RESEARCH REGARDING THE ANALYSIS OF YOGHURT QUALITY BY METHODS OF CALIMETRY

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RESEARCH ARTICLE

Abstract

The concept of food quality is complex, and consists in satisfying the needs and demands of consumers, who are considered the main pawn in the running of all economic activities.

Yoghurt, which originated in the East, is now consumed in many countries and is highly appreciated by consumers. Like the milk from which it is made, yoghurt is a valuable source of calcium, contains fats based on short-chain fatty acids, specific carbohydrates (lactose) and some vitamins. Yoghurt consumption is associated with improved health outcomes. This paper is a study carried out to highlight the main quality characteristics of yoghurt using mathematical and statistical methods.

Keywords: yoghurt, quality, calimetry, nutrients

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INTRODUCTION

Yogurt is an ancient food that has been given many names over the millennia: katyk (Armenia), dahi (India), zabadi (Egypt), mast (Iran), leben raib (Saudi Arabia), laban (Iraq and Lebanon), roba (Sudan), iogurte (Brazil), cuajada (Spain), coalhada (Portugal), dovga (Azerbaijan) and matsoni (Georgia, Russia and Japan). Dairy products are believed to have been incorporated into the human diet around 10,000–5,000 BC with the domestication of milk-producing animals (cows, sheep, and goats, as well as yak, horses, buffalo, and camels). (https://chimie-biologie.ubm.ro/Cursuri%20on-line.pdf; https://www.scribd.com/doc/316110151/Iaurt)

The word 'yoghurt' is thought to come from the Turkish word 'yoğurmak', which means to thicken, coagulate or curdle. The use of yoghurt by the medieval Turks has been recorded in the books Diwan Lughat al-Turk by Mahmud Kashgari and Kutadgu Bilig by K. H. Yusuf, both written in the 11th century. The texts mention the word 'yoghurt' and describe its use by nomadic Turks. The Turks were also the first to evaluate the medicinal use of yogurt for a variety of illnesses and symptoms, such as diarrhea and cramps, and to alleviate the discomfort of sunburned skin. Genghis Khan, the founder of the Mongol Empire, is reputed to have fed his army yoghurt, a staple of the Mongol diet, on the belief that it instilled bravery in his warriors. (https://www.scribd.com/document/227587844/IAURT; https://historia.ro/)

It wasn't until the 20th century that researchers offered an explanation for the health benefits associated with yoghurt consumption. In 1905, a Bulgarian medical student, Stamen Grigorov, was the first to discover Bacillus bulgaricus (now L. bulgaricus), a lactic acid bacterium that is still used in yoghurt cultures today. Based on Grigorov's findings, in 1909, Russian Nobel laureate Yllia Metchnikoff of the Pasteur Institute in Paris suggested that lactobacilli in yoghurt were associated with the longevity of the Bulgarian rural population. In the early 20th century, yoghurt became known for its health benefits and was sold in pharmacies as a medicine. Yoghurt became commercially successful when Isaac Carasso, from Barcelona, started producing yoghurt with jams. After running away from the Nazi occupation, Isaac Carasso's son Daniel Carasso founded Dannon (Danone in France). The first yogurt laboratory and factory opened in France in 1932; in the United States, the first laboratory and factory opened in 1941. (https://historia.ro/; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9455928/)

Today, yogurt is typically milk that has been fermented and acidified with viable and well-defined bacteria, creating a coagulated

dairy product with an extended shelf life. (Pirvulescu L., 2014; https://academic.oup.com /nutritionreviews/article/73/suppl_1/4/1819293)

Consumption of yogurt and other fermented products is associated with improved health outcomes. Although dairy consumption is included in most dietary guidelines, there have been few specific recommendations for yogurt and cultured dairy products. A qualitative systematic review was conducted to determine the effect of consumption of fermented dairy products on gastrointestinal and cardiovascular health, cancer risk, weight management, diabetes and metabolic health, and bone density. (Radu Florina 2021; https://www.ncbi.nlm.nih.gov/ pmc/articles/PMC8579104/)

