www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; SP-9(9): 59-64

www.thepharmajournal.com
Received: 19-07-2020
Accepted: 10-09-2020

Shekhara Naik R
Department of Food Science and Nutrition Yuvaraja's College (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Pavithra R
Department of Food Science and Nutrition Yuvaraja's College (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Prakruthi M
Department of Food Science and Nutrition Yuvaraja's College (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Mahesh Shivananjappa
Department of Food Science and Nutrition Yuvaraja's College (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Corresponding Author:
Mahesh Shivananjappa
Department of Food Science and Nutrition Yuvaraja's College (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Physicochemical analysis and microbial quality evaluation of cow butter sold in Mysuru district, India

Shekhara Naik R, Pavithra R, Prakruthi M and Mahesh Shivananjappa

Abstract
Butter is an emulsion of water in oil and should contain >80% fat and <16% water. Several varieties of butter are found in market each differing from the type of cream from which they are made as well as in manufacturing process and salting. Non-standard production at all stages of processing, packaging can reduce quality. The purpose of this work was to evaluate the quality of commercial cream butter, traditional homemade butter and traditional butter prepared in home industry. Quality of butter was determined by organoleptic parameters, moisture, fat, curd content, free fatty acid, Reichert-Meisll value, and Polenske value and Microbial quality. Further a product named butter masala dosa (pan cake smeared with butter) was also prepared to evaluate the sensorial attributes of the products prepared from these butters. Commercial cream butter fared well in all the quality parameters and all the values were within the legal permissible limit. Amongst traditional butters, the one prepared at home by researchers was on par with commercial butter in physico-chemical and microbial analysis and was superior organoleptically. However traditional butter sourced from local market fared poorly in all tested parameters.

Keywords: Butter, fatty acid, Reichert-Meisll value, Polenske value, Mysuru

1. Introduction
Butter is a traditional food and one of the oldest dairy product composed of milk fat which is widely consumed all over the world,best way of preserving milk fat for longer storage. Dietary milk fats, on account of their higher content of saturated fatty acids, have long been associated with a variety of human diseases; however, recent studies have focused on the healthy components of milk fats, including conjugated linoleic acid [1]. The consumption of milk fat has, in the past, been a concern for consumers compared with spread and margarine alternatives because of its high levels of SFA, whose intake has been linked to high cholesterol, atherosclerosis, and heart disease [2, 3]. However, recent reviews and meta-analysis of the topic have concluded no significant association with incident CVD or CVD subtypes, and a modest inverse association with type2 diabetes. Thus butter is back in favor [4].
Butter is used directly or as ingredient in processed food such as pastries and convenience dishes and condiment, as well as in cooking applications, such as baking, sauce making, and pan-frying [5]. Butter is usually made directly from milk in traditional way and form cream industrially. These butters are differing with the type of cream from which they are made and with variations in the manufacturing process and the different kinds of butter may or may not have been salted [6]. Butter is made of fermented or unfermented milk or cream industrially and traditionally. By churning the cream or milk, coalescence of fat globules happens and larger clusters is formed which is finally separated from the liquid portion and forms a semisolid phase called butter [7]. Traditionally, fermented milk used in making butter. Butter may be washed, salted or colored and then packaged in different sizes and shapes. This dairy product consists of butterfat, water, and milk proteins [8]. Quality of butter depends on many factors such as quality of raw material, production method, ingredients used, type of packaging. Chemical changes taking place during storage of final product Extent of oxidation and the amount of free fatty acids are also important [9].
Non-standard production at all stages of processing, packaging and supply causes quality reduction and can result in economic problems and pathogenesis, which is why, quality of these products are important. The traditional way of butter preparation is also prone to adulteration [10]. The aim of this study was evaluating chemical and biological characteristics and quality matching of traditional butters with commercial butter marketed in Mysuru, Karnataka, India and stored for different time periods.

