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Physico-chemical and microbial quality of spiced Quarg type cheese

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Abstract
The present work entitled "physico-chemical and microbial quality of spiced quarg type cheese" was carried out in laboratory of Department of Animal Husbandry and dairy Science, Post Graduate Institute, M.P.K.V., Rahuri (M.H.). The quarg type cheese optimized with the levels of spices (Ginger, Garlic, Clove and Cumin) was subjected to analysis of fat, protein, lactose, total solid, ash, acidity and pH as well as standard plate count, yeast and mould count and coliform count. The chemical composition of quarg type cheese prepared by using 1.6 per cent ginger and 1.2 per cent cumin contains 12.10 per cent fat, 13.64 per cent protein, 2.26 per cent lactose, 29.20 per cent total solid, 1.24 per cent ash, 0.79 per cent acidity (% LA), 4.62 pH. The microbial count of fresh cheese was SPC 1.50 $\log_{10}$ cfu/gm, YMC and coliform count found to be absent.

Keywords: Quarg cheese, chemical, microbial, spices

Introduction
Cheese is one of the most popular manufactured dairy products. Cheese has been a part of balance diet all across the world. Cheese is highly nutritious; cheese contains high casein content which is the repository of several bio-active peptides which are released by a number of proteases. These peptides have biological activities like anti-carcinogenic, anti-hypertensive, anti-oxidative, opioid-activity etc. (Gomez-Ruiz *et al*., 2002) [8]. World cheese production is growing steadily in last five years reach to 21.0 MT in 2019 (Ermolaev *et al*., 2020) [4]. Also, the proportion of milk converted in cheese is increasing and is currently about 40 per cent (Kanawjia, 2021) [16]. This ascribed to increased milk production and greater demand for cheese. The knowledge of the technology of cheese making, biochemistry and microbiology of cheese ripening is increasing results into the diversity of cheese in the market (Farkye, 2004) [5]. At present cheese is the highly diversified dairy product with little differences in flavour from extremely mild to very sharp and in texture from semi solid to almost stone hard.

Quarg is a natural, unripened, fresh cheese produced on a large scale in Germany and is very popular there. It is essentially a milk protein paste, manufactured by acid coagulation of milk by proper bacterial cultures (e.g. *Streptococcus cremoris and Leuconostoc citrovorum*) with a small rennet addition for better separation of the protein coagulum from the whey and thus better yields. It can be produced in a variety of fat levels, ranging from almost fat-free to as much as 40 per cent fat in the dry matter. This cheese is popular in central Europe (e.g. Germany, Poland and Austria). Other names for this type of product in different countries include kvarg, tvarog, tworog, twarog, Sauermilchquark and Speisequark (Gahane, 2008) [7]. Quarg is milky white in colour, may be even faintly yellowish. Body and texture are homogeneously soft, smooth and mildly supple or elastic. Spreadability must be good. Due to high moisture content (~ 82%, w/w), the shelf-life is limited to 2-4 weeks at < 8 ^{0}C. There should be no appearance of water or whey, dryness or graininess, bacteriological deterioration, over acidification or bitter flavour during storage (Kroger, 1980; Siggelkow, 1984; Guinee *et al.*, 1993; Kanawjia, 2021) [17, 25, 9, 16].

Spices have long been known for their medicinal properties and the chemical components found in spices, such as phenylpropanoids, terpenes, flavonoids, and anthocyanins, have piqued interest in their potential (De La Torre Torres *et al*., 2017) [3]. 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. Spices have long been used in foods

due to their flavouring and antimicrobial effects on bacteria, fungi, and virus, and the antioxidant functional properties. The spices have been documented for their medicinal, preservative and antioxidant properties (Souza *et al*., 2005) [28]. Keeping the above fact in view attempts would have been made to explore the flavour effect of spices in Quarg type cheese.

