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PROPERTIES OF DRINKING YOGURT OBTAINED FROM COW'S AND GOAT'S ORGANIC MILK FERMENTED BY TRADITIONAL YOGURT CULTURES

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Abstract

This paper presents an assessment of selected qualitative attributes of fermented drinks obtained from organic cow's and goat's milk by using yogurt cultures in 10-day refrigeration storage process (5 ± 1°C). The raw material was purchased in organic farms located in north-west Poland. Two yogurt starters obtained from the Chr. Hansen company were used in the study: YC-X16 and YF-L811. Both cultures contained *Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp. bulgaricus*. These cultures did not differ in the qualitative content of the lactic acid bacteria but their use allows for obtaining products with different qualitative properties. Four variants of yogurt were produced: i. J-X16 – yogurt from cow's milk with YC-X16 culture, ii. J-L811 – yogurt from cow's milk with YF-L811 culture, iii. KJ-X16 – yogurt from goat's milk with YC-X16 culture, iv. KJ-L811 – yogurt from goat's milk with YF-L811culture. All samples of fermented milk were subjected to microbiological, physico-chemical, rheological (hardness) analyzes and a sensory assessment (PN-EN ISO 6658:1998). It was determined that the yogurt cultures (YE-L811 and YC-X16) used in the experiment are worthy of recommendation for the production of fermented milk from both organic cow's and goat's milk. The physical and chemical properties (titratable acidity, pH and hardness), the vitality of the microflora as well as sensory properties of yogurt from organic cow's and goat's milk depended on the type of used yogurt culture and time of refrigeration storage. The type of used milk has no impact on the vitality of the microflora.

Keywords: organic cow's and goat's milk, fermented milk drink, yogurt cultures

INTRODUCTION

More and more consumers of the food market appreciate health products, including those obtained through organic production, which is seen as more natural, without dangerous toxins and characterized by higher nutritional value (Bloksma *et al.* 2008, Vicini *et al*. 2008, Florence *et al*. 2009). The world production of organic food is characterized by an upward trend and the largest demand for organic products is observed in North America and Europe (Koperska 2014). Currently, cow's milk and its products follow vegetables and fruits among organic products with the highest sales dynamics. During the last years in Poland organic farming has increased considerably. The main product is cow's milk, although production of organic goat's milk is growing by around 24% annually (Zuba-Ciszewska and Zuba 2014). Among the assortment of organic food, there is a wide range of dairy products, such as yogurt, kefir, cottage cheese, ripening and rennet cheese made from cow's as well as goat's milk (Koperska 2014). Fermented milk drinks are popular within the group of dairy products, including the traditional ones, i.e. yogurt and kefir classified as products of particularly high health value. Following the literature (Kudełka 2005), traditional yogurt is produced using only two thermophilic bacteria: *Lb. delbrueckii* ssp. *bulgaricus* and *Str. thermophilus*. The basic raw material to produce dairy fermented drinks is cow's milk obtained from suppliers who keep their animals in a traditional manner. However, it is increasingly common to be able to buy in organic shops (and not only) drinks produced using organic cow's or goat's milk characterized by potentially therapeutic, antiallergic and nutritional properties. Scientific reports (Palupi *et al.* 2012, Butler *et al.* 2008, Florence *et al*. 2009) have confirmed that milk from organic holdings contains more protein, iron and more natural, fat soluble antioxidants (such as tocopherols, β-carotene), which protect our organism against oxidative stress and carcinogenic processes. It is also characterized by considerably better fatty acid profile than the conventional milk. From technological viewpoint, the proper ratio of protein to fat is very important as it favors obtaining of proper qualitative traits of yogurts (Costa *et al.* 2016). The research (Florence *et al*. 2009) shows that yogurts made from organic milk contain much more CLA than those obtained from of conventional milk. Goat's milk is similar to cow's milk in its qualitative composition, yet certain differences in its quantitative composition and the structure of basic components, i.e. fat and protein, translate into different qualitative properties of the finished products. In the case of dairy fermented drinks the most visible differences concern the curd texture. It has been observed that yogurt gel from goat's milk is more delicate and less viscous in comparison to cow's milk yogurt. In addition, during yogurt fermentation of goat's milk, a considerably lower amount of volatile aromatics (acetaldehyde, diacetyl) and carbon dioxide are produced. Goat's milk is characterized by lower buffer volume as well as higher content of protein nitrogen and vitamins, which eventually determined more rapid increase of acidity in fermented drinks (And and Guo 2006, Park *et al.* 2007, Mituniewicz-Małek *et al*. 2009b).

The study aimed at the assessment of qualitative traits of fermented drinks obtained on the basis of organic cow's and goat's milk with traditional yogurt cultures during refrigeration storage (temperature 5 ± 1°C).

MATERIALS AND METHODS

Materials and bacterial cultures

The study material consisted of yogurts made from cow's and goat's milk obtained from organic farms. Samples were prepared in laboratory conditions using a thermostatic method. The raw material was cow's and goat's milk purchased in organic farm holdings located in the West Pomeranian voivodeship. For the production of the study drinks two commercial yogurt cultures were used, i.e. YE-L811 and YC-X16 by Chr. Hansen company (Poland). Following the manufacturer's specification both used cultures do not differ in the qualitative composition of the lactic acid bacteria (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus)*, yet their usage enables obtaining of a product with different qualitative properties.

Preparation of fermented milk samples and study design

Organic cow's and goat's milk was pasteurized using vat method (85°C/15–20 min), and then cooled to temperature 40°C. Subsequently, each milk type was divided into two portions and each portion was inoculated with one of two, prior activated yogurt cultures (YC-X16 or YE-L811, Chr. Hansen, Poland) in the form of an inoculum (5%). The inoculum was obtained through incubation (in temperature 40°C) of weighed culture (0.6 g/1000 cm^3) in skimmed milk (0.0%) for 4÷8 h, defining the end of the fermentation process based on the pH and fermentation curve set in the culture specification. Four variants of yogurt were prepared:

- J-L811 – cow's milk yogurt with YE-L811 yogurt culture,
- J-X16 – cow's milk yogurt with YC-X16 yogurt culture,
- KJ-L811 – goat's milk yogurt with YE-L811 yogurt culture,
- KJ-X16 – goat's milk yogurt with YC-X16 yogurt culture.

Organic cow's and goat's milk inoculated with the proper culture was poured into 50 ml unit containers, tightly closed and transferred to an incubator to perform its fermentation. Incubation of the study drinks was conducted at 42°C until pH 4.7 was obtained, then the prepared drinks were immediately cooled to the temperature of 5 ± 1°C and under such conditions samples were stored for 10 days. Samples for the analyzes were selected randomly after 1 and 10 days of refrigeration storage, 10 samples from each variant. The total of 80 study yogurt samples were examined.

Analysis of raw material

In organic processed milk the following parameters were determined: the total protein content (Zmarlicki 1981), fat (PN-ISO 2446:2010), density, titratable and active acidity (Affane *et al*. 2011, Bylund 1995). Moreover, toxicological analysis was performed to determine the content of remaining chloroorganic compounds (α-HCH, β-HCH, γ-HCH, pp′-DDE, pp′-DDD, pp′-DDT) using the GC-MS method (Witczak *et al*. 2013).

Microbiological, physicochemical, textural and sensory analysis of the yogurts

The yogurts were subjected to a microbiological, physicochemical and rheological (texture) analysis and sensory assessment. Microbiological analysis of the samples included determination of the number of yogurt microflora cells using the pour plate method. To determine *Lb. delbrueckii* subsp. *bulgaricus* MRS agar medium (Merck) was used, whereas for the determination of the number of bacteria cells of *Str. thermophilus*, M17 agar (Merck) medium was applied. In both cases, microbiological analysis was performed according to the Polish Standard (PN-ISO 7889:2007). Inoculations of the *Lb. delbrueckii* subsp. *bulgaricus* and *Str. thermophilus* bacteria were incubated in temperature of 37°C for 72 h – the first group was incubated in anaerobic conditions and the second one in aerobic conditions. After the incubation of plates with the inoculum, the result was calculated as the number of colony-forming units per 1 g of the product (cfu/g). Physicochemical analysis included determination of: titratable acidity in °SH (Affane *et al.* 2011), active acidity using a pH-meter (CP-411) and the acetaldehyde content (Lees and Jago 1969). The analysis of the hardness was performed using TA.XT plus texture analyzer with a computer set (Stable

Micro System, UK). The samples of yogurt were penetrated with an aluminum cylinder with a diameter of 20 mm to the depth of 25 mm, at the rate of 5 mm·s^{-1} and the force at 1G (Miocinovic *et al*. 2016). Based on the available literature (Salvador and Fiszman 2004), the study was limited to the hardness analysis as the main texture parameter. The sensory evaluation of the yogurts obtained from organic cow's and goat's milk was conducted at laboratory conditions by a trained team of 6 panelists who assessed appearance, taste, smell and consistency on a 5-point scale (PN-EN ISO 6658:1998).

Statistical analysis

The obtained results of microbiological, physicochemical and rheological analyzes were statistically analyzed. A two-way analysis of variance (ANOVA) with repetitions and analyses for estimating differences between two dependent and independent means (t-Student and Cochran-Cox) were done. All statistical analyses were performed at the significance level P = 0.05.

RESULTS AND DISCUSSION

Raw material characterization

The chemical composition of the raw material to produce the studied fermented drinks is presented in Table 1 – cow's milk on average contained 3.26% total protein and 4.6% fat, titratable acidity equaled 6.90°SH and active acidity was 6.73 pH. On the other hand, goat's milk was characterized by 2.69% total protein content and 3.38% fat content, and the titratable and active acidity values were 6.07°SH and 6.89 pH, respectively. The density of cow's milk was 1.031 g/cm^3, and goat's milk 1.026 g/cm^3. The protein and fat content in both raw materials differed slightly from those in the available literature (Costa *et al*. 2016, Eissa *et al.* 2011, Vargas *et al.* 2008). However, milk composition may differ between breeds, lactation period, genetic and environmental factors, medical condition of the animals as well as the feeding method. Values of titratable acidity and pH of the tested raw materials remained at the levels similar to the values obtained by other authors (Costa *et al.* 2016, Eissa *et al.* 2011, Gomes *et al.* 2013). During toxicological analysis of the raw material, found that the chloroorganic pesticides residues (Table 2) in cow's and goat's milk was at a low, safe level for consumers (from 0.068 ng/g pp′DDD in cow's milk fat to 3.49 ng/g pp′DDE in goat's milk fat). The obtained results constituted the base to qualify both raw materials for yogurt production.

Table 1. Physical and chemical properties of the raw material for yogurt production

Milk type	Total protein (%)	Fat (%)	pH	Titratable acidity (°SH)	Density ($g \cdot cm^{-3}$)
Cow's milk	3.26	4.60	6.73	6.90	1.031
Goat's milk	2.69	3.38	6.89	6.07	1.026

Table 2. Residues of selected chloroorganic pesticides in the raw material for yogurt production

ng/g of milk fat	α-HCH x ± SD	β-HCH x ± SD	γ-HCH x ± SD	pp′-DDE x ± SD	pp′-DDD x ± SD	pp’-DDT x ± SD
Cow's milk	0.12 ± 0.006	0.44 ± 0.032	0.237 ± 0.085	1.950 ± 0.223	0.068 ± 0.013	1.027 ± 0.030
Goat's milk	0.167 ± 0.052	0.813 ± 0.009	0.680 ± 0.052	3.49 ± 0.10	0.153 ± 0.039	0.682 ± 0,024

α-HCH – α-hexachlorocyclohexane; β-HCH – β-hexachlorocyclohexane; γ-HCH – γ-hexachlorocyclohexane; pp′DDE – 1,1-*bis*-(4-chlorophenyl)-2,2-dichloroethene; pp’DDD – 1-chloro-4-(2,2-dichloro-1-(4-chlorophenyl)ethyl)benzene; pp′DDT – 1,1’-(2,2,2-Trichloroethane-1,1-diyl) bis (4-chlorobenzene)

Microbiological, physicochemical, textural and sensory characteristics of the yogurts

Microbiological quality of yogurt depends on the presence of the proper number of live and active microflora originating from a starter culture during the entire shelf life of the product. Thermophilic lactic acid bacteria, *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*, are used for the production of yogurts. Yogurt produced with these bacteria is characterized by the typical taste and smell properties and proper texture (Kycia and Krysiński 2014).

The symbiosis between *Str. thermophilus* and *Lb. delbrueckii* subsp. *bulgaricus* occurring in commercial yogurt cultures YC-X16 and YE-L811 used in the experiment has been discussed in numerous publications. *Lactobacillus bulgaricus* possesses proteolytic enzymes, oligopeptides and free amino acids, which can be used as the source of nitrogen for lactic streptococci during fermentation. In turn, *Str. thermophilus* produces substances stimulating the growth of lactic bacilli, including lactic, pyruvic and formic acid, as well as carbon dioxide. Moreover, *Str. thermophilus* absorbs oxygen, thus creating favorable conditions for the growth of lactic bacilli (Li *et al.* 2012).

The initial mean number of *Streptococcus thermophilus* in the obtained fermented drinks from cow's and goat's milk ranged from 8–9 log (cfu/g), whereas the mean number of *Lactobacillus delbrueckii* subsp. *bulgaricus* was

8.6 ± 0.3 log (cfu/g) and 6.3 ± 0.4 log (cfu/g), for samples obtained using YE-L811 and YC-X16 cultures respectively, independent of the type of milk used. In the final stage of storage, a decline in the number of yogurt microflora was observed in the tested fermented drinks, and the mean number of lactic streptococci was 8.7–7.5 log (cfu/g) for YE-L811 and in the range 6.6–5.5 log (cfu/g) for YC-X16 cultures.

The conducted study demonstrated that the vitality of the starter microflora in the study yogurts from organic cow's and goat's milk depended on the type of used starter and time of refrigeration storage, and not on the type of used milk. Also Florence *et al*. (2009) found that the level of starter bacteria in yogurt obtained from organic milk was comparable to that found in products from conventional milk. According to Zaręba *et al.* (2008), the survivability of lactic acid bacteria in fermented milk depends on the type, species and strain of the used bacteria. On the other hand, the study of Beal *et al.* (1999) also determined the strong impact of storage time on the vitality of lactic streptococci and bacilli. During 21 storage days of yogurts at 4°C, the population of bacteria decreased by 40–75%, especially between 7 and 21 day of refrigeration storage. As indicated in the study of Beal *et al.* (1999) and Shori *et al.* (2012), the decrease of the number of yogurt microflora cells may be linked to the progressing decrease of pH of fermented drinks during refrigeration storage. Results obtained in the present study are comparable with the results of other researchers, indicating that yogurts from cow's and goat's milk have higher values of *Streptococcus thermophilus* in comparison to *Lactobacillus delbrueckii* subsp. *bulgaricus* (Birollo *et al.* 2000, Shori *et al.* 2012).

Titratable acidity of the analyzed fermented drinks from organic cow's milk was in the range from 24.53 to 40.13 ^{o}SH, whereas significantly lower values were found in the drinks from organic goat's milk (22.80 to 29.87 ^{o}SH). Titratable acidity of all fermented drinks increased during storage, and in the samples produced from goat's milk the acidity fluctuations were considerably lower than in those obtained from cow's milk (Table 3). However, in both cases during the entire storage period, higher values of titratable acidity were found in the products with the YC-X16 culture than with YE-L811, and for the J-L811 drink the acidity on the last day was slightly higher than in J-X16 (by 1.06 percentage point). The conducted statistical analysis indicated that the type of milk and type of bacteria culture used and the storage time had significant impact on titratable acidity of the tested samples (Table 5). Gomes *et al.* (2013), by testing the physicochemical properties of yogurts produced from cow's and goat's milk, determined significant increase of titratable acidity of the drinks as well; in this research yogurts from cow's milk were characterized by slightly higher acidity values as compared to goat's milk yogurts. Similarly, Salvador and Fiszman (2004) demonstrated increase in the titratable acidity in the case of flavored yogurts from skimmed cow's milk. As provided by the available publications, the increase of acidity is caused by progressing (yet limited by refrigeration temperature) development of lactic acid bacteria (Baba *et al.* 2014). Danków *et al.* (2000), who studied the effect of refrigeration storage on the quality of goat's milk yogurts, observed a significant increase of titratable acidity in yogurts from goat's milk produced using commercial yogurt cultures.

In the course of the conducted study, similarly to titratable acidity, lower pH was typically observed in goat's products than in cow's products. Thus, pH in goat's drinks remained in the range from 4.32 to 4.45 and in cow's yogurts from 4.44 to 4.86 (Table 3). The collected data differed from those obtained by other researchers (Gomes *et al.* 2013, Kozioł and Gustaw 2012), in which lower pH values were determined in cow's than goat's yogurts. However, it should be emphasized, that in contrast to titratable acidity, the pH of samples was significantly less influenced by the starter culture used. Yet in goat's drinks after 1 and 10 days of storage the differences in pH between KJ-L811 and KJ-X16 turned out to be significant (Table 5). Considering the storage time, a statistically significant decrease of active acidity was observed in all yogurt samples from organic cow's milk (J-L811 and J-X16) and in the KJ-X16 sample of organic goat's milk yogurt. On the other hand, sample KJ-L811 demonstrated statistically significant increase of pH, which was 2.92% after 10 days of storage (Table 3). The decrease in pH during refrigeration storage was also noted by other authors (Gomes *et al.* 2013, Mituniewicz-Małek *et al.* 2009a). The phenomenon of titratable acidity increase and decrease of active acidity of fermented drinks during their storage is explained by Bonczar and Wszołek (2002) by the fermentation activity of microorganisms originating from yogurt culture, which in the temperature of 4°C continue to decompose lactose, though at a considerably slower rate than in their optimum temperature.

Statistical analysis demonstrated statistically significant differences in pH values of yogurts produced from organic cow's and goat's milk using both bacteria cultures (Table 5). The effect of bacteria culture on pH of yogurts was also observed by other authors (Beal *et al.* 1999). Also the research conducted by Florence *et al*. (2009) showed that in case of yogurt made from organic milk, the acidification rate was slower in comparison with product made from conventional raw material.

The major volatile compounds found in yogurts are carbonyl compounds such as acetaldehyde, diacetyl, acetone and acetoin. The present study analyzed the acetaldehyde content as the most important compound forming typical yogurt aroma (Xu *et al.* 2015). The acetaldehyde content in all samples ranged from 0.074–1.232 mg/dm^3 (Table 3), yet significantly higher values were observed in drinks produced from cow's milk (J-L811 and J-X16), compared to goat's milk drinks (KJ-L811 and KJ-X16) (Table 4). Lower acetaldehyde content in goat's yogurts may be linked to higher level of free glycine, which inhibits threonine aldolase transforming threonine to acetaldehyde and glycine (Beshkova *et al.*

1998). The present study proved that, the type of culture had a significant influence on the acetaldehyde content of yogurt samples obtained from both cow and goat's milk. Statistically significant differences in acetaldehyde content have previously been correlated to the type of milk as well as the properties of starter culture (Mituniewicz-Małek *et al.* 2009a, Xu *et al.* 2015). The conducted study further indicated influence of the refrigeration storage time on the acetaldehyde content. In the case of drinks obtained from cow's milk, the acetaldehyde content decreased, while it significantly increased in yogurts from goat's milk. The decrease of the content of acetaldehyde in fermented drinks made from bovine milk was previously reported by Xu *et al.* (2015), and can be explained by the effect of alcohol dehydrogenase, produced by yogurt microflora, which during storage transforms acetaldehyde into ethanol. The decrease of the content of acetaldehyde was also reported by Mituniewicz-Małek *et al.* (2015) for fermented drinks from goat's milk, which is not confirmed in the presented results (Table 5).

Table 3. The changes in physicochemical and microbiological characteristics of yogurt samples from cow's (J-L811, J-X16) and goat's milk (KJ-L811, KJ-X16)

Product	Feature											
	pH		Titratable acidity (°SH)		Acetaldehyde ($mg\cdot dm^{-3}$)		Hardness (N)		*Str. thermophilus* (log cfu/g)		*Lb. bulgaricus* (log cfu/g)	
	Storage time (days)											
	1	10	1	10	1	10	1	10	1	10	1	10
J-L811	4.86^{a}	4.48^{a}	24.53^{ab}	40.13^{d}	1.232^{b}	0.414^{b}	0.482^{b}	0.542^{b}	9.00^{b}	8.30^{b}	8.60^{b}	6.60^{b}
J-X16	4.86^{a}	4.44^{a}	31.33^{c}	39.07^{c}	1.021^{b}	0.525^{b}	0.536^{b}	0.667^{b}	8.90^{b}	8.30^{b}	6.20^{a}	5.80^{a}
KJ-L811	4.32^{b}	4.45^{a}	22.80^{a}	25.60^{a}	0.074^{a}	0.296^{b}	0.200^{a}	0.223^{a}	8.90^{b}	8.70^{b}	8.50^{b}	6.40^{b}
KJ-X16	4.41^{b}	4.32^{b}	26.40^{b}	29.87^{b}	0.126^{a}	0.152^{a}	0.268^{a}	0.272^{a}	8.00^{a}	7.50^{a}	6.30^{a}	5.50^{a}

Different letters in superscript indicate statistically significant differences ($p<0.05$).

The texture of fermented drinks depends on, among others a quality of the raw material, a type of bacterial culture used, a fermentation method and structure forming additives (Mituniewicz-Małek *et al.* 2015, Tratnik *et al.* 2006, Żuraw 2002). The drinks obtained from bovine milk in the present study (J-L811 and J-X16) were characterized by significantly higher hardness during the entire study period in comparison to those obtained from goat's milk (KJ-L811 and KJ-X16) (Table 3). The obtained results corroborate the study conducted by Miocinovic *et al.* (2016), who also observed significantly lower hardness values of capric milk yogurts in comparison to bovine yogurts. This can be explained by the fact that acidic curd in goat's yogurts is softer and more delicate in comparison to curd of cow's milk yogurts (Mituniewicz-Małek *et al.* 2009a). According to Salwador and Fiszman (2004), higher content of protein in cow's milk may influence the increase of hardness of yogurts produced from it in comparison to goat's milk yogurts. Compared to cow's milk, goat's milk contains less casein and is characterized by low content or complete absence of α_{s1} casein and higher dispersion level of casein micelles, which may also be linked to the hardness differences between goat's and cow's yogurts (Herrero *et al.* 2006). On the other hand, Vinderola *et al.* (2009) determined that the rheological properties of dairy products depend on the active acidity and the higher this acidity is the higher their hardness. This observation has been confirmed in the present study, i.e. in yogurts obtained from cow's milk and for goat's yogurt fermented with YC-X16 culture. In the course of the conducted study a statistically significant influence of the type of yogurt culture on the hardness of the analyzed drinks was observed independently of the type of milk used — this is supported by the study of Mituniewicz-Małek *et al.* (2013) and Zhang *et al.* (2016). On the other hand, in the study of Domagała and Wszołek (2008) and Domagała (2005), no significant impact of the bacterial culture was observed for the hardness of analyzed yogurts. During refrigeration storage of study drinks, a statistically significant increase of their hardness was determined, and it is worth mentioning that higher values characterized samples obtained using the YC-X16 culture, independently of milk type (Table 5). Also Mituniewicz-Małek *et al.* (2013) determined statistically significant increase of the hardness of drinks from goat's milk in the 21-day period of refrigeration storage. However, different hardness values (no significant changes) in yogurts from goat's milk during storage were obtained by Herrero *et al.* (2006).

Table 4. Results of sensory analysis (on a 5-point scale) of drinks fermented from cow's and goat's milk

Product	**Characters**							
	Appearance		Taste		Smell		Consistency	
	Storage time (days)							
	1	10	1	10	1	10	1	10
J-L811	4.80	5.00	3.83	3.83	4.67	3.83	4.67	4.83
J-X16	5.00	5.00	4.00	3.75	3.83	3.83	3.83	3.50
KJ-L811	5.00	5.00	3.83	3.83	4.50	3.67	4.67	4.33
KJ-X16	5.00	5.00	3.33	3.00	4.50	4.17	3.67	3.50

J-L811 – cow's milk yogurt with YE-L811 yogurt culture; J-X16 – cow's milk yogurt with YC-X16 yogurt culture; KJ-L811 – goat's milk yogurt with YE-L811 yogurt culture; KJ-X16 – goat's milk yogurt with YC-X16 yogurt culture

Table 5. Results of bi-factor analysis of variance of physicochemical indicators and rheological fermented drinks from cow's and goat's milk

