

## Comparative studies on quality indicators for plain and fruit yogurt

Ramona Cristina Hegheduș-Mîndru<sup>1</sup>, Natașa Adelina Mărăcine<sup>1</sup>,  
Gabriel-Hegheduș Mîndru<sup>1\*</sup>

<sup>1</sup>Faculty of Food Engineering, Banat's University of Agricultural Sciences and Veterinary Medicine  
"King Michael I of Romania" – Timișoara, Calea Aradului 119, 300645 – Timișoara, Romania

---

### Abstract

At present, consumption of acidic dairy products is very high, is consumed due to the amalgam of benefits it brings. Low caloric value of acidic dairy products is also an important feature in context of re-intensifying nervous activity and reducing physical exertion. Lacto-acid products are important despite this, being recommended, having antidecalcifying action and regulating the intestinal microflora in some digestive tract defects. In this paper, comparative and statistical analyzes were performed based on quality indicators studied (*pH*, titratable acidity, fat, protein and moisture) in case of nine samples of plain yogurt and fruit yogurt. Following multivariate analysis of data, samples were grouped according to type of yogurt they belong to. First group includes samples of plain yogurt, second group includes samples of fruit yogurt and group three includes samples of fig yogurt.

**Keywords:** yogurt, quality indicators, Principal Components Analysis – (PCA).

---

### 1. Introduction

Dairy products are essential for people because they provide basic energy and nutrients, which are very necessary for proper functioning of metabolic processes and growth. Among dairy products, yogurts are most important and consumed class. Of yogurt varieties, ones with fruit are most appreciated by consumers [1].

Yogurt is product of development of two species of lactic acid bacteria in milk: *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, between which symbiotic relationships are created.

Due to this symbiosis, activity of two microbial species intensifies, accelerating process of lactic fermentation and formation of aromatic substances specific to product [2, 3].

This product is similar to dairy fruit with difference that raw material is 3% normalized milk to which 4% sugar is added. After pasteurization of the mixture at 90-95° C for 20-30 minutes and cooling to 45-48° C, dyes and flavorings are added as an aqueous or alcoholic solution [2, 3].

Fermentation of milk is one of oldest methods of preserving milk with an extended shelf life.

The great researchers believe that milk fermentation was accidentally discovered by Neolithic people of Central Asia when they stored milk in primitive methods, such as in sheepskin bags, which were left in the sun [2, 3].

First industrialized production of yogurt was held in 1919 in Barcelona, Spain at a company called Danone, then expanding worldwide. Nowadays, yogurts are made in many styles and varieties with different fat contents, flavors and textures suitable for tastes of each person [2, 3].

Yogurt is made with a variety of ingredients, including sweeteners, stabilizers, fruits, flavors and bacterial cultures. Milk is main ingredient used in manufacture of yogurt, type of milk to be used depends on variety or type of yogurt to be prepared. For example, full-fat full-fat milk is used for regular yogurt, partially skimmed milk is used for lower-fat yogurt [2, 3].

Stabilizers are usually added to blending process to improve texture of product, prevent separation / syneresis of whey and help to evenly distribute ingredients in product. In addition, sweeteners are added to enhance flavor and attractiveness of consumer [2, 3].

As a first benefit we can remember that yogurt comes from milk, which is very rich in nutrients.

The most important nutrients are calcium, vitamin B-2, vitamin B-12, potassium, magnesium and most important nutrient are probiotics [4].

Probiotics are those good bacteria that are naturally found in digestive system. These bacteria can help boost the immune system and maintain a healthy digestive tract. Following a study, researchers found that probiotics can help with inflammatory bowel disease, intestinal microflora is changing [4].

Another important benefit of yogurt is that it can help prevent osteoporosis, as it contains a lot of calcium [4].

A study by a group of American researchers has shown that moderate consumption of yogurt can help the body prevent type 2 diabetes. Another study found that these probiotic bacteria successfully protect children and pregnant women from the effects of accidental exposure to heavy metals. Unfortunately, not all yogurts are good for the body [5].

Those with a high sugar content or unnecessary additives can bring a huge disadvantage to these products [5].

## 2. Material and Methods

In order to make comparisons in terms of quality indicators (pH, titratable acidity, fat, protein and moisture) results obtained in case of 9 yogurt samples were studied as follows: plain yogurt - sample 1, plain yogurt - sample 2, plain yogurt - sample 3, fruit yogurt - sample 1, fruit yogurt - sample 2, fruit yogurt - sample 3, fig yogurt - sample 1, fig yogurt - sample 2 and fig yogurt - sample 3. Values obtained were compared with values prescribed in product standards. Values of quality indicators were used as input data in case of the analysis (PCA – Principal Components Analysis).

