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# FATTY ACID PROFILE AND QUALITATIVE EVALUATION OF THE FAT FRACTION IN WHITE BRINED CHEESE AT 24-HOURS OF PRODUCTION

**Tsvetelina DIMITROVA[1], Silviya IVANOVA[2], Miroslav HRISTOV[1], Nikolay MARKOV[1]**

[1]Agricultural Academy, Research Institute of Mountain Stockbreeding and Agriculture,
281 Vasil Levski Str., 5600, Troyan, Bulgaria
[2]Agricultural Academy, Institute of Cryobiology and Food Technology,
53 Cherni vrah Blvd, 1407, Sofia, Bulgaria

Corresponding author email: c.dimitrova@abv.bg

***Abstract***

*The fatty acid composition of 24-hour white brined cheese produced from goat's milk from three groups of animals- Bulgarian White Dairy (BWD) breed and its crosses with Anglo-Nubian (BWD x AN) and Togenburg (BWD x TG) breeds during the lactation and the fatty acid composition of the milk fat of the product has been evaluated as a healthy source for human nutrition. Goat white brined cheese at the 24th hour after production, from the three groups of animals is characterized by a high level of saturated fatty acids from 75.52 g/100 g fat at BWD to 76.09 g/100 g fat at BWD x TG breed. MUFAs predominate in purebred goat cheese- 24.98 g per100 g fat and MUFA in the crosses of BWD x AN breed- 3.32 g/100 g fat. The lipid preventive score is highest in BWD cheese - 53.85 g per 100 g cheese, and the atherogenic and thrombogenic index in BWD x TG breed cheese respectively 2.60 and 2.71. The analysed cheeses at the 24th hour from three goat groups is defined as having low content of TFA according to Regulation (EC) No1924/2006.*

***Key words****: conjugated linoleic acid (CLA), fatty acids, goat cheese, indices.*

## INTRODUCTION

Milk and milk products have formed an essential part of the human diet since the beginning of the domestication of farm animals because together with other foods of animal and vegetable origin, they contain the necessary nutrients for the human body in an appropriate ratio.

Cheese as a source of fat and fatty acids is an integral part of a healthy diet, and the low lactose content makes it suitable for people with lactose intolerance (Hasler, 2000). Although the fat content, especially saturated and trans fatty acids, is associated with the occurrence of cardiovascular diseases, cheese consumption has not been proven to have a harmful effect, and the content of conjugated linoleic acid and oleic acid in cheese have health benefits (Gómez-Cortés et al., 2013).

The products of the decomposition of milk fat-fatty acids change the organoleptic indicators of cheese, which participate as substrates for oxidation to methyl ketones or as independent aromatic components, and on the other hand, as substrates for oxidation to methyl ketones. Minimum quantities of butyric, caproic, caprylic and capric acid give the cheese a pronounced taste (Senoussi et al., 2022).

Renna et al. (2012) traces the change of fatty acid profile upon a sudden change from indoor (hay and concentrate) to pasture grass-feeding (green grass). This change is mainly expressed in the increase of certain unsaturated fatty acids. From the point of view of healthy nutrition, changes in the content of vaccenic (C18:1t11), rumenic (C18:2c9t11) and Ω-3 fatty acids show that the profile improves significantly in the first days after switching from pasture to grazing. Scientists were working on the issue of improving the quality of milk by applying pasture feeding to ruminants, which in turn contributes to the production of high-quality cheese (Cismileanu et al., 2020; Dauber et al., 2022). Several scientists found that goat's milk is characterized by a higher content of short and medium-chain fatty acids (C4:0-C14:0) compared to cow's milk (Barłowska et al., 2011; Tziboula-Clarke, 2003; Park et al., 2017). The physicochemical and biochemical composition of processed milk is a determinant of its technological processing into dairy products and delicacies, which is determined by the breed and nutrition of different types of ruminants

(Bauman & Grinari, 2003; Cabiddu et al., 2005; Mihailova & Odjakova, 2006; Gosteva et al., 2017, Markov & Ivanova, 2020). The highest CLA values were determined in ewe's milk. Ivanova et al. (2017) studies showed that the level of CLA in sheep dairy foods was affected by the amount of concentrate feed, the type of roughage and the growth stage at harvest.

