International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1617-1621

Received: 03-10-2020
Accepted: 09-11-2020

Ambhore SS
Department of Animal Husbandry and Dairy Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra, India

PV Padghan
Department of Animal Husbandry and Dairy Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra, India

GK Londhe
Department of Animal Husbandry and Dairy Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra, India

Soni Khobragade
Department of Animal Husbandry and Dairy Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra, India

Corresponding Author:
Ambhore SS
Department of Animal Husbandry and Dairy Science, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra, India

Studies on physico-chemical properties of buffalo milk ghee prepared by using turmeric powder (*Curcuma longa* L.)

Ambhore SS, PV Padghan, GK Londhe and Soni Khobragade

DOI: https://doi.org/10.22271/chemi.2020.v8.i6w.10996

Abstract
In the present investigation *ghee* was prepared by considering treatment combination of buffalo milk and turmeric powder as 99.5%, 99% and 98.5% of buffalo milk and 0.5%, 1% and 1.5% of turmeric powder. The physico-chemical parameters include moisture, free fatty acid, iodine value, peroxide value, melting point, butyro-refractoeter reading were studied. It was observed that as the turmeric powder increase decrease in moisture content, peroxide value, butyro-refractometer reading, free fatty acid of the developed product.

Keywords: Buffalo milk, *Ghee*, Turmeric powder, physico-chemical properties

Introduction
Plants have been used since ancient times to cure diseases and improve human health (Taher *et al*. 2017) [32]. 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 (Samah and Youssef 2019) [26]. Consumption of herbs has significant health promoting effect and reduces the incidence of cardiovascular disease, cancer and various degenerative diseases (Singh *et al*. 2006; Craig 1999; Shishodia *et al*. 2005) [29, 6, 28]. Turmeric has also been used for centuries in Ayurvedic medicine, which integrates the medicinal properties of herbs with food. One tablespoon of turmeric powder contains: 29 calories, 2.1 g of fiber, 0.91 g of protein, 0.31 g of fat, 0.3 g of sugar, 6.31 g of carbohydrates, 26% manganese, 3% Vitamin C, 16% iron, 5% potassium, 2.1 g of fiber, 0.91 g of protein, 0.31 g of fat, 0.3 g of sugar, 6.31 g of carbohydrates, 26% manganese, 3% Vitamin C, 16% iron, 5% potassium. (Khan 2019) [14]. *Ghee* chemically may be defined as complex lipids of triacylglycerol, together with small quantity of free fatty acids, phospholipids, sterols, hydrocarbons, carbonyl compounds, fat soluble vitamins (A,D, E, and K), carotenoid pigments, moisture and traces of elements like copper and iron. *Ghee* is also good source of butyric acid, conjugated linoleic acid, phospholipid and fat-soluble vitamins A, D, E and K. etc.The present study was proposed to prepared *ghee* by using turmeric powder having medicinal and nutritional properties and examined its physico-chemical properties.

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, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Physico-chemical properties of the product
Physico-chemical parameters like moisture content, free fatty acid, butyro-refractometer reading, iodine value, peroxide value and melting point were examined by adopting standard procedure and data were analyzed statistically by using Completely Randomized Design (CRD) as per Panse and Sukhatme (1985) [21].

Result and Discussion

Moisture content of turmeric powder added *ghee*

The data on moisture content in *ghee* is presented in table 1. It was observed that the average moisture (per cent) of *ghee* prepared under each treatment was T_1 (0.237), TM_2 (0.218), TM_3 (0.206) and TM_4 (0.195) per cent respectively in 1st stage, in 2nd stage TD_2 (0.215), TD_3 (0.206) and TD_4 (0.195) and in 3rdstage TB_2 (0.189), TB_3 (0.200) and TB_4 (0.210). From the table 1 it is clear that the moisture content of the control (T_1) *ghee* was 0.237 per cent.

As the proportion of the turmeric powder level increased the moisture per cent of *ghee* decreased. The decreasing trend of moisture from T_2 to T_4 in 1st and 2nd stages may be due to the increased in level of turmeric powder level which expose more hydrophobic nature of turmeric as curcumin is hydrophobic in nature supported by Lodh and Khamrui (2017) [18]. But in third stage the moisture percent was found increased as the turmeric powder increased might be due to the less processing of turmeric occurred due to which the hydrophilic property of turmeric remain sustain or may be increased in combination of milk fatty acids in this case. As Yazadi (2012) [33] stated that curcumin in is hydrophobic in nature and the processing affected on the structural and functional properties of food ingredients. (Fox and McSweeney, 1998) [9].

