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Studies on turmeric powder (*Curcuma Longa L.*) added *ghee*

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Abstract

In the present investigation an attempt was tried to prepare the buffalo milk *ghee* by using turmeric powder (*Curcuma longa L.*). The *ghee* preparation process was standardized by adding turmeric powder at different stages and screening the different combinations of turmeric powder with buffalo milk. The developed *ghee* was subjected to sensory parameters. The average score for colour and appearance in all three stages was ranged 6.30 to 8.68. Its ranged in 1st stage 7.17 to 8.68, 2nd stage 6.68 to 8.68 and 3rd stage 6.42 to 8.68 found decreasing order due to the changed in colour in developed *ghee*. Statistically the colour and appearance score for all the treatments were differ significantly with each other. The maximum score was found in T₁ where as minimum score was recorded in TB₄. TM₂ treatment in 1st, TD₂ in 2nd stage and TB₂ in 3rd stage is better indicate that 0.5 per cent powder was better for *ghee* preparation than than other combination it may be due to that increased yellow colour and appearance of *ghee* in other treatments. There was a decreasing trend in the flavour score, The average score for flavour in all three stages was ranged between 6.18 to 8.81. Its range in 1st stage 6.75 to 8.81, in 2nd stage 6.62 to 8.81 and in 3rd stage 6.18 to 8.81. The average score for body and texture in all three stages was ranged between 6.92 to 8.81. It ranged 7.56 to 8.81 in 1st stage, 6.92 to 8.25 in 2nd stage and 7.40 to 8.00 in 3rd stage. Overall average score for the finished product including control ranged in between 6.50 and 8.75 i.e. for TB₄ to T₁ in all three stages treatment combinations. The mean scores of overall acceptability showed a decreasing trend with increase in level of turmeric powder.

Keywords: Buffalo milk, *Ghee*, Turmeric powder, *Curcuma longa*

Introduction

Preparation of different milk products from milk is traditional practice in India and developed years ago, currently 46% of the total milk produced in the country is consumed as fluid milk and remaining 54% is converting into different milk products. Among all these products *ghee* is major dairy product known as a balance wheel of dairy industry. It has important place in diet of people of the Indian subcontinent due to its good flavour, pleasant aroma and semi solid (granular) texture, the rich pleasing flavour of *ghee* cannot be duplicated by any other fats. *Ghee* bears several medicinal claims and many of its combinations with herbs are reported in ancient texts. Literature survey revealed that very few scientific investigation has been made in regard to the nutritional, meditational and functional activity of *ghee* and its combination with turmeric having natural antioxidant is curcumin (diferuloylmethane), a fat-soluble bioactive, yellow pigment present in Indian spice turmeric (*Curcuma longa L.*), known for its numerous functional attributes e.g. anti-inflammatory, anti-oxidant, hypotensive, hypocholesteremic, antidiabetic, anti-bacterial, anti-viral, etc. Its application in food not only to enhance the organoleptic properties of food, but also to increase the shelf life by decreasing or eliminating the foodborne pathogens (Lai and Roy, 2004) [10]. Therefore, preparation of *ghee* with turmeric could help to provide functionality with nutritional and medicinal values. Spices have been well known for their medicinal, preservative and antioxidant properties (Souza *et al.* 2005) [22]. Turmeric has a high medicinal value in the traditional medicinal system of South Asia, Which includes aiding in wound healing, inflammatory condition and blood purification (Aggrawal *et al.* 2007) [2]. Safety evaluation studies indicate that both turmeric and curcumin are well tolerated at a very high dose without any toxic effects. It contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (23.1%). It is principally known for yellow-orange colouring powder, having a musky flavour and aroma, which necessities classified it as a spice (Rathore *et al.* 2020) [20]. Turmeric contains lipophilic bioactive compounds called curcuminoids, which include curcumin, dimethoxycurcumin (DMC), and bisdemethoxycurcumin (BDMC).

