

NUTRITIONAL AND SENSORY CHARACTERIZATION OF SOME FERMENTED FOOD PRODUCTS MADE IN THE CARPATHIAN-DANUBIAN-PONTIC AREA

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Abstract

The territory of Romania has been known as the Carpathian-Danubian-Pontic space since ancient times, being traversed from one end to the other by the Carpathian Mountains and being bordered to the south by the Danube River (Danubius) which flows into the Black Sea (Pontic area). Fermented food products manufactured in Romania belong to the many categories, such as: lactic acid dairy products or fermented dairy products (yogurt, sana, buttermilk, kefir, fermented cream, fresh cheese), pickled vegetables (cabbage, cucumbers, red pepper), non-alcoholic fermented beverages (braga, borsch, vinegar, socata), traditional fermented bread, matured cheeses, raw dried salami and alcoholic beverages (beer, wine). In the present article we will focus on a nutritional and sensory characterization of the most famous fermented products that are manufactured almost exclusively in the Carpathian-Danubian-Pontic area, of course also due to the influence of the neighbours, this being: fermented dairy products (yoghurt, sana and buttermilk), lactic fermented pickles (pickled cabbage) and non-alcoholic fermented drinks (braga, borsh and socata).

Keywords: fermented food, nutritional characterization, sensory evaluation, yoghurt, pickled cabbage, non-alcoholic fermented beverages

1. INTRODUCTION. FERMENTATION PROCESS APPLIED TO FOOD.

Fermentation is an ancient food preservation technique, being considered one of the oldest known uses of biotechnology. Fermentation was initially developed to allow a longer storage of raw materials (milk, meat, cereals, vegetables, etc.), so as a preservation method, later the beneficial effects on health were also noted. The functional nature of this process determines the obtaining of foods with excellent sensory and nutritional attributes and with a beneficial probiotic effect on health. Fermentation is a natural process by which microorganisms (yeasts, bacteria and sometimes moulds) transform the carbohydrates contained in food products - such as starch, sugar, lactose - into alcohol or acids, acting as natural preservatives, also giving a distinct flavour for the fermented products.

Food fermentation process can be classified in two main directions, namely:

- ✓ acid fermentation
- ✓ alcoholic fermentation.

Through acid fermentation, which is carried out by bacteria, a large amount of acid (lactic, acetic, propionic) is produced, but also a variety of other metabolites (flavours, vitamins), which lead to more complex organoleptic properties of fermented foods.

Alcoholic fermentation is carried out by yeasts and leads to the release of ethanol (alcohol) and carbon dioxide. *Saccharomyces* is by far the most commonly used yeast in food fermentation, and a large number of strains coming from these bacteria have been selected for the fermentation of: bread, beer, wine and other products.

The mechanism behind the preservation of food, through the fermentation process, was clarified in 1857, by Louis Pasteur who identified the so-called "lactic acid bacteria" as a promoter of obtaining lactic acid.

The time required for the fermentation process varies from a few days to a few months.

Like humans, in order to grow and develop, microorganisms need a source of food and an environment conducive to development.

Thus, for the fermentation process to take place, a source of food is necessary for the development of microorganisms, the source which usually consists of the simple sugars present in a food product. Another source of food for the microorganisms that lead the fermentation is the nitrogen present in the proteins of the raw material and which contributes, as in the case of humans, to the growth and development of the mass of microorganisms.

In addition to these 2 nutritional factors, for the success of a fermentation process, it is necessary to ensure certain parameters for the development of fermentation microorganisms, namely: temperature, acidity, pressure, humidity. Afterwards, the fermented foods are usually stored in a cool place to slow down any further fermentation, so to prevent spoilage of the end products. Thus, by excessively increasing the number of good bacteria in a food, harmful microorganisms (pathogens) are unable to reproduce and grow, thus preventing food spoilage. The acidic, low-oxygen environment and the addition of salt help to develop a habitat that is friendly to good bacteria and hostile to potentially harmful microorganisms (for bacteria - yeasts and molds and for yeasts - bacteria).

Fermented foods have different shelf lives, depending on the type of raw material, storage temperature, packaging method or any other subsequent processing of the fermentation process.

Thus, acid dairy products can be kept for several days to weeks, fermented vegetables for 6 months - 1 year, fermented cheeses and salamis for several months and wine and vinegar can be kept for years.

