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Physico-chemical properties of *Paneer* prepared from blends of raw turmeric extract and buffalo milk

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Abstract
Turmeric is a spice that has received much interest from both the medical/scientific worlds as well as from the culinary world. Turmeric has nutritional and health benefits of curcumin and it has been traditionally used for centuries in Asian cuisine. In present investigation an attempts was made to prepare *paneer* by using buffalo milk and raw turmeric extract and studied its compositional parameters. The *paneer* was prepared by considering treatment combination of buffalo milk and raw turmeric extract as 95%, 90% and 85% of buffalo milk and 5%, 10% and 15% of raw turmeric extract in treatments T_2, T_3 and T_4 and treatment T_1 taken as a control prepared from buffalo milk only. The compositional parameters include acidity, pH, fat, protein, moisture, total solid, ash were studied. It was observed that as the raw turmeric extract increase decreased the acidity of the developed product. This effect may be due to alkaline nature of turmeric.

Keywords: Bufalo milk, *paneer*, raw turmeric, Physico-chemical properties

Introduction
Paneer is 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 (Shrivastava and Goyal 2007) [25]. Herbs and spices come from different parts of the plant are used to impart an aroma and taste to food. Several herbs have therapeutic properties such as antioxidative, anti-inflammatory, antidibtic, anti-hypertensive and anti-microbial activities. Therefore, fortification of dairy food with herbs and spices could help to provide functional dairy products with nutritional and medicinal values. Also herbs and spices used to improve the appearance and attractiveness of fortified foods for consumers and to increase the sale of those herbs. Therefore only the highest quality herbs or spices can be added to dairy products to combat contaminating microorganisms (Samah and Youssef 2019) [24]. Turmeric is a golden spice derived from the rhizome of the plant *curcuma longa*. Turmeric has long been used as a spice, flavoring agent, and colorant. Traditionally, the spice has been used to treat numerous human ailments. Turmeric is a rich source of numerous biologically active constituents such as polyphenols, sesquiterpenes, diterpenes, triterpenoids, sterols and alkaloids (Gupta *et al.* 2013) [10].

In present investigation an attempts was made to prepare *paneer* using buffalo milk and raw turmeric extract and studied its compositional parameters.

Material and Methods
Buffalo Milk and Raw turmeric
Already standardized fresh Buffalo milk was procured from local market of Latur city, of Natural Milk Pvt., Ltd., Latur having 6.0 per cent fat and 9 per cent SNF. The pure raw turmeric (Selam variety) required for preparation of *paneer* was obtained from local market of Latur city.

Chemicals
Analytical (AR) or guaranteed grade (GR) reagents were used in the chemical analysis.

Packing Material
Polythene bags (200 gauges) was obtained from local market and used for packaging the raw turmeric added paneer.

Equipment and Accessories
Equipments and accessories include stainless steel vessels of requisite capacity, knives, fruit extractor/mixture, muslin cloth, standard weight balance, thermometer, gas shegdi, *paneer* press machine, etc. used for preparation of *paneer*. Before using this material, it was properly cleaned and washed with detergent solution and all the precautionary measures was considered during the conduct of trials to avoid contamination.

Preparation of raw turmeric extract
The fresh raw turmeric was collected, washed, peeled and cut into small pieces. After cutting raw turmeric pieces were grinded in the mixer for homogenous fine mixture by adding 1:5 ratio of water for extract filtration through muslin cloth.

Preparation Buffalo milk *Paneer* blended with Raw Turmeric extract
The buffalo milk (6% fat and 9% SNF) was taken in pan then raw turmeric extract was added before heating and mixed properly through glass rod. Milk was heated to 86°C and cooled up to temperature 76°C. After cooling citric acid were added in milk @ 1-3% at 76°C with stirring. After complete coagulation the stirring was stopped and allow the curd to sink to the bottom. The whey was then drained through a stainless steel strainer. The curd was collected and filled in stainless steel *paneer* hoope. The hoope used was circular blocks with holes on its side to facilitate the expulsion of whey. *Paneer* was pressed 10-15 minutes @ 3 kg/sq cm. The pressed block of curd was removed from the hoop, cut into pieces and immersed in chilled water (4° C) for 2 to 3 hours. The chilled *paneer* was then removed from water to drain out and packed in polythene bag and finally storage in refrigerator (5° C).