2. Materials and Methods

2.1 Procurement of raw materials

Collection of butter Samples

Two samples of commercial cream butter (CCB1 and CCB2) were bought from local market. One sample of traditional butter prepared in home industry (TBHI) and sold commercially was also purchased from local market. One sample of traditional butter homemade (TBHM) butter was prepared in-house following traditional method.

Materials for Microbiological Study

Different growth media were prepared freshly using required chemicals and ingredients for the microbiological analysis. All material used for microbiological assays were procured from HiMedia Laboratories Pvt. Ltd., Mumbai, India.

Packaging Materials for butter Samples

The packaging materials used for butter storage studies consisted of metalized polyester flexible pouches which were manually sealed using sealing machines. Butter samples were stored at 0-4°C.

2.2 Preparation of butter

a. Industrial butter makingprocess

Pasteurization of cream at 62.8° C
↓
Cooling down of cream
↓
Addition of culture
↓
Resting for several hours at 21.1° C
↓
Churning
↓
Addition of permitted preservative

b. Processing of traditional butter

Boiling the milk
↓
Cooling it down to room temperature
↓
Addition of curd
↓
Resting it for 16-20 hours (incubation)
↓
Churning
↓
Collecting the butter

2.3 Product development

Development of Benne masala dosa (BMD) by using Commercial and Traditional butter

Table 1: Formulation for Preparation of BMD (Rice pan cake)

Ingredients	Amount (g)
Parboiled rice	200
Urad dhal (Black gram)	100
Butter	10

Prepare the batter by grinding the soaked urad dhal and rice into a smoothpaste.
↓
Let it ferment for 6-7 hrs.
↓
Add salt and mix it well.
↓
Spread the batter on the pan using a spoon in a circular motion.
↓
After the batter dries out add butter on it.
↓
Cook evenly and the Dosa is ready to be served.

2.4 Evaluation of organoleptic quality of butter samples

The developed product was evaluated organoleptically for different attributes of appearance, color, texture, flavor, taste and overall acceptability by semi trained sensory panelists. A score card was given based on the 9 point hedonic scale.

2.5 Estimation of moisture in butter samples

The moisture content of Butter is the loss in mass, expressed as a percentage by mass when the product is heated in a hot air oven at 100±1°C to constant mass [11].

2.6 Estimation of fat

Fat was estimated using AOAC method.

2.7 Determination of Free Fatty Acids in butter

Weigh 10 g Butter sample in a 250 ml conical flask. Add 45 ml of boiled distilled water to the flask and dissolve it. Add 2 to 3 drops of phenolphthalein indicator. Titrate against 0.1 N NaOH solution till the pale pink colour persists. Repeat the titration until the concordant values are obtained.

The acidity was calculated by,

$N_1V_1=N_2V_2$

2.8 Estimation of Curd Content [12].

Take 10 g of Butter sample to aluminum dish, direct heat under the flame until moisture is evaporated and then cool to settle the content. Take 55 ml of petroleum ether and wash the aluminum dish until the fat is completely dissolved. Finally curd content is obtained. Then take the weight of aluminum dish

Calculation

$W = W2 - W1$

Where, W1= empty dish + sample weight W2= dish+ sample obtained

2.9 Determination of Reichert-Meisll (R.M.) and Polenske Value (P.V)

The Reichert-Meisll (R.M.) value is the number of ml of 0.1 N aqueous alkali solution required to neutralize the water-

soluble, steam volatile fatty acids distilled from 5 g of melted butter under the precise conditions specified in the method.
The Polenske value (P.V.) is the number of ml of 0.1 N aqueous alkali solution required to neutralize the water-insoluble, steam volatile fatty acids distilled from 5 g of melted butter under the precise conditions specified in the method.
In the following method butter (5 g) was saponified using glycerol potash diluted with water and acidified, steam distilled in a glass apparatus (Polenske distillation apparatus) at a controlled rate. The condensed and cooled distillate is filtered, the water-soluble acids which pass through are estimated by titration with alkali to give the R.M. value, while the water-insoluble acids collected on the filter paper are dissolved out in alcohol and titrated to give the P.V.