Table 1: Moisture content in turmeric powder added *ghee*

Treatments	Moisture per cent (%)				
	R-l	R-1I	R-III	R-IV	Mean
T_1	0.235	0.239	0.245	0.232	0.237
TM_2	0.220	0.218	0.216	0.218	0.218
TM_3	0.209	0.205	0.204	0.207	0.206
TM_4	0.200	0.199	0.192	0.190	0.195
TD_2	0.218	0.215	0.212	0.217	0.215
TD_3	0.208	0.202	0.206	0.208	0.206
TD_4	0.198	0.191	0.200	0.193	0.195
TB_2	0.189	0.190	0.187	0.188	0.189
TB_3	0.200	0.207	0.197	0.198	0.200
TB_4	0.210	0.216	0.208	0.210	0.210
SE = ± 0.00182 CD at 5% = 0.005267					

The values recorded in moisture content in the present investigation were comparable with below mentioned research. PFA, (2008) [23] as per PFA standards moisture content of *ghee* should not be more than 0.5%. Sserunjogi *et al.* (1998) [31] the moisture content of *ghee* sample varies from 0.17 0.19% among different treatments. Moisture content of *ghee* is reported to vary from 0.3% maximum. Gupta *et al.* (1979) [11] reported that 2.5% to 5.0% moisture in *ghee* offered antioxidant properties. Achaya (1997) [2] storage stability of *ghee* is attributed to the low moisture content (0.2%). Buch *et al.* (2014) [5] studied that moisture content in *paneer* decreased 50.40 (0.4%) and 50.02 (0.6%) with increase in level of turmeric powder in *paneer*. Paul *et al.* (2018) [21] 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). Prasad *et al.* (2017) [24] prepared *burfi* using different herb in which moisture content of turmeric powder added *burfi* decreased than control 14.68 (control) and 14.38(1%).

Free fatty acid content

The free fatty acid content in turmeric powder added *ghee* as influenced by different proportions of turmeric powder incorporated in buffalo milk has been presented in table.2

Table 2: FFA content in turmeric powder added *ghee* (in per cent)

Treatments	FFA (per cent)				
	R-l	R-1I	R-III	R-IV	Mean
T_1	0.20	0.21	0.22	0.20	0.20
TM_2	0.18	0.20	0.21	0.19	0.19
TM_3	0.11	0.13	0.13	0.16	0.13
TM_4	0.05	0.11	0.09	0.10	0.08
TD_2	0.19	0.17	0.18	0.20	0.17
TD_3	0.14	0.14	0.12	0.13	0.12
TD_4	0.09	0.11	0.09	0.10	0.11
TB_2	0.09	0.05	0.08	0.07	0.10
TB_3	0.13	0.13	0.12	0.11	0.11
TB_4	0.15	0.16	0.15	0.18	0.15
SE = ± 0.01501 CD at 5% = 0.043348					

The data on free fatty acid content in *ghee* is presented in table 2. It was observed that the average FFA content of *ghee* prepared under each treatment was T_1 (0.20), TM_2 (0.19), TM_3 (0.13) and TM_4 (0.08) per cent respectively in 1st stage, in 2nd stage TD_2 (0.17), TD_3 (0.12) and TD_4 (0.11) and in 3rd stage TB_2 (0.10), TB_3 (0.11) and TB_4 (0.15). The content of free fatty acid was found decreased as the proportion of turmeric increased indicate that the excess FFA in treated treatments absorb or link with hydrophobic part of turmeric may be curcumin, which showed stronger antioxidant activity in quenching free radicals, Lodh and Khamrui (2017) [18]. This changes in developed treatment may be helpful for enhancement of shelf life of *ghee*. As the FFA more prone for oxidative rancidity of *ghee*, might be reduce the possibility in developed treatments. As per the PFA, (2008) [23] standards FFA content of *ghee* should not be more than 3%.As per the standards and categories of *ghee* mentioned by AGMARK, according to agmark free fatty acid contains should not be more than 1.4% for special grade *ghee*, 2.50% for general grade *ghee* and 3.0% for standard grade *ghee*, the *ghee* of present study comes under special grade *ghee*.