## 3. Results and discussions

Table 1 shows results obtained from study performed for 9 yogurt samples.

**Table 1.** Results obtained from study performed for 9 yogurt samples [6-10]

Yogurt samples studied	Physico - chemical characteristics of studied yogurt samples				
	pH	Titrable acidity °T	Fats (%)	Protein (%)	Humidity(%)
Plain yogurt - sample 1	4,34	80,2	5,21	3,04	86
Plain yogurt - sample 2	4,27	77,8	5,54	3,022	86
Plain yogurt - sample 3	4,28	84,7	5,31	3,08	86,3
Fruit yogurt - sample 1	4,13	92,2	0,4	3,02	87,1
Fruit yogurt - sample 2	4,04	99,6	0,52	3,86	84,5
Fruit yogurt - sample 3	4,14	100,1	2,8	3,71	86
Fig yogurt - sample 1	4,49	96,6	3,4	3,3	82,1
Fig yogurt - sample 2	4,45	98,9	3	5,6	83,4
Fig yogurt - sample 3	4,52	108,2	3,5	4,03	80,2
STANDARD [11-16]	3,8 - 5,5	75-145	1 - 6	Min. 3,2	

### *pH assessment for nine yogurt samples studied*

Highest pH value was recorded in fig yogurt sample - 3, 4.52. Other samples showed a pH value in range 4.45 - 4.13. Lowest pH value was recorded in case of fruit yogurt sample - 2, 4.04.

### *Assessment of acidity in case of nine yogurt samples studied*

Evaluation of acidity of yogurt samples led to a higher value, 108.2 ° T - fig yogurt - sample 1.

Other yogurt samples showed acidity values in range 80.2 - 100.1° T. Lowest value of acidity was recorded in case of plain yoghurt sample - 2.

### *Assessment of fat content in case of nine yogurt samples studied*

Highest fat content was recorded in plain yogurt samples 1, 2 and 3 with values in range 5.21% - 5.54%. Fig yogurt samples 1, 2 and 3 recorded values of fat content in range 3% - 5.5%. Fruit yogurt sample showed a fat content of 2.8%.

Lowest fat content was recorded in fruit yogurt

samples 2 - 0.52% and fruit yogurt 1 - 0.4%.

**Assessment of protein content in case of nine yogurt samples studied**

In case of protein content, highest values were recorded in case of fig yogurt sample 2 - 5.6% and fig yogurt sample 3 - 4.03%. Samples fig yogurt 1 and 2, fruit yogurt sample 2 recorded values of protein content in range 3.3% - 3.86%. Lowest protein content was recorded in case of fruit yogurt sample 1, plain yogurt samples 1, 2 and 3 with values in range 3.02% - 3.08%.

**Assessment of water content in case of nine yogurt samples studied**

Regarding water content, highest values were recorded in case fruit yogurt samples 1 and 3, plain yogurt 1, 2 and 3, in range 86% - 87.1%. Fig yogurt samples 1 and 2, fruit yogurt sample 2 showed a water content with values in range 82.1% - 84.5%. Lowest water content was recorded in fig yogurt sample 1 - 80.2%.

**Statistical results obtained from Principal Components Analysis (PCA) in case of nine yogurt samples**

Input data for PCA analysis were represented by values obtained from study performed in terms of quality indicators of nine yogurt samples. Following PCA analysis, samples were grouped according to type of yogurt they belong to. First group includes samples of plain yogurt 1, 2, and 3, second group includes fruit yogurt samples 1, 2, and 3, respectively group three includes fig yogurt samples 1, 2 and 3, (Figure 1). Responsible for these groups are independent variables given by value of indicators of quality, humidity and fat in case of PC<sub>2</sub> component, protein, acidity, even pH in case of PC<sub>1</sub> component, (Figure 2). Variance of data is 99% explained by first two principal components (4% PC<sub>1</sub> and 95% PC<sub>2</sub>).

Figure 3 shows residual variance of data for PCA analysis of data obtained from study on value of quality indicators (pH, titratable acidity, fat, protein and moisture) of nine yogurt samples.