2.10 Microbial examination of butter
The prepared butter was examined for its microbial count using standard procedures of total plate count and yeast and mould count

2.11 Statistical Analysis
Result obtained were pooled and presented as mean standard deviation. The data were tabulated and statistically analyzed for significant difference using Holm Sidak method.

3. Results and Discussion

Table 2: Evaluation of butter samples

Butter Samples	Methods of Butter Making	Adaptability	Flavor	Texture	Keeping Quality
CCB1	Direct Cream method	Commercial large scale	Bland flavor	Firm	Excellent
CCB2	Direct Cream method	Commercial large scale	Good Characteristic flavor	Firm	Excellent
TBHI	Indigenous method	Rural home industry	Characteristic fermented flavor	Soft	Poor
TBHM	Indigenous method	Home	Characteristic fermented flavor	Firm	Excellent

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made

The three butter samples CCB2, TBHI and TBHM had characteristic flavor while the CCB1 had bland flavor. The texture the butter sample CCB1, CCB2 and TBHM were firm. However, the sample TBHI was soft. Further the samples, CCB1, CCB2 and TBHM showed excellent keeping quality whereas keeping quality TBHI was not that great.

Table 3: Moisture, fat and curd contents of butter

S. No.	Butter Samples	Moisture (%)	Fat (%)	Curd content (%)
1	CCB1	12.0±0.2	83.5±1.2	2.2±0.07
		12.3±0.5	83.5 ±1.9	2.2±0.04
		12.5±0.4	83.3±1.4	2.2±0.01
		12.9±0.9	83.0±1.7	2.2±0.02
2	CCB2	13.0±0.1	86.0±1.1	1.5±0.03
		13.5±0.6	85.5±1.3	1.5±0.05
		13.5±0.8	85.5±1.6	1.5±0.06
		13.8±0.2	85.0±1.9	1.5±0.07
3	TBHI	31.0±1.3*	68.8±2.2*	1.0±0.08
		31.5±1.5*	65.5±2.6*	1.0±0.01
		30.8±1.4*	61.5±2.4*	1.0±0.09
		30.9±1.7*	60.0±2.8*	1.0±0.05
4	TBHM	12.5±0.1	84.5± 1.5	1.2±0.01
		12.5±0.5	84.2±1.1	1.2±0.04
		12.9±0.9	84.0±1.5	1.2±0.03
		13.2±0.1	83.5±1.9	1.2±0.08

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made
Values are mean±SD
Data analyzed by Holm Sidak method, * $p \leq 0.05$

TBHI which is the butter prepared by traditional method but sourced from local market had highest moisture content (>30%) (Table 3). Normally moisture content of butter varies between 12-17% but TBHI had moisture content more than double than acceptable limit. Moisture content of all other samples were well within the acceptable limit.
Traditionally and legally, however, butter must contain >81% of only milk fat [13].
Fat content of all the butters were well within the acceptable limit (>80%) except TBHI which had fat content around 60%. Curd content of the all the butter were well within the normal range of 1-2%. Legal compositional standards for butter are a minimum of 80% butter fat and a maximum of 16% moisture. The high level of moisture in traditional butter which is sourced from open market may have an influence on its microbiological and physicochemical quality since the presence of water in butter can activate lipases, stimulate the growth of micro-organisms and cause the hydrolysis of triglycerides spoilage when stored at room temperature [14, 15].
The free fatty acid value of the all the four butter samples increased along with the length of the days of storage (Table 4). The FFA value as well as rate increase was more in sample TBHI. However, the FFA of the TBHM was quite stable till the end of the storage period. Quality of the butter depends on the content of free fatty acids of the butterfat and it varies widely depending on the extent of hydrolysis of the triglycerides [9]. The number of free fatty acids can increase significantly as the result of lipolysis.
In addition to natural lipase, milk can also contain the lipase of microbial origin. Hydrolysis of milk fat produces free fatty acids from triglycerides, free fatty acids, in turn, are oxidized to aldehydes, ketones [9, 16, 17]. Higher Free fatty acid content indicates unhygienic processing and handling of butter as well as high moisture content which in turn can harbor microbes.
High moisture stimulates the growth of microorganisms, microbial lipase activity resulting in hydrolysis of the triglycerides [18]. High moisture content in TBHI may be one of the reason for increased FFA in it.

