1</sub> | 2.2±0.1                                          | 2.61±0.42 <sup>a</sup> | spoiled                 | spoiled                | spoiled   | spoiled |
| T <sub>2</sub> | 2.1±0.1                                          | 2.61±0.42 <sup>a</sup> | 2.74±0.27 <sup>a</sup>  | spoiled                | spoiled   | spoiled |
| T <sub>3</sub> | 2.1±0.1                                          | 2.3±0.1 <sup>b</sup>   | 2.34±0.05 <sup>ab</sup> | 2.75±0.27              | spoiled   | spoiled |
| T <sub>4</sub> | 2.1±0.1                                          | 2.3±0.1 <sup>b</sup>   | 2.1±0.1 <sup>b</sup>    | 2.1±0.1                | 2.26±0.14 | spoiled |
| F value        | 0.250 <sup>ns</sup>                              | 9.79**                 | 3.458*                  | -                      | -         | -       |
| t value        | -                                                | -                      | -                       | 2.23 <sup>ns</sup>     | -         | -       |

<sup>ns</sup> non significant \*\* significant at one per cent level ( $p \leq 0.01$ ) \*significant at five percent level ( $p \leq 0.05$ )

Figures are mean±standard error of three replicates

T<sub>1</sub>: controlT<sub>2</sub>: 20per cent antimicrobial concentration solution added at 12per cent level of condensed wheyT<sub>3</sub>: 25per cent antimicrobial concentration solution added at at 10per cent level of condensed wheyT<sub>4</sub>: 25per cent antimicrobial concentration added at 12per cent level of condensed whey

Means having different superscript (a,b) within a column vary significantly.

**Table2:** Effect of different treatment coatings on the sensory attributes of paneer when stored at room temperature.

| Sample         | DAYS OF STORAGE            |                          |                          |                         |            |         |
|----------------|----------------------------|--------------------------|--------------------------|-------------------------|------------|---------|
|                | 0                          | 1                        | 2                        | 3                       | 4          | 5       |
| A              | CHANGE IN FLAVOUR          |                          |                          |                         |            |         |
| T <sub>1</sub> | 7.83 ± 0.08                | 5.33± 0.16 <sup>a</sup>  | spoiled                  | spoiled                 | spoiled    | spoiled |
| T <sub>2</sub> | 8.16± 0.17                 | 7.8 ± 0.08 <sup>ab</sup> | 6.3± 0.16 <sup>a</sup>   | spoiled                 | spoiled    | spoiled |
| T <sub>3</sub> | 8.33± 0.17                 | 7.58± 0.08 <sup>ab</sup> | 6.83± 0.17 <sup>ab</sup> | 6.66± 0.08 <sup>a</sup> | spoiled    | spoiled |
| T <sub>4</sub> | 8.33± 0.17                 | 8.33± 0.17 <sup>b</sup>  | 7.91± 0.08 <sup>b</sup>  | 7.66± 0.08 <sup>b</sup> | 7.16± 0.17 | spoiled |
| Z value        | 5.77 <sup>ns</sup>         | 9.028*                   | 6.830*                   | 4.091*                  | -          | -       |
| B              | CHANGE IN BODY AND TEXTURE |                          |                          |                         |            |         |
| T <sub>1</sub> | 7.83± 0.08                 | 5.5 ± 0.28 <sup>a</sup>  | spoiled                  | spoiled                 | spoiled    | spoiled |
| T <sub>2</sub> | 8.16± 0.17                 | 7.8 ± 0.08 <sup>ab</sup> | 6.3± 0.16 <sup>a</sup>   | spoiled                 | spoiled    | spoiled |
| T <sub>3</sub> | 8.33± 0.17                 | 7.83± 0.08 <sup>ab</sup> | 6.83± 0.17 <sup>ab</sup> | 6.83± 0.08 <sup>a</sup> | spoiled    | spoiled |
| T <sub>4</sub> | 8.33± 0.17                 | 8.33± 0.17 <sup>b</sup>  | 7.91± 0.08 <sup>b</sup>  | 7.66± 0.08 <sup>b</sup> | 7.16± 0.17 | spoiled |
| Z- value       | 4.460 <sup>ns</sup>        | 9.207*                   | 6.830*                   | 4.019*                  | -          | -       |

| C              | CHANGE IN COLOUR AND APPEARANCE |                         |                          |                         |            |         |
|----------------|---------------------------------|-------------------------|--------------------------|-------------------------|------------|---------|
| T <sub>1</sub> | 7.8± 0.03                       | 6.0± 0.5 <sup>a</sup>   | spoiled                  | spoiled                 | spoiled    | spoiled |
| T <sub>2</sub> | 7.75± 0.14                      | 7.5±0.08 <sup>ab</sup>  | 6.3± 0.16 <sup>a</sup>   | spoiled                 | spoiled    | spoiled |
| T <sub>3</sub> | 8.33± 0.17                      | 7.58±0.08 <sup>ab</sup> | 6.83±0.17 <sup>ab</sup>  | 6.66± 0.08 <sup>a</sup> | spoiled    | spoiled |
| T <sub>4</sub> | 8.33± 0.17                      | 8.16± 0.17 <sup>b</sup> | 7.91± 0.08 <sup>b</sup>  | 7.66± 0.08 <sup>b</sup> | 7.00± 0.25 | spoiled |
| Z- value       | 7.221 <sup>ns</sup>             | 9.76*                   | 6.830*                   | 4.091*                  | -          | -       |
| D              | CHANGE IN OVERALL ACCEPTIBILITY |                         |                          |                         |            |         |
| T <sub>1</sub> | 7.91 ± 0.08                     | 6.00 ± 0.50             | spoiled                  | spoiled                 | spoiled    | spoiled |
| T <sub>2</sub> | 8.16± 0.17                      | 7.8 ± 0.08              | 6.66± 0.17 <sup>a</sup>  | spoiled                 | spoiled    | spoiled |
| T <sub>3</sub> | 8.33± 0.17                      | 7.91± 0.30              | 6.83± 0.17 <sup>ab</sup> | 6.83± 0.08 <sup>a</sup> | spoiled    | spoiled |
| T <sub>4</sub> | 8.33± 0.17                      | 8.16± 0.17              | 7.91± 0.08 <sup>b</sup>  | 7.66± 0.08 <sup>b</sup> | 7.25± 0.25 | spoiled |
| Z- value       | 4.460 <sup>ns</sup>             | 7.665 <sup>ns</sup>     | 6.054*                   | 4.091*                  | -          | -       |