Material and Methods

Fresh cow milk was procured from RCDP on cattle at M.P.K.V. Rahuri. The milk was standardized at 4 per cent fat using Pearson's square method. Standardized milk was heated to 85 ºC for 15 min and mixed thoroughly and cooled to 30-37 ºC. The milk was inoculated by adding 1 per cent starter culture (NCDC-149) and incubated at temperature 37 ^{0}C. Two and half hrs after the addition of starter culture, microbial rennet @ 250mg/100L milk was added and mixed thoroughly. The content was left undisturbed for curd setting in incubator at 37 ^{0}C, which took around 8-10 hrs starting from culturing. The coagulum was then cut using knives and it was again left undisturbed for about 10-15 minutes. The curd was heated slowly and gradually increasing temperature to 55-60 ^{0}C @ 1 ^{0}C per minute and curd hold for 10 minutes at 60 ^{0}C. Cooked curd was then cooled to room temperature and filled in muslin cloth hanging for 3 to 4 hrs. The obtained quarg type cheese was homogenized by mixing spices (Brand name: Spice valley procure from Jain Farm Fresh, Jalgaon) thoroughly. The quarg type cheese prepared by using cow milk was packed in sterilized PVC boxes and stored in refrigerator at 4 ± 1 ºC.

Treatment detail

T_0: Control (Quarg type cheese)
T_1: Quarg type cheese added with 1.6% ginger + 1.2% cumin
T_2: Quarg type cheese added with 0.6% garlic + 1.2% cumin
T_3: Quarg type cheese added with 0.6% clove + 1.2% cumin
T_4: Quarg type cheese added with 1.6% ginger + 0.6% garlic
T_5: Quarg type cheese added with 1.6% ginger + 0.6% clove
T_6: Quarg type cheese added with 0.6% garlic + 0.6% clove

The fat content in spiced quarg cheese was determined by Gerber method described in IS: 1224-(1977). The protein content of cheese was estimated by Micro-Kjeldhal method (AOAC, 1992) [1]. The lactose was determined as per Lane-Eynon's method given in IS: 1479 (Part-II), 1961. The total ash content of Quarg cheese sample was measured as per method given in IS: 1479 (Part-II) 1961. Total solids were determined as per method given in IS: 1479, (Part-II) 1961. Acidity of Quarg cheese samples was measured as per procedure stated in IS: 1479 (Part-I) 1960. The pH was determined using microprocessor controlled pH Analyzer (Labindia, New Delhi, Version I). Standard plate count was determined by method described in IS 5402: 1969. Yeast and mould count was determined by method described in IS 5403:1999. Violet Red Bile Agar (VRBA) of Hi-Media was used to enumerate the coliform counts in Quarg type cheese samples. The data obtained from trials of final treatment replicated three times was analyzed by Completely Randomized Design (Snedecor and Cochran, 1994) [27].

Result and discussion

Physico-chemical quality of spiced quarg type cheese Fat

The influence of different spices treatments on the fat content of spiced quarg type cheese is given in Table 1. The fat content of experimental quarg type cheese was in the range of 11.16 to 12.38. It was observed that the addition of spices significantly (<0.05) increases the fat content of quarg type cheese than control sample (11.16) such as T_1 (12.10), T_2 (11.46), T_3 (12.38), T_4 (11.28), T_5 (11.35) and T_6 (11.32). This effect may be attributed to compositional characteristics of spices.

The results obtained are in agreement with Milanovic *et al*. (2004) [20] who studied the quality of quarg produced by probiotic application and he found that the fat content of the product was in the range of 12 to 14.5 per cent. Gahane (2008) [7] who reported that fat content in functional quatg cheese was 10 per cent. Kadiya (2009) [15] developed functional quarg cheese and observed the fat content of product was 10.16 per cent. Kumar (2012) [18] developed sweetened functional soft cheese and found 14 per cent fat in control and 12 per cent fat in sweetened functional soft cheese.