Evaluation of physico-chemical properties of *Paneer*
Paneer samples of different treatments were subjected for analysis for titratable acidity {IS: 1479 (1960) [12] Part-I}, pH {digital pH meter (335)}, fat {IS: 1224 (part II) (1977)} [11], protein {A.O.A.C. (1965)} [1], moisture/total solid/ash {IS: SP (Part XI) 1981} [13]. The data were analyzed statistically by using Completely Randomized Design (CRD) as per Panse and Sukhatme (1985) [19].

Result and Discussion
Physico-chemical analysis of *paneer*
The requisite samples of *paneer* with different treatments were subjected for proximate analysis *viz*. Acidity, pH, fat, protein, moisture, total solid and ash.

Acidity content of raw turmeric extract added *paneer*
The data on acidity content in *paneer* is presented in table no. 1 it was observed that the average acidity (per cent) of *paneer* prepared under each treatment was decreased as the turmeric extract added.

Table 1: Acidity content in raw turmeric extract added *paneer*

Treatments	Acidity per cent				
	R-l	R-1I	R-III	R-IV	Mean
T_1	0.49	0.52	0.55	0.52	0.52[a]
T_2	0.43	0.42	0.45	0.43	0.43[b]
T_3	0.37	0.39	0.38	0.40	0.39[c]
T_4	0.33	0.34	0.33	0.35	0.34[d]
SE ± 0.007	CD at 5% 0.024				

The values with different small letters superscripts row wise differ significantly at 5% level of significance.
From table no. 1 it indicates that the mean average scores acidity of *paneer* was 0.52, 0.43, 0.39 and 0.34 per cent for treatment T_1, T_2, T_3 and T_4, respectively. It was observed that as the raw turmeric extract decreased the acidity of the developed product. The highest value for acidity had shown by treatment T_1 (0.52) and lowest value for acidity had shown by treatment T_4 (0.34). All the treatment shown significant differed between each other. The raw turmeric extract in *paneer* affected on the acidity of *paneer*. This effect may be due to alkaline nature of turmeric.
Aparanthi (2009) [3] studied effect of turmeric on acidity of *paneer* was decreased i.e. 0.55 (0.00%), 0.52 (0.4%) and 0.52 (0.6%).
Buch (2014) [6] incorporated turmeric into *paneer*. She found that decreased in titrable acidity of *paneer* with increased in turmeric powder level i.e. 0.55(0.4%) and 0.50 (0.6%).
Mhatre (2018) [18] studied that there is slightly decreased in titrable acidity with the addition of ginger juice in *panner* i.e. 0.561(T_0), 0.547(T_1), 0.528(T_2), 0.513 (T_3) and 0.492(T_4).
Prasad (2017) [22] studied that titrable acidity value decreased with incorporation of turmeric essential oil in burfi 0.23.
The present findings are agreed with the above research workers.

pH content of *paneer*
The pH content in the finished product prepared under different treatments combinations had been determined. The results obtained are presented in table no. 2.

Table 2: pH in raw turmeric extract added *paneer*

Treatments	pH per cent				
	R-l	R-1I	R-III	R-IV	Mean
T_1	5.72	5.75	5.73	5.76	5.74[a]
T_2	5.77	5.75	5.77	5.76	5.78[b]
T_3	5.82	5.81	5.82	5.83	5.82[c]
T_4	5.88	5.87	5.89	5.86	5.88[d]
SE ± 0.006	CD at 5% 0.019				

The values with different small letters superscripts row wise differ significantly at 5% level of significance.
From table no. 2 it is revealed that, the average scores for pH of developed *paneer* went on increasing. The highest value of pH was shown by treatment T_4 i.e. 5.88 and the lowest had shown by treatment T_1 i.e. 5.74. The average scores for pH of developed *paneer* were ranged from 5.74 to 5.88. The increased in pH of all treatments of developed *paneer* was due to decreased in its acidity due to addition of raw turmeric extract.

Kumar *et al.* (2008) [16] studied that the pH decreased with the increased in titratable acidity, contrary to this no such interaction was observed in the present study.

Prajapat *et al.* (2018) [21] prepared spice incorporated camel and goat milk *paneer*. The level of spices was black pepper 0.6% (T_1), cardamom 0.6% (T_2), and black pepper + cardamom 0.3+0.3% (T_3). The pH value of spice incorporated camel and goat milk *paneer* was 6.00 (T_0), 5.91(T_1), 5.94 (T_2) and 5.97 (T_3). The investigation shows that pH value decreased with increased in level of spices.