Some fermented foods that are pasteurized after fermentation no longer contain live microorganisms and thus no longer offer the same health benefits, but have a longer shelf life.

Fermentation can be natural when it occurs spontaneously and thus products of plant origin can be fermented: fermented vegetables, fermented cereals, pickled cabbage. In addition, many wines and even some fermented sausages and beers are also obtained through natural fermentation. Other fermented foods are obtained by adding selected cultures (yeasts or bacteria, or even molds). In general, fermented dairy products, cheese and raw-dried salami are usually obtained using selected cultures because in this way a controlled fermentation is ensured and a high safety in consumption.

2. HEALTH BENEFITS, FOOD SAFETY AND SIDE EFFECTS IN THE CONSUMPTION OF FERMENTED PRODUCTS

Fermentation develops a series of beneficial bacteria, some of them known as probiotics. Many people know probiotics as "good" or "gut-friendly" bacteria, and *Lactobacillus* or *Bifidobacterium* strains are the most well-known. Probiotics are live microorganisms that provide health benefits to the human body and there are countless studies which have found that fermented foods are often more nutritious than their unfermented form, while also having a probiotic effect.

The FAO / WHO organization defined probiotics in 2002 as "live microorganisms which confer a health benefit to the host, when are administered in adequate amounts". Maintaining the viability of these microorganisms until the end of the validity period imposes certain technological requirements on the manufacture of probiotic food product. Thus, in order to bring health benefits to the consumer, the minimum number of microorganisms must be guaranteed until the end of the validity period, in the amount of at least 10^7 - 10^8 colony forming units (CFU) / ml or g.

The human gastrointestinal tract hosts more than 10^{12} microorganisms that form a complex ecosystem known as **microbiota** or **microbiome**. This ecosystem provides protection against pathogens, helps extract nutrients from ingested food, and modulates the immune system. Fermented foods are considered safe for most people to consume, but some people may experience adverse reactions. Due to the high probiotic content of fermented foods, the most common side effect is an initial and temporary increase of gas formation and bloating. These symptoms may be worse after eating high-fiber fermented foods like pickled cabbage, but it's important to remember that not all fermented foods are created equal.

Some products can contain high levels of added sugar, salt and fat - so it is important for consumers to read the nutrition label to ensure they are making a healthy choice. Thereby, if there are problems with the heart and it is the case of maintaining a diet, the consumption of pickles vegetables is not recommended, even if they have a low caloric density, because they contain a lot of salt.

The practice of fermentation is actually simple, accessible and applied in many households in the Carpathian-Danubian-Pontic area, because it requires only a few ingredients and can lead to saving money, while adding variety, new flavors and interesting textures to the diet. Vegetables such as: cabbage, beetroot, cucumbers, red peppers and carrots are some of the easiest foods to ferment at home, because the living bacteria from their surface determinate the fermentation process to take place naturally.

In order to maintain food safety when fermentation is applied in the home kitchen, the recipes must be followed closely because incorrect temperatures, fermentation times or non-sterile equipment can cause the spoilage of the obtained products, which makes them no longer safe for consumption.

3. ACID LACTIC DAIRY PRODUCTS

The fermentation processes that can be applied to milk are the following:

- lactic fermentation, carried out by lactic bacteria, which leads to obtaining acidic dairy products (yoghurt, sana, sour milk, fermented cream, fresh cheese),
- alcoholic fermentation, carried out in symbiosis with lactic fermentation, which leads to obtaining kefir,
- the propionic fermentation given by the propionic bacteria, which leads to obtaining cheeses with holes in the paste,
- the fermentation caused by the development of yeasts or moulds, in general, on the surface of the cheeses, with the formation of aromatic compounds.

In general, fermented dairy products are the only products whose label states that they contain live lactic cultures or live ferments. According to the CODEX Alimentarius standards, in order to make such a mention on the label, the minimum number of lactic bacteria that initiated the fermentation must be in the yogurt in the amount of at least 10^7 UFC per g (CODEX STAN 243-2003).

If other live microorganisms, such as probiotics, are indicated on the label, they must be present in a proportion of 10^2 UFC per g, at the end of the validity period.

Acid dairy products also known as fermented dairy products, are products made from milk or from milk derivatives (whey, buttermilk, cream) that are subjected to the lactic fermentation process.