Although curcumin shows many bioactivities including anti-inflammatory and anticancer properties (Aggarwal *et al.* 2003) ^[1]. The present study was proposed to develop turmeric powder added dairy products.

Materials and Methodology

In the present research work the standard material and methods were used and work was carried out at the Department of Animal Husbandry and Dairy Science, College of Agriculture Latur, Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani.

The *ghee* was prepared as per the *desi* method suggested by De. (2004) ^[4] during experiment with slight modification for stage of turmeric powder addition, form and level as shown in following flow diagram.

Preparation of turmeric powder added *ghee*

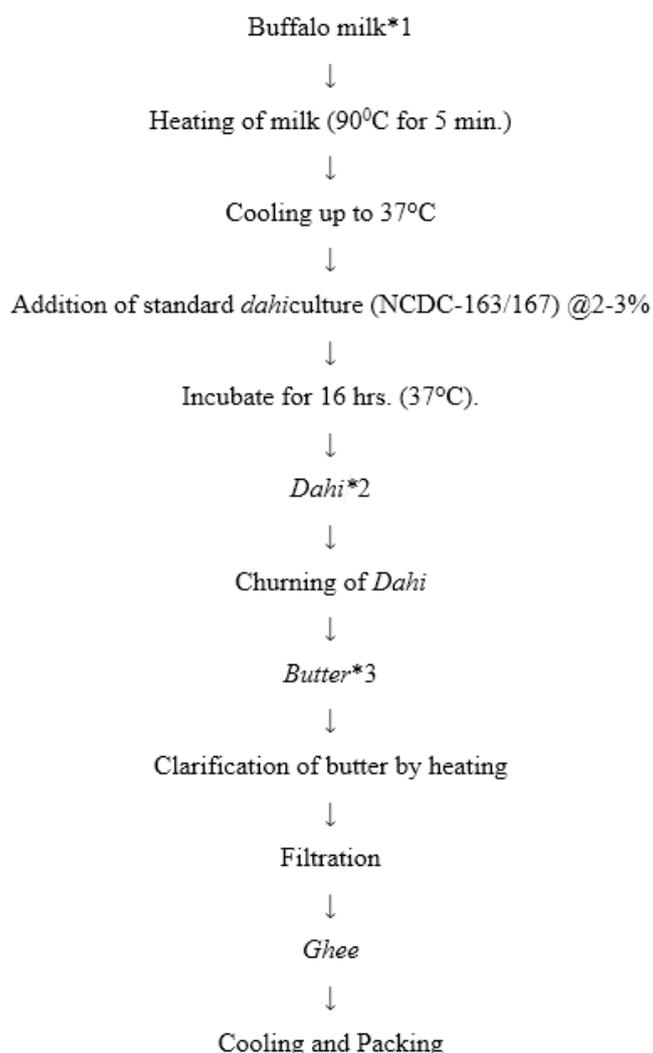


Fig 1: Preparation of *Ghee*, (De. 2004) ^[4].

Note- The turmeric powder was added as per treatment combination at different stage as shown as star (*).

For preparation of turmeric powder added *ghee* was prepared as per the method described by De Sukumar, 2004 ^[4] with slight modification for addition of turmeric powder as shown in flow diagram(1). The turmeric powder was added at three stage i.e. First at initial stage in milk, Second at middle stage in *dahi* and third at final stage in butter (Figure 3.1 marked as

star). The fresh buffalo milk (6% fat and 9% SNF) was heated at 90°C and cooled up to temperature 37°C. After cooling the standard *dahiculture* (NCDC-167) was added in milk @ 3% and incubate at 37°C for 16 hours. The curd so obtained was churned by electric churner. At the end of the churning in the *ghee* manufacturing process, butter and buttermilk get segregated. The produced butter was kept in karahi and it gets heated against a medium to high flame. Then butter boiled for some more time for water evaporation. Then boiled butter gets clarified and visible layer of solids was found at the bottom of the karahi that indicate that the *ghee* was almost ready. In final step liquid *ghee* was filtered by using filter paper. Turmeric powder was added in *ghee* as per treatment.

