

# Formulation and study on the chemical and microbiological aspect of spiced paneer

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## ABSTRACT

Milk is considered to be a wholesome food. Any food product made out of milk will obviously be highly nutritious. However, milk per se has certain limitations like allergenicity, lactose intolerance, cholesterol, saturated fat content, etc. In this study paneer was produced with the combination of some Indian traditional spices. As per the overall acceptability by the sensory panelists, the ratio of 1:1:0.1:0.1:0.2 of ginger, garlic, cloves, black pepper and cinnamon respectively was selected for the further analysis and found the extended self life in comparison to the control sample.

**Keywords:** Milk, paneer, garlic, ginger, yeast/mold, self-life

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## 1. INTRODUCTION

Indian dairying is emerging at an important growth level of the Indian economy. It is the single largest contributor to Agriculture sector (17%) in India, contributing about 8% to Gross Domestic Product. When the world milk production in 2008 is around 700 million tonnes, India has maintained its position since then by producing 106 million tons of milk [1]. It has led India to emerge as the largest milk producer in the world, transcending a record level of 142 million metric tonnes (MMT) in 2008 accounting for 15% of the world's total milk production [2]. Paneer is a South Asian variety of soft cheese obtained by acid and heat coagulation of milk. It is a non fermentative, non-renneted, non-melting and unripened type of cheese.

Paneer is very popular in northern region of India; no feast is complete without having paneer as, one of the items in culinary dishes, snack foods. It is highly rich in proteins and fat, and also contains vitamins, minerals, fibre, sulphur compounds, and is laxative in nature [3]. Good quality paneer is characterized by a marble white colour, sweetish, mildly acidic taste, nutty flavor. Paneer is a rich source of animal protein available at a comparatively lower cost and forms an important source of animal protein for vegetarians. Over and above its high protein content and digestibility, the biological value of protein in paneer is in the range of 80 to 86 [4]. The importance of milk and milk products has been recognized since Vedic times and it is considered to be complete food [5].

As the popularity of bio preservatives continues to increase, consumers, regulatory agencies and food processors require reliable information on the safety, standardization and efficacy of these products. Many spices and herbs extracts possess antimicrobial activity which have been used for thousands of centuries by many cultures to enhance the flavor and aroma of foods. Ginger (*Zingiberofficinale*) and garlic (*Alliumsativum*) are traditionally used as spices in food preparation [6]. They also have both antioxidant and antimicrobial activities. Ginger was reported to have bacteriocidal effect against *Escherichia coli* and *Streptococcus*[7]. Garlic is widely used in medicine [8].

## 2. MATERIALS & METHODS

### Raw materials

Standardized milk (Amul brand), fresh ginger, garlic, cloves, cinnamon, black pepper and iodized salt were procured from local market.

### Chemicals/Media

All the Chemicals and medias (plate count agar, violet red bile agar and potato dextrose agar) were used of analytical grade of brand Hi-media.

### **Standardization of protocol for ready-to-serve (RTS) spicy paneer**

Method suggested by [9] was used for preparation of paneer with some modifications. Milk was heated to 85°C, well washed and chopped vegetable leaves viz; ginger, garlic and their combinations with 1%, 1.5%, and 2.5% separately were incorporated into the heated milk and then it was cooled down to 72 °C. Further some spices such as cloves, black pepper and cinnamon with the level of 0.1, 0.2 and 0.3 % separately were sprinkled over the coagulum before pressing and finally dipped into cold water. The one best sample of paneer was selected based on sensory attributes and used for further studies.

### **Enhancement of shelf life**

An attempt was made to enhance the shelf life of RTS spicy paneer by dipping paneer in brine solution (5%) and dry salting (2, 3 and 4%). The samples were packed in polystyrene cups with lids and stored at refrigeration temperature. The samples were analyzed at every 2 days intervals till the time they were deemed unfit for consumption.

### **Physico-chemical analysis**

#### **Proximate composition**

The proximate composition such as moisture, ash, protein and titrable acidity were determined as per the procedure given in AOAC (1995)[10].

#### **Fat content**

Exactly 10 ml of Gerber's sulphuric acid in butyrometer was taken. Accurately 1.69 gm of shredded paneer was weighed and added in 10 ml sulphuric acid. Added 1 ml amyl alcohol. Butyrometer was centrifuged for 5 min. at 1000 rpm. Reading was then read from the fat tube.

#### **Free fatty acids (FFA)**

FFA was determined by the method given by Koniecko (1979)[11]. 5 gm of sample was blended with 30 ml of chloroform for about 2 minutes, in the presence of about 5 grams of anhydrous sodium sulphate. Contents were filtered into a 250 ml conical flask by using Whatman Filter Paper No. 1. Titrate the filtrate against 0.1N alcoholic KOH (0.1gm KOH in 100ml of alcohol), using phenolphthalein as indicator.

$$\% \text{ FFA} = \text{Volume of 0.1N KOH used} \times 2.82 / \text{Weight of sample}$$

#### **Peroxide value**

The peroxide value was determined by method of AOAC (1995) [10].

#### **pH**

The pH was determined as per BIS (1989) [12] method. Ten g of sample was made into a paste by adding 10 ml of distilled water. The pH was measured by using a pH meter (Systronics-361).

#### **Tyrosine value**

The TCA extraction method of Strange et al. (1977)[13] was followed. Tyrosine value was determined by blending 20 g of paneer with 100 ml of 20 per cent TCA and filtering it through Whatman # 1 filter paper. 2.5 ml of TCA extract was taken and diluting it with equal volume of distilled water. To this 10 ml of 0.5 ml 1N NaOH were added followed by 3 ml of Folin's reagent. After mixing, colour was developed at room temperature for 15 min before reading at 660 nm. The tyrosine value was reported as mg of tyrosine 100g<sup>-1</sup> paneer.

### **Microbiological analysis**

#### **Total Plate Count (TPC)**

The total numbers of viable bacteria in paneer were determined by I.S.I (1969) [14] method, using composition of try tone (5.0 gm), yeast extract (2.5 gm), glucose (1.0 gm), agar-agar (15.0 gm), Distilled Water (1000ml) with adjusting pH 7.0± 0.2 by using 1 N NaOH and 1 N HCl.

#### **Yeast and mould count**

Potato-dextrose-agar medium (Hi-media) was used to determine the yeast the mould counts in the paneer samples (I.S.I, 1969)[14].

### Coli form count

Coli form bacteria were studied by using Hi-Media of Violet Red Bile Agar medium [14]. To rehydrate this medium, 41.5 gm was suspended in 1000 ml of distilled water and boiled to dissolve the medium completely. The pH was adjusted to  $7.4 \pm 0.2$  by using 1N NaOH or 1N HCl. Plates were incubated at  $37.5^\circ$  C for 18-24 hours and colonies were counted.

### Sensory evaluation

Stored samples of RTS spicy paneer was sensory evaluated by 9 point hedonic scale.

## 3. RESULTS AND DISCUSSION

### Standardization of additives levels for preparing ready-to-serve (RTS) spicy paneer

From the sensory evaluation of various recipes of RTS paneer with different combination of ginger, garlic, cloves, black pepper and cinnamon and it was concluded that the combination ratio of 1:1:0.1:0.1:0.2 of ginger, garlic, cloves, black pepper and cinnamon respectively was the best and this recipe was freeze for further analysis. Furthermore, 5 % brine solution and 3% dry salt treatment based open sensory evaluation was used to extend the shelf of spicy paneer.

### Proximate composition

The proximate composition of ready to serve spicy paneer is presented in table 1. Control and ready to serve sample contained moisture ranges from 52.10 and 56.0 %, fat 24.40 and 21.00 %, protein 21.00 and 19.00 %, ash 2.21 and 2.42 %. These constituents of spicy paneer are almost similar to those of reported by Bajwaet al., (2005) [15].

**Table 1. Proximate composition**

| Constituents (%) | Control          | RTSspicy paneer  |
|------------------|------------------|------------------|
| Moisture         | 52.10 $\pm$ 2.21 | 56.00 $\pm$ 3.11 |
| Fat              | 24.40 $\pm$ 1.11 | 21.00 $\pm$ 1.21 |
| Protein          | 21.00 $\pm$ 1.21 | 19.00 $\pm$ 1.11 |
| Ash              | 2.21 $\pm$ 0.15  | 2.42 $\pm$ 0.10  |

### Sensory attributes of RTS spicy paneer

Mean scores obtained for different sensory attributes during storage are presented in Table 2. Overall acceptability of both, the treated samples as well as of the controls of RTS spicy paneer were rated as liked very much by the judges at hedonic scale at 0 day. In case of brine treated control, dry salt treated samples and dry salt treated control of RTS spicy paneer showed significant changes in their overall acceptability after 10<sup>th</sup> day and judges yet rated them in the range of liked very much for the brine treated control where as dry salt treated samples and its respective control were rated by the judges in the range of liked moderately.

Further on 15<sup>th</sup> day of storage, these samples had shown decreasing trend in their overall acceptability but judges still moderately and scores continue to decrease up to 20<sup>th</sup> day for the samples treated with dry salt and its respective control where as brine dipped was spoiled and did not offered for sensory evaluation. For brine treated samples significant change were observed after 15<sup>th</sup> day and judges yet rated them in the range of liked moderately. On 20<sup>th</sup> day, brine dipped samples and its respective control was spoiled and was not given for sensory evaluation.

**Table 2. Sensory attributes of spicy paneer samples during refrigeration storage**

| Treatments                   |                     | Storage ( Days ) |           |           |           |           | Mean |
|------------------------------|---------------------|------------------|-----------|-----------|-----------|-----------|------|
|                              |                     | 0                | 5         | 10        | 15        | 20*       |      |
| <b>Colour and appearance</b> |                     |                  |           |           |           |           |      |
| <b>B T</b>                   | <b>Control</b>      | 8.12±0.12        | 7.12±0.14 | 8.71±0.11 | 7.37±0.12 | S         | 7.80 |
|                              | <b>Spicy paneer</b> | 8.37±0.22        | 8.25±0.16 | 7.00±0.13 | 8.62±0.11 | S         | 8.06 |
| <b>SS</b>                    | <b>Control</b>      | 8.12±0.21        | 8.05±0.12 | 7.75±0.15 | 6.35±0.12 | 7.50±0.12 | 7.79 |
|                              | <b>Spicy paneer</b> | 8.50±0.13        | 8.37±0.11 | 8.00±0.14 | 6.62±0.13 | 7.50±0.14 | 8.12 |
| <b>Flavour</b>               |                     |                  |           |           |           |           |      |
| <b>B T</b>                   | <b>Control</b>      | 8.37±0.12        | 8.00±0.17 | 8.35±0.12 | 7.50±0.13 | S         | 8.04 |
|                              | <b>Spicy paneer</b> | 8.12±0.14        | 7.87±0.18 | 7.87±0.13 | 7.31±0.14 | S         | 7.75 |
| <b>S S</b>                   | <b>Control</b>      | 8.62±0.16        | 8.25±0.11 | 7.75±0.16 | 7.37±0.11 | 6.25±0.15 | 8.00 |
|                              | <b>Spicy paneer</b> | 8.00±0.22        | 7.87±0.12 | 7.87±0.15 | 7.20±0.19 | 6.37±0.16 | 7.70 |
| <b>Body and texture</b>      |                     |                  |           |           |           |           |      |
| <b>B T</b>                   | <b>Control</b>      | 8.25±0.16        | 8.20±0.13 | 8.00±0.11 | 7.37±0.13 | S         | 7.92 |
|                              | <b>Spicy paneer</b> | 8.12±0.17        | 7.12±0.16 | 8.87±0.12 | 7.24±0.12 | S         | 7.83 |
| <b>S S</b>                   | <b>Control</b>      | 8.62±0.18        | 8.37±0.13 | 7.00±0.17 | 7.50±0.15 | 6.55±0.11 | 7.92 |
|                              | <b>Spicy paneer</b> | 8.12±0.15        | 7.79±0.12 | 7.50±0.18 | 6.87±0.16 | 6.37±0.14 | 7.60 |
| <b>Overall acceptability</b> |                     |                  |           |           |           |           |      |
| <b>B T</b>                   | <b>Control</b>      | 8.43±0.15        | 8.29±0.13 | 8.00±0.16 | 7.50±0.17 | S         | 8.13 |
|                              | <b>Spicy paneer</b> | 8.12±0.14        | 8.04±0.14 | 7.83±0.11 | 7.30±0.11 | S         | 7.80 |
| <b>S S</b>                   | <b>Control</b>      | 8.58±0.18        | 8.33±0.14 | 7.85±0.12 | 7.27±0.11 | 6.50±0.07 | 8.05 |
|                              | <b>Spicy paneer</b> | 8.04±0.11        | 7.92±0.17 | 7.71±0.13 | 7.17±0.13 | 6.50±0.08 | 7.75 |

BT- 5% brine treated paneer; SS- 3% salt sprinkled paneer; S – Spoiled

### Physico-chemical properties of RTS spicy paneer

Changes in physico-chemical properties of RTS spicy paneer during storage of the samples under refrigeration condition were observed at five days interval up to 20 days storage period and are presented in Table 3.