Lactic fermentation is carried out by cultures of lactic bacteria that transform lactose from milk into lactic acid and other metabolites (flavours, vitamins). To carry out lactic fermentation, it is necessary to maintain optimal temperatures for the development of lactic bacteria.

Thereby, the fermentation of yogurt takes place optimally, at temperatures of 40-45°C (thermophilic fermentation), while the fermentation of sour milk and sana or cream takes place at lower temperatures between 20-28°C (mesophilic fermentation).

The lower the fermentation temperature, the longer the fermentation time is and thus more flavour substances can be formed. Yogurt can be obtained in a 3-6 hour interval, sour milk, sana and fermented cream require an interval of 16 hours, so that the fermentation process can take place optimally.

Fermentation is considered finished when the coagulum has formed (a compact mass of proteins, fat and liquid mass in the form of whey), and the pH of the product drops below the value of 4.6, considered the pH of coagulation of milk proteins.

Below will be presented the particularities of obtaining some fermented dairy products obtained in the Carpathian-Danubian-Pontic region:

Yogurt is the most studied and best-known fermented milk product in which, in addition to the lactic bacteria in the fermentation process, probiotics can also develop with a positive effect on health.

Due to the proximity to the Bulgarian neighbours in the Carpathian-Danubian-Pontic space, yogurt has been manufactured since ancient times, first at home with the help of spontaneous microflora and then industrially under controlled conditions with the help of selected bacteria. Yogurt consumption in Romania consists of 65% set yogurt or spoonable yogurt and 35% drinking yogurt.

According to the technical definition, yogurt is an acidic dairy product manufactured by fermentation of milk by cultures of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. By fermenting lactose, these bacteria create an acidic environment, favourable for the absorption of calcium in a rather large proportion and also cause a significant increase in the digestibility of the raw material.

Sana and **sour milk** are fermented dairy products that are obtained exclusively in Romania and are an invention of the milk industry from the '50s that wanted to copy the fermented milk produced in Romanian homes at that time, also known as "covasit" milk. Thus, the fermentative process takes place over a longer period of time (mesophilic fermentation), the difference between them being the fact that sana is a acid dairy product, with a higher fat content than sour milk and the number of flavour formation bacteria from the fermentation culture are double than in sour milk.

3.1. Nutritional characterization of fermented dairy products

Probiotics and lactic bacteria that develop in fermented dairy products give the body a series of benefits, among which we mention:

- synthesis of vitamins, such as: vitamin B₁, B₂, B₆, B₁₂, K and folic acid and source of minerals, such as: calcium, potassium, phosphorus. These minerals are essential for several biological processes, such as blood pressure regulation, metabolism and bone health.
- stimulating the well-being of the intestines, alleviating the symptoms of irritable bowel

syndrome and removing the unwanted manifestations of diarrhea and constipation, thanks in particular to the probiotic content

- achieving a better digestibility of proteins and carbohydrates (lactose) contained in raw milk. Because lactose is broken down during the fermentation process, people with lactose intolerance can more easily tolerate fermented dairy products such as: yogurt and fresh cheese.
- protection against osteoporosis. Acid dairy products contain several key nutrients for maintaining bone health, including calcium, protein, potassium, phosphorus, in an appropriate proportion.
- help in regulating body mass. The consumption of yogurt and fermented milk is associated with weight loss and better weight control because these products have a high protein content, from which, through fermentation, peptides with the role of reducing appetite (peptide YY and GLP-1).
- maintaining the health of the cardiovascular system through the richness of group B vitamins, especially vitamin B₁₂ and riboflavin. Dairy fermented products have been found to modestly lower blood pressure and cholesterol levels. The fat content of acid dairy products is one of the reasons why the beneficial effect on the heart is often controversial, since it consists mainly of saturated fat, with a small amount of unsaturated fatty acids. But some research has shown that the intake of saturated fats from fermented dairy products increases the blood parameter HDL cholesterol (considered "good" cholesterol), which can protect heart health.
- improving brain function. Fermented dairy products have been shown to improve cognitive function in adults due to their high content of B vitamins.

All the health benefits related to the consumption of acid dairy products and their influence on the immune, cardiovascular and nervous systems have begun to be studied recently and therefore more research is needed in the field to reach a unanimously accepted conclusion. In general, dairy products that consistently contain higher levels of microorganisms (10⁹ CFU/ml or g) are a good source of live lactic acid bacteria that can provide the above mentioned benefits to human health.

