

## SEASONAL CHANGES IN THE LEVEL OF CONJUGATED LINOLEIC ACID (CLA) IN RIPENED CHEESES<sup>1</sup>

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**Abstract:** Ripened cheeses were subjected to estimation of the level of saturated and unsaturated fatty acids as well as CLA and cholesterol content during summer and winter period.

The level of CLA was positively related to the level of unsaturated fatty acids ( $r = 0,67$ ;  $b = 15,62$ ) and negatively related to the level of saturