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Effect of incorporation of cardamon powder on physiochemical, sensory attributes, and shelf life of a cow and buffalo milk paneer

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A B S T R A C T

Paneer is a nutritious, delectable acid-heat-coagulated indigenous dairy product, but it has a short shelf life due to its high moisture content. Although herbs are known for their qualities as antioxidants, preservatives, and flavor enhancers. Therefore, the current study examined the quality parameters such as (titratable acidity, lactose, moisture content, ash content, fat content, protein content, phenolic content, and sensory parameters) of herbal paneer produced by incorporating cardamom powder percentages in four different samples 0.15% with cow milk, 0.20% with cow milk, 0.15% with buffalo milk and 0.20% with buffalo milk and coded as (A, B, C, and D). The findings showed that the herbal paneer was superior in terms of organoleptic, but that it had little to no impact on the paneer's proximate and physiochemical parameters. The herbal paneer samples slightly higher total phenolic content of buffalo milk paneer compared to the cow milk paneer. The 0.20% of cardamom with buffalo milk sample was found to be overall effective. As a result, the study suggests that cardamom could be used to develop a novel functional dairy product with enhanced antioxidant properties and longer shelf life.

1. INTRODUCTION

1.1. Research Background

A popular soft cheese in South Asia called paneer is made by pressing the coagulum formed after acid and heat are used to coagulate buffalo milk or a mixture of cow and buffalo milk.[1]. Despite Paneer's popularity, its low shelf life has always been a problem because it loses its freshness in just 2-3 days [2]. Paneer spoilage is caused primarily by the growth of microorganisms, which cause various physicochemical changes that result in the development of off-flavor in the product [3]. In recent years, a number of preservation techniques have been used to extend the shelf life of paneer, including chemical additives, packaging, thermal processing, and low-temperature storage, but these techniques are either expensive or increase the toxicity of paneer due to chemical additives [4]. Spices and herbs are well known for their ability to prevent microbial growth in food, which serves as a preservative. Cardamom is a popular spice known for its flavor, aroma, and antimicrobial properties [5]. Due to its aroma, cardamom is a well-known aromatic spice that is frequently used in Scandinavian, Arab, and Eastern cuisines. Cardamom (*Afromomum subulatum*) is a popular food spice and flavoring ingredient. It also adds fragrance and is well-known for its advantageous health properties [6]. It has several biological functions, including antioxidant, antidiabetic, antibacterial, anticancer, gastro-protective, and insecticidal activities, and is referred to as the "queen of spices." [7].

1.2. Research Objective

The main goal of this study is to significantly extend the shelf life of traditional Paneer and improve its flavor using cardamom extract [3]. Additionally, it aims to improve Paneer's nutritional value by incorporating several antioxidants and antimicrobial qualities that come from cardamom [8].

2. MATERIAL AND METHODS

Raw materials, analytical grade reagents, calibrated glassware, and equipment used in the study are described below. Fresh cow milk 3.5% fat and 7.5% Solid not fats (SNF) and buffalo milk 5% Fat and 8% Solid not fat (SNF) were collected from the local area of Lalitpur. Small cardamom was collected from the local market of Lalitpur. LDPE bags were used for packaging samples during the storage study.

2.1. Optimization of herbs in Paneer

Green cardamom powder was added at a different ratio to Paneer prepared from cow milk and buffalo milk and their physicochemical as well as sensory properties during storage were studied (Table 1) . For, cardamom several studies have found by addition of cardamom up to 0.20% in Paneer to be acceptable [3]

Table 1. Green cardamom powder addition ratio to Paneer

Samples	Formulation
A	0.15% Cardamom with cow milk
B	0.20% Cardamom with cow milk
C	0.15% Cardamom with buffalo milk
D	0.20% Cardamom with buffalo milk

*Samples A, B, C, and D represent the paneer samples where herbs extracts are directly treated on milk