**Table 3. Physico-chemical changes in spicy paneer samples during refrigeration storage.**

BT- 5% brine treated paneer; SS- 3% salt sprinkled paneer; S – Spoiled

| Treatments                                    |              | Storage ( Days ) |            |            |            |            | Mean  |
|---|--------------|------------------|------------|------------|------------|------------|-------|
|   |              | 0                | 5          | 10         | 15         | 20         |       |
| <b>Free fatty acids (per cent Oleic acid)</b> |              |                  |            |            |            |            |       |
| B T   | Control      | 0.13±0.01        | 0.15±0.02  | 0.17±0.02  | 0.18±0.02  | S          | 0.16  |
|   | spicy paneer | 0.13±0.02        | 0.15±0.01  | 0.23±0.02  | 0.29±0.02  | S          | 0.20  |
| S S   | Control      | 0.11±0.02        | 0.13±0.01  | 0.14±0.01  | 0.18±0.01  | 0.22±0.02  | 0.16  |
|   | spicy paneer | 0.12±0.01        | 0.14±0.02  | 0.18±0.02  | 0.21±0.01  | 0.24±0.02  | 0.18  |
| <b>Mean</b>                                   |              | 0.12             | 0.14       | 0.18       | 0.22       |            |       |
| <b>Tyrosine value (mg/100g)</b>               |              |                  |            |            |            |            |       |
| B T   | Control      | 13.00±1.12       | 13.70±2.12 | 16.12±1.11 | 23.20±2.21 | S          | 16.50 |
|   | spicy paneer | 12.65±1.14       | 14.00±1.15 | 15.75±2.12 | 22.50±2.24 | S          | 16.23 |
| S S   | Control      | 11.00±1.21       | 12.70±1.13 | 15.70±1.13 | 23.50±1.94 | 28.00±2.12 | 18.18 |
|   | spicy paneer | 12.00±1.12       | 13.50±1.12 | 16.00±1.12 | 22.20±1.93 | 29.55±2.11 | 18.65 |
| <b>Mean</b>                                   |              | 12.16            | 13.47      | 15.89      | 22.85      |            |       |
| <b>Moisture %</b>                             |              |                  |            |            |            |            |       |
| B T   | Control      | 52.00±3.31       | 51.65±2.23 | 51.41±3.45 | 51.10±4.45 | S          | 51.54 |
|   | spicy paneer | 57.07±3.23       | 57.01±5.23 | 56.80±4.45 | 56.41±5.12 | S          | 56.82 |
| S S   | Control      | 51.77±4.12       | 50.66±4.12 | 50.48±4.32 | 50.08±3.38 | 49.80±6.12 | 50.55 |
|   | spicy paneer | 54.03±5.11       | 53.58±6.12 | 53.00±6.52 | 52.35±6.34 | 51.78±7.11 | 52.94 |
| <b>Mean</b>                                   |              | 53.71            | 53.22      | 52.92      | 52.48      |            |       |
| <b>Fat %</b>                                  |              |                  |            |            |            |            |       |
| B T   | Control      | 23.36±1.12       | 24.54±1.11 | 24.72±1.21 | 25.75±2.12 | S          | 24.59 |
|   | spicy paneer | 19.70±1.32       | 20.19±1.23 | 20.48±1.42 | 21.60±1.32 | S          | 20.49 |
| S S   | Control      | 23.30±.22        | 24.46±2.21 | 25.67±2.02 | 26.03±2.21 | 27.17±2.12 | 25.32 |
|   | spicy paneer | 21.75±1.24       | 21.92±1.12 | 22.34±1.94 | 23.17±1.91 | 24.01±1.28 | 22.64 |
| <b>Mean</b>                                   |              | 22.02            | 22.78      | 23.30      | 23.13      |            |       |
| <b>Titration acidity (% lactic acid)</b>      |              |                  |            |            |            |            |       |
| B T   | Control      | 0.23±0.01        | 0.29±0.02  | 0.43±0.02  | 0.54±0.02  | S          | 0.37  |
|   | spicy paneer | 0.19±0.02        | 0.25±0.01  | 0.43±0.01  | 0.51±0.01  | S          | 0.35  |
| S S   | Control      | 0.20±0.02        | 0.24±0.02  | 0.37±0.02  | 0.45±0.02  | 0.53±0.02  | 0.36  |
|   | spicy paneer | 0.19±0.04        | 0.21±0.03  | 0.35±0.03  | 0.41±0.02  | 0.50±0.01  | 0.33  |
| <b>Mean</b>                                   |              | 0.20             | 0.25       | 0.39       | 0.48       |            |       |
| <b>pH</b>                                     |              |                  |            |            |            |            |       |
| B T   | Control      | 5.60±0.12        | 5.30±0.14  | 5.10±0.12  | 5.06±0.24  | S          | 5.26  |
|   | spicy paneer | 5.91±0.14        | 5.62±0.14  | 5.35±0.16  | 5.11±0.14  | S          | 5.50  |
| S S   | Control      | 5.71±0.12        | 5.56±0.16  | 5.34±0.16  | 5.22±0.13  | 5.01±0.22  | 5.37  |
|   | spicy paneer | 5.91±0.16        | 5.87±0.15  | 5.34±0.16  | 5.03±0.12  | 5.00±0.23  | 5.43  |
| <b>Mean</b>                                   |              | 5.78             | 5.59       | 5.28       | 5.10       |            |       |