Sharma (1981) [27] reported the FFA content of *ghee* samples varied on an average 0.16 to 0.20% (unripened cream) among different treatments. FFA content of *ghee* is reported to vary from 0.23 to 0.28.

Lodh and Khamuri (2016) [17] reported initially there was no significant difference in FFA content among the different *ghee* samples. The initial FFA content of the CFB, CFP, BGB, BGP, CB and CP were 0.204±0.011, 0.200±0.006, 0.200±0.006, and 0.223±0.009%.

Naaz and Prakash (2000) [20] studied the traditional method of *ghee* production with various spices (cardamom, clove, fenugreek, pepper and turmeric) and determine the effect of these spices on keeping quality. FFA value were lowest with turmeric.

Peroxide value

The peroxide value in turmeric powder added *ghee* as influenced by different proportions of turmeric powder incorporated in buffalo milk has been presented in table 3.

Table 3: Peroxide value in turmeric powder added *ghee*

Treatments	Peroxide value (meq O_2/kg)				
	R-l	**R-1I**	**R-III**	**R-IV**	**Mean**
T_1	0.30	0.32	0.31	0.31	0.31
TM_2	0.30	0.31	0.31	0.30	0.30
TM_3	0.29	0.30	0.29	0.30	0.29
TM_4	0.28	0.28	0.27	0.28	0.27
TD_2	0.32	0.31	0.30	0.32	0.31
TD_3	0.31	0.30	0.29	0.30	0.30
TD_4	0.29	0.28	0.27	0.29	0.28
TB_2	0.28	0.29	0.28	0.28	0.28
TB_3	0.29	0.31	0.29	0.29	0.29
TB_4	0.30	0.32	0.32	0.31	0.31
SE = ± 0.00395 CD at 5% = 0.011417					

The peroxide value of turmeric powder added *ghee* of the treatment T_1, TM_2, TM_3 and TM_4 in 1st stage were found to be as 0.31, 0.30, 0.29 and 0.27 per cent, respectively. TD_2, TD_3 and TD_4 in 2nd stage were 0.31, 0.30, 0.28 and TB_2, TB_3 and TB_4 in 3rd stage as 0.28, 0.29 and 0.31, respectively. It is clear from above table that the peroxide value of turmeric powder added *ghee* was positive in first and second stage of addition but observed negative in case of third stage of addition, indicate that the stage of addition of turmeric in food most important to preserve its functionality as well as nutritionally.

Mehulkumar and Aparnathi (2011) [19] reported that the addition of curcumin powder at 0.4% gave *ghee* lower peroxide value as compare to control sample. 1st day of storage in control *ghee* 0.32 and in turmeric added *ghee* is 0.32. 3rd day of storage *ghee* 1.75 and turmeric added *ghee* is 1.55.

Ghatak and Bandyopadhyay (1989) [10] reported peroxide value of 0.2 to 0.7 and 0.6 to 3.10 (mM of O_2/kg) for *ghee* sample from organized and unorganized sector respectively. The age of samples at the time of analysis was in the range of 1 to 4 months.

Hazra *et al*. (2015) [12] reported that addition of two variety of tomato skin increase the oxidative stability of *ghee* during accelerated storage. Peroxide value was lower for tomato added *ghee* sample as compare to control sample.

Naaz and Prakash (2000) [20] studied the traditional method of *ghee* production with various spices (cardamom, clove, fenugreek, pepper and turmeric) and determine the effect of these spices on keeping quality. Peroxide value 1.39 meq/kg were lowest with turmeric.

Fasludeen (2016) [8] peroxide value was less in pomegranate peel powder 0.908.

Lodh and Khamurai (2016) [17] prepared curcumin fortified buffalo *ghee* in that the initial value of control *ghee* after 3 day of storage (<0.005). At the end of the six day of storage peroxide value of curcumin fortified buffalo *ghee* curcumin fortified buffalo *ghee* (CFB), curcumin fortified buffalo *ghee* in PE (polyethelene) pouch (CFP), control buffalo *ghee* in HDPE (high density polyethelene) bottle (CB) and control buffalo *ghee* in PE pouch (CP) sample were 0.556±0.002, 0.543±0.001, 3.859±0.002 and 3.730±0.003 meq.o_2/kg respectively.

