

ASSESSMENT OF THE TECHNOLOGICAL PARAMETERS OF BUTTER PRODUCTION AND THE INFLUENCE OF THE STORAGE CONDITIONS ON ITS FRESHNESS

Carmen Daniela PETCU¹, Dana TĂPĂLOAGĂ¹, Emilia CIOBOTARU-PÎRVU¹, Oana Diana MIHAI¹, Oana Mărgărita GHIMPEȚEANU¹, Otilia Cristina MURARIU²

e-mail: otliamurariu@yahoo.ro

Abstract

Butter is the dairy product obtained by processing cream. It is a food rich in nutrients and is characterized by a very high digestibility. In the study carried out in a dairy products processing unit, located in the south of Romania, the technological flow of obtaining different types of butter, as well as their physico-chemical characteristics were followed. Laboratory determinations were carried out regarding the freshness of the butter (organoleptic examination, acidity determination, Kreiss reaction etc.). At the same time, a questionnaire was carried out in which 170 people participated, regarding the consumption of butter, a study performed through the Google forms platform. Following the determination of the acidity of the fresh, refrigerated and frozen butter samples, values below the maximum allowed limit were recorded, all samples being considered compliant, and the butter samples stored at temperatures higher than 4°C exceeded the maximum allowed value from the first days of the deviations temperature, being classified as non-compliant products. This aspect highlights the importance of respecting the storage conditions recommended by the manufacturers. Following the opinion poll on butter consumption, 71.2% confirmed the preference to consume butter in the morning. For most participants, the producing company is the determining factor in the choice of butter.

Key words: butter, fat, acidity, storage conditions.

Butter has been known since ancient times, from the Greeks, from where its preparation was taken over by the Romans, then gradually spreading to other nations (Dulce D., 2013). It has been considered a symbol of the "good life" throughout most of human civilization and is a staple food in many cultures. It is said that people ate butter and cheese instead of raw milk (Frey J., 2014).

Butter is the product obtained by processing pasteurized cream and sown with selected lactic starter cultures (Savu C., Petcu C.D., 2002; Floriștean V., Borș A., 2021).

This product is characterized by a very high digestibility, over 95%, due to the increased content of volatile fatty acids over 20% of their total (Usturoi M.G., 2007; Sala C., 2008).

Butter is obtained from sweet cream, but it can also be obtained from bacteriologically fermented cream. Since the 19th century, butter has been obtained from cream naturally separated from milk, floating to the surface of the milk, followed by placing the cream in a cylindrical wooden container, called churn (figure 1). Butter was churned manually, but this processing method also had disadvantages, namely, it favored

contamination with microorganisms and the product's validity was limited (Savu C., Petcu C.D., 2002).

Currently, butter is obtained at an industrial level, and the obtaining technology is based on scientific progress and the experience in the field of bacterial acidification and thermal treatments (Savu C., Petcu C.D., 2002).

Moreover, particular attention must also be paid to food safety (Murariu F., 2019; Murariu O.C., 2016; Borș A. *et al.*, 2018), the manufacture, packaging and storage of final dairy products (Petcu, 2006; Petcu, 2021).



Figure 1 Cylindrical wooden container for butter churning (traditional churn)



Figure 2 Industrial churn

The difference between the butter types all around the world

Depending on the country where it is obtained, the butter can differ due to different production methods, so each of these butters will be slightly different.

Therefore, when we talk about butter produced in Europe, we are actually talking about a style of butter produced throughout Europe. European-style butter refers to butter inoculated with selected dairy cultures that has been churned for a long time to obtain up to 82% fat. Traditionally, butter is left to ferment to achieve a slightly sour taste, but most often we will identify butter with the addition of selected lactic cultures. European-style butter is generally preferred for its rich flavor (this is a direct result of the higher milk fat content). More creaminess also means a softer texture, faster melting, and usually a saturated yellow hue. Due to its low moisture content but high fat content, it is often used in bakery, giving the dough an aromatic taste and a softer texture.

Butter made in the United States is monitored and overseen by the U.S. Department of Agriculture. For a dairy product to be considered butter, it must contain up to 80% fat. This butter, unlike butter from Europe, does not include any added lactic culture, resulting in a more neutral taste (Owen E., 2017; Ramdene H.B., 2019).

The benefits of butter consumption

As for consuming butter, it has been shown to have a number of benefits.

Butter is rich in vitamin A, which is easily absorbed and necessary for thyroid and adrenal glands health (Fallon S., Mary G., 2000; Weston P., 2020).