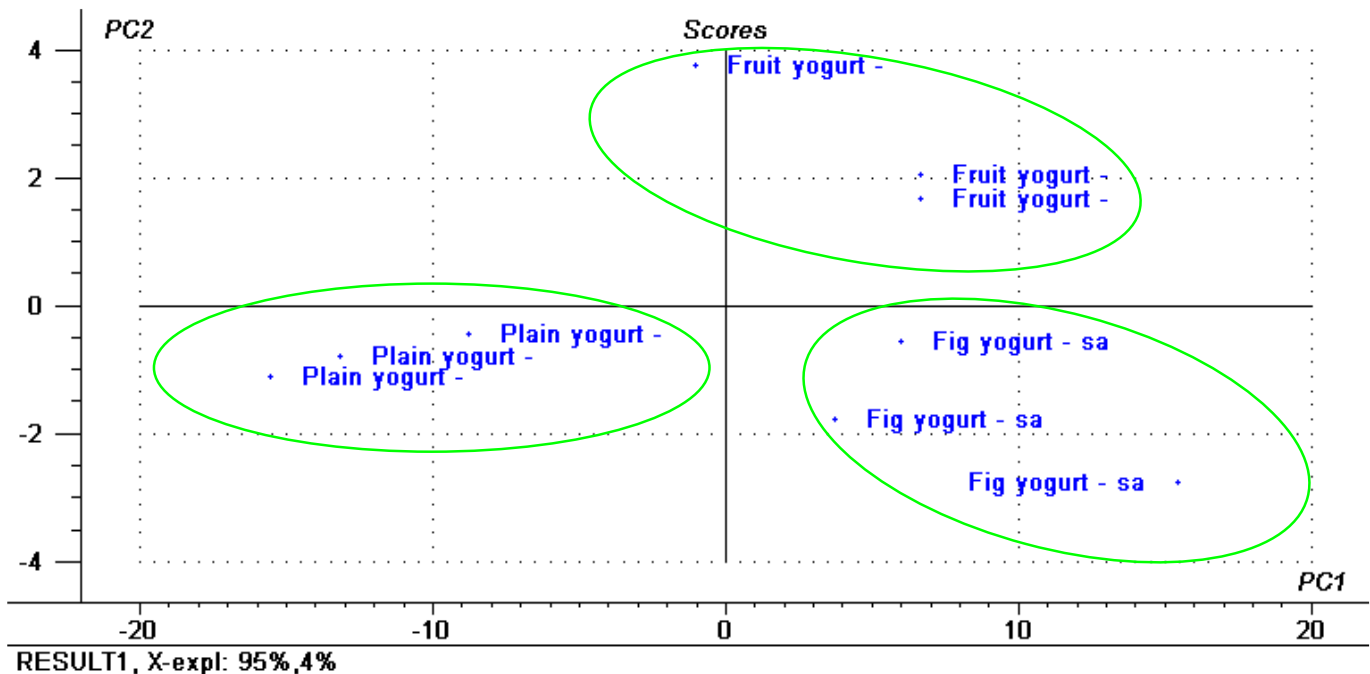
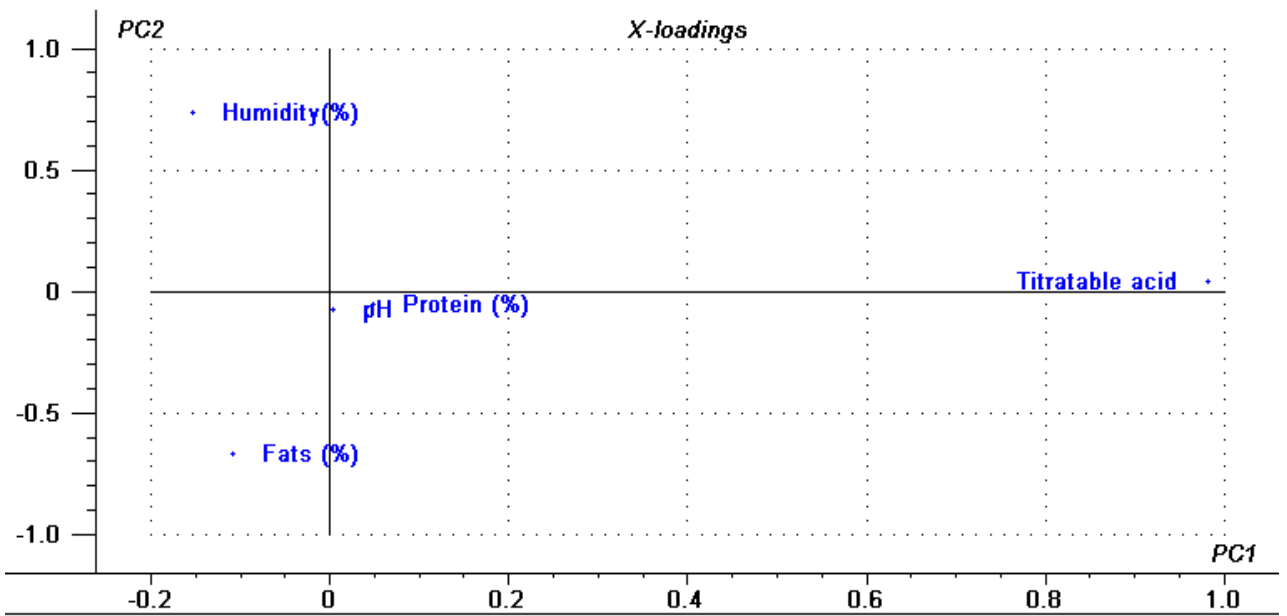