Singh *et al.* (2014) [30] reported the peroxide values of the *paneer* varies from 0.486 to 2.38 which shows that the peroxide value increased gradually during the storage.

Butyro-refractometer reading

The Butyro-refractometer reading in turmeric powder added *ghee* as influenced by different proportions of turmeric powder incorporated in buffalo milk has been presented in table 4.

Table 4: Butyro-refractometer reading in turmeric powder added *ghee*

Treatments	Butyro-refractometer reading				
	R-l	**R-1I**	**R-III**	**R-IV**	**Mean**
T_1	41.60	41.61	41.52	41.50	41.55
TM_2	40.40	40.40	40.39	40.37	40.39
TM_3	40.22	40.26	40.21	40.27	40.24
TM_4	40.09	40.12	40.10	40.14	40.11
TD_2	40.42	40.43	40.41	40.39	40.41
TD_3	40.25	40.25	40.26	40.21	40.24
TD_4	40.08	40.09	40.15	40.17	40.12
TB_2	40.56	40.54	40.59	40.57	40.56
TB_3	40.68	40.71	40.70	40.69	40.69
TB_4	40.83	40.84	40.88	40.80	40.83
SE = ± 0.01507 CD at 5% = 0.043523					

The butyro-refractometer reading of turmeric powder added *ghee* of the treatment T_1, TM_2, TM_3 and TM_4 in 1st stage were found to be as 41.55, 40.39, 40.24 and 40.11 per cent, respectively. TD_2, TD_3 and TD_4 in 2nd stage as 40.41, 40.24 and 40.12 and in 3rd stage TB_2, TB_3 and TB_4 were 40.56, 40.69 and 40.83, respectively. It is observed from the butyro-refractometer reading of turmeric powder added *ghee* samples that turmeric powder reduced the butyro-refractometer reading of treated samples than control might be due to the scattering and reflecting difference of turmeric components than control *ghee* changed butyro-refractometer reading of treated samples. The present values for BR reading were found within a limit of standards prescribed by PFA, (2008) [23] standards BR reading of *ghee* should be 40.0 to 43.5 and Agmark standards BR reading of *ghee* should be 40.0 to 43.0 for areas other than cotton tract areas in Gujarat. The findings also supported by following workers:

Mehulkumar and Aparnathi (2011) [19] reported the curcumin fortified buffalo *ghee* butyro-refractometer reading at 40°C in control *ghee* 41.7, butylated hydroxyanisole (BHA) added *ghee* is 40.4 and in turmeric (0.5%) added *ghee* is 40.2.

Kapadiya (2017) [13] reported the BR reading of different *ghee* samples at 40°C varied on an average from 40.61 to 42.16. All the sample of *ghee* treated with both the sample like betel leaves (41.05) and blend of betel leaves plus liquorice (40.61) showed the significant lower BR reading compare to BR reading of control *ghee*.

Achaya (1948) [3] the BR reading of *ghee* samples at 40°C varied on an average from 40.2 to 41.7 among different treatments. BR reading of *ghee* is reported to vary from 39.2 to 43.1.

Lodh and Khamurai (2016) [17] reported butyro-refractometer reading at 40°C in curcumin fortified buffalo *ghee* is 41.5± 0.01.
Ramya *et al*. (2019) [25] reported average value of BR reading at 40°C in uthkuli*ghee* is 40.7 ±0.04.

Iodine value
The iodine value in turmeric powder added *ghee* as influenced by different proportions of turmeric powder incorporated in buffalo milk has been presented in table 5.
The iodine value of turmeric powder added *ghee* of the treatment T_1, TM_2, TM_3 and TM_4 in 1st stage were found to be as 31.14, 31.27, 31.35 and 31.44 respectively. TD_2, TD_3 and TD_4 in 2nd stage 31.22, 31.43, 31.47 and in 3rd stage 31.32, 31.25 and 31.19, respectively for TB_2, TB_3 and TB_4. The pattern for iodine value of turmeric powder added *ghee* samples were not show fixed trend it was found decreasing in 1st and 2nd stage whereas increasing in 3rd stage of addition of turmeric powder.