Preparation of cardamom-incorporated paneer (Figure 1)/

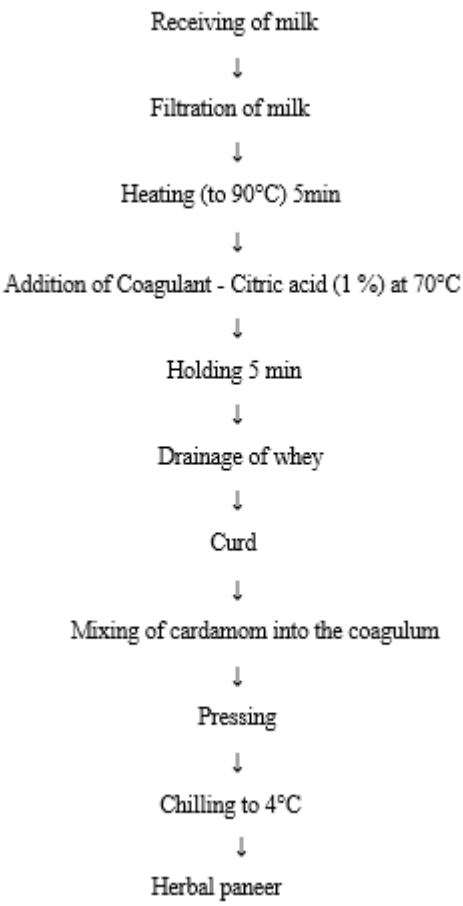

Fig. 1 Processing flowchart of herbal paneer
Source: Badola et al. [8]

2.2. Physio-chemical analysis

Moisture content, crude fiber, and total ash were determined by using the standard of Association of Official Chemists (AOAC) official methods [9]. The protein content was analyzed using the micro Kjeldahl process AACC 2000 [10]. Fat content was determined by Gerber's method. The acidity of milk is determined by titration with an alkali (sodium hydroxide) in the presence of an indicator (phenolphthalein) [11]. COB, alcohol, and SNF were carried out by Ref. [12]) method. The total phenolic content of the clove and pakhanbedh extract was determined according to Ref. [13].

2.3. Microbial analysis

The total plate count and coliform test were estimated as per the method of Ref. [9]. Similarly, yeast and mold were performed as per IDF [14].

2.4. Sensory evaluation

Herb-incorporated Paneer samples were subjected to sensory evaluation by 10 semi-trained panelists. A 9-point hedonic rating test was used and a sensory evaluation card was provided to the panelists.

2.5. Statistical method

Analysis was carried out in triplicates and sensory analysis was done in 10 replications. Statistical calculations were performed in Microsoft Office Excel 2016. All the data obtained in this experiment were analyzed for significance test at a 5% level of significance by two-way ANOVA using IBM SPSS statistics 20.

3. RESULTS AND DISCUSSION

The experimental findings from the preparation of cardamom-incorporated Paneer are presented and discussed in this part. Blends of cardamom with cow milk and buffalo milk were heated and coagulated to prepare Paneer. The results that show the effect of cardamom on the chemical and sensory and microbiological characteristics of milk and its Paneer are presented.

Table 2. Proximate composition of herbal paneer

Samples	**Moisture %**	**Protein %**	**Fat %**	**Ash %**
A	55.55±0.65	21.25±0.39	18.37±0.15	2.56±0.22^{a}
B	56.10±0.56	21.02±0.03	18.00±0.20^{a}	2.43±0.24^{a}
C	55.16±0.28	18.10±0.26	21.65±0.57^{b}	2.35±0.41^{a}
D	55.97±0.95	18.05±0.28	20.97±0.06^{b}	2.28±0.13^{a}

Table 2 shows the moisture content varied from 55%-56% among all samples. Sometimes the difference in moisture content of samples might be due to insufficient pressing time and the pressure difference of Paneer during preparation. The data were slightly higher than the data reported by Ref. [15]. The fat content of sample A and B were significantly lower than that of sample C and D, due to the presence of lower fat content in cow milk than the buffalo milk. Also, Ref. [16] reported that the fat content of buffalo milk is higher than that of cow milk. The data were lower than the data reported by Ref. [17]. The protein content and ash content of samples A and B were significantly higher than that of samples C and D. But Ref. [16] reported that protein content is higher in buffalo milk than in cow and goat milk. Similarly, Ref.