Feature	Factor	F	P	F test
Titratable acidity (°SH)	Storage time	1120.091	3.06E−16*	4.494
	Variant of yogurt	474.576	7.73E−16*	3.239
	Interactions	177.242	1.75E−12*	3.239
pH	Storage time	336.160	3.64E−12*	4.494
	Variant of yogurt	255.665	1.01E−13*	3.239
	Interactions	153.288	5.37E−12*	3.239
Acetate aldehyde ($mg \cdot dm^{-3}$)	Storage time	35.844	3.28 E−04*	5.318
	Variant of yogurt	68.576	4.76E−06*	4.066
	Interactions	28.643	1.25E−04*	4.066
Hardness (N)	Storage time	11.597	0.004*	4.494
	Variant of yogurt	138.106	1.2E−11*	3.239
	Interactions	3.107	0.056	3.239

*statistically significant differences ($p < 0.05$)

The study fermented drinks from cow's and goat's milk were characterized by desired sensory properties for 10 days of storage (Table 4). Highest score (4.37÷4.50 p) was awarded to the yogurt produced from cow's milk using YE-L811 culture (J-L811), which during the entire storage time was characterized by smooth, slightly acidic taste and slightly aromatic smell of fermented milk. No whey (syneresis) was observed in this yogurt and its consistency was very thick and ductile. Considering the group of products obtained using goat's milk the highest score (4.21÷4.50 p) was awarded to the yogurt also obtained using the YE-L811 culture (KJ-L811). At the beginning of the storage period, KJ-L811 was characterized by slightly salty and acidic taste with slightly perceptible goat taste, which disappeared during storage. The smell was typical of a fermented drink, although indiscinct and poorly perceptible. No syneresis was determined for KJ-L811, and its consistency was thick. Slightly lower scores of taste, smell and consistency of drinks containing YC-X16 culture were linked to their semi-fluid consistency and, in the case of KJ-X16 yogurt, very perceptible goat taste. It cannot be denied, however, that in the course of the study all study drink samples deteriorated in quality, which is reflected by lower scores for the yogurts on the 10th day of storage (Table 4). Similarly, the deterioration the quality of yogurts from goat's milk was observed by Borek-Wojciechowska (2001). On the other hand, Pazakova *et al.* (1999), who compared the quality of drinks derived from goat's, cow's and sheep's milk during refrigeration storage observed too loose consistency and strong goat taste in yogurts from goat's milk, which determined their lowest score. In their study, Costa *et al.* (2016) did not find statistically significant differences in the assessment of cow's yogurt smell in comparison to goat's yogurts, yet the yogurts from goat's milk were awarded with lower mean score. The characteristic goat taste in yogurts obtained using goat's milk results in greater popularity of cow's milk (Silanikove *et al.* 2010). Likewise, Domagała and Wszołek (2008) observed strong goat taste and smell in yogurts, which may have stemmed from the fact, that the raw material used for the production of the drinks was supplied by the authors with goat's milk powder.

CONCLUSIONS

1. The conducted study demonstrated that the traditional yogurt cultures (YE-L811 and YC-X16) used in the experiment can be recommended for the production of fermented drinks from organic cow's and goat's milk.
2. Based on the collected results it was determined that the viability of the microflora (lactobacilli and streptococci) in the study yogurts from organic cow's and goat's milk depended on the type of used starter and the time of refrigeration storage, but not on the type of the used milk.
3. The number of *Str. thermophilus* cells directly after production of yogurts, remained in the range 8.9–9.0 log (cfu/g), with the exception for yogurts obtained from goat's milk with YC-X16 culture, where the initial number of streptococci was significantly lower – on average 8.0 log(cfu/g).
4. The initial population of *Lb. delbrueckii* subsp. *bulgaricus* was on average 8.6 – 8.5 log(cfu/g) and 6.2 – 6.3 log(cfu/g), respectively for samples obtained using YE-L811 and YC-X16 cultures, independently of the type of milk used.
5. The type of yogurt culture as well as time of refrigeration storage altered the physicochemical properties (titratable acidity, pH and hardness) and sensory properties of drinks from both organic cow's and goat's milk.
6. In the case of both types of yogurt obtained from organic cow's as well as goat's milk, the products produced with the use of YE-L811 starter culture, were assessed higher in terms of sensory characteristics.

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