It contains lauric acid, which is important for treating fungal infections as well as those caused by *Candida albicans* (Arnfinnsson J. *et al.*, 2001).

It contains lecithin, which is essential for cholesterol metabolism (Fallon S., Mary G., 2000; Craciun O.C. *et al.*, 2012).

In addition, it contains antioxidants, which can prevent free radical damage and dilate arteries (Brezeanu C. *et al.*, 2020), thus helping to increase blood flow (Fallon S., Mary G., 2000).

It helps reduce the risk of type 2 diabetes (King I.B. *et al.*, 2018; Campos H., 2016).

It is an important source of vitamin E and K (Fallon S., Mary G., 2000; Weston P., 2020). It is a rich source of selenium (Fallon S., Mary G., 2000).

Saturated fats in butter may have antitumor and anticarcinogenic properties (Choi K., *et al.*, 1986; Fallon S., Mary G., 2000;).

Butter contains conjugated linoleic acid, which is an effective anticarcinogenic agent, muscle and immune enhancer (Cho H.Y. *et al.*, 2005).

Vitamin D in butter is essential for calcium absorption (Fallon S., Mary G., 2000; Weston P., 2020).

It is the only source of anti-stiffness factor (Vulsen Factor) and prevents joints calcification (Weston P., 2020).

It is a source of "Activator X" (vitamin K₂), which helps the body absorb minerals (Price, W.A., 2010). In addition, it is a highly absorbable source of iodine (Fallon S., Mary G., 2000).

It is a quick source of energy and is not stored in the adipose tissue of our body (Fallon S., Mary G., 2000).

Cholesterol contained in milk fat is essential for the development of the brain and nervous system of children (Fallon S., Mary G., 2000; Arenas E. *et al.*, 2009).

It contains arachidonic acid (AA), which plays a role in brain function and is an important part of cell membranes (Weston P., 2020).

It can prevent gastrointestinal infections in children or the elderly (Weston P., 2020).

According to the National Institute of Statistics, butter production in February 2020 was 1039 tons, and in February 2021 it was 785 tons, thus showing a decrease in butter production by 254 tons (24.4%).

In the period January-February 2020, the butter production recorded in Romania was 1957 tons, and in the period January-February 2021 1759 tons. Butter production decreased by 198 tons (10.11%) (www.insse.ro).

MATERIAL AND METHOD

The study was conducted in a dairy unit located in southern Romania.

Milk and dairy products can be sold in a wide variety of packaging methods and are subject to a large number of analyzes before being put on the market (Visoescu D.I. *et al.*, 2015; Petcu C.D. *et al.*, 2020). Thus, the aim is to know the chemical composition and assess the nutritional value, identify possible counterfeits etc. (Oprea O.D. *et al.*, 2020; Petcu C.D. *et al.*, 2021; Petcu C.D. *et al.*, 2022).

The dairy processing unit under study is supplied with raw milk from sanitary-veterinary authorized farms and the frequency of supply depends on the performance of the animals and the amount of milk obtained from them (Oprea O.D. *et al.*, 2019). The milked milk is cooled in isothermal tanks and then is collected by the company's tankers and transported to the processing unit, where it is analyzed and subsequently processed. At the milk reception, a series of qualitative parameters are tested in the laboratory, by which it is assessed whether the properties of the milk have undergone changes due to non-compliance with the hygiene rules during milking, transport or if falsifications have been made (Verraes C. *et al.*, 2015).

In the study, the technology for obtaining the butter assortments, as well as their physico-chemical characteristics was followed. The technological diagram has been verified in the unit with the food safety team. Each technological stage was monitored until the finished product was obtained. Also, laboratory determinations were carried out regarding the freshness of the butter (organoleptic examination, acidity determination, Kreiss reaction). At the same time, a questionnaire was carried out on butter consumption among consumers.

The statistical study was carried out through the Google forms platform, a study in which 170 people participated. The participants expressed their opinion regarding the frequency and time of day they consume butter, up to opinions related to the price of butter on the Romanian market.

The freshness determination study involved the examination and analysis of 12 butter samples groups of 5 samples each group, stored under different temperature conditions: freezing (-18°C), refrigeration (4°C) and temperatures above 4°C, maintained for different time intervals namely: 0 days, 21 days, 30 days and 48 days. The duration of the study is March-July 2022.

Sampling was done by buying packages of butter with 82% fat content from a commercial unit.

Until the determinations were made, the butter samples were packed in non-vacuum polyethylene bags, after which they were labeled and stored in the three storage conditions previously mentioned.