Results and Discussion

Chemical composition of buffalo milk

The buffalo milk which used in this study was procured from Natural Milk Pvt. Ltd, Latur. The chemical composition was found as fat 6 per cent, SNF 9 per cent; protein 3.5 per cent, lactose 4.5 per cent and energy value 80 Kcal/100 gm. (Table No. 1.) this milk is marketed as buffalo milk in Marathwada region.

Table 1: Chemical composition of buffalo milk

Nutritional profile (%)	Value
Fat	6.00
SNF	9.00
Protein	3.50
Lactose	4.50
Energy value	80 Kcal/ 100gm
Total solid	15.00
Ash	0.76
Moisture	85.00

Chemical composition of turmeric powder

The readymade turmeric powder was purchased from the local market of Latur city which was prepared from the turmeric variety of selum prepared. This variety of turmeric is grown in local area of Marathwada region particularly Hingoli and Nanded district. The major components of turmeric powder used for present study was estimated and found as protein 6.9 per cent, fat 6.3 per cent, minerals 3.15 per cent, carbohydrate 49.95 per cent and moisture 19.20 per cent as shown in table no. 2. The content of raw turmeric extract was found different than the Chatopadhyay *et al.* 2004 and Rathur *et al.* 2012 ^[21] might be due to the varieties difference.

Table 2: Chemical composition of turmeric powder

Parameter	Composition (per cent)	Composition (%) Rathur <i>et al.</i> 2012 ^[21]
Protein	6.90	6.3
Fat%	6.30	5.1
Mineral%	3.15	3.5
Carbohydrate%	49.95	69.4
Moisture%	19.2%	9.2
Essential oil	-	5-8%

Preparation of *ghee* by using turmeric powder

The turmeric powder added *ghee* was prepared as per the method described by De Sukumar, 2004 ^[4] with slight modification for stage of addition of turmeric powder. The turmeric powder was added at three stage i.e. First at initial stage in milk, Second at middle stage in *dahi* and third at final stage in butter (Figure 1 marked as star). The fresh buffalo

milk (6% fat and 9% SNF) was heated at 90⁰ C and cooled up to temperature 37⁰ C. After cooling the standard *dahiculture* (NCDC-167) was added in milk @ 3% and incubate at 37⁰ C for 16 hours. The *dahiso* obtained was churned by electrical churner. At the end of the churning in the *ghee* manufacturing process, butter and buttermilk get segregated. The produced butter was kept in karahi and it gets heated against a medium to high flame. Then butter boiled for some more time for water evaporation. Then boiled butter gets clarified and visible layer of solids was found at the bottom of the karahi that indicate that the *ghee* was almost ready. In final step liquid *ghee* was filtered by using filter paper. Turmeric powder was added in *ghee* as per treatment.

Optimization of stage of addition of turmeric powder in *ghee*

Treatment T₁ taken as a control from only buffalo milk as per treatment combination. The turmeric powder was optimized by taking its proportion in first and second stage 0.5%, 1% and 1.5% in combination 99.5%, 99% and 98.5% for the

treatments T₂, T₃ and T₄ respectively. The turmeric powder was added at three stage i.e. First at initial stage in milk, Second at middle stage in *dahi* and third at final stage in butter as shown in table 3.

Table 3: Treatment combination of buffalo milk and turmeric powder for *ghee* preparation

Treatments	Buffalo milk (%)	Turmeric Powder (%)
1st Stage on the basis of milk		
T ₁	100	-
TM ₂	99.5	0.5
TM ₃	99	1
TM ₄	98.5	1.5
2nd Stage on the basis of <i>dahi</i>		
TD ₂	99.5	0.5
TD ₃	99	1
TD ₄	98.5	1.5
3rd Stage on the basis of butter		
TB ₂	99.5	0.5
TB ₃	99	1
TB ₄	98.5	1.5

Table 4: Sensory score of *ghee* prepared by adding turmeric Powder (@1%) at different stages:

Sr No.	Colour and appearance	Flavour	Body and texture	Over all acceptability	Remarks
Control Ghee	8.9	8.5	8.5	8.63	
First at initial stage in milk	8.6 ± 0.80	8.5 ± 0.10	8.7 ± 0.18	8.6 ± 0.25	Uniform yellowish colour
Second at middle stage in <i>dahi</i>	7.6 ± 0.45	7.0 ± 0.12	7.0 ± 0.50	7.2 ± 0.40	intense yellow colour shed
Third at final stage in butter	7.0 ± 0.56	7.0 ± 0.42	6.0 ± 0.16	6.35 ± 0.71	Dark yellow colour with dusty appearance

SE = ± 0.15197 CD at 5% = 0.468265

Observations are the average of four replications and an in each replication average of five judges were considered as a single observation.

The *ghee* was prepared by using turmeric powder in combination with buffalo milk, *dahi* and butter as shown in figure 1. The rate of turmeric powder was considered as average of three treatments i.e. 1 per cent of milk, *dahi* and butter. The turmeric added *ghee* samples along with control *ghee* were subjected for sensory analysis by a panel of five judges using a nine-point Hedonic scale. The numerical score given by judges for individual quality attributes were computed to get the mean and these mean was considered as a single observation for that replication and four replications were carried out. The general remarks of judges also noted in remarks column which was also observed in photo copy of samples. The results obtained for sensory evaluation of turmeric powder added *ghee* are presented in table no.4. It is observed that *ghee* can be produce by using all three stage of turmeric addition. The *ghee* obtained in initial stage secured more point as compared to other two stages and which was more akin to the control sample. When we considered the quality of *ghee* on the basis of nine-point Hedonic scale all samples secured between like slightly to like extremely. All samples were statistically different at five per cent level of significant but acceptable on sensory parameters, feel need to study for further observations. Therefore, all stages of turmeric addition were considered for preparation of *ghee* in further study.

Sensory evaluation of turmeric powder added *ghee*

Turmeric powder added *ghee* was evaluated for its colour and appearance, flavour, body and texture by a panel of five judges using a nine-point Hedonic scale. The numerical score given by judges for individual quality attributes were

computed to get the mean and these mean were then subjected to the statistical analysis. The results obtained for sensory evaluation of turmeric powder added *ghee* are discussed as under.

Colour and appearance

The colour and appearance score of *ghee* as influenced by the proportion of turmeric powder levels have been recorded in table 5.

Table 5: Colour and appearance score for turmeric powder added *ghee*

Treatments	Colour and appearance score				
	R-I	R-II	R-III	R-IV	Mean
T ₁	8.50	9.00	8.75	8.50	8.68
TM ₂	8.50	9.00	8.50	8.50	8.62
TM ₃	8.00	8.50	8.00	8.00	8.12
TM ₄	7.50	7.00	7.70	6.50	7.17
TD ₂	8.50	8.00	8.50	8.25	8.31
TD ₃	7.50	7.00	8.00	8.00	7.62
TD ₄	7.00	6.50	7.00	6.25	6.68
TB ₂	7.50	7.75	7.25	7.20	7.42
TB ₃	7.00	7.00	7.50	7.50	7.25
TB ₄	6.25	6.5	6.2	6.25	6.30

SE = ± 0.16312 CD at 5% = 0.471136

From above table no 5, it is clear that the average score for colour and appearance in all three stages was ranged 6.30 to 8.62. Its range in 1st stage 7.17 to 8.68, in 2nd stage 6.68 to 8.68 and in 3rd stage 6.30 to 8.68. *Ghee* prepared under different stage and different proportion of turmeric powder indicate that first stage i.e. powder added at milk was superior than other stage and 0.5 per cent turmeric powder showed highest score (8.62) than other treatments and more similar to

control treatment (T₁). The trend for colour and appearance score at all stages were found decreasing as the proportion of turmeric powder increased. T₁ was found to be superior over the rest of the treatments. Statistically most of the treatments differed significantly for colour and appearance with each other. The maximum score was found in T₁ where as minimum score was recorded in TB₄. TM₂ treatment in 1st, TD₂ in 2nd stage and TB₂ in 3rd stage is better indicate that 0.5 per cent powder was better for ghee preparation than than other combination it may be due to that increased yellow colour and appearance of *ghee* in other treatments. It is observed that more levels of turmeric powder lowered the score of *ghee* for colour and appearance. The following workers also agreed with present observation.