Table 4: Free Fatty Acid Value of Butter Samples (mg of NaOH/g butter)

S. No.	Butter Samples	Days	Acidity
1	CCB1	01	1.4±0.01
		10	1.4±0.05
		20	1.9±0.03
		30	2.1±0.01
2	CCB2	01	1.6±0.02
		10	1.6±0.05
		20	1.8±0.05
		30	2.0±0.07
3	TBHI	01	3.1±0.02*
		10	3.5±0.8*
		20	4.8±0.1*
		30	5.2±0.4*
4	TBHM	01	1.5±0.04
		10	1.5±0.05
		20	1.6±0.02
		30	1.8±0.09

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made
Values are mean±SD
Data analyzed by Holm Sidak method, * p≤0.05

Table 5: Reichert-Meislle value and Polenske value

S. No.	Butter Samples	Days	RMV	PV
1	CCB1	01	26.0±0.02	1.8±0.01
		30	28.0±0.05	2.0±0.05
2	CCB2	01	26.0±0.08	2.0±0.09
		30	28.0±0.03	2.1±0.07
3	TBHI	01	20.0±0.04*	1.2±0.05
		30	19.0±0.07*	1.0±0.03
4	TBHM	01	26.0±0.09	1.8±0.08
		30	26.0±0.06	2.0±0.06

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made
Values are mean±SD
Data analyzed by Holm Sidak method, * p≤0.05

There was no significant difference between the RMV and PV over the storage (Table 5). However RMV was significantly less in TBHI. RMV is an indicator of how much volatile fatty acid can be extracted from fat through saponification which is useful indicator of non-fat compounds in edible fats and is especially high in butter [19]. Variations in quality attributes due to bad processing and maintenance or any adulteration by adding nonedible oils, plant oils, old used oils or industrial cream to both industrial or traditional produced butters have negative affect on consumer acceptability and health that lead to low marketability and economic losses of product [20]. The RM values of TBHI indicates that the product may be adulterated with nonedible oils and or plant oil.

Table 6: Microbiological Analysis of butter Samples

S. No.	Butter Samples	Days	Total plate count (CFU/g)	Yeast and Molds (CFU/g)	E.coli
1	CCB1	01	$6.0x10^5$	$1.08x10^6$	Nil
		30	$6.2x10^5$	$1.10x10^6$	Nil
2	CCB2	01	$6.5x10^5$	$1.18\ x10^6$	Nil
		30	$6.8x10^5$	$1.30x10^6$	Nil
3	TBHI	01	$9.0x10^{5*}$	$9.80\ x10^{6*}$	Nil
		30	$10.9x10^{5*}$	$11.00\ x10^{6*}$	Nil
4	TBHM	01	$4.5x10^5$	$1.54x10^6$	Nil
		30	$5.0x10^5$	$1.82\ x10^6$	Nil

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made
Values are mean±SD
Data analyzed by Holm Sidak method, * p≤0.05

Microbiological analysis of all the four butters were carried out at the beginning and at the end of the storage period. The results of the same is presented in the table 6. The total plate count, yeast and mould were all increased in TBHI whereas it was well within the limits in all other butter samples. Microbial criteria require that specific microorganisms or toxins produced by a microorganism must not be present at all, are allowed in a limited number per gram of samples, or be present at less than a specified number or amount in a given quantity of a food ingredient [14, 21]. The presence of mould contamination in butter indicates contamination by water or air after production [22].

TBHI sample had high moisture content which might have harbored the microbes indicating the unhygienic conditions prevailing during its preparation.