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[16] also reported that buffalo milk contains a higher amount of protein compared to camel and cow.

Table 3. chemical composition of herbal paneer

Samples	Acidity %	Lactose %	Total phenolic content, mg GAE/g
A	0.33±0.01^{a}	2.27±0.08^{a}	0.422
B	0.35±0.02^{ab}	2.45±0.19^{a}	0.425
C	0.37±0.02^{b}	2.74±0.45^{a}	0.475
D	0.38±0.02^{b}	2.73±0.72^{a}	0.479

In Table 3 the titratable acidity content of sample A was significantly lower than that of other samples. The obtained value of acidity of samples A, B, C, and D were 0.33%, 0.35%, 0.37%, and 0.38% respectively. Similarly, in a study by Ref. [8], the acidity percentage was found around 0.32-0.45%. The data were higher than the data reported by Ref. [15]. The lactose value was found to be higher in sample C and D compared to other samples which are due to the buffalo milk containing a higher amount of lactose compared to cow milk and goat milk [16]. Higher total phenolic content was observed in samples C and D compared to A and B. Ref. [8] also reported that herbal paneer fortified with black pepper 0.25% and cardamom 0.50% significantly increase the TPC of paneer compared to the control paneer sample.

3.1. Effect of cardamom powder on the acidity and moisture content of Paneer during storage

The data obtained for the change in the acidity and moisture of paneer samples during storage at 5±1°C.

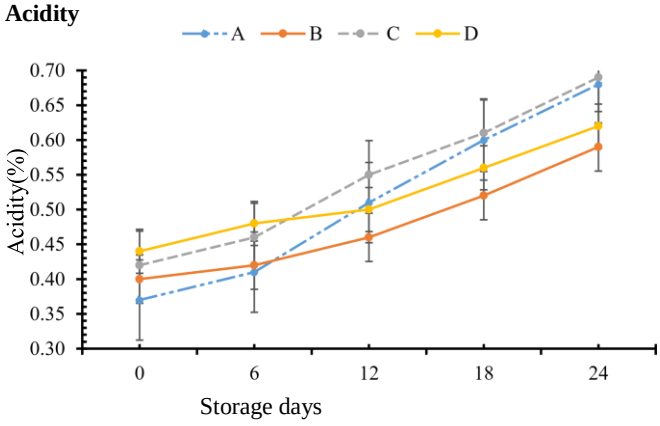

Fig 2: Effect of cardamom on the acidity content of herbal paneer samples during storage

Fig 2 represents the acidity of cow milk Paneer slowly increased from the initial day 0.37% -0.41% till the 6th day of storage and then rapidly increased from the 6th day to 0.41%-0.68% till the last day 24th days of storage. Similarly, the acidity of buffalo milk Paneer of 0.15% cardamom increases rapidly from the initial day 0.42%-0.69% 24th days of storage. While the acidity of cow milk Paneer with 0.20% increased slowly from the initial day 0.40% to 0.59% 24th day of storage and the acidity of buffalo milk Paneer also increased slowly initial 0.44% to 0.62% till the last day of storage. Ref. [18] found that the acidity of Paneer increased gradually from 0.224 to 0.472 % at the end of the ninth-day storage, followed by a sharp increase towards the end of storage. The acidity of cardamom incorporated samples of Paneer was found to be an acceptable label as compared to other spices as seen as from [3].