Lodh and Khamuri (2016) [11] colour and appearance score was significantly reduced with increasing level of curcumin addition in curcumin fortified buffalo *ghee*.

Khamuri and Khetra (2013) [8] reported usually good quality buffalo *ghee* should have a white or without a yellowish or greenish tinge with pleasant enjoyable flavor that lingers on the mouth and possess medium to large size grains that uniformly distributed throughout the product.

Parmer (2013) [17] reduction of colour score was reported in arjunaghee during longer time.

Manoharan *et al.* (2012) [13] reported that the incorporation of curcumin powder at maximum 0.5% level in butterscotch flavoured ice cream was equally acceptable as a naturally coloured ice cream.

Buch (2014) [3] studied that colour and appearance score declined with increase in turmeric powder% in *paneer* from 8.2 (0.0%), 8.0 (0.2%), 7.8(0.4%), 6.9 (0.6%), 6.2 (0.8%), 6.1 (1%).

Prasad (2017) [18] incorporated turmeric powder in *burfi* in which colour and appearance score decrease from 7.10 (0.5%) to 6.11 (1.5%).

Mervat *et al.* (2007) [15] studied *yoghurt* appearance score decreased significantly ($p < 0.5$) by increasing turmeric powder concentrations from 8.8 (T₁), 8.3 (T₂), 7.6 (T₃), 7.4(T₄) and 7.7 (T₅).

Maji *et al.* (2018) [12] studied herbal *lassi* fortified with turmeric (*Curcuma longa* L.) extract decreased colour and appearance score with increased in turmeric extract from control 7.66 control, 7.50 (1%), 7.45 (2%), 7.33 (3%) and 6.66 (4%) level.

Flavour

From above table 6, it is clear that the average score for flavour in all three stages was ranged between 6.18 to 8.81. Its range in 1st stage 6.75 to 8.81, in 2nd stage 6.62 to 8.81 and in 3rd stage 6.18 to 8.81. *Ghee* prepared under control treatment (8.81) was found to be superior over the rest of the treatments. Statistically the flavor score for all the treatments were differ significantly with each other. The maximum score was found in T₁, TM₂, TD₂ and TB₂ where as minimum score was recorded in TM₄, TD₄ and TB₄ for control, 1st, 2nd and 3rd stage of turmeric powder addition, it may be due to that in first stage bitterness of turmeric reduced in fermentation process by the action of fermented by bacteria. Pianpumepong and Noomhorm (2010) revealed that LAB strains, namely *Enterococcus faecium*, *Lactococcus lactis subsp. lactis* and *Lactobacillus plantarum* were isolated from turmeric rhizomes can be used as starter. In all stages the rate of flavor decreased significantly over control indicates that turmeric powder influenced on flavor of *ghee* might be due to the bannyflavour

of turmeric also proved in rate of turmeric powder addition in respective treatments. This indicates that the increased in proportion of turmeric powder in *ghee* decreased flavour of *ghee*. It is observed that more levels of turmeric powder lowered the score of *ghee* for flavour.