Badola *et al.* (2018) [4] incorporated black pepper and cardamom on quality characteristics of *paneer*. The pH was observed in *paneer* sample in the range of 5.63+0.15 (control) and 5.03+0.15 (0.25% black pepper and 0.50% cardamom powder).

Josef and Rao (2019) [14] incorporated lemongrass extract and lemongrass oil on the sensory, physico-chemical and textural profile of *paneer*. The pH values were also found to be slightly reducing with the increased addition of lemongrass leaf extract as well as oil.

Martina *et al.* (2020) [17] incorporated graded levels of turmeric (Curcuma longa) on different qualities of stirred yoghurt. The values for pH ranged from 4.68±0.02 to 5.21±0.07. Within the yoghurt, the pH increased with increase in the amount of turmeric added.

This indicates that the addition of turmeric significantly increased the pH of the stirred yoghurt. Data presented showed that all samples except sample YTB1 (95:5) had pH values significantly higher than that of the plain yoghurt. Considerable increase in pH of the yoghurt samples was also observed when pH of the samples before and after fermentation was compared.

The present findings are not agree with the above research workers might be due to the raw turmeric used have more alkaline nature than the ingredients used by them i.e. black pepper, cardamom spice.

Fat percentage of *Paneer*

The fat content in the finished product prepared under different treatments combinations had been determined. The results obtained are presented in table no. 3.

From the table no. 3, it is clear that the average fat per cent in *paneer* decreased from treatment as T_1 to T_4. The fat content was highest in T_1 i.e. 26.06 per cent and lowest in T_4 i.e. 25.71 per cent. This decreasing trend must have been due to lower fat content in raw turmeric i.e. 2.10 per cent. The treatments T_1, T_2, T_3 and T_4 were differed significantly over each other.

Table 3: Fat content in raw turmeric extract added *paneer*

Treatments	Fat per cent				
	R-I	R-II	R-III	R-IV	Mean
T_1	26.02	26.09	26.00	26.13	26.06[a]
T_2	25.88	25.92	25.90	25.94	25.91[b]
T_3	25.77	25.80	25.82	25.81	25.80[c]
T_4	25.70	25.71	25.68	2573	25.71[d]
SE ± 0.018			CD at 5% 0.05		

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

The values recorded in fat content in the present investigation were comparable with below mentioned research.

Desale *et al.* (2009) [8] 16.0 to 28.0% fat content of *paneer* while studying the physical, chemical and microbial attributes of *paneer* marketed in Ahemadnagar city of Maharashtra State.

Karande (2011) [15] prepared *paneer* from milk of cow and buffalo by using different coagulants and he observed that *paneer* prepared from buffalo milk using citric acid as coagulant contained 25.23% fat. Buch *et al.* (2014) [6] studied that evaluation of efficacy of turmeric powder as a preservative in *paneer* in which fat content in *paneer* decreased 27.77 and 27.73% with increase in level of turmeric powder i.e. 0.4% and 0.6%.

Mhatre (2018) [18] who stated that there was decreased in fat with the addition of ginger juice in *panner*. 25.15 (T_0), 23.93 (T_1), 22.37 (T_2), 21.67 (T_3) and 20.87 (T4)

Singh *et al.* (2018) [26] prepared *paneer* by using buffalo milk and mint. The fat percent was recorded in T_0 (22.69) followed by T_1 (22.24), T_2 (21.78), and T_3 (21.33), T_4 (20.87) which is decreasing. The present findings are comparable and agree with above research workers.

Protein content of raw turmeric extract added *paneer*

The protein content in the finished product formulated under different treatment combinations had been determined. The results obtained are presented in table no. 4.

Table 4: Protein content in raw turmeric extract added *paneer*.

Treatments	Protein per cent				
	R-I	R-II	R-III	R-IV	Mean
T_1	18.22	18.09	18.15	18.25	18.18[a]
T_2	18.27	18.25	18.28	17.22	18.26[b]
T_3	18.43	18.47	18.44	18.48	18.46[c]
T_4	18.55	18.60	18.58	18.62	18.59[d]
SE ± 0.021	CD at 5% 0.065				

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

It could be seen from the table no. 4 that the protein content in raw turmeric extract added *paneer* sample studied ranged from 18.18 to 18.59 for T_1 to T_4, respectively. There was an increasing trend in protein values of the raw turmeric extract added *paneer* due to level of protein content in raw turmeric extract i.e. 2.30 per cent and milk casein may bind protein content of raw turmeric extract. The treatments T_1, T_2, T_3 and T_4 were differed significantly over each other.