Table 5: Iodine value in turmeric powder added *ghee*

Treatments	Iodine value (gm)				
	R-l	R-1I	R-III	R-IV	Mean
T_1	31.12	31.16	31.15	31.13	31.14
TM_2	31.29	31.22	31.28	31.29	31.27
TM_3	31.35	31.36	31.32	31.37	31.35
TM_4	31.43	31.40	31.48	31.46	31.44
TD_2	31.21	31.20	31.25	31.24	31.22
TD_3	31.34	31.31	31.38	31.35	31.34
TD_4	31.48	31.48	31.49	31.45	31.47
TB_2	31.32	31.31	31.34	31.33	31.32
TB_3	31.25	31.27	31.26	31.23	31.25
TB_4	31.18	31.20	31.20	31.19	31.19
SE = ± 0.01163 CD at 5% = 0.033584					

Deshmukh (2018) [7] reported that the iodine value was small increased with herb extract. Iodine value of control *ghee* is 35.33 and ashwagandha herb added is 35.48. Lakshminarayana and Murthy (1985) [16] reported the average iodine value of buffalo *ghee* is 31.1.Ramya *et al.* (2019) [25] reported that the average iodine value of Uthukuli buffalo *ghee* samples were 27.1 ±0.74.

Melting point
The melting point in turmeric powder added *ghee* as influenced by different proportions of turmeric powder incorporated in buffalo milk has been presented in table 6.

Table 6: Melting point in turmeric powder added *ghee*

Treatments	Melting point(ºC)				
	R-l	R-1I	R-III	R-IV	Mean
T_1	32.26 ºC	32.28 ºC	32.27 ºC	32.26 ºC	32.26
TM_2	32.31 ºC	32.33 ºC	32.32 ºC	32.34 ºC	32.32
TM_3	32.33 ºC	32.32 ºC	32.33 ºC	32.34 ºC	32.33
TM_4	32.34 ºC	32.34 ºC	32.34 ºC	32.34 ºC	32.34
TD_2	32.29 ºC	32.28 ºC	32.30 ºC	32.29 ºC	32.29
TD_3	32.34 ºC	32.32 ºC	32.30 ºC	32.27 ºC	32.30
TD_4	32.31 ºC	32.33 ºC	32.33 ºC	32.32 ºC	32.32
TB_2	32.40 ºC	32.34 ºC	32.36 ºC	32.35 ºC	32.36
TB_3	32.37 ºC	32.37 ºC	32.39 ºC	32.48 ºC	32.39
TB_4	32.46 ºC	32.44 ºC	32.43 ºC	32.43 ºC	32.44
SE = ± 0.01121 CD at 5% = 0.032372					

The melting point of turmeric powder added *ghee* of the treatment T_1, TM_2, TM_3 and TM_4 in 1st stage were found to be as 32.26, 32.32, 32.33 and 32.34 respectively. TD_2, TD_3 and TD_4 in 2nd stage 32.29, 32.30, 32.32 and in 3rd stage 32.36, 32.39 and 32.44 for TB_2, TB_3 and TB_4, respectively. The melting point of turmeric powder added *ghee* samples were found increased as the turmeric powder increased in the *ghee* samples might be due to the decreased in FFA in successive treatments of turmeric powder added samples which have liquid or less melting temperature responsible for lowering melting point of developed samples supported by Fox and McSweeney, 1998 [9] in his book on, "Advanced Dairy Chemistry" volume second on Lipids and following researcher in their respective milk products developed by using turmeric.
Kumar *et al.*, (2015) [15] reported that nanoencapsulated curcumin *ice-cream* melts slower (0.83 ±0.01 g/min) than the control *ice-cream* (0.90± 0.08). Arun Raj *et al*. (2016) [4] reported melting point of ashwagandhaghritha is 43ºC. Ramya *et al.* (2019) [25] reported melting point of the prepared uthukuli buffalo *ghee* was 33.5±0.61.