Protein

The protein content of experimental quarg type cheese was in the range of 12.72 to 13.82. It was observed that the addition of spices significantly (<0.05) increases the protein content of quarg type cheese than control sample (12.72) such as T_1 (13.64), T_2 (13.82), T_3 (13.57), T_4 (13.74), T_5 (12.90) and T_6 (13.70). The highest protein was observed in T_2 (13.82) followed by T_4 (13.74), T_6 (13.70), T_1 (13.64), T_3 (13.57) and T_5 (12.90) where as lowest was in control sample. This effect may be attributed to protein compositional characteristics of spices. 890 The results obtained are in agreement with Milanovic *et al*. (2004) [20] who studied the quality of quarg produced by probiotic application and obtained quarg type cheese containing protein ranged from 10.20 to 18.24 per cent. Patange *et al*. (2018) [22] found that cumin level increased the protein content were significantly increased. Hailu *et al*. (2014) [10] observed 16.40 per cent protein content in soft unripened cheese added with ginger extract.

Lactose

The lactose content in resultant qaurg type cheese is ranged from 2.05 to 2.26 per cent. With addition of spices there was significantly (<0.05) increased in lactose content in quarg type cheese. The highest lactose per cent was found in T_1 (2.26) followed by T_2 (2.25), T_5 (2.24), T_4 (2.22) T_1 (2.20) and T_3 (2.19). The treatment T_1 is at par with T_2 and T_5 as well as T_3 is at par with T_6.

The result obtained was in agreement with Patange *et al*. (2018) [22] he observed that the lactose content was increased as the level of ginger and cumin was increased in WPC fortified quarg cheese. Milanovic *et al*. (2004) [20] who noted that the lactose content of the quarg cheese was ranged from 1.4 to 3.21 per cent. Gahane (2008) [7] who observed 2.05 per cent lactose in quarg cheese. Kumar (2012) [18] who obtained 2.79 per cent lactose in plain quarg cheese and 1.83 per cent lactose in sweetened functional soft cheese.

Total solid

Total solid content in resultant qaurg type cheese was ranged from 26.98 to 27.80 per cent. The highest total solid per cent was found in T_3 (29.32) followed by T_1 (29.20), T_2 (28.58), T_4 (28.52) T_6 (28.48) and T_5 (27.80). With addition of spices there was significantly (<0.05) increased in total solid content in quarg type cheese. This due to negligible moisture per cent in the spices powder ranged from 3.91 to 4.63 per cent

(Shirsir *et al*., 2012; Tiwari *et al*., 2020; Nadeem, 2012; Saxena, 2015; Mariam and Devi, 2016) [29, 21, 23].

Similar observations were recorded by Patange *et al*. (2018) [22] who observed that as the ginger and cumin level increased in WPC fortified quarg cheese the total solid content was significantly increased. Milanovic *et al*. (2004) [20] who observed the total solid content of the quarg cheese was 23.13 to 33.4 per cent.

Ash

Ash content in the resultant quarg type cheese was ranged between 1.06 and 1.28 per cent. The highest ash per cent found in T_5 (1.28) followed by T_4 (1.26) and T_6 (1.25) where as lowest observed in T_2 (1.18) but less than control sample (1.06). From the result it was revealed that the addition of spices significantly (<0.05) increased the ash content of the product. The results found are in agreement with the Patange *et al*. (2018) [22] who found that as the ginger and cumin level increased, the ash content was also increased significantly.