3.2. Moisture

The data obtained for the change in moisture content of Paneer samples during storage at 5±1°C

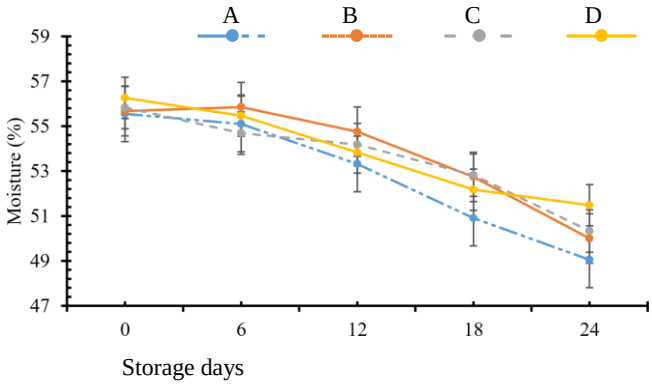

Fig. 3. Effect of cardamom on the moisture content of herbal paneer samples during storage

Fig 3 shows that the initial average moisture of cardamom-treated Paneer samples ranged from 55.5- 56.26%. The moisture content of cow milk Paneer with 0.15% cardamom decreased in 0 days from 55.5% to53.32 % up to 12th days while buffalo milk Paneer with 0.15% cardamom also decreased from 55.83% to 54.18% in between 0 -12th days of storage. After the 12th day of storage moisture content of cow milk Paneer with 0.15% decreased rapidly from 53.32%-49.5% between the 12th -24th days of storage. Similarly, buffalo milk Paneer of 0.15% cardamom also decreased from the 12th day 54.18% to 50% till the last day of storage. Cow milk Paneer moisture content of 0.20% from the initial day 55.67%-50% till the last day of storage similarly buffalo milk Paneer with 0.20% moisture content decreases from 56.26% to 51.48%. In all the cardamom-treated samples, sample B shows the smallest decrease in moisture, until the 6th day of storage, whereas the moisture content of all the samples drastically declines after the 6th day. Ref. [19] reported that the moisture content of spiced cheese decreased with an increase in the level of black pepper from 0.5 to 1.5%. A similar trend of decrease in moisture content of Paneer during storage was also observed earlier by Ref. [20, 21, 22].

3.3. Effect of the addition of cardamom on the sensory attributes of Paneer

The effect of storage at 5±1°C on the color and appearance of Paneer samples after treatment with cardamom added directly to milk after heat treatment.

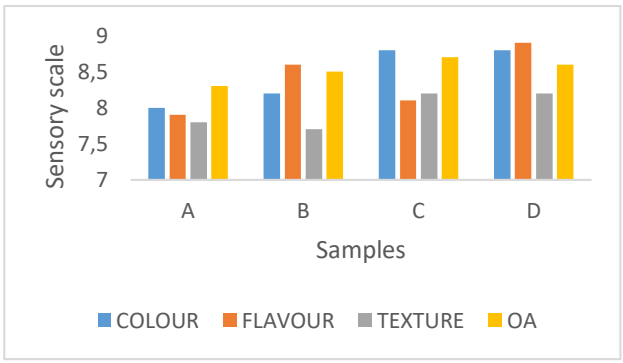

Fig 4. Sensory attributes of paneer samples

From the Fig 4, the statistical analysis shows that samples A &B were not significantly (P<0.05) different from each other similarly, C & D were also not significantly (P<0.05) different from each other whereas samples A and B were significantly (P<0.05) difference with Sample C, D. The decrease in score of color and appearance of a sensory score of sample A & B as compared to sample C &D is because of its different milk properties. Sample A &B is made with the incorporation of cardamom at the rate of 0.15% and 0.20% in cow milk respectively. whereas sample C & D is made up of the addition of cardamom at the rate of 0.15% and 0.20% with buffalo milk respectively. Ref. [23] observed that Paneer prepared from buffalo milk with a mixture of different spices (cumin and black pepper powder) was found likely in different treatments. According to Ref. [3], the addition of spices was found to reduce the color and appearance score of Paneers with a storage period of time, this adverse effect on the color and appearance score of the Paneer may be attributed to the brown to black color imparted by respective spices to the Paneer.