From a nutritional point of view, the nutritional declaration of several acidic dairy products present on the Romanian market is presented below.

Table 1. The average nutritional declaration for 100 g of acid lactic products

Nutritional declaration for 100 g of product	Set yoghurt with 3,7% fat	Drink yoghurt with 0 % fat	Spoonable yoghurt with 2,8 % fat	Sourmilk with 2 % fat	Sana with 3,6% fat
Energy, kJ/ kcal	264/63	155/37	228/54	190/45	244 /59
Fat from which, g	3.7	0.1	2.8	2	3.7
Saturated fats, g	2.2	0.06	1.7	1.2	2.2
Carbohydrates, from which, g	4.2	4.5	3.6	3.9	3
Sugars, g	4.2	4.4	3.6	3.9	3
Proteins, g	3.3	4.4	3.7	2.9	3.3
Salt*, g	0.1	0.1	0.1	0.1	0.1

As can be observed, the caloric density of 100 g of Romanian acid dairy products is quite low (63 kcal/100 g maximum), therefore they can be used successfully in weight loss diets. The salt content expressed in the table is due exclusively to the presence of sodium in the milk like raw material.

3.2. Sensory characterization of fermented dairy products

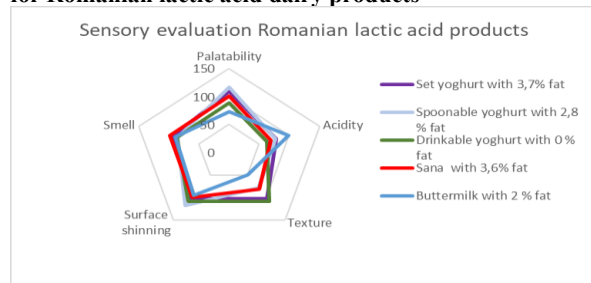
Due to the fact that acid dairy products were the subject of my doctoral thesis, they were studied closely and from a sensory point of view with the help of a number of 30 untrained tasters who provided feedback on the defining sensory characteristics of these products. For this reason, the determination scale exceeds the value of 100 because it was obtained by the arithmetic mean of the points given by each taster.

Therefore, the results of this sensory test, which were based on hedonic analysis, can be found in Table 2, and their graphic representation in the form of a spider graph can be found in Figure 1.

Table 2. Sensory characteristics of lactic acid dairy products

Type of lactic acid products	Palatability	Acidity	Texture	Surface shining	Smell
Set yoghurt with 3,7% fat	109	78	103	102	93
Spoonable yoghurt with 2,8 % fat	117	77	79	117	85
Drinkable yoghurt with 0 % fat	88	63	109	108	87
Sana with 3,6% fat	101	69	81	99	98
Buttermilk with 2 % fat	73	99	50	95	89

Figure 1. Grafic representation of sensory characteristics for Romanian lactic acid dairy products



From this graph can be observed that the best appreciate Romanian lactic acid products is yoghurt with higher content of fat which confer smoothness, creamy texture and appealing shinnines of the surface.

4. LACTIC PICKLED VEGETABLES

Pickled cabbage is a lactic fermented vegetable preserved in a salty solution in which fresh, cleaned cabbage is introduced. The traditional fermentation process, which does not differ much from the industrial one, applied to cabbage involves the following steps: the cabbage is cleaned, its spine is removed (if it is desired to be preserved whole) or it is finely cut or shredded and then it is placed in layers in a large vessel, usually a wood barrel or glass jar. The next step is adding salt between the layers of cabbage or sprinkle salt on each head of cabbage to favour the extraction of water from

each cabbage and to start the fermentation process. The fermentation process can last several weeks or months, depending on personal preferences and storage conditions, and from time-to-time air is bubbled in the fermentation vessel for better development of lactic bacteria, which are aerobic bacteria.

Pickled cabbage can be kept for a long period of time under proper storage conditions, usually in a cool, dark place. Fermentation can continue and thus add complexity and more flavour to the pickled cabbage as time passes.

4.1. Nutritional characteristics of pickled cabbage

Pickled cabbage is an excellent source of probiotics, beneficial for intestinal health, contributing to maintaining a healthy balance of intestinal flora and improving digestion and absorption of nutrients. Regular consumption of pickled cabbage can help stimulate the secretion of digestive enzymes and improve intestinal transit, thanks to the lactic acid and fibre content, which also plays a prebiotic role. This is also due to the content of acetylcholine in pickled cabbage, a neurotransmitter identified in the central nervous system that transmits messages from the brain to the body through nerve cells. The bacteria present in pickled cabbage can also help in of increase the body's resistance to infections and improve the immune response to pathogens.