In terms of its microbiological composition, yoghurt is a dairy product resulting from the development in milk of two main and characteristic species of lactic acid bacteria: Lactobacillus bulgaricus and Streptococcus thermophilus, between which symbiotic relationships are formed. Thanks to this symbiosis, the activity of the two microbial species is intensified, accelerating the process of lactic fermentation and the formation of the specific flavour substances of the product. (Radu Florina, 2017; Radu Florina, 2021; https://chimie-biologie.ubm.ro/Cursuri%20on-line.pdf)

The requirements for the properties of yoghurt that give it its special characteristics are as follows:

- curd with a fine, creamy, compact consistency, without whey separation (whey exudate after breaking must not be more than 2,5 %);
- porcelain appearance;
- white or yellowish-white colour, specific smell, sour taste and pleasant aroma;
- the dry matter content is variable, with a minimum protein content of 3,2 %;
- the acidity varies according to the type of yoghurt (extra 75-145°T, and full-fat and low-fat yoghurt 75-140°T);
- pH between 4.4 and 4.2;
- pathogenic bacteria - missing and coliform bacteria differentiated according to the type of packaging. (Diaconescu, I., 2008; https://www.scribd.com/doc/316110151/Iaurt; ; https://www.academia.edu/ 41329323/Iaurtul_tehnologia_laptelui)

All the physical, technical, aesthetic, organoleptic, energetic, nutritional, environmental protection characteristics, the degree of chemical toxicity, microbiological toxicity, etc., can be found in the quality components of the food product, namely: hygienic quality, nutritional quality, sensory quality, the component psycho-social quality, technological quality and the economic component of quality. (Diaconescu, I., 2008)Developing the idea, the quality of food products must be analyzed under the aspect:

- nutritional: what conditions human health (content in proteins, carbohydrates, lipids, vitamins, mineral salts, etc.);
- sanitary: determined by natural toxicity, chemical and microbiological contamination;
- organoleptic (shape, color, taste, smell, consistency);
- aesthetics (packaging and presentation on the market, labeling, etc.) (Diaconescu, I., 2008; Iloiu M., 2012)

Quality assessment is the systematic examination of the extent to which an entity (product or service) is able to satisfy specified conditions, i.e. requirements translated into a set of characteristics expressed quantitatively or qualitatively. The result of the quality assessment is often expressed by specific indicators determined using statistical-mathematical methods. (Diaconescu, I., 2002; Iloiu M., 2012)

The basic criterion for assessing the level of quality is the degree of satisfaction of the beneficiaries' needs. Therefore, the aim is to evaluate the degree of usefulness of the product through a comparative assessment against the need expressed by consumers, through the quality requirements formulated in the market tests. (Diaconescu, I., 2002; Stanciu, I., 2001)

Quality is considered to be a function of the main quality characteristics of the product, seen in correspondence with consumer requirements and needs. The basic principle of calimetry is the weighting of characteristics according to their contribution to determining the quality of products at a given time. (Stanciu, I., 2001)

MATERIAL AND METHOD

The paper carries out a comparative analysis of the quality of yogurt through a method of calimetry, namely the method of the synthetic, integral indicator of quality.

The formula of the synthetic, integral quality indicator, in which only the values of

quality characteristics are taken into account, is as follows: (Stanciu, I., 2001)

$$I_{cq} = \left(\sum_{i=1}^{n} \frac{x_{ai}}{x_{ri}} \cdot p_i + \sum_{j=1}^{m} \frac{x'_{rj}}{x'_{aj}} \cdot p'_j \right)$$

in which:

x_a and x_r – the quality characteristic values of the product to be analyzed and the reference product;

i - the number of product characteristics directly proportional to quality;

j – the number of product characteristics inversely proportional to quality;

p and p' – the weights of the quality characteristics, their sum being equal to 1. (Stanciu, I., 2001)

RESULTS AND DISCUSSIONS

The food product Yoghurt was chosen for the study, from five companies (C1 - C5). Of these product variants, C1 yoghurt is chosen as the reference product. The following quality characteristics have been chosen:

- Appearance coagulum;
- Taste-smell;
- Colour;
- Fat content, %;
- Acidity,°T

Attributive quality characteristics (appearance coagulum, taste-smell and colour) were scored using the 0 - 1 quality score scale (Table 1).