Cheeses made from the milk of pasture-raised compared to conventional ruminants were rich in unsaturated fatty acids, antioxidants and aromatic ingredients and have a low cholesterol content (Burgos et al., 2021; Nudda et al., 2021; Beltrão et al., 2022; Kavas et al., 2022; Galina et al., 2023; Shedeed et al., 2023; Thanh et al., 2023).

Rahmann et al. (2014) determined a lower concentration by long-chain and PUFAs, CLA and ratio from Ω-6 to Ω-3 fatty acids at indoor rearing goats.

Markova & Slavov (2019) determined an atherogenic index in milk from Srednostaroplaninska sheep breed a higher value (2.71) compared to Koprivshtenska breed (2.22). This makes the milk of Koprivshtenska breed a better product for healthy eating. The milk from Koprivshtenska breed had closer values of the lipid preventative score and the total fat content. The results are indicative of a better balance of the fatty acids in the milk of Koprivshtenska breed.

The fatty acid composition of white brined cheese, 24 hours after production from goat's milk from three groups of animals - Bulgarian White Dairy (BBM) and its crosses with Anglo-Nubian (BBM x AN) and Togenburg (BBM x TG) breeds was studied for a lactation period and it was evaluated that the fatty acid composition of the milk fat of the product is a healthy source in human nutrition.

## MATERIALS AND METHODS

Nine samples of white brine cheese (3 x 3 pieces) were examined during the lactation period of the milk from three groups of animals - Bulgarian White Dairy (BWD) breed and its crosses with Anglo-Nubian (BWD x AN) and Togenburg (BWD x TG) breeds for fatty acid and evaluation of milk fat as a healthy source in human nutrition. The milk was taken in April, June and September and subjected to technological processing for cheese production. The white-bined goat's milk cheeses were examined at 24 hours after production.

The milk used is from experimental animals reared in one flock under the same production conditions in base at the Rimsa-Troyan which are 3 to 5 years old (second to fourth lactation with the indications being in February and the rearing system is indoor-pasture grass.

The extraction of total lipids was carried out by the Roese-Gottlieb method, using diethyl ether and petroleum ether and subsequent methylation with sodium methylate ($CH_3ONa$, Merck, Darmstadt) and drying with $NaHSO_4 \cdot H_2O$. Fatty acid methyl esters (FAME) were analysed using a Shimadzu-2010 gas chromatograph (Kioto, Japan) equipped with a flame ionization detector and an automatic injection system (AOC-2010i). The analysis was performed on a CP 7420 capillary column (100 m x 0.25 mm i.d., 0.2 μm film, Varian Inc., Palo Alto, CA). Hydrogen was used as the carrier gas, and as a make-up gas - nitrogen. Four-step furnace mode was programmed - the column's initial temperature was 80°C/min, maintained for 15 minutes, then increased by 12ºC/min to 170ºC and maintained for 20 minutes, followed by a further increase of 4ºC/min to 186ºC for 19 minutes and up to 220ºC with 4ºC/min until the process is complete.

The qualitative assessment of the fat fraction of the resulting samples includes the following: lipid preventive score (LPS), atherogenic (AI) and thrombogenic index (TI) (Ulbricht & Southgate, 1991), the ratio between hyper- and hypo-cholesterolemic (h/H) fatty acids, trans fatty acids (TFA) and the amount of saturated fatty acids (Regulation (EC) No 1924/2006).

LPS=FAT+2xSFA-MUFA-0.5PUFA,

AI=12:0+4×14:0+16:0/[ΣMUFAs+PUFA n-6+PUFAn-3]

TI=(14:0+16:0+18:0)/[0.5×ΣMUFAs+0.5×PUFAn-6+3×PUFAn-3+PUFAn-3/PUFA n-6]

h/H=(C18:1n-9+C18:1n-7+C18:2n-6+C18:3n-3+C18:3n-6+C20:3n-6+C20:4n-6+C20:5n-3+C22:4n-6+C22:5n-3+C22:6n-3)/(C14:0+C16:0).

The data was processed using the variation statistics methods using the statistical package of the EXCEL 2013 computer program.

## RESULTS AND DISCUSSIONS

Different starters can change the total protein, fat and ash content, and the fatty acid composition of the cheese, due to the different activity and specificity of the proteolytic and lipolytic enzymes (Taboada et al., 2015; Lešić et al., 2016).

Saturated fatty acids (SFA) in white brined cheese at 24 hours from production with the highest amount were C-16: 0, followed by C-18:0, C-10:0 and C-14:0 (Table 1).

The contents of C-12:0, C-14:0 and C-16:0 that were associated with an increase in cholesterol levels in humans vary respectively: for C-12:0 from 3.52 g/100g fat from BWD to 4.16 g/100 g fat at BWD x TG, for C-14:0 from 9.40 g/100 g fat at WBD x AN to 10.02 g/100 g fat at WBD and for C-16: 0 from 26.90 g/100 g fat at WBD x AN to 28.50 g/100 g fat at WBD x TG. Similar results were obtained by Medeiros et al. (2013) for the cheese after seven days of ripening from the milk of Saan and Alpine goats in Brazil, fed with rations enriched with vegetable oils from different oilseed plants. The same authors also found stearic acid in different cheeses (C-18:0) - from 15.13% to 11.63% near to ours - from 11.56 at WBD x TG to 11.97 g/100 g fat at WBD x AN. Mihailova et al. (2004) were found in their studies on milk from the Bulgarian White Dairy breed and its crosses, that the levels of medium chain (C12:0 to C16:0) and long chain fatty acids over the C18:0 fatty acids in the analyzed milk were 38.5-39.8% and significantly higher than the short chain ones (C4:0- C10:0) - 20.5 and 21.5% respectively.

Table 1. Saturated fatty acids, g/100 g fat (n = 9)

| Fatty acids | Breed group | | |
|---|---|---|---|
| | BWD | BWD x TG | BWD x AN |
| | x ± Sx | x ± Sx | x ± Sx |
| C-4:0 | 3.90±0.555 | 3.98±0.207 | 4.28±0.182 |
| C-6:0 | 3.30±0.296 | 3.30±0.138 | 3.59±0.069 |
| C-7:0 | 0.01±0.004 | 0.01±0.0 | 0.02±0.005 |
| C-8:0 | 3.17±0.202 | 3.15±0.182 | 3.39±0.106 |
| C-9:0 | 0.03±0.005 | 0.03±0.005 | 0.03±0.008 |
| C-10:0 | 10.62±0.368 | 10.70±0.677 | 11.11±0.644 |
| C-11:0 | 0.04±0.007 | 0.04±0.012 | 0.03±0.007 |
| C-12:0 | 3.52±0.311 | 4.16±0.677 | 3.70±0.387 |
| C-13:0 | 0.05±0.012 | 0.05±0.009 | 0.04±0.011 |
| C-14:0 | 10.02±0.581 | 9.66±0.652 | 9.40±0.737 |
| C-15:0 | 0.60±0.088 | 0.64±0.099 | 0.57±0.080 |
| C-16:0 | 28.15±1.913 | 28.50±1.497 | 26.90±2.030 |
| C-17:0 | 0.55±0.033 | 0.56±0.048 | 0.55±0.046 |
| C-18.0 | 11.90±1.463 | 11.56±1.781 | 11.97±1.712 |
| C-20:0 | 0.24±0.007 | 0.24±0.014 | 0.24±0.012 |
| C-21:0 | 0.05±0.010 | 0.06±0.010 | 0.05±0.011 |
| C-22:0 | 0.07±0.005 | 0.07±0.005 | 0.06±0.012 |
| C-23:0 | 0.02±0.005 | 0.02±0.014 | 0.03±0.005 |
| C-24:0 | 0.01±0.011 | 0.03±0.005 | 0.03±0.005 |
| C-26:0 | 0.01±0.004 | 0.06±0.031 | 0.02±0.008 |

White-brined cheeses are a good source of monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA). The largest amount was oleic acid (C-18:1c9), which ranges from 20.53 g/100 g fat at WBD x TG to 21.17 g/100 g fat at WBD (Table 2). These data were higher than those obtained by Markiewicz-Keszycka et al. (2013) - 18.65 g/100 g. Mihailova et al. (2004) determined the amount of trans isomers by oleic acid (C18:1) - 2.5%, and the concentration of conjugated linoleic acid (CLA) in goat milk from the Middle Balkan Mountain from 0.5 to 0.6 g/100 g fat.