Simultaneously with the study on the freshness degree of butter, the organoleptic properties were also assessed according to the storage conditions and time intervals, respectively, T_0 =the moment of sample collection (day zero),

day 21, day 30 and day 48 of storage. The following properties were appreciated: color, appearance, consistency, smell and taste.

RESULTS AND DISCUSSIONS

It has been shown that there is a direct correlation between the quality of the milk used in the production of dairy products and the quality of the finished products obtained from it.

Results and discussions on the technology of obtaining butter in the specialized unit

All raw milk comes from sanitary-veterinary authorized farms and is transported to the processing unit by isothermal tanks.

Results and discussion regarding the assessment of the freshness state by determining the acidity of butter

To determine acidity, 12 butter samples groups with a 82% fat content, stored in different environmental conditions, respectively, samples A0, A1, A2 and A3 were stored at refrigeration temperatures (4°C), samples B0, B1, B2 and B3 were stored at temperatures above 4°C, and samples C0, C1, C2 and C3 at freezing temperatures (-18°C).

The determinations were performed on each sample separately, and then the results obtained for each group of samples were averaged.

Following the acidity determination, it was found that 75% of the analyzed samples had acidity values below the maximum allowed for butter, namely 3.5°A being considered compliant products, and 25% recorded values above the maximum allowed limit (table 1, figure 3).

Table 1
Results regarding the determination of butter acidity

Sample	Storage period	Storage condition °C	Quantity taken for analysis	No ml NaOH use for titration	Acidity value	Result interpretation
A0	after manufacturing	4°C	5 g	0.2	0.4	compliant
A1	21 days	4°C	5 g	1.1	2.2	compliant
A2	30 days	4°C	5 g	1.4	2.8	compliant
A3	48 days	4°C	5 g	1.5	3.0	compliant
B0	after manufacturing	ambient temperature	5 g	0.2	0.4	compliant
B1	21 days	ambient temperature	5 g	2.4	4.8	non-compliant
B2	30 days	ambient temperature	5 g	2.6	5.2	non-compliant
B3	48 days	ambient temperature	5 g	2.7	5.4	non-compliant
C0	after manufacturing	-18°C	5 g	0.2	0.4	compliant
C1	21 days	-18°C	5 g	0.2	0.4	compliant
C2	30 days	-18°C	5 g	0.3	0.6	compliant
C3	48 days	-18°C	5 g	0.35	0.7	compliant

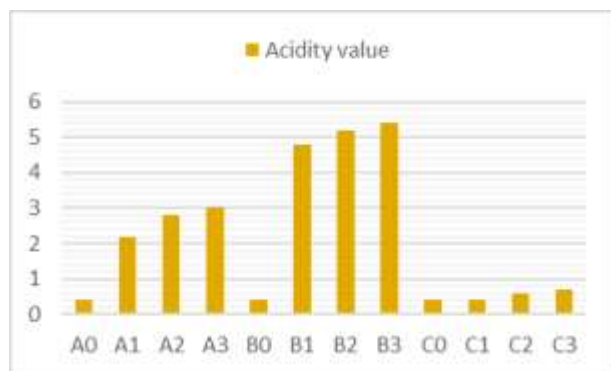


Figure 3 The variation of butter acidity depending on the storage period and storage conditions

With regard to the Kreiss reaction, all analyzed samples obtained negative results.

Results and discussion of organoleptic examination of butter according to storage conditions and different time intervals

The organoleptic examination of the butter indicated that:

- 91.7% of the total samples presented a clean appearance and 8.3% a partially clean appearance;
- 58.4% had a yellowish-white color; 33.3% had yellowish color and 8.3% had yellowish-blackish color;
- 66.7% had an unctuous consistency and 33.3% had an oily consistency;
- 50% kept their specific smell, 33.3% had a non-specific smell and 16.7% had a rancid smell;
- 66.7% had the specific taste, 8.3% neutral taste, 16.7% metallic/oily taste and 8.3% musty taste.

It is noteworthy that a percentage of 91.7% of the samples kept their clean appearance even when exposed to different environmental conditions and only 8.3% displayed a partially-clean appearance, most likely due to contamination with mold spores.

Results and discussion following the opinion poll on butter consumption

Following the opinion poll carried out by means of 170 participants, 9 essential questions related to the butter consumption were answered, questions such as the frequency and time of day in which it is consumed, the preferred category and fat content, but also the determining factor in choosing the butter assortment.

To the question "At what time of day do you generally consume butter?" 71.2% of participants consume butter in the morning.