Table 6: Flavour score for turmeric powder added *ghee*

Treatments	Flavour score				
	R-I	R-II	R-III	R-IV	Mean
T ₁	9.00	8.75	8.50	9.00	8.81
TM ₂	8.50	8.25	8.25	8.25	8.31
TM ₃	7.75	8.00	7.75	7.75	7.81
TM ₄	6.50	7.00	7.00	6.50	6.75
TD ₂	8.50	8.25	8.25	8.25	8.25
TD ₃	8.00	8.00	7.50	7.75	7.81
TD ₄	7.00	6.50	6.00	7.00	6.62
TB ₂	8.00	8.20	8.00	8.25	8.11
TB ₃	7.00	7.50	7.25	7.25	7.25
TB ₄	6.15	6.15	6.25	6.20	6.18

SE = ± 0.11567 CD at 5% = 0.334087

As flavour is the main parameters for *ghee* and fond decreasing trend in the present study agree with Mehulkumar (2011) [14] reported that effect of increased concentration of turmeric on changes in flavour score of *ghee* during storage. But, Lodh (2016) reported six level of curcumin *viz.*, 160, 200, 250, 300, 350 and 400 ppm were tried in the preparation of curcumin fortified buffalo *ghee*. Flavour score was not affected upto 200 ppm of curcumin addition into buffalo *ghee* beyond the score was decreased with increasing level of curcumin content. Supported by Gaba and Jain (1973) [5] reported that the decline in the flavour score of *ghee* was considered to be due to the production of carbonyl compound in the *ghee*. Other herbs also affect on the flavor of *ghee* observed by Kumar *et al.* (2013) [9] also reported that flavour preference of tulsi extract based herbal ice-cream increased compared to plain ice-cream when tulsi extract was used up to 3% level only while increase in level of extract (i.e. 4% level) led to decreased in flavour score due to presence of excessive amounts of tulsi extract and intense flavor. In other milk product also turmeric affected on flavor observed by Hosny *et al.* (2011) [7] reported that *karish cheese* fortified with curcumin enhanced its organoleptic properties, particularly for flavor and taste which were much appreciated by the sensory panelists; Buch (2014) [3] studied that flavour score declined with increase in turmeric powder% in *paneer* from 7.9 (0.0%), 7.8 (0.2%), 7.9 (0.4%), 7.2 (0.6%), 6.2 (0.8%), 5.8 (1%) in which 0.4% level was better; Prasad (2017) [18] incorporated turmeric powder in *burfi* in which flavour score decrease from 7.05 (0.5%) to 5.92 (1.5%); Mervat *et al.* (2007) [15] studied *yoghurt* flavor score decreased significantly ($p < 0.01$) by increasing turmeric powder concentrations from T₁ to T₅; Maji *et al.* (2018) [12] studied herbal *lassi* fortified with turmeric (*Curcuma longa* L.) extract decreased flavour score with increased in turmeric extract from control 8.33 control, 8.2 (1%), 7.33 (2%), 6.0 (3%) and 4.33 (4%) level. The possible reason supported by Purseglove *et al.* (1981) [19] reported turmeric owns its aromatic taste and smell to the oil pleasant in the rhizomes. It has a major role in the aroma and flavour of turmeric. They dry rhizomes possess earthy, slightly unpleasant odour and bitter, mild acrid taste.

Body and texture

The body and texture of turmeric powder added *ghee* as influenced by the different levels of turmeric powder and

score recorded on account of this is presented in table 7.

Table 7: Body and texture score for turmeric powder added *ghee*.

Treatments	Body and texture score				
	R-I	R-II	R-III	R-IV	Mean
T ₁	9.00	8.75	9.00	8.50	8.81
TM ₂	8.50	8.25	8.50	8.25	8.37
TM ₃	7.25	7.50	8.00	7.75	7.68
TM ₄	7.50	7.25	7.75	7.75	7.56
TD ₂	8.25	8.00	8.50	8.25	8.25
TD ₃	8.00	7.50	7.25	8.00	7.68
TD ₄	7.00	7.2	6.75	6.75	6.92
TB ₂	7.5	7.5	8.00	7.75	7.68
TB ₃	7.75	8.00	7.50	7.00	7.56
TB ₄	7.60	7.75	7.25	7.00	7.40