Likewise, the consumption of pickled cabbage can also help to reduce inflammation in the body, through the content of antioxidants and anti-inflammatory compounds formed as metabolites of lactic fermentation. Last but not least, pickled cabbage is a rich source of vitamins and minerals, including vitamin C, vitamin K, folic acid, iron and calcium, nutrients contained both in the raw material and formed as metabolites of fermentation.

From a nutritional point of view, 2 varieties of pickled cabbage present on the Romanian market were chosen, whose nutritional declaration is presented in table 3.

Table 3. Nutritional declaration for 100 g of pickled cabbage (without brine)

Nutritional declaration for 100 g of product	Pickled cabbage 1	Pickled cabbage 2
Energy, kJ/ kcal	112/27	59/14
Fat from which, g	0.1	0.1
Saturated fats, g	0	0.1
Carbohydrates, from which, g	4.3	2
Sugars, g	1.8	1
Proteins, g	2.5	1.2
Salt, g	0.9	0.7

As can be seen, the caloric density of pickled cabbage is quite low (maximum 27 kcal/100 g), being obtained from a low fat and protein content, but given the content of carbohydrates and especially other fibres present in cabbage raw material. The salt content of the brine can reach the value of 3%, but in the nutrition table it is only the salt content of the drained pickled cabbage, so what the cabbage has absorbed from the brine.

4.2. Sensory characterization of pickled cabbage

Pickled cabbage made in Romania has a sour and salty taste, with an intense and rich aroma, given especially by fermentation added spices. The fermentation process adds a level of sensory complexity, and the cabbage can also have subtle aromas of spices or other ingredients that are added in the fermentation process, namely: bay leaves, black pepper or garlic.

Pickled cabbage is highly appreciated by Romanian consumers and can be consumed as such, in the form of a salad to which olive oil and ground pepper or ground paprika are added, depending on the area of the country where it is consumed. It is also consumed as a food usually prepared in the oven, highly appreciated, namely in the form of sauteed cabbage. The leaves of pickled cabbage are used to cover the “sarmale”, usually made from pork, a very popular dish in Romania, so that their acidity counteracts the fat in the “sarmale”.

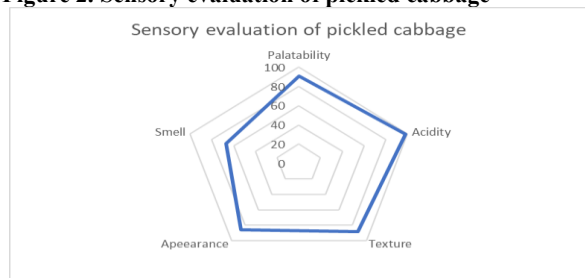
From the point of view of the appearance, the pickled cabbage is immersed in a liquid with high turbidity, quite opaque and showing some effervescence.

The smell of pickled cabbage varies in intensity and the nature of the smell, from sour to sweet or pungent, being often accompanied by the aromas of spices or added spices. There are people who do not appreciate the smell of pickled cabbage, especially when it was not aerated during fermentation or the proper hygiene conditions were not respected, and therefore, in addition to the usual metabolites obtained through lactic fermentation, there are also compounds with nitrogen or sulphur that creates an undesirable smell.

From a taste point of view, we can say that the main taste of pickled cabbage is the sour one accompanied by the salty taste, but also with secondary flavours, given by the vegetables or spices added in the fermentation process. The texture of pickled cabbage is elastic and soft, but not excessively soft.

Figure 2 graphically presents a series of sensory characteristics of Romanian pickled cabbage from the point of view of an authorized food taster.

Figure 2. Sensory evaluation of pickled cabbage



5. FERMENTED NON-ALCOHOLIC BEVERAGES (BRAGA, BORSH, SOCATA)

Braga is a refreshing drink that was made by the ancient Greeks who lived on the territory of Romania and is specific to the Danubian-Pontic area, i.e. in the counties: Braila, Galati, Giurgiu, Mehedinti and Constanta. Braga

is a cloudy, mucilaginous refreshing drink with colloidal substances in suspension and with a high content of nutritious components obtained after fermentation. The fermentation process of this drink begins with a short alcoholic fermentation, initiated by yeasts, which is then replaced by a lactic fermentation with the formation of lactic acid, given by the lactic bacteria present in the flour.