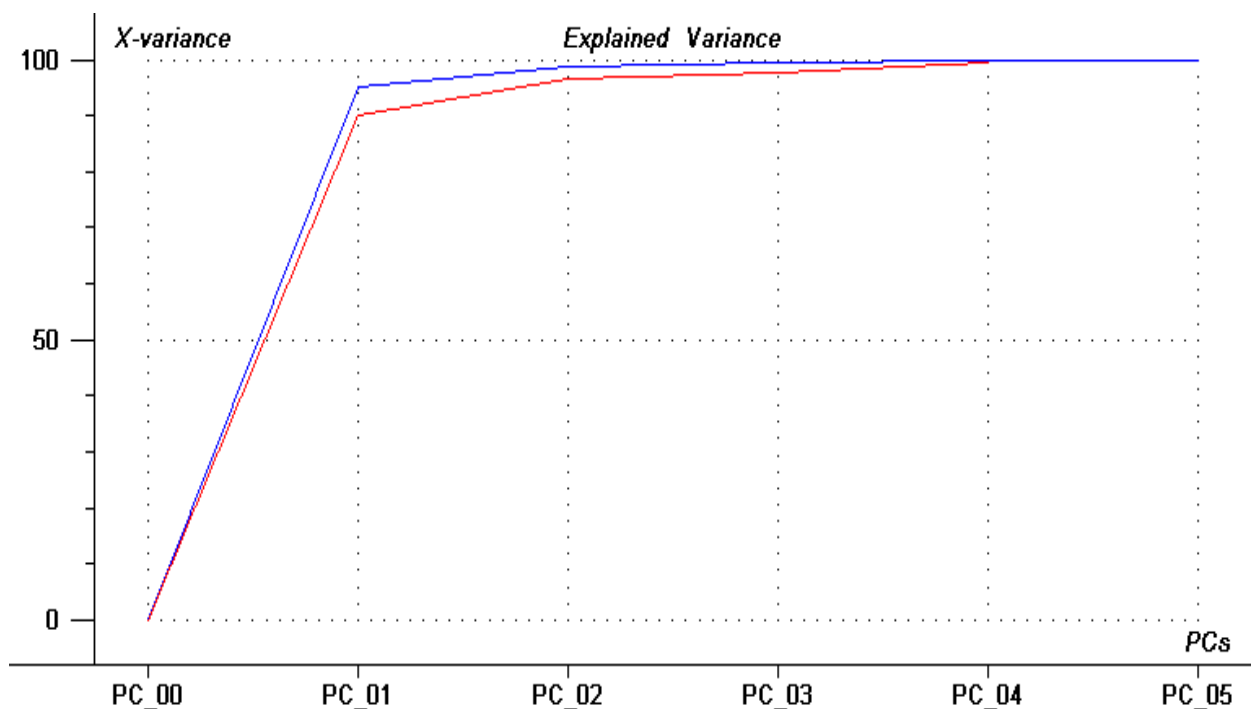