48.2% of consumers preferred butter with 65% fat, 50% butter with 82% fat and 0.8% of participants preferred other types of butter.

Regarding the price of butter on the Romanian market, 51.2% of the participants mentioned that the purchase price is high.

CONCLUSIONS

The raw material milk used in the study unit comes from authorized farms and is subject to qualitative and quantitative examination.

In the study regarding the assessment of the freshness status of the butter, by determining the acidity over a predetermined period of time, using samples of butter stored in different temperature conditions, it was concluded that 75% of the samples had acidity values below the maximum allowed limit, being considered compliant samples, and 25% exceeded the maximum allowed value, being considered non-compliant. This aspect highlights the importance of complying with the storage conditions recommended by the manufacturers, as well as observing the thermal chain.

Following the opinion poll on butter consumption, attended by people of different ages and genders, it was concluded that 33.5% of the participants consume butter 4-5 times a month and only 1.8% do not consume butter. 71.2% of the questionnaire participants confirmed their preference for eating butter in the morning. The percentages were roughly equal in terms of consumers' preferred category of butter, with 49.4% preferring salted butter and 50.6% opting for sweet butter. 33.5% of 170 people chose the producing company as the determining factor in choosing butter.

REFERENCES

- Arenas E., Gustafsson J.Å., Hall C., Hazenberg C., Hovatta O., Liste I., Parish C.L., Richter Å.L., Sacchetti P., Sousa K.M., Steffenser K.R., Theofilopoulos S., 2009 - *Liver X Receptors and oxysterols promote ventral midbrain neurogenesis in vivo and in human embryonic stem cells*. Cell Stem Cell.
- Arnfinnsson J., Bergsson G., Steingrímsson Ó., Thormar H., 2001 - *In vitro killing of Candida albicans by fatty acids and monoglycerides*. Antimicrob Agents Chemother. 45(11):3209-12. <https://doi.org/10.1128/AAC.45.11.3209-3212.2001>.
- Borș A., Rusu O.R., Borș I., Floriștean V., 2018 - *Application of HACCP (hazard analysis critical control point) to cow telemea cheese production*. LSMV, 61:135-141. <https://repository.uaiaasi.ro/xmlui/handle/20.500.12811/1007>.
- Breazeanu C., Robu T., Trofin A., Brezeanu P., Murariu O.C., 2020 - *Research on the physico-chemical characterization of improved genotypes for Lycopersicon esculentum Mill. Obtained in the ecological system*, Lucrări Științifice, vol. 63 (1)/2020, seria Agronomie, pag. 95 - 100.
- Campos H., Hu F.B., Mozaffarian D., Orav E.J., Rexrode K.M., Shi P., Willett W.C., Yakoob