Table 7: Organoleptic characteristic of butter masala dosa (pan cake smeared with butter)

S. No.	Butter Samples	Appearance	Color	Texture	Flavor	Taste	OAA
1	CCB1	8.03±0.42	8.22±0.52	8.23±0.52	8.08±0.56	8.10±0.56	8.10±0.46
2	CCB2	8.33±0.41	8.26±0.43	8.36±0.48	8.25±0.46	8.17±0.40	8.52±0.40
3	TBHI	7.33±0.41	7.86±0.59	7.26±0.53	7.13 ±0.54	7.03±0.5	7.03±0.56
4	TBHM	8.63±0.33*	8.76±0.23*	8.68±0.25*	8.54±0.34*	8.47±0.24*	8.72± 0.38*

CCB1: Commercial Cream Butter 1
CCB2: Commercial Cream Butter 2
TBHI: Traditional Butter from Home Industry
TBHM: Traditional Butter Home Made
Values are mean±SD
Data analyzed by Holm Sidak method, * $p \leq 0.05$

Butter masala dosa was prepared using all the four butter samples. Sensory scores of butter masala dosa smeared with TBHI butter were significantly lower compared to TBHM. Butter masala dosa with TBHM had better scores in all attributes even compared to dosa's prepared from commercial cream butter. However, butter masala dosa prepared using TBHM scored highest among all the four dosas in all the sensorial attributes. Its general belief that traditionally processed butter is superior sensorially compared to factory processed [23].

4. Conclusion

Butter is an emulsion of water in oil [5] and should contain >80% fat and <16% water [24]. Several varieties of butter are found in market [25] each different from the type of cream from which they are made, difference in manufacturing process which may or may not have been salted. Non-standard production at all stages of processing packaging can reduce quality [10]. The purpose of this work was to evaluate the quality of commercial cream butter, traditional homemade butter and traditional butter prepared in home industry. Quality of butter was determined by organoleptic parameters, moisture, fat and curd content, free fatty acid, RMV and PV. Microbial quality evaluation was also done. Further a product (butter masala dosa/ pan cake smeared with butter) was also prepared to evaluate the sensorial attributes of the products prepared from these butters. Commercial cream butter fared well in all the quality parameters and all the values were within the permissible legal limit. Amongst traditional butters, the one prepared at home by researchers was on par with commercial butter in physico-chemical and microbial analysis and superior organoleptically. However traditional butter sourced from local market fared poorly in all tested parameters. Considering to growing demand for traditional dairy products due to being nutritious and providing other benefits for human health, continuous monitoring of their quality is necessary. Chemical qualities of butter samples can be protected by control of hygienic conditions in production process as well as strictly adhere to all the quality parameters [20].

5. References

1. Seçkin AK, Gürsoy O, Kınık O, Akbulut N. Conju-Gated Linoleic Acid (CLA) Concentration, Fatty Acid Composition and Cholesterol Content of Some Turkish Dairy Products. Swiss Society of Food Science and Technology. 2005; 38(8):909-915.
2. Ulbricht TLV, Southgate DAT. Coronary heart disease: seven dietary factors, The Lancet. 1991; 8773(338):985-992.
3. Rasmussen BM, Vessby B, Uusitupa M *et al*. Effects of dietary saturated, monounsaturated, and n-3 fatty acids on blood pressure in healthy subjects. Am J Clin Nutr. 2006; 83(2):221-226. doi:10.1093/ajcn/83.2.221
4. Pimpin L, Wu JHY, Haskelberg H, Del Gobbo L, Mozaffarian D. Is Butter Back? A Systematic Review and Meta-Analysis of Butter Consumption and Risk of Cardiovascular Disease, Diabetes, and Total Mortality. PLoS ONE. 2016; 11(6):e0158118. doi:10.1371/journal.pone.0158118
5. Lane R. Butter and mixed fat spreads. The Technology of Dairy Product, (ed. R. Early), 2nd edn. Blackie Academic & Professional, London, 1998, 158-197
6. FAO. Milk and Dairy products in human nutrition. Rome, 2013. Available: http://www.fao.org/docrep/018/i3396e/i3396e.pdf
7. Tvrzicka E, Kremmyda LS, Stankova B, Zak A. Fatty acids as bio compounds: their role in human metabolism, health and disease–a review. Part 1: classification, dietary sources and biological functions. Biomedical papers. 2011; 155(2):117-130.
8. Ghasemloy Incheh KH, Hassanzadazar H, Forouzan SH, Banafshehchin El, Mozafarian E, Aminzare M *et al*. A survey on the quality of traditional butters produced in West Azerbaijan province, Iran International Food Research Journal. 2017; 24(1):327-332
9. Laikoja K, Teder L2, Jõudu I. assessment of chemical and sensory quality of unsalted and salted sweet cream butter during storage at different temperatures and time Journal of agricultural science. 2017; 28(2):76-81.
10. Lees, M. WHO Food Authenticity. Eurofins Scientific, Nantes, (Issues and Methodologie), 1999.
11. AOAC. Official Methods of Analysis. 13th Edition, Association Official Analytical Chemists, Washington DC, 1980.
12. Food safety and standards Authority of India (FSSAI).