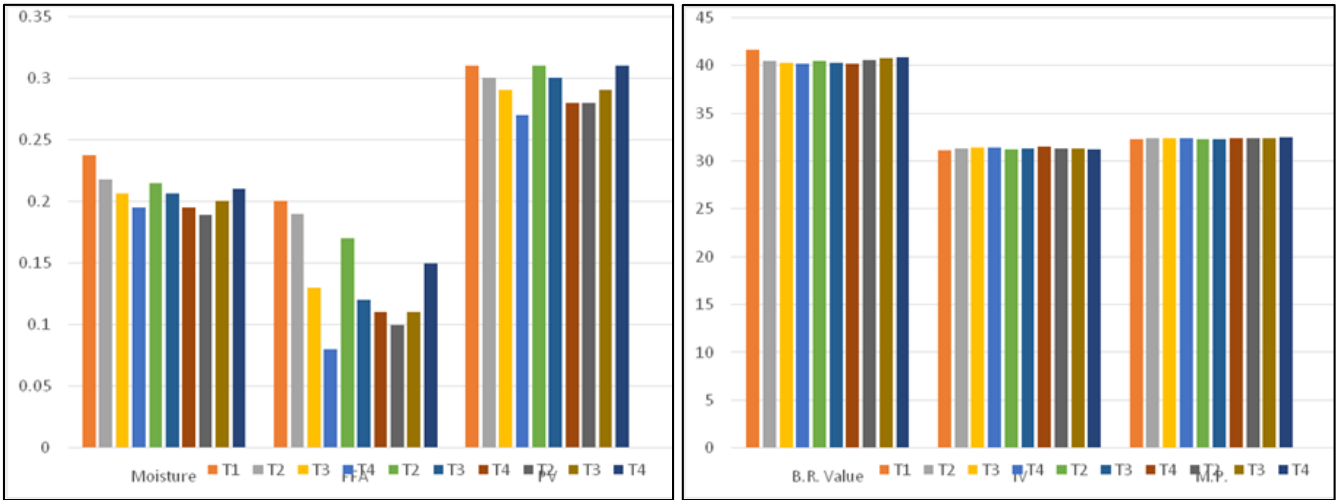

Fig 1: Physico-chemical Properties of Turmeric Powder added *Ghee*

Conclusion
Use of herbs as ayurvedic medicines is a traditional practice in India. Turmeric is a medicinal plant having various health benefits without any side effects. Ghee could absorb all the fat soluble and partially water soluble components from the herbs enhancing their effectiveness. Therefore, it is used as a base material for the preparation of many ayurvedic medicines. 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*. It was observed that as the amount of turmeric powder increased, there was increase in iodine value, melting point whereas, decreasemoisture content, peroxide value, butyro-refractometer reading, free fatty acidof *ghee*.