The raw material for the manufacture of this drink consists of various types of flour: rye, corn, wheat, some of which are baked in the oven at temperatures of 100-105°C. These flours are hydrated with water, to which brewer's yeast is added and left to ferment for 4-5 days. Sugar is added on top of this liquid to create the degree of sweetness specific to this drink. The lactic acid obtained through fermentation gives the drink a pleasant, aromatic and fresh taste.

Borsh is a sour, tasty drink, obtained by the lactic fermentation of wheat bran mixed with corn flour immersed in boiled and cooled water. Other ingredients are also used for flavouring, such as: cherry sprig, dill and lovage.

Borsh is used especially in the region of Moldova for souring soups, but it can also be consumed as a refreshing drink due to the beneficial effects it has on the body. Industrially, the borsh is pasteurized and then bottled, which causes an extension of its shelf life.

Socata is a traditional soft drink popular in our country but also in neighbouring countries such as: Bulgaria and Serbia. Socata is a refreshing drink obtained by the fermentation of elder flowers (*Sambucus nigra*) and sugar, and a percentage of lime juice, which gives it a refreshing and slightly sweet taste. The fermentation process is generally applied at home and has as its raw material the elderflowers picked during the period of maximum flowering, namely at the end of spring or the beginning of summer. The elderflowers are washed and placed in a large glass jar over which warm water is poured, sugar and lemon juice are added, as well as lemon slices. The mixture is left to ferment for several days or weeks, depending on how effervescent we want to get the refreshing drink. The fermentation is alcoholic and allows the development and extraction of the aroma of the elderflowers, as well as the creation of an effervescence due to the carbon dioxide formed.

After the end of fermentation, the refreshing drink is filtered by the solid remains of elderflowers and lemons and bottled in glass containers, then stored in cold conditions. If you want to extend the shelf life of this drink, you can easily pasteurize the bottles with the product, followed by a slow cooling.

5.1. Nutritional characteristics of fermented non-alcoholic beverages

The benefits of braga are multiple, because it is obtained from natural ingredients and can be considered a healthy alternative to carbonated juices. Braga contains a complex of vitamins from group B (B₁, B₂, B₃, B₆, B₁₂) formed after the fermentation process, proteins and

minerals (phosphorus, calcium, iron and zinc). The presence of varied microflora in braga, formed especially by lactic bacteria and yeasts, considered probiotics, has a beneficial influence on the digestive system and bactericidal properties, and the carbon dioxide formed in small quantities helps digestion. However, due to the rather high content of sugars, this refreshing drink should be consumed with caution.

Borsh has an important effect of strengthening the immune system, antibacterial and antiviral properties. Also, borsch can be considered a digestive adjuvant, ensuring good functioning of the colon, due to the fact that through lactic fermentation, a series of probiotic bacteria are found in it, such as: *Lactobacillus acidophilus* and *Bifidobacterium bifidus*. Due to the very low caloric content (4 kcal/100 ml), it is recommended for people who want to lose weight, stimulating fat burning.

The bran used as the first step in obtaining borsch is a good source of fibres, and the borsch prepared from them can preserve some of these fibres, with a beneficial effect on maintaining intestinal health and regulating intestinal transit. Being a lactic fermentation as metabolites, small amounts of vitamins and minerals can be obtained from the fermented bran, such as vitamin B and some essential minerals, although in quite small amounts compared to other food sources. Borsh can also represent a natural remedy for hangovers, due to its acidity, and can be recommended to patients with anaemic conditions, as it can restore appetite, eliminate apathy and the feeling of drowsiness associated with this condition. Socata is often served cold, with ice, and can be diluted with water or added to cocktails or other drinks.

Socata is generally considered a low-calorie soft drink (when not overly sweetened), but which also does not provide a significant amount of essential nutrients. Although elderflowers contain certain nutrients, such as vitamin C and antioxidants, but the amount of these in the socata is usually very low, so the socata does not represent a significant source of vitamins and minerals. In table 4, the nutritional declarations of the 3 non-alcoholic fermented drinks available on the Romanian market are presented.