The values recorded in protein content in the present investigation were comparable with below mentioned research. Desale *et al.* (2009) [8] mentioned arrange of protein content in *paneer* as a15.06 to 20.33% while studying the physical, chemical and microbial attributes of *paneer* marketed in Ahemdnagar city of Maharashtra State.

Eresam (2009) [9] prepared *paneer* using black pepper, cardamom, cinnamon, and clove. The protein contained was 17.19, 17.68, 17.57, 17.68 and 17.59 in control (0.00%), Bp (0.6%), Ci (0.6%), Ca (0.4%) and Cl (0.6%)

Karande (2011) [15] prepared *paneer* from milk of cow and buffalo by using different coagulants and he observed that *paneer* prepared from buffalo milk using citric acid as coagulant contained 17.08% protein.

Buch *et al.* (2014) [6] studied that evaluation of efficacy of turmeric as a preservative in *paneer* in which protein content in *paneer* increased 18.41% and 19.15% with increase in level of turmeric i.e. 0.4% and 0.6%.

The results recorded in the present study are match with the research findings quoted above.

Moisture content of raw turmeric extract added *paneer*

The data on moisture content in *paneer* is presented in table no. 5. It was observed that the average moisture (per cent) of *paneer* prepared under each treatment was T_1 (52.50), T_2 (52.36), T_3 (52.20) and T_4 (52.07) per cent respectively.

Table 5: Moisture content in raw turmeric extract added *paneer*

Treatments	Moisture per cent				
	R-l	R-1I	R-III	R-IV	Mean
T_1	52.50	52.48	52.49	52.52	52.50[a]
T_2	52.34	52.36	52.37	52.35	52.36[b]
T_3	52.18	52.20	52.22	52.21	52.20[c]
T_4	52.07	52.05	52.08	52.07	52.07[d]
SE ± 0.007	CD at 5% 0.028				

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

From the table no. 5, it is clear that the moisture content of the control (T_1) *paneer* was 52.50 per cent. As the proportion of the raw turmeric extract level increased the moisture per cent of *paneer* decreased. The decreasing trends of moisture from T_2 to T_4 because of increase in level of raw turmeric extract level. This may be due to curcumin is hydrophobic in nature. The treatments T_1, T_2, T_3 and T_4 were differed significantly over each other.

The values recorded in moisture content in the present investigation were comparable with below mentioned research.

An increase in temperature of coagulation from 60 to 90° C decreased the moisture content of *paneer* from 59.0 to 49.0%. Sachdeva and Singh 1988b; Chandan 2007b [23, 7]. Eresam (2009) [9] prepared *paneer* using black pepper, cardamom, cinnamon, and clove the moisture contained was 50.21, 49.81, 49.71, 49.52 and 49.70 in control (0.00%), Bp (0.6%), Ci (0.6%), Ca (0.4%) and Cl (0.6%). The results mentioned by Sachdeva and Singh 1988b; Chandan 2007b [23, 7] and Eresam (2009) [9] indicate that the ingredients and temperature affected on the moisture content of finished products. And further Yazadi *et al.* (2013) stated that curcumin in is hydrophobic in nature which may responsible for the decreased moisture. Proved by Buch *et al.* (2014) [6] studied that moisture content in *paneer* decreased 50.40 (0.4%) and 50.02 (0.6%) with increased in level of turmeric powder in *paneer*; Paul *et al.* (2018) [20] prepared *paneer* by incorporating herbal extract i.e. basil ginger and mint in which moisture content of ginger added *paneer* decreased 44.88 (T_1) 52.45 (T_2), 52.15 (T_3) and 52.08 (T_4). And Prasad *et al.* (2017) [22] prepared burfi using different herb in which moisture content of turmeric powder added burfi decreased than control 14.68 (control) and 14.38 (1%).

The present findings are agreeable with the above research workers.

Total solids content raw turmeric extract added *paneer*

The data obtained in respect of total solids content of the finished product are presented in table no. 6.