SE = ± 0.14352 CD at 5% 0.414526

The body and texture is the main parameter as far as the consumer appeal is concerned. As far the body and texture parameters were concerned, the addition of turmeric powder lowered the scores recorded but not affected so much in different stage of turmeric powder addition and within treatments also. The highest body and texture score were observed for T₁ (Control) followed by TM₂, TD₂ and TB₂ for 1st, 2nd and 3rd stage of turmeric addition, respectively. Lodh and Khamuri (2017) reported granulation of *ghee* is an important criteria for its selection. Good grainy texture is much preferred textural attributed of *ghee*. It is revealed that more than 80% of variability in texture of curcumin fortified buffalo *ghee*. Buch (2014) [3] studied that body and texture score declined with increased in turmeric powder% in *paneer* from 7.9 (0.0%), 7.8 (0.2%), 7.6 (0.4%), 6.9 (0.6%), 6.7 (0.8%), 6.4 (1%). Prasad (2017) [18] incorporated turmeric powder in *burfi* in which flavour score decreased from 7.11 (0.05%) to 6.80 (1.5%). Mervat *et al.* (2017) studied *yogurt* body and texture score decreased significantly (p<0.05) by increasing turmeric powder concentrations from T₁ to T₅. Maji *et al.* (2018) [12] studied herbal *lassi* fortified with turmeric (*Curcuma longa L.*) extract decreased flavour score with increased in turmeric extract from control 8.33 control, 8.25 (1%), 7.7 (2%), 7.0 (3%) and 7.0 (4%) level.

Overall acceptability for turmeric powder added *ghee*

The overall acceptability score is the average score worked out from the score given by the judges for the different characteristics of the product i.e. colour and appearance, flavour, body and texture. Thus the average score worked out as overall acceptability score is presented in table 8.

Table 8: Overall acceptability for turmeric powder added *ghee*

Treatments	Overall acceptability				
	R-I	R-II	R-III	R-IV	Mean
T ₁	8.75	8.70	8.80	8.75	8.75
TM ₂	8.31	8.62	8.37	8.39	8.42
TM ₃	7.81	8.12	7.68	7.73	7.83
TM ₄	6.75	7.17	6.56	6.98	6.86
TD ₂	8.25	8.31	8.25	8.40	8.30
TD ₃	7.81	7.62	7.68	7.58	7.67
TD ₄	6.62	6.68	6.62	6.63	6.63
TB ₂	6.31	6.43	6.68	6.58	6.50
TB ₃	7.25	7.25	7.56	7.29	7.33
TB ₄	8.18	8.12	8.00	8.24	8.13

SE = ± 0.07165 CD at 5% = 0.206945

The table 8 it is clear that the overall average score for the

finished product including control ranged in between 6.50 and 8.75 i.e. for TB₄ to T₁ in all three stages treatment combinations. The mean scores of overall acceptability showed a decreasing trend with increase in level of turmeric powder. There was a decreased in the acceptability of the finished product in all treatments but secured acceptable score on 9 point hedonic scale. Lodh and Khamuri (2016) [11] reported that decreased the overall acceptability score in curcumin fortified buffalo *ghee* with increasing level of turmeric. Buch (2014) studied that overall acceptability score declined with increased in turmeric powder% in *paneer* from 8.0 (0.0%), 7.9 (0.2%), 7.8 (0.4%), 6.9 (0.6%), 6.3 (0.8%), 5.8 (1%). Prasad (2017) [18] incorporated turmeric powder in *burfi* in which overall acceptability score decreased in turmeric added burfi. Maji *et al.* (2018) [12] studied herbal *lassi* fortified with turmeric (*Curcuma longa L.*) extract decreased overall acceptability score with increased in turmeric extract from control 8.30 control, 8.23 (1%), 7.33 (2%), 6.66 (3%) and 5.66 (4%) level.

Conclusion

From present investigation it can be concluded that the turmeric powder can be very well utilized for preparation of medicinal and nutritional *ghee*. The turmeric powder of 0.5%, 1% and 1.5% was added in all three stages. 0.5% is more acceptable than 1.5% added turmeric powder in *ghee*. 1.5% addition is less acceptable.

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