Table 4. Nutritional declaration for fermented non-alcoholic beverages

Nutritional declaration for 100 ml of product	Socata	Braga	Borsh
Energy, kJ/ kcal	174/41	410/97	19/4
Fat from which, g	0.3	0.15	0
Saturated fats, g	0	0	0
Carbohydrates, from which, g	9.5	22.2	0.6
Sugars, g	8.7	12	0
Proteins, g	0	1.2	0.2
Salt, g	0.1	0.1	0.4

As can be seen from this table, borsch from bran has the lowest caloric density (4 kcal/100 ml), and braga, due to the content of sugar and total carbohydrates, has the highest caloric density (97 kcal/100 ml).

The fat content of these soft drinks is insignificant, as is the protein content, which is slightly higher in braga due to the fact that in suspension there are also particles from the pregelatinized flours used as raw materials.

5.2. Sensory characteristics of fermented non-alcoholic beverages

Borsh. The color of this fermented drink is light and starts from pale yellow to amber. It can sometimes have a slight brown tint depending on the fermentation time and other ingredients added. Due to the bran in suspension, it may have sediment that, by stirring, disturbs the appearance of the borsh.

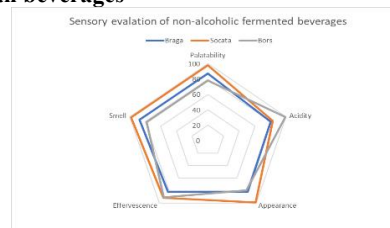
The smell of bran borsch is acidic, with slightly sweet notes due to the spices used in fermentation. The taste of borsch is sour, with a slight hint of bran, comparable to that of other fermented beverages, such as kombucha. The texture of bran borsch is liquid, but thanks to the bran remaining in suspension, a slightly dusty consistency can be obtained.

Socata. The color of the socata can vary from a slightly yellowish turbid color to a darker yellow, with fine bubbles due to the presence of carbon dioxide resulting from fermentation. The aroma of socata is distinct, easily recognizable, fresh and floral, with subtle notes of elderflower and lemon. Socata has a refreshing and slightly sweet taste, with a subtle balance between the natural sweetness of elderflowers and the acidity of lemon or other added fruits. The texture of socata is usually fluid and slightly effervescent, due to the fermentation process. In general, socata is valued more for its pleasant taste and refreshing properties than for its nutritional value. It's a healthy alternative to sugary fizzy drinks and can be a refreshing and enjoyable option during hot summer days. However, it should be consumed in moderation, especially in the case of excessively sweetened versions, due to the sugar content. Braga is usually golden-brown to dark brown in color with high turbidity due to sediments or particles resulting from the fermentation process.

The smell of braga is complex, with sweet and intense notes of roasted cereals and sometimes chocolate, and the taste is characterized by a balance between sweetness and acidity, with a distinct note of effervescence due to fermentation. The texture of braga can vary from liquid to slightly viscous or full, with a slight effervescence due to fermentation.

In Figure 3, the sensorial evaluation of the 3 fermented alcoholic beverages present on the Romanian market is graphically represented.

Figure 3. Sensory evaluation of non-alcoholic fermented Romanian beverages



As it can be observed, the most appreciated fermented soft drink of these 3 is socata, braga not being so appreciated due to its cloudy consistency, and borsh due to its acidity and specific smell.

6. CONCLUSIONS

Fermentation is a food processing technology that favors the development and metabolic activity of microorganisms for the transformation of raw materials (milk, vegetables, cereals, meat, fruits, flowers) into fermented food products, mostly with a probiotic effect, such as: fermented dairy products, fermented cheeses, pickles vegetable, raw dried salami, bread, beer, wine, vinegar, cider, socata. The consumption popularity of fermented foods and drinks is due to their improved shelf life, food safety in general, their functionality and sensory properties, but also their nutritional properties. The latter include the presence of bioactive molecules, vitamins and other constituents with increased bioavailability, which were formed following the fermentation process. Many fermented foods also contain live microorganisms that can improve gastrointestinal health. Recently, there is an increased interest in the consumption of fermented food products, interest determined mainly by the benefits they bring to health, and the trend will continue in the future, due to the prevalence of metabolic syndromes, such as: obesity, various food allergies and intolerances (lactose, gluten), lifestyle choices (vegetarianism and veganism), as well as the growing interest of consumers in all that is perceived as natural and promotes health and even longevity.

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