It has been seen from the table no. 6 that the control (T_1) has total solids content as 47.50 per cent and other treatments i.e. T_2 (47.65), T_3 (47.80) and T_4 (47.94) per cent. It was observed that the total solid content increased with increased in level of raw turmeric extract from T_1 to T_4. A total solid of product is the counter part of the moisture content parameter of the product and hence moisture content directly influenced the total solid per cent, decreased in moisture content of the product increased the total solid content.

The lowest total solid content was noticed at T_1 (47.50) i.e. control *paneer*, while highest total solid contain in T_4 (47.50) i.e. *paneer* prepared with 15% raw turmeric extract.

Table 6: Total solid content in raw turmeric extract added *paneer*

Treatments	Total solids per cent				
	R-l	R-1I	R-III	R-IV	Mean
T_1	47.50	47.52	47.51	47.48	47.50[a]
T_2	47.66	47.64	47.63	47.65	47.65[b]
T_3	47.82	47.80	47.78	47.79	47.80[c]
T_4	47.93	47.95	47.92	47.93	47.93[d]
SE ± 0.007			CD at 5% 0.024		

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

The treatments T_1, T_2, T_3 and T_4 were differed significantly over each other. The values recorded in moisture content in the present investigation were comparable with below mentioned research.

Thakur *et al.* (2016) [27] prepared soy *paneer* from a blend of toned milk and soy milk. The significant different in total solid percentage was found amongst the treatments at $P < 0.05$. Experimental *paneer* (T_3) had highest average total solid of 43.31 percent whereas (T_0) had lowest average total solid contents of 35.55 percent.

Bhandekar *et al.* (2018) [5] revealed total solid contain in *paneer* of Nagpur city were 45.51, 48.68, 47.44, 50.67 and 47.21 per cent of different samples.

Algarani (2016) prepared soft cheese supplemented with thyme, cumin and turmeric @ 2% level. They found that total solid content was 35.7%, 36.5%, 36.6%, and 36.6% in control, thyme, cumin, and turmeric added cheese.

The results obtained in the present finding are agreed with the previous finding.

Ash content

The ash content in raw turmeric extract added *paneer* as influenced by different proportions of raw turmeric extract incorporated in buffalo milk has been presented in table no. 7.

Table 7: Ash content in raw turmeric extract added *paneer*

Treatments	Ash per cent				
	R-l	R-1I	R-III	R-IV	Mean
T_1	1.50	1.55	1.52	1.51	1.52[a]
T_2	1.54	1.55	1.54	1.56	1.55[b]
T_3	1.59	1.58	1.60	1.58	1.59[c]
T_4	1.62	1.64	1.63	1.64	1.63[d]
SE ± 0.006	CD at 5% 0.020				

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

The ash content of raw turmeric extract added *paneer* of the treatment T_1, T_2, T_3 and T_4, were found to be as 1.52, 1.55, 1.59 and 1.63 per cent, respectively. The ash contain of *paneer* was ascending trend. This might be due to high content of mineral as compared to milk and their binding ability to milk components. The values recorded in ash content in the present investigation were comparable with below mentioned research.

Prasad *et al.* (2017) [22] prepared burfi using different herb in which ash content of 1% turmeric powder added burfi increased than control i.e. 2.95 (control) and 3.03 (1%).

Mhatre (2018) [18] who stated that there was increased in ash with the addition of ginger juice in *panner* i.e. 1.68 (T_0), 1.94 (T_1). 2.09(T_2) 2.29 (T3) and 2.41 (T_4).

Paul *et al.* (2018) [20] prepared *paneer* by incorporating herbal extract i.e. basil ginger and mint in which ash content of ginger added *paneer* increased 1.57 (T_1), 2.25 (T_2), 2.3 (T_3) and 2.05 (T_4).

In the present investigation, a value for ash content was found to be comparable with the research finding recorded above.