Statistical analysis shows that in flavor all the samples were significantly (P<0.05) different from each other. According to Hamid (2014), the flavor score of soft white cheese increased with the addition of cumin oil. Ref. [4] suggested that the flavor score of paneer increased with the addition of cinnamon spice. Ref. [19] indicated that the score for the flavor of cottage cheese blended with spice was increased with the addition of black pepper. The texture of all samples were significant (P<0.05) differences between samples. Ref. [3] found that reducing the body and texture score of Paneer is due to the addition of spices.

Ref. [23] also reported that mixing buffalo milk with individual or different spices makes a good quality body and texture Paneer. Statistical analysis shows that in overall acceptability all the samples were not significantly different from each other (P<0.05). The overall acceptability of the stored paneer depends upon several factors the degree of proteolysis, lipolysis, flavor changes, and microbial activity. The overall acceptability was found to be better for the samples in which the proteolysis, lipolysis, flavor changes, and microbial growth had been lesser i.e., sample D > C > B > A respectively. The data showed by Ref. [4] that the score for overall acceptability of *Paneer* increased with the addition of cinnamon spice. Ref. [19] reported that the score for the overall acceptability of cottage cheese blended with spices was increased with the addition of black pepper.

3.4. Microbiological quality of cardamom incorporated Paneer

The data obtained for the change in the Total Plate Count of Paneer samples during storage at 5±1°C

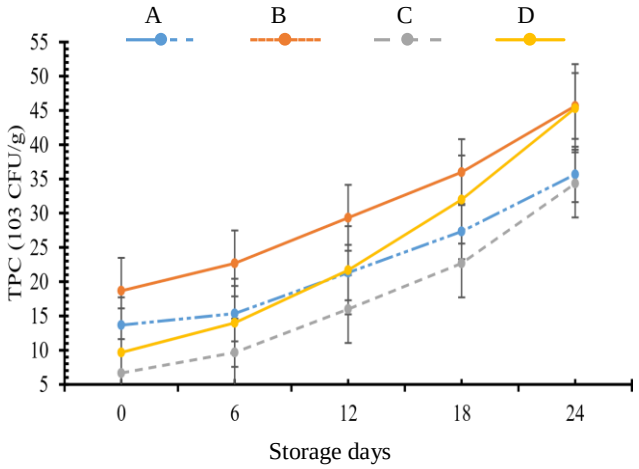

Fig 5. Effect of cardamom on TPC of Paneer sample

From the Fig 5 the initial day of storage, all samples showed a significant (P<0.05) difference between each other. On the 6th and 12th day of storage samples A &D didn't show any significant (P<0.05) difference while samples B & C showed a significant (P<0.05) difference from each other. On the. 18th day of storage, all samples showed significant (P<0.05) differences from each other. On the last day of the storage sample, A, B, C & D didn't show any significant (P<0.05) difference from each other. Ref. [24] found that the total viable count (TVC) of control significantly increased throughout the storage period while the count of different treatments decreased up to 15 days.

The mean value for coliform of all treatments was found to be nil. Ref. [25] using buffalo milk and a mint sample of different treatments were found to be nil in the coliform test. Also, Ref. [26] claimed that the coliform count of fiber-enriched Paneer was found nil during storage under refrigeration temperature for up to 15 days.