Figure 1. Graph of PC<sub>2</sub> versus PC<sub>1</sub> scores for PCA analysis using all data from study on value of quality indicators (pH, titratable acidity, fat, protein and moisture) of nine yogurt samples studied.



RESULT1, X-expl: 95%,4%

Figure 2. Graph of PC<sub>2</sub> versus PC<sub>1</sub> records for PCA analysis using all data from study in terms of quality indicators (pH, titratable acidity, fat, protein and moisture) of nine yogurt samples studied)



RESULT5, Variable: *c.Total* *v.Total*

Figure 3. Residual variance for PCA analysis using all data from study in terms of quality indicators (pH, titratable acidity, fat, protein and moisture) of nine yogurt samples studied

#### 4. Conclusion

Following bibliographic study of comparisons and statistical analysis (PCA) performed for quality indicators of nine yogurt samples, following conclusions were drawn:

➤ pH indicator showed values in range 4.04 - 4.52 respecting limits provided in product STANDARD - 3.8 - 5.5;

➤ Titrable acidity expressed in °T presented values within range 77.8 ° T - 108.2 ° T respecting limits provided in product STANDARD - 75 ° T - 145 ° T;

➤ In case of evaluation fat content, fruit yogurt samples 1 and 2 registered values of 0.4% and 0.52%, they do not fall within limits provided by product STANDARD - 1% - 6%. Other yogurt samples registered values that respect limits provided by STANDARD, their interval being between 3% - 5.54%;

➤ Evaluated protein substances registered values in range 3.04% - 5.6% respecting limits provided in product STANDARD - min. 3%;

➤ Following PCA analysis, samples were grouped according to type of yogurt they belong to. First group includes plain yoghurt samples 1, 2, and 3, second group includes fruit yoghurt samples 1, 2, and 3, respectively group three includes fig yogurt samples 1, 2 and 3.

Responsible for these groups are independent variables given by value of indicators of quality, humidity and fat in case of PC<sub>2</sub> component, protein, acidity, even pH in case of PC<sub>1</sub> component. The variance of data is 99% explained by first two principal components - 4% PC<sub>1</sub> and 95% PC<sub>2</sub>.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

**Acknowledgements:** This work was supported by proving the equipment's of the Faculty of Food Engineering Timișoara - "Food Science"- Research Center.

#### References

1. Bratu, C., Trasca, T., Ioan, Cioban, C. & Dogaru, D., Veronica; (2017) Compositional, functional and sensory characteristics of a symbiotic dairy product, *17th International Multidisciplinary Scientific GeoConference SGEM* **2017**, 17, 1314-2704, 10.5593/sgem2017/61/S25.080.
2. Weerathilake, W., A., D., V.;, Rasika, D., M., D.;, Ruwanmali, J., K., U.; & Munasinghe, M., A., D., D.; The evolution, processing, varieties and health benefits of yogurt, *International Journal of Scientific and Research Publications.*, **2014**, 4, 2250-3153.
3. <https://www.berkeleywellness.com/healthy-eating/food/article/types-yogurt>.
4. <https://www.medicalnewstoday.com/articles/295714#types>.
5. <https://www.webmd.com/food-recipes/features/benefits-yogurt#:~:text=Here%20are%20six%20possible%20health%20benefits%20to%20having>.
6. Ferrão, J., Luís; & Pitrosse, G., Micaela, Chemical and Microbiological Quality Evaluation of Yoghurt Produced and Marketed in Chimoio, Mozambique, *Food & Nutrition Journal.* **2018**, 3, 10.29011/2575-7091.100063.
7. Joseph, A., O., Olugbuyiro; & Joy, E., Oseh, Physico-chemical and Sensory Evaluation of Market Yoghurt in Nigeria, *Pakistan Journal of Nutrition*, **2011**, 10, 10.3923/pjn.2011.914.918.
8. De Silva, K., L., S., R.; & Rathnayaka, R., M., U., S., K.; Physico-chemical Sensory and Microbiological Evaluation of Set and Fruit Yoghurt in Sabaragamuwa Province, Sri Lanka, *Journal of Scientific Research and Reports*, **2013**, 10.9734/JSRR/2014/6512.
9. Zlatev, Z., Taneva, I., Baycheva, S. & Petev, M. A comparative analysis of physico-chemical indicators and sensory characteristics of yogurt with added honey and bee pollen., *Bulgarian Journal of Agricultural Science.*, **2018**, 24, 1310-0351.
10. Hatice, E. & Songul, C. Shelf life and quality of probiotic yogurt produced with *Lactobacillus acidophilus* and *Gobdin*, *International Journal of Food Science & Technology*, **2017**, 53, 10.1111/ijfs.13653.
11. SR 3665: 1999 Iaurt. Condiții tehnice de calitate in

12. *ISO 26323:2009 Milk products - Determination of the acidification activity of dairy cultures by continuous pH measurement (CpH)*
13. *ISO 8968-1:2014 Milk and milk products - Determination of nitrogen content - Part 1: Kjeldahl principle and crude protein calculation in*
14. *ISO 488:2008 Milk - Determination of fat content - Gerber butyrometers in*
15. *ISO 13580 Yogurt Determination of total solids content (Reference method) in*
16. *ISO/TS 22113:2012 - Milk and milk products — Determination of the titratable acidity of milk fat*