In different types of cheese, polyunsaturated fatty acids range from 1.66 to 11.03% (Barac et al., 2016). In the batches of white brined cheese we studied, they were relatively close and varied within a narrow range - from 3.16 (WBD x TG) to 3.33 g/100 g fat (WBD x AN) (Table 3). The content of linoleic (C-18:2c9,12) acid was lowest-1.66 g/100 g fat by cheese from milk of WBD x TG and highest in cheese from milk of BWD - 1.79 g/100 g fat. The obtained results were lower than that found by Marinho et al. (2014) in "Kualo" cheese-2.05-2.53%.

Table 2. Monounsaturated fatty acids, g/100 g fat (n = 9)

| Fatty acids | Breed group | | |
|---|---|---|---|
| | BWD | BWD x TG | BWD x AN |
| | x ± Sx | x ± Sx | x ± Sx |
| C-10:1 | 0.18±0.025 | 0.18±0.033 | 0.19±0.025 |
| C-12:1n1 | 0.01±0.003 | 0.02±0.003 | 0.02±0.005 |
| C-14:1n5 | 0.05±0.010 | 0.06±0.012 | 0.05±0.014 |
| C-16:1n7 | 0.33±0.018 | 0.38±0.040 | 0.36±0.035 |
| C-17:1n7 | 0.19±0.018 | 0.17±0.015 | 0.19±0.022 |
| C-18:1t4 | 0.01±0.003 | 0.01±0.0 | 0.01±0.0 |
| C-18:1t5/6/7 | 0.16±0.014 | 0.17±0.026 | 0.16±0.026 |
| C-18:1t9 | 0.20±0.020 | 0.17±0.012 | 0.19±0.018 |
| C-18:1t10 | 0.17±0.009 | 0.17±0.010 | 0.18±0.022 |
| C-18:1t11 | 0.92±0.235 | 0.95±0.287 | 0.92±0.248 |
| C-18:1c9/C-18:1t12/13/ | 21.17±1.072 | 20.53±0.796 | 21.07±1.367 |
| C-18:1t15 | 0.12±0.020 | 0.11±0.021 | 0.11±0.033 |
| C-18:1c11 | 0.40±0.037 | 0.45±0.056 | 0.43±0.045 |
| C-18:1c12 | 0.10±0.007 | 0.10±0.010 | 0.10±0.011 |
| C-18:1c13 | 0.23±0.035 | 0.25±0.053 | 0.24±0.054 |
| C-18:1t16 | 0.02±0.005 | 0.03±0.005 | 0.03±0.007 |
| C-18:1c14 | 0.06±0.003 | 0.07±0.007 | 0.07±0.014 |
| C-18:1c15 | 0.07±0.003 | 0.10±0.010 | 0.07±0.014 |
| C-22:1n9 | 0.03±0.003 | 0.03±0.019 | 0.03±0.005 |

Table 3. Polyunsaturated fatty acids, g/100 g fat (n = 9)

| Fatty acids | Breed group | | |
|---|---|---|---|
| | BWD | BWD x TG | BWD x AN |
| | x ± Sx | x ± Sx | x ± Sx |
| C-18:2t9,12 | 0.19±0.017 | 0.17±0.014 | 0.18±0.009 |
| C-18:2c9,12/19:0 | 1.79±0.014 | 1.66±0.125 | 1.72±0.083 |
| gC-18:3n6 | 0.07±0.007 | 0.06±0.003 | 0.06±0.003 |
| aC-18:3n3 | 0.48±0.152 | 0.51±0.129 | 0.54±0.131 |
| CLA9c,11t | 0.43±0.041 | 0.41±0.054 | 0.42±0.053 |
| CLA9c,11c | 0.02±0.011 | 0.02±0.005 | 0.04±0.010 |
| C-20:2n6 | 0.03±0.008 | 0.04±0.012 | 0.04±0.010 |
| C-20:4n6 | 0.03±0.005 | 0.03±0.007 | 0.04±0.012 |
| C-20:3n3 | 0.15±0.028 | 0.17±0.023 | 0.17±0.035 |
| C-22:5n3 | 0.06±0.039 | 0.07±0.024 | 0.09±0.015 |
| C-22:6n3 | 0.01±0.007 | 0.02±0.007 | 0.03±0.003 |

The amounts of gC-18:3n6 and gC-18:3n3 vary slightly between the cheeses produced - 0.06 g/100 g fat in WBD x TG and WBD x AN and 0.07 g/100 g fat in WBD breed and 0.48 g/100 g fat at WBD and 0.54 g/100 g fat at WBD x AN, which is consistent with the results of Medeiros et al. (2013) for gC-18:3n6 - 0.08%, but they had lower values for gC-18:3n3 compared to those authors who receive concentration from 0.24 to

0.25% in cheese from milk of goat's rearing with supplements from spurge and ricin oil.

The present aspects concerning the composition of lactic fat in ruminants relate mainly to the content of conjugated linoleic acid (CLA), which can reduce the risk of many diseases such as obesity, atherosclerosis, cancer and more (Lawson et al., 2001). The CLA isomer 9c, 11t is the predominant form whose content is about 75-90% of the total CLA content in ruminant fat (Bauman et al., 2001). The CLA-containing products have been found to contribute to the reduction of body fat by inhibiting lipogenesis and stimulating lipolysis (Raff et al., 2009). The conjugated linoleic acid (CLA9c, 11t) is the highest in WBD cheese - 0.43 g/100 g fat and the lowest in WBD x TG-0.41 g/100 g fat, with no statistically significant differences. Mihailova et al. (2004) obtained a concentration of conjugated linoleic acid (CLA) in goat milk from the Middle Balkan Mountain from 0.5 to 0.6 g/100 g fat. Vieiteza et al. (2016) studied various types of goat cheese (fresh, ripe and storage) produced in Uruguay and determined the content of vaccenic acid from 1.4 to 4.9%, cis- isomers of oleic acid from14.9 to 25.4% and CLA - 0.4 to 1.5%.

Arachidonic acid (C-20:4n6), which is the other representative, besides the linoleic of the omega-6 group, has very low amounts between the batches of analyses cheese (0.03-0.04 g/100 g fat).

In recent years, there has been a growing interest in branched-chain fatty acids, as some of them have been shown to have health-promoting effects, and some dairy products can serve as a biomarker to evaluate the function of the abdomen (Vazirigohar et al., 2018).

The main representative of the studied cheese from the three batches was C-17iso, with values from 0.30 g/100 g fat at WBD to 0.31 g/100 g fat at WBD x TG and WBD x AN and C-17aiso, with a difference of 0.01% between batches, followed by C-15aiso, which is highest in WBD x TG - 0.29 g/100 g fat and lowest in WBD breed - 0.24 g/100 g fat (Table 4).

Table 4. Branched fatty acids, g/100 g fat (n = 9)

| Fatty acids | Breed group | | |
|---|---|---|---|
| | BWD | BWD x TG | BWD x AN |
| | x ± Sx | x ± Sx | x ± Sx |
| C-13iso | 0.02±0.007 | 0.03±0.021 | 0.03±0.005 |
| C-13aiso | 0.01±0.012 | 0.01±0.012 | 0.02±0.024 |
| C-14iso | 0.05±0.022 | 0.06±0.031 | 0.05±0.024 |
| C-15iso | 0.21±0.036 | 0.21±0.102 | 0.21±0.021 |
| C-15aiso | 0.24±0.027 | 0.29±0.051 | 0.26±0.031 |
| C-16iso | 0.20±0.031 | 0.22±0.037 | 0.20±0.027 |
| C-17iso | 0.30±0.021 | 0.31±0.018 | 0.31±0.026 |
| C-17aiso | 0.30±0.021 | 0.32±0.031 | 0.31±0.028 |
| C-18iso | 0.04±0.0 | 0.03±0.003 | 0.03±0.0 |

The trans isomers in the investigated white brine cheeses ranged from 1.89 g/100 g fat at WBD to 1.94 g/100 g fat at WBD x TG, and the cis isomers from 21.05 at WBD x TG to 21.64 g/100 g fat at WBD breed (Table 5), while total content of CLA is in the range from 0.43 to 0.45 g/100 g fat.