Methods of analysis of foods, 2012.
13. Gebremedhin B, Tegegne A, Hoekstra D, Jemaneh S, Shiferaw K, Bogale A *et al*. Developing the butter value chain in Ethiopia. LIVES Working Paper 1. Nairobi, Kenya: International Livestock Research Institute, 2014.
14. Gazu L, T Eshete, G Kassa. Physicochemical analysis and microbial quality of cow butter obtained from Menz district of Amhara region, Ethiopia. African Journal of Bacteriology Research. 2018; 10(3):34-43.
15. Stine Rønholt, PatriziaBuldo, Kell Mortensen, Ulf Andersen, Jes C Knudsen, Lars Wiking *et al*. The effect of butter grains on physical properties of butter-like emulsions,
16. Henno, M. Piimakvaliteetjasedamõjutavadtegurid. – Doktoritöö. Eesti Põllumajandusülikool, Tartu, 2005, 143.
17. Fearon AM. Butter and butter products. In: Dairy ingredients for food processing (Eds. R.C. Chandan, A. Kilara). – Iowa: Blackwell Publishing Ltd, 2011, 199-223.
18. Idoui T, Benhamada N, Leghouchi E. Microbial quality, physicochemical characteristics and fatty acid composition of a traditional butter produced from cows' milk in East Algeria. Grasas y Aceites. 2010; 61(3):232-236.
19. Paksoy N, KılıçAltun S. Evaluation of Reichert Meissl Values of Butter Produced in Turkey. International Journal of Scientific Research and Management. 2018; 6(12).
20. Hassanzadazar H, Salim A, Forghani M, Aminzare M. Chemical Quality and Fatty Acid Profile of Zanjan Traditional Butter. Annual Research & Review in Biology. 2017. 20(4):1-7. https://doi.org/10.9734/ARRB/2017/37765
21. Michael H, Joseph W, Frank F. Standard Methods for the Examination of Dairy Products. 17th ed, American Public Health Association, Washington DC. USA, 2004, 112-118.
22. Bereda A, Eshetu M, Yilma Z Microbial properties of Ethiopian dairy products: A review. African Journal of Microbiology. 2009; 8(23):2264-2271.
23. Mariod AA, Ali RT, Ahmed YM, Abdel Wahab SI, Abdul AB. Effect of the method of processing on quality and oxidative stability of anhydrous butter fat (samn). African Journal of Biotechnology, 2010; 9(7):1046-1051.
24. Mortensen BK. Butter and other milk fat products. In: Encyclopedia of Dairy Sciences, 2nd edn (eds J.F Fuquay, P.F. Fox & P.L.H. McSweeney), 2011; 1:492-499. Academic Press, London.
25. Kalyankar SD, Deshmukh MA, Chopde SS, Khedkar CD, Lule VK, Deosarkar SS *et al*. Milk Powder. The Encyclopedia of Food and Health. 2016; 3:724-728.