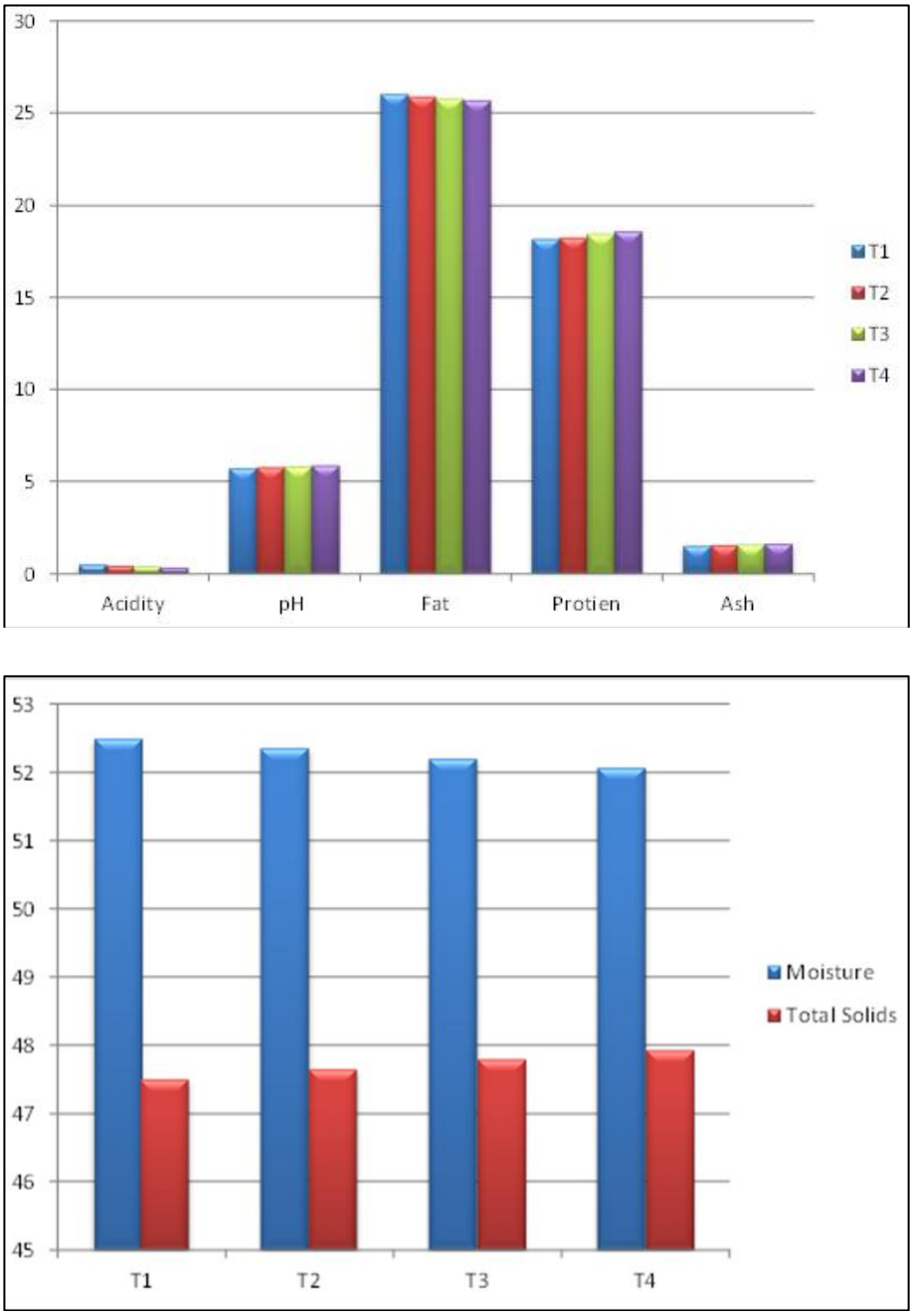

Fig 1: Physico chemical analysis of Raw Turmeric extract added *Paneer*

Conclusion

Raw turmeric extract is type of ingredients in food products, which can impact specific functionalities to food products, while enhancing, preserving and nutritional and compositional quality of food. The Raw turmeric extract could be successfully utilized for preparation of raw *paneer*. On an average the acidity content of raw turmeric extract added *paneer* was found as 0.52, 0.43, 0.39 and 0.34 per cent; pH 5.74, 5.78, 5.82 and 5.88 per cent; fat 26.06, 25.91, 25.80 and 25.71 per cent; protein 18.18, 18.26, 18.46 and 18.59 per cent; moisture 52.50, 52.36, 52.20 and 52.07 per cent; total solids 47.50, 47.65, 47.80 and 47.94 per cent; ash 1.52, 1.55, 1.59 and 1.63 per cent for control T_1 and treated samples T_2, T_3, and T_4, respectively. It was observed that as the amount of raw turmeric extract increased, there was increase in pH, protein, total solid and ash content whereas, decrease in acidity, fat and moisture of *paneer*.

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