Ivanova et al. (2018) found out for whole fat goat curd, CLA contains from 0.23 to 0.84 g/1000 g fat, omega-3 fatty acids from 0.26 to 1.12 g/100 g fat and from omega-6 fatty acids from 1.36 to 2.40 g/100 g fat.

Saturated fatty acids (SFA) and polyunsaturated (PUFA) have the lowest concentrations in WBD cheese - 75.52 g/100 g fat and 3.30 g/100 g fat, while monounsaturated (MUFA) were highest at WBD cheese - 24.98 g/100 g fat.

In recent years, there has been increasing interest in the role of Ω-6 and Ω-3 fatty acids in healthy nutrition. The appropriate ratio of Ω-6 and Ω-3 fatty acids for the prevention of cardiovascular disease is equal to or less than 4:1. In milk fat, this ratio is about 5:1 (much lower than in other foods), indicating that dairy products represent a good food for humans (Simopoulos, 2008).

Table 5. Fatty acid groups, g/100 g fat (n = 9)

| Fatty acids | BWD | BWD x TG | BWD x AN |
|---|---|---|---|
| | x ± Sx | x ± Sx | x ± Sx |
| Σ CLA | 0.45±0.042 | 0.43±0.057 | 0.45±0.052 |
| Σ C-18:1 TFA | 1.89±0.285 | 1.94±0.346 | 1.92±0.323 |
| Σ C-18:1 CFA | 21.64±1.079 | 21.05±0.825 | 21.54±1.402 |
| SFA | 75.52±0.725 | 76.59±0.989 | 76.01±1.879 |
| MUFA | 24.98±1.182 | 24.43±0.989 | 24.93±1.651 |
| PUFA | 3.30±0.156 | 3.22±0.297 | 3.32±0.210 |
| Σ omega -3 | 0.71±0.155 | 0.82±0.130 | 0.82±0.116 |
| Σ omega -6 | 2.25±0.050 | 2.08±0.108 | 2.14±0.105 |
| Σ omega- 6/ omega -3 | 3.93±1.212 | 2.70±0.353 | 2.75±0.441 |
| BFA | 1.38±0.168 | 1.48±0.205 | 1.42±0.161 |
| CLA | 0.43±0.041 | 0.41±0.054 | 0.42±0.053 |

The Ω-3 fatty acids had the lowest concentration in cheese from WBD milk- 0.71 g/100 g fat and for Ω-6 by cheese from WBD x TG milk- 2.08 g/100 g fat. The ratio of Ω-6 and Ω-3 fatty acids ranges from 2.70 in cheese from WBD x TG to 3.93 in cheese from WBD, but remains below the recommended by The English Health Department (1994) is below 4.

Close to our results are obtained by Rahmann et al. (2014), in the production of goat cheese from the milk of goats reared under different feeding regimes, respectively saturated fatty acids - 75.1 and 75.8 g/100 g fatty acids, monounsaturated fatty acids - 20.0 and 19.7 g/100 g fatty acids, polyunsaturated fatty acids - 4.0 and 3.8 g/100 g fatty acids, Ω-3 fatty acids - 1.1 and 0.8 g/100 g fatty acids, Ω-6 fatty acids - 1.4 and 1.8 g/100 g fatty acids and CLA content - 1.0 and 0.8 g/100 g fatty acids.

The calculated lipid preventive score for the cheese at 24 hours after production (Table 6) is the lowest for the cheese produced from the milk of WBD x TG - 43.70 g/100 g cheese, and the highest for that from the WBD - 53.85 g/100 g cheese, with statistically significant results.