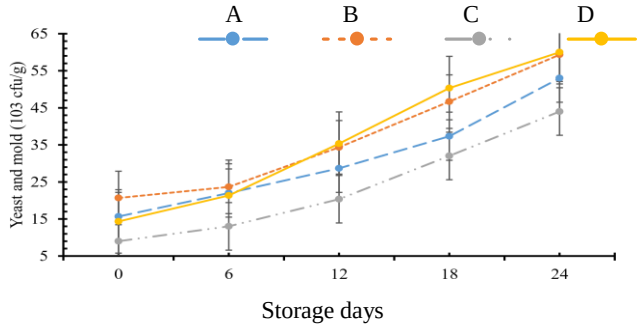

Fig 6. Effect of cardamom on yeast and mold count of Paneer samples

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Fig 6 shows that the storage days have a significant (P<0.05) effect on the yeast and mold count of the Paneer samples of both cow and buffalo milk with cardamom-treated samples. On the initial day of storage sample, C showed a significantly different (P<0.05) between all samples, whereas samples A & D didn't show any significant (P<0.05) difference from each other. On the 6th day of storage sample, C was a significant difference from another sample while samples A, B, and D were not significantly (P<0.05) different from each other. On the 12th day of storage sample, A, B, and C didn't have any significant (P<0.05) difference.

On the 18th day of storage, all samples were significantly (P<0.05) different from each other. On the 24th day of storage samples B and D didn't show any significant difference (P<0.05) between them while the other sample showed a significant (P<0.05) difference. Devaki *et al.* [29] explained that the use of star anise and red chili flakes paneer has good keeping quality for more than 30 days under refrigeration storage conditions. In order to reduce the yeast and mold count in Paneer during storage, cardamom [3, 27, 28] has been found to be highly effective.

4. CONCLUSION

The acidity, moisture, and microbial counts of the paneer samples were significantly influenced by the addition of cardamom powder and the number of storage days. The shelf life of the paneer samples was significantly impacted by the addition of cardamom powder to different cow and buffalo milk that were tested. The shelf life of all formulated cardamom-incorporated paneer cannot exceed more than 24 days stored at refrigerated temperature. The addition of cardamom powder caused moisture retention on the paneer samples. Among all treatments, paneer samples treated with 0.20%cardamom of buffalo milk were found to cause a minimum change in the sensory scores and in the chemical characteristics during the storage period, all the formulations of cardamom powder were proved to have preservative action on the paneer samples and had a longer shelf life in comparison to the normal Paneer.

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CONFLICTS OF INTEREST

The author does not have any conflicts of interest.

REFERENCES

[1] Kumar, S., Rai, D. C., Niranjan, K. and Bhat, Z. F. (2014). Paneer- An Indian soft cheese variant: A review. *J. Food Sci.Technol*. **51** (5), 821-831.

[2] Goyal, S. and Goyal, G. K. (2016). Maximizing shelf life of paneer-A review *Crit. Rev. Food Sci. Nutri.* **56** (8), 53-61.

[3] Eresam, E. K. K., Pinto, S. and Aparnathi, K. D. (2015). Concise and informative title: evaluation of selected spices in extending shelf life of paneer. *J. Food Sci. Technol*. **52** (4), 2043-2052.

[4] Khatkar, A. B., Ray, A. and Kaur, A. (2017). Studies on shelf-life extension of paneer with the addition of plant essential oil and different packaging materials. *Int. J. Current Microbiol. App. Sci.* **6** (9), 376-389.

[5] Nanasombat, S. and Wimuttigosol, P. (2011). Antimicrobial and antioxidant activity of spice essential oils. *Food Sci. Biotechnol.* **20**, 45-53.

[6] Ravindran, P. N. and Madhusoodanan, K. J. (2002). "Cardamom: The Genus Elettaria". CRC Press.

[7] Wyk, B. E. (2013). "Culinary Herbs and Spices of the World". University of Chicago Press. USA.

[8] Badola, R., Kumar, S., Fahad, M., Kanade, P. P., Upadhayay, S., Kholi, D. and Rautela, I. (2018). Effect of incorporation of black pepper and cardamom on quality characteristics of paneer. *Int. J. Appl. Sci. Eng.* **6** (2), 121-127.

[9] AOAC. (2005). "Official Method of Analysis" (18th ed.). Association of Official Analytical Chemist. Washington D.C.

[10] AACC 2000. Approved methods of the American association of cereal chemists. Vol. 1. American Association for Cereal Chemist, St. Paul, MN.