Table 1 Score for attributive quality characteristics

	Appearance coagulum	Taste-smell	Colour
PC1	1	1	0,75
PC2	1	0,75	0,75
PC3	0,75	1	0,50
PC4	0,75	0,50	0,75
PC5	1	1	1

The weights of the selected quality characteristics were determined by the expertise method, resulting in the following values:

p1 = 0,2368
p2 = 0,2421
p3 = 0,2
p4 = 0,1947
p5 = 0,1263

Table 2 shows the values of the numerical and attributive quality characteristics, previously converted into points on a scale of quality points from 0 to 1, the values of the weights of the characteristics, determined by the expertise method.

Table 2 Data centralisation

Reference product and analyzed products	**Product characteristics directly proportional to quality**				**Product characteristics inversely proportional to quality**
	Appearance coagulum	Taste-smell	Colour	Fat content, %;	Acidity,°T
PC1	1	1	0,75	3,5	138
PC2	1	0,75	0.75	3	138
PC3	0,75	1	0,50	3,8	137
PC4	0,75	0,50	0,75	2,8	140
PC5	1	1	1	3,5	140
Weights of the quality characteristics	0,2368	0,2421	0,2	0,1947	0,1263

Next, the calculation formula was applied for the yogurt variants chosen in the study, taking into account the fact that the yogurt variant offered by the C1 company is the reference product. The reference product will always have the value of the quality indicator equal to 1. The values of the calculated quality indicators (Icq) for the chosen yoghurt variants are:

Icq PC1= 1
Icq PC2 = 0,9114
Icq PC3 = 0,8916
Icq PC4 = 0,7788
Icq PC5 = 1,065

Figure 1 shows the ranking of the yoghurt variants chosen in the study according to the values of the quality indicators.

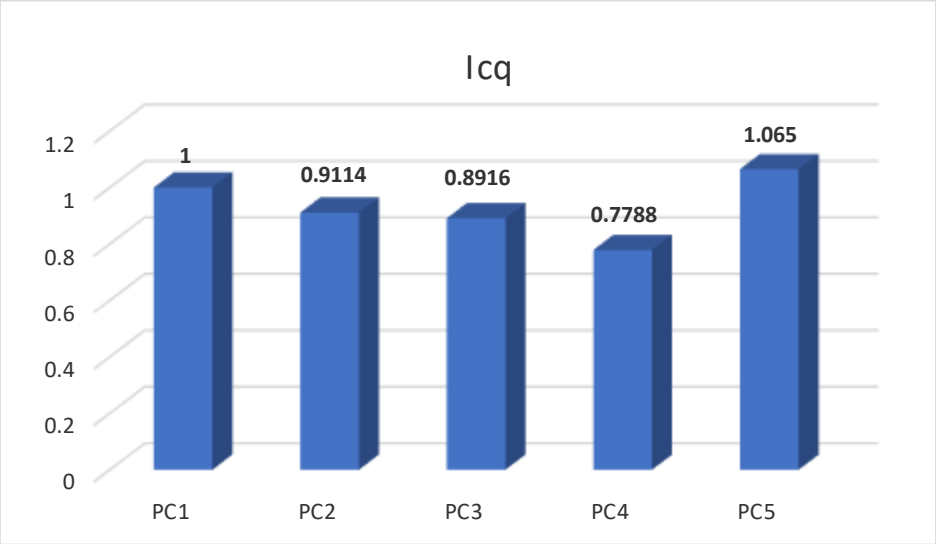

Figure 1 Ranking of yoghurt variants by quality indicator values

CONCLUSIONS

By applying the methods of calimetry it is possible to identify certain quality characteristics of products with an impact on consumer behaviour.

The synthetic, integral quality indicator method is mainly used for the comparative analysis of several products of the same group, referring to a product considered as a reference and allowing the comparison of products whose quality characteristics are expressed numerically or attributively.

Analysing the results obtained by the calimetry method used, it can be seen that the yoghurt variant offered by the company C4 is qualitatively superior to the reference product (PC4), while the other yoghurt variants are qualitatively inferior to it.

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