Table 6. Goat cheese indices

| Indices | Breed group | | |
|---|---|---|---|
| | BWD | BWD x TG | BWD x AN |
| | x ± Sx | x ± Sx | x ± Sx |
| LPS (g/100 g cheese) | 53.85±1.43 a**, b* | 43.70±1,18 | 46.46±0.60 |
| AI | 2.57±0.24 | 2.60±0.25 | 2.48±0.37 |
| TI | 2.56±0.24 | 2.71±0.12 | 2.62±0.24 |
| h/H | 0.63±0.06 | 0.61±0.05 | 0.67±0.08 |
| TFA (g/100 g cheese) | 0.45±0.05 | 0.38±0.07 | 0.40±0.06 |
| SFA+TFA (g/100 g cheese) | 18.57±0.45 a***, b* | 15.08±0.39 | 16.06±0.18 |

a - BWD/BWDxTG; b - BWD/BWDxAN; *P≤0.05, **P≤0.01, ***P≤0.001

The atherogenic index gives the correlation between the sum of the main saturated fatty acids and the unsaturated fatty acids, the former being considered proatherogenic (favoring the adhesion of lipids in the cells of the immune and circulatory system) and the second are anti-atherogenic (inhibit plaque aggregation and decrease levels of esterified fatty acids, cholesterol and phospholipids, thus preventing the occurrence of micro- and macro-coronary diseases).

The atherogenic index has the lowest values for cheese obtained from WBD x AN - 2.48 and the highest for WBD x TG - 2.60, which is in line with the one indicated by Cossignani et al. (2014) atherogenic index - 2.7÷2.4 in fresh and semihard cheeses from the Umbria trade network.

The thrombogenic index has the tendency to clot formation in blood vessels and is defined as the ratio between prothrombogenic (saturates) and antithrombogenic (monounsaturated and polyunsaturated Ω-3 and Ω-6 fatty acids) fatty acids (Ghaeni et al., 2013). The thrombogenic and atherogenic index, as indicators, should not exceed 1.00 while the cholesterol index is above 1.00 (Ivanova & Hadzhinikolova, 2015).

The thrombogenic index ranged from 2.56 in WBD cheese to 2.71 in WBD x TG, and the cholesterolemic index was low (below 1.0) in all three batches of cheese.

The values for trans fatty acids are in the range - 0.38 g/100 g cheese at WBD x TG to 0.45 g/100 g cheese at WBD, so the cheeses produced can be attributed to low TFA products according to Regulation 1924/2006.

Dimitrova et al. (2017) have obtained the following results for cheese produced during the lactation: lowest lipid preventive score in cheeses made from goat's milk WBD from 44.22 to 60.46 g/100 g product, lowest atherogenic and thrombogenic index in WBD x TG, respectively from 1.55 to 2.28 and from 2.03 to 2.56, and the highest ratio of hyper- and hypocholesterolemic fatty acids in cheese from milk of WBD x TG from 0.65 to 0.96, saturated fatty acids in cheeses ranges during the lactation to the following for WBD from 15.48 to 21.03 g/100 g cheese, at WBD x AH from 18.20 to 20.96 g/100 g cheese and in WBD x TG from 17.35 to 21.42 g/100 g cheese.

## CONCLUSIONS

Goat white brined cheese at the 24th hour after production from the three groups of animals is characterized by a high level of saturated fatty acids from 75.52 g/100 g fat at Bulgarian White Dairy Breed to 76.09 g/ 100 g fat at Bulgarian White Dairy crosses with the Togenburg breed. MUFAs predominate in purebred goat cheese - 24.98 g/100 g fat and MUFA in the crosses of BWD x AN breed- 3.32 g/100 g fat. The lipid preventive score is highest in BWD cheese- 53.85 g/100 g cheese, and the atherogenic and thrombogenic index in BWD x TG breed cheese respectively 2.60 and 2.71. The analysed cheeses at the 24th hour after milk production of the three goat groups are defined as low content of trans fatty acid food - from 0.38 g/100 g cheese from Bulgarian White Dairy x Togenburg breed to 0.45 g/100 g cheese from the milk of Bulgarian White Dairy breed according to Regulation (EC) No 1924/2006.

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