References

1. AGMARK. *Ghee* Grading and Marking Rules, 1938 (as amended in 1988). Ministry of Food and Agriculture, Department of Agriculture, Government of India, New Delhi 1988.
2. Achaya KT. *Ghee*, Vanaspati and Special fats in India. Lipid Technologies and Applications. Gunstone F. D., Pandley F. B. and Marcel Dekkar Inc., New York 1997, Pp: 369-390.
3. Achaya KT. Rancidity in Indian Butterfats (*ghee)*. Biochem 1948;44:561.
4. Arun Raj, Viswaroopan D, Uppinakudru S. Standardization of AshwagandhaGhrita: a Herbal *Ghee* based Ayurvedic Medicinal preparation. International Journal of Pharmaceutical Sciences and Research 2016;7(2):819-823.
5. Buch S, Pinto S, Aparanti K. Evaluation of Efficacy of Turmeric as a Preservative in *Paneer*. J Food Sci. Technol 2014.
6. Craig WJ. Health Promoting properties of common Herbs. Am. J Cli. Nutr 1999;70:491-499.
7. Deshmukh AR, Desale RJ, Fulpagare YG, Khupse SM. Physico-Chemical study of herbal *Ghee* prepared with Ethanolic Extract of *Asparagus racemosus* (Shatavari) and *Withaniasomnifera* (Ashwagandha). International Journal of Current Microbiology and Applied Sciences 2018;7(8):257-265.
8. Fasludeen NS. Comparison of the Antioxidants potential of Natural Antioxidants in *Ghee*. International Journal of Multidisciplinary and Current Research 2016;4:432-434.
9. Fox PF, McSweeney PLH. Dairy Chemistry and Biochemistry. Department of Food Chemistry University College Cork, Ireland 1998.
10. Ghatak PK, Bandyopadhyay AK. Chemical and Sensory quality of *Ghee* marketed in Calcultta and Kalyani (West Bengal) Indian Dairyman 1989;41:515-518.
11. Gupta S, Sukhija PS, Bhatis IS. Role of Phenolics and Phospholipids as antioxidants. Milchwissenschaft 1979;34:205.
12. Hazra T, Mehta BM, Aparnathi KD. Effect of Two Varieties of Tomato skin addition on Oxidative stability of *Ghee*. A Comparative Study International Journal of Food and Nutritional Sciences 2015;3(3):24-27.
13. Kapadiya DB, Aparnathi KD. Comparison of Physicochemical, Nutritional and Sensory aspect of *Ghee* obtained from different Species. International Journal of Trend in Scientific Research and Development 2017;1(6):1231-1236.
14. Khan N. Miracles of the Golden Spice-Turmeric. SM Dermatology Journal 2019;5(1):1031.
15. Kumar R, Sari P, Mann B, Singh R, Sharma R, Bhardwaj M, *et al*. Preparation and Characterization of Nanoemulsion Encapsulating Curcumin. Food Hydrocolloids 2015;43:540-546.
16. Lakssminarayanan M, Murthy R. Cow and Buffalo milk fat fractions. Part-1-yield, fatty acid composition and Physico-chemical characteristics of the fractions. Indian Journal of Dairy Science 1985;38:256-264.
17. Lodh J, Khamuri K. Development of Technology for Curcumin Fortified Buffalo *Ghee* and evaluation of its functional attributes. M. Tech Thesis submitted to National Dairy Institute (Deemed University) Karnal 2016.
18. Lodh J, Khamrai K. Evaluation of Physico-Chemical Changes in Curcumin Fortified Buffalo *Ghee* during storage at 30±1°C. International Journal of Chemical Studies 2017;5(2):141-144.
19. Mehulkumar S, Aparnathi KD. Antioxidant activity of Turmeric in *Ghee.* M.Sc Thesis submitted to Anand Agriculture University, Anand, Gujrat 2011.
20. Naaz T, Prakash J. Storage Stability of *Ghee* with added Spices. Indian Journal of Nutrition and Dieteticsm 2000;37(1):20-27.
21. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. *Second Edn.* ICAR, New Delhi 1985.
22. Paul V, Kushwaha P, Paul A. Enrichment of low fat paneer by incorporating herbal extracts (Basil, Ginger and Mint). Nutrition and Public Health, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India. The Pharma Innovation Journal 2018;7(7):472-476.
23. PFA. Prevention of Food Adulteration Act (1954) and Rules (1955). Seventh amendment. The universal law publishing Co. Pvt. Ltd 2008, PP:102.
24. Prasad W. Studied on Technology and Shelf life of Herb incorporated *Burfi*. Thesis submitted to Karnal-132 001 (Hariyana), India 2017.
25. Ramya SB, Baskaran D, Vijayarani K, Palanidorai R, Ramasamy D. A study on Physico-Chemical properties of Uthukuli*Ghee*. International Journal of Current Microbiology and Applied Sciences 2019;8(4):2090-2099.
26. Samah SM, Youssef AM. Potential Application of Herbs and Spices and Their Effects in Functional Dairy Products. Dokki, Gizza, Egypt. Heliyon 2019.
27. Sharma RS. *Ghee*: A resume of recent research. Journal of food science and technology 1981;18:Pp:70.
28. Shishodia S, Sethi G, Aggarwal BB. Curcumin: Getting back to the roots. Ann. N. Y Acad. Sci. 2005;1056:206-217.
29. Singh BP, Panesar S, Nanda V. Utilization of carrot pomace for the preparation of a value added product. World J. Dairy Food Sci 2006;1(1):22-27.
30. Singh RR, Singh R, Shakya BR. Impact of Turmeric addition on the Properties of prepared from different types of milk. International Journal of Current Engineering and Technology 2014;4(3):1874-1883.
31. Sserunjogiab M, Abrahamsena R, Narvhusa J. A review paper: Current Knowledge of *Ghee* and related products. Int. Dairy Journal 1998;8:677-688.
32. Taher M, Hamidon H, Susanti D, Zakaria ZA. Garcinia atroviridis-a review on phytochemicals and pharmacological properties. Marmara Pharm J 2017;21(1):38-47.
33. Yazdi SR. Heating of milk alters the binding of Curcumin to casein Micelles. A Fluorescence Spectroscopy Study. Department of food Science, University of Guelph Ontario, Canada 2012;132(3):1143-1149.