Table 1: Physico-chemical quality of spiced quarg type cheese

Treatments	Fat	Protein	Lactose	Total solid	Ash	Acidity	pH
T_0	11.16	12.72	2.05	26.98	1.06	0.72	4.70
T_1	12.10	13.64	2.26	29.20	1.24	0.79	4.62
T_2	11.46	13.82	2.25	28.58	1.18	0.76	4.65
T_3	12.38	13.57	2.19	29.32	1.20	0.78	4.63
T_4	11.28	13.74	2.22	28.52	1.26	0.74	4.68
T_5	11.35	12.90	2.24	27.80	1.28	0.78	4.64
T_6	11.32	13.70	2.20	28.48	1.25	0.76	4.66
SE ±	0.009	0.011	0.008	0.009	0.010	0.006	0.008
CD @ 5%	0.028	0.032	0.026	0.028	0.029	0.019	0.023

Acidity

The acidity (% lactic acid) of spices treated quarg type cheese was ranged between 0.74 and 0.79 which was more than control sample (0.72). The highest acidity found in T_1 (0.79) followed by T_2 (0.78) which is at par with T_5 (0.78), further T_2 (0.76) at par with T_6 (0.76) where as lowest acidity found in T_4 (0.74). From the result it was clear that addition of spices significantly (<0.05) increased in acidity content of resultant product. Increased in acidity of treated sample may be attributed to formation of lactic acid as a result of fermentation.

The result found was in agreement with Shirshir *et al*. (2012) [24] who reported 1.32 per cent acidity of ginger powder. Patange *et al*. (2018) [22] who observed the addition of ginger and cumin in WPC enriched quarg type cheese increased acidity content in the product.

pH

The pH of treatment combinations was ranged between 4.62 and 4.68, which was less than control sample (4.70). The highest pH was observed in control sample (4.70) followed by T_4 (4.68) and T_6 (4.66). Whereas lowest was in T_1 (4.62). It was observed that addition of different level of spices reduces the pH of quarg type cheese and the change in pH value of cheese followed an opposite trend to change in acidity (% lactic acid).

The results are in agreement of those reported by Simsek and Tuncer (2018) [26] who found that decreased in pH with increase in acidity by the addition of clove and black cumin in fresh Akcakatic cheese (Yoghurt cheese). Felfoul *et al*. (2017) [6] noted that addition of ginger powder in yoghurt reduces the pH content.

Microbial quality of spiced quarg type cheese

The standard plate count present in the experimental treatments ranged from 1.50 $\log_{10}$ cfu/gm to 1.70 $\log_{10}$ cfu/gm. There was significant (<0.05) difference observed between the treatments. The lowest count was noted in T_1 (1.50 $\log_{10}$ cfu/gm), where as highest count observed in control sample (1.70 $\log_{10}$ cfu/gm). It was found that the addition of spices reduces the standard plate count in the resultant quarg type cheese than control sample. This might be due to the combine effect of antimicrobial compound present in the spices.

The result of yeast and mould count and coliform count showed that the average initial YCM and coliform count in quarg type cheese was nil in the entire sample.

The result found are in close agreement with Belewu *et al*. (2005) [2] who observed the ginger was most effective to reduced microbial load followed by garlic in West African soft cheese. Patange *et al*. (2018) [22] found the close result in WPC fortified quarg cheese.

Table 2: Microbial quality of spiced quarg type cheese

Treatments	SPC ($\log_{10}$ cfu/gm)	YMC ($\log_{10}$ cfu/gm)	Coliform ($\log_{10}$ cfu/gm)
T_0	1.70	NIL	NIL
T_1	1.50	NIL	NIL
T_2	1.52	NIL	NIL
T_3	1.56	NIL	NIL
T_4	1.54	NIL	NIL
T_5	1.53	NIL	NIL
T_6	1.58	NIL	NIL
SE ±	0.00984	-	-
CD @ 5%	0.029847	-	-

Conclusion

The addition of spices in quarg type cheese could enhance the quality in respect of fat (11.16 to12.38%), protein (12.72 to 13.82%), lactose (2.05 to 2.26%), ash (1.06 to 1.28%), acidity (0.74 to 0.79%) and pH (4.62 to 4.68%). The addition of spices reduces the standard plate count in the resultant quarg

type cheese than control sample due the combine effect of antimicrobial compound present in the spices. The yeast and mould count and coliform count was nil in the entire sample.

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