<sup>ns</sup> non significant \*\* significant at one per cent level ( $p \leq 0.01$ ) \*significant at five percent level ( $p \leq 0.05$ )

Figures are mean±standard error of three replicates

T<sub>1</sub>- control

T<sub>2</sub>- 20per cent antimicrobial concentration solution added at 12per cent level of condensed whey

T<sub>3</sub>- 25per cent antimicrobial concentration solution added at at 10per cent level of condensed whey

T<sub>4</sub>-25per cent antimicrobial concentration added at 12per cent level of condensed whey

Means having different superscript (a,b) within a column vary significantly.

#### IV. DISCUSSION

The results for microbiological analysis of paneer samples coated with treatment coatings are presented in Table 1. The samples were analysed for Total viable count (standard plate count), Coliform and Yeast and mould counts. From the table it's clear that T<sub>4</sub>ie sample coated with coating containing 12per cent of lactic acid and potassium sorbate (solution strength of 25per cent) showed significant difference from other treatments and also yielded microbial counts within the limits during a period of four days of storage at room temperature while the control (without coating) got spoiled within a day. The SPC, coliform and yeast and mould counts at the end of fourth day for T<sub>4</sub> were 3.66±0.03, 2.37±0.34 and 2.26±0.14 log<sub>10</sub>cfu/g respectively.

Lamdandeet al. (2012) reported that using milk added with nisin for production of paneer and then coating the paneer produced with whey protein coating containing potassium sorbate gave satisfactory microbial counts up to 12 days when packaged in LDPE pouches and stored at ambient conditions. Ramos et al. (2012) stated that whey protein based coating containing lactic acid and chitoooligosaccharides when coated onto semi-hard cheese (regionally know as D. Pedro) showed antimicrobial activity with lactic acid showing maximum bacteriocidal activity against gram positive organisms.

The statistical results for sensory scores obtained for the same are presented in Table 2. Sample T<sub>4</sub> showed significant difference from the other treatments and gave maximum sensory scores because of increased visual and tactile appearance. These observations were found to be in agreement with results obtained by Reetaet al. (2012) for paneer coated with whey based edible coating.

#### V. CONCLUSION

The study indicated that when paneer samples were coated with the treatment coatings, it resulted in increasing the shelf-life of samples when stored at room temperature. The samples coated with edible coating containing antimicrobial solution (lactic acid and potassium sorbate of strength 25 per cent each) at 12 per cent level showed maximum shelf-life extension of four days as against the control sample (without coating) which got spoiled within one day when stored at ambient conditions.

#### REFERENCES

1. Chopra S, Mamtani R(1995) Soy Paneer or Paneer. Indian Dairyman47: 27-29.
2. Han JH (2002)Protein-based films and coatings.CRC Press, Florida



3. IS: SP: 1224 (1981) Microbiological Methods. Bureau of Indian Standards, Manak Bhavan, 9- Bahadur Shah Zafar Marg, New Delhi
4. Kanawjia SK, Singh S (2000) Technological advances in paneer making. Indian Dairyman 52(10): 45-50.
5. Lamdande AG, Garud, SR, Kumar A (2012) Impact of edible coating and different packaging treatments on microbial quality of paneer. Journal of food process technology 3(6)
6. Makhal S, Sen DC (2001) Exploration of attributes influencing the quality of paneer- A review. Journal Dairyng Foods and Home Science 20: 71-79.
7. Naik, Y.K., Khare, A., Choudhary, P.L., Goel, B.K. and Shrivastava, A (2009) Studies on physico-chemical and sensory characteristics of whey based watermelon beverage. Asian journal of research in chemistry 2(1): 57-59
8. Ozdemir M, Floros JD (2008) Optimization of edible whey protein films containing preservatives for mechanical and optical properties. J Food Eng 84(1): 116-123
9. Ramos Oscar LJO, Pereira Sara I, Silva Joao C, Fernandes MI, Franco JA, Lopes-da-Silva ME, Pintado F, Xavier Malcata (2012) Evaluation of antimicrobial edible coatings from a whey protein isolate base to improve the shelf life of cheese. J Dairy Sci 95(11): 6282-6292
10. Seydim AC, Sarikus G (2006) Antimicrobial activity of whey protein based edible films incorporated with oregano, rosemary and garlic essential oils. Food Res Int 39(5): 639-644

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