### Free Fatty Acids (FFA)

An increase in FFA content of all the samples were observed throughout the storage period. Increasing trend of FFA content during storage may be contributed by increase in the population of lipolytic bacteria.

### Tyrosine value

The tyrosine value of freshly prepared brine treated control and spicy paneer were 13.00 and 12.65 mg/100 gm. With storage, tyrosine value increased up to the level of 23.20 and 22.50 mg/100 gm respectively, during 15 days of storage. Tyrosine value had shown gradual increase to the tune of 28.00 and 29.55 respectively, at 20<sup>th</sup> day of storage. The increased values of tyrosine indicates that all the samples had undergone proteolysis due to the growth of proteolytic microorganisms. Results of present study are in agreement with Pal et al. (1993)[16] they reported faster increase of tyrosine value about 4 times in control samples of packaged in butter paper as compared to paraffin paneer at 15 days of storage and a strong correlation between the various microbiological counts and tyrosine value was reported.

### **Moisture content**

During storage losses of moisture content was noticed in all the samples irrespective of treatments. It decreased up to the levels of 51.77 and 54.03 per cent respectively, in brine treated control and spicy paneer at 15<sup>th</sup> day of storage while a decline to the tune of 49.80 and 51.78 per cent was observed at 20<sup>th</sup> day of storage in case of dry salt treated control and experimental samples respectively. The loss of moisture was higher in dry salted spicy paneer in comparison to brine treated spicy paneer. Rao and Patil (1999) [17] also reported diffusion of NaCl and citric acid into paneer cubes. Loss of moisture from RTS spicy paneer may be due to the movement of water molecules from spicy paneer cubes onto surface due to a concentration gradient. Pal (1998)[18] reported over 3 per cent moisture loss in paneer packed in parchment paper and stored for 15 days.

### **Fat per cent**

The fat per cent increased up to the level 25.75 and 21.60 respectively, in brine dipped control and experimental samples at 15<sup>th</sup> day of storage. Fat per cent showed an increase to the tune of 27.17 and 24.01 respectively in dry salted control and experimental paneer, at 20<sup>th</sup> day of storage. A slight increase in fat content was noticed during storage irrespective of treatments. The significant increase in fat content between 0 to 15<sup>th</sup> days of storage this increase may be due to significant decrease of moisture under different treatments due to evaporation loss.

### **Titration acidity / pH**

The results showed that per cent acidity increased in all treatments during storage. The increase in acidity may be due to formation of lactic acid as a result of lactose fermentation and diffusion of acid into the paneer cubes; as evident from an increased microbial growth during storage. Sensory evaluation brine dipped control and experimental samples showed that these samples were acceptable upto 15<sup>th</sup> day of storage and thereafter at 20<sup>th</sup> day, judges had noticed very high distinct acidic flavor and rejected the samples. On 20<sup>th</sup> day of storage judges noticed distinct acidic flavor in dry salted control and experimental spicy paneer samples and experiment was terminated.

### **Microbiological count**

Changes in microbiological counts of RTS spicy paneer (brine treated & salt sprinkled) during storage of the samples under refrigeration condition were observed at five days interval up to 20 days storage period and results are presented in Table 4.