- M.Y., 2016** - *Circulating Biomarkers of Dairy Fat and Risk of Incident Diabetes Mellitus Among Men and Women in the United States in Two Large Prospective Cohorts*. Circulation. <https://doi.org/10.1161/CIRCULATIONAHA.115.018410>.
- Cho H.Y., Kim Y.J., Lee H.J., Lee K.W., 2005** - *Role of the conjugated linoleic acid in the prevention of cancer*. Crit Rev Food Sci Nutr. 2005;45(2):135-44. <https://doi.org/10.1080/10408690490911800>
- Choi K., Cohen L.A., Karmali R.A., Rose D.P., Thompson D.O., 1986** - *Dietary fat and mammary cancer, II: modulation of serum and tumor lipid composition and tumor prostaglandins by different dietary fats: association with tumor incidence patterns*. Journal of the National Cancer Institute, 77:43-51. <https://pubmed.ncbi.nlm.nih.gov/3459925/>.
- Crăciun O. C., Lazăr R., Boișteanu P.C., 2012** – *Research regarding the biological value of meat protein from sheep*, Scientific Papers Journal, Zootehnic Series, Iasi, ISSN 1454-7368, vol. 57: 56 – 60;
- Dulce D., 2013** - *Operații și aparate în industria alimentară*, Proiect, Universitatea de Științe Agronomice și Medicină Veterinară Iași, Facultatea de Agricultură, specializarea: T.P.P.A, Îndrumător științific Șef lucr. Dr.: Budui Costin.
- Fallon S., Mary G., 2000** - *Why Butter Is Better*, The Weston A. Price Foundation. <https://www.westonaprice.org/health-topics/know-your-fats/why-butter-is-better>.
- Floriștean V., Borș A., 2021** - *Igienă și tehnologie alimentară. Laptele și produsele lactate* – Manual practic, „Ed. Ion Ionescu de la Brad”, Iași, ISBN 978-973-147-445-8.
- Frey J., 2014** - *A brief history of butter*, The churncraft journal. <https://churncraft.com/blogs/the-churncraft-journal/a-brief-history-of-butter>.
- Hackfort A., 2021** - *Your Complete Guide to the Different Types of Butter*, TasteofHome. <https://www.tasteofhome.com/article/your-complete-guide-to-butter/>.
- King I.B., Lemaitre R.N., Marcia C.O.O., Siscovick D.S., Song X., 2018** - *Serial measures of circulating biomarkers of dairy fat and total and cause-specific mortality in older adults: the Cardiovascular Health Study*. The American Journal of Clinical Nutrition.
- Murariu F., Voda A. D., Murariu O.C., 2019** - *Researches on food safety assessment - supporting a healthy lifestyle for the population from NE of Romania*. Journal of Biotechnology, vol.305, pp. s68-s68, Supplement.
- Murariu O.C., Irimia L.M., Diaconu C.M., Murariu F., 2016** - *The right of a healthy live provided by a healthy eating support*, The legal universe, Monthly Review, ISSN 2393 - 3445.
- Oprea O.D., Petcu C.D., Ciobotaru-Pîrvu E., 2019** - *A study concerning quality assessment and processing particularities in certain dairy products*. Scientific Works. Series C. Veterinary Medicine. Vol. LXV (1), 121-126, ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295.
- Oprea, O.D., Răduță, A., Călin (Nicolae), S., Andrei, C. 2020** - *Research on percentage variation concerning cow's milk protein, lactose and fat, depending on the season*. Scientific Papers. Series D. Animal Science, LXIII(1), 182-186.
- Owen E., 2017** - *The Real Difference Between American and European Butter*, Travelandleisure. <https://www.travelandleisure.com/food-drink/european-american-butter>.
- Petcu C., 2006** - *HACCP-Food safety guarantor*. Bucharest, RO: Idea Design Publishing House.
- Petcu, C.D., Ciobotaru-Pîrvu, E., Oprea, O.D., Ghimpețeanu, O.M. 2020** - *Ecological dairy products: healthy or just a trend?* Scientific Works. Series C. Veterinary Medicine, LXVI (1), 87-95.
- Petcu, C.D., Ghiță, M., Raba, D.N., Codreanu, I., Bălăceanu, R., Andrei, C., Mihai (Oprea), O.D. 2021** - *Research on the quantitative and qualitative evolution of sheep's milk during the lactation period*. Scientific Papers. Series D. Animal Science, LXIV (1), 462-467, ISSN 2285-5750; e-ISSN 2393-2260.
- Petcu C.D., Gâjălă G., Mihai (Oprea) O.D., Călin(Nicolae) Simona, Ghimpețeanu O.M., Codreanu I., Ciobotaru-Pîrvu E., 2022** – *Research on the influence of lactation stage on goat's milk characteristics*. Scientific Papers. Series D. Animal Science. Vol. LXV (1), 536-541, ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750.
- Price W.A., 2010** - *Nutrition and physical degeneration: A comparison of primitive and modern diets and their effects*, Milton Keynes.
- Ramdene H.B., 2019** - *What's the Difference Between European and American Butter?*, Kitchn. <https://www.thekitchn.com/whats-the-difference-between-european-and-american-butter-229135>.
- Sala C.C., 2008** - *Igiena, tehnologia și controlul laptelui și a produselor derivate*. Timișoara, România, Editura Eurobit.
- Savu C., Petcu C.D., 2002** - *Hygiene and control of products of animal origin*. Bucharest, România, Semne Publishing House.
- Usturoi M.G., 2007** - *Tehnologia laptelui și a produselor derivate*, Editura Alfa, Iași, România.
- Verraes C., Vlaemynck G., Van Weyenberg S., De Zutter L., Daube G., Sindic M., Uyttendaele M., Herman L., 2015** - *A review of the microbiological hazard of dairy products made from raw milk*. International Dairy Journal, 50:32-44.
- Visoescu D.I., Petcu C.D., Tapaloaga D., 2015** - *Researches regarding the influence of packaging on the quality of some dairy products*. Journal of Biotechnology, 208, S19-S19.
- Weston P., 2020** - *Know Your Fats*, The Weston A. Price Foundation. <https://www.westonaprice.org/know-your-fats/>.
- www.insse.ro – Institutul Național de Statistică, Comunicat de presă Nr. 90, / 12 aprilie 2021.