[11] Ranganna, S. 2002. Handbook of analysis of quality control for fruit and vegetable products, 2nd Edn, Tata McGraw Hill Publ. Co., New Delhi

[12] NDDB. (2001). "Laboratory Handbook". Nepal Dairy Development Board. Nepal.

[13] Genwali, G. R., Acharya, P. P. and Rajbhandari, M. (2013). Isolation of gallic acid and estimation of total phenolic content in some medicinal plants and their antioxidant activity. Nepal J. Sci. Technol. 14 (1), 95-102.

[14] IDF. (1998). "Enumeration of Yeast and Mold Count".

[15] DFTQC. (2017a). "Food Composition Table for Nepal". Department of Food Technology and Quality Control (Ministry of Agriculture Development). Nepal.

[16] Kapadiya, D. B., Prajapati, D. B., Jain, A. K., Mehta, B. M., Darji, V. B., & Aparnathi, K. D. (2016). Comparison of Surti goat milk with cow and buffalo milk for gross composition, nitrogen distribution, and selected minerals content. *Veterinary world*, *9*(7), 710.

[17] DFTQC. (2017b). "Minimum Mandatory Standards for Food and Feed Materials". Department of Food Technology and Quality Control, Ministry of Agriculture and Livestock Development, Kathmandu

[18] Venkateswarlu U., Reddy, k. Y. and Kumar, S. (2003). Preparation of filled milk paneer by incorporating coconut milk. *Indian J. Dairy Sci.* **56**, 352-358.

[19] Himabindu, D. and Arunkumar, H. (2017). Effect of black pepper (*Piper nigrum L.*) on the keeping quality of spiced cottage cheese. *J. Food. Dairy Tech.* **5** (4), 30-36.

[20] Mistry, C. D., Singh, S. and Sharma, R. S. (1992). Physico-chemical characteristics of paneer prepared form cow milk by altering its salt balance. *Aust. J. Dairy Technol*. **47** (1), 23-27.

[21] Pal, M. A., Beniwal, B. S. and Karwasra, R. K. (1999). Comparative efficacy of citric and malic acids as coagulants for paneer manufacture. *Indian J. Dairy Sci*. **52** (3), 156.

[22] Rao, K. J. and Patil, G. R. (1999). Water activity lowering ability of some humectants in paneer. *Indian J. Dairy Biosci*. **10** (1), 121-122.

[23] Gole, R. R., Shelke, R. R., Kale, V. S. and Dhage, R. D. (2019). Preperation of spicy flavoured paneer blended with cumin and black pepper powder. J. *Food Sci. Research* **10** (2), 170-175.

[24] Ratiba, B. A., Wedad, A. M., Mohamed, O. and Abd El-Baky, H. M. (2006). Effect of cardamom, thyme and clove powder on the composition and quality of white soft cheese made from goat's milk. *Assiut. J. Agri. Sci.* **37**, 139-157.

[25] Singh, O., Arora, P., Pratima, Mishra, S., Bharti, B. K. and Kumar, P. (2018). Studies on physico-chemical and microbiological analysis for preperation of paneer by using mint buffalo milk and mint. *J. Pharmacognosy and Phytochemistry*. **7** (5), 11981202

[26] Chauhan, S. and Chandra, R. (2016). Preperation and shelf life extension of fiber enriched paneer. *Int. J. Life Sci. Scienti. Res.* **2** (5), 566-569.

[27] Jagannath, D. R. (2012). Efficacy of Herbal Preservatives to Enhance Shelf Life of Paneer. Ph.D Thesis Mahatma Phule Krishi Vidyapeeth, India.,

[28] Rajarshibhai, B. A. (2012). Evaluation of extracts from selected spices to extend shelflife of paneer. Msc. Thesis. Anand Agricultural Univ., India.

[29] Devaki, C. S., Rashmi, H. S., Pallavi, R., & Shekhara, R. N. (2021). Development and storage studies on ready to use spice-based paneer. *J Adv Dairy Res*, *9*, 250.

 https://doi.org/10.29165/ajarcde.v7i2.249