### **Total plate count**

Total plate count (log cfu/gm) had shown increasing trend during entire storage period. Freshly prepared samples of control and spicy paneer had total plate count to the tune of 3.97 and 4.20 respectively in brine treated samples; which increased up to the level of 4.79 and 4.90 respectively at the termination of storage period i.e. 15 days. While in case of dry salted control and spicy paneer had total plate count to the tune of 4.12 and 4.15 respectively, when freshly prepared. Their number was found to reach to the levels of 5.25 and 5.35, during 20 days of storage. As is evident from the table data with the advancement of storage total plate count had shown gradual increase in number and at the end of storage of brine dipped samples their number was well within permissible limits under PFA for paneer i.e. log 5/gm while in case of dry salt applied samples had crossed this limit at termination of storage period i.e. 20<sup>th</sup> day.

### **Yeast and molds count**

In case of freshly prepared brine treated control and spicy paneer, yeast and molds count was found to be 2.05 and 2.02 respectively; which gradually increased up to the level of 3.62 and 3.57 at 15<sup>th</sup> days of storage. In case of dry salted control and spicy paneer their number was found to be 2.24 and 2.23 respectively when these were assessed just after preparation. And these were found to grow to the levels of 3.55 and 3.42 at 20<sup>th</sup> days of storage. As is evident from the table data with the advancement of storage period yeast and molds count had shown gradual increase in number and at the end of storage it crosses the permissible limits of PFA for paneer i.e. not more than 250/gm in all the samples regardless of treatment.

### **Coli form count**

Coli form count of freshly prepared brine treated control and spicy paneer was found to be 1.87 and 1.77 respectively; which increased up to the level of 2.60 and 2.50, during 15 days of storage whilst dry salted control and spicy paneer, coli form count was found to be 1.82 and 1.62 respectively. Count had shown gradual increase in number and it was found to increase to the tune of 2.64 and 2.43, at the time of termination of storage period i.e. 20<sup>th</sup> day. Coli form count of fresh samples irrespective of treatment had indicated that during experiments proper hygiene was not maintained and their number found to be well beyond PFA limits i. e. not more than 90 /gm in fresh samples. The results, regarding microbial changes in spicy paneer, of present study are in close agreement with observations made by Bajwaet al. (2005)[15] in vegetable impregnated and salted paneer samples.

**Table 4: Microbiological count (log cfu/gm) changes in Spicy paneer samples during storage refrigeration.**

| Treatments            |                     | Storage ( Days ) |           |           |           |           |
|-----------------------|---------------------|------------------|-----------|-----------|-----------|-----------|
|                       |                     | 0                | 5         | 10        | 15        | 20*       |
| Total plate count     |                     |                  |           |           |           |           |
| B T                   | <b>Control</b>      | 3.97±0.12        | 4.48±0.21 | 5.63±0.12 | 5.79±0.12 | S         |
|                       | <b>spicy paneer</b> | 4.20±0.11        | 4.66±0.12 | 5.78±0.21 | 5.90±0.13 | S         |
| S S                   | <b>Control</b>      | 4.12±0.09        | 4.27±0.21 | 4.78±0.22 | 5.00±0.22 | 5.25±1.12 |
|                       | <b>spicy paneer</b> | 4.15±0.14        | 4.24±0.22 | 4.81±0.23 | 5.15±0.12 | 5.35±1.11 |
| Yeast and mould count |                     |                  |           |           |           |           |
| B T                   | <b>Control</b>      | 2.05±0.12        | 2.83±0.17 | 3.14±0.12 | 3.62±0.11 | S         |
|                       | <b>spicy paneer</b> | 2.02±0.11        | 2.72±0.22 | 3.31±0.18 | 3.57±0.12 | S         |
| S S                   | <b>Control</b>      | 2.24±0.13        | 2.37±0.15 | 3.11±0.17 | 3.17±0.12 | 3.55±0.11 |
|                       | <b>spicy paneer</b> | 2.23±0.13        | 2.31±0.12 | 3.17±0.16 | 3.11±0.12 | 3.42±0.12 |
| Coli form count       |                     |                  |           |           |           |           |
| B T                   | <b>Control</b>      | 1.87±0.12        | 2.23±0.12 | 2.47±0.17 | 2.60±0.11 | S         |
|                       | <b>spicy paneer</b> | 1.77±0.11        | 2.09±0.12 | 2.29±0.16 | 2.57±0.16 | S         |
| S S                   | <b>Control</b>      | 1.82±0.13        | 1.99±0.16 | 2.17±0.16 | 2.22±0.17 | 2.64±0.04 |
|                       | <b>spicy paneer</b> | 1.62±0.15        | 1.83±0.17 | 1.89±0.16 | 2.13±0.09 | 2.43±0.09 |

BT- 5% brine treated paneer; SS- 3% salt sprinkled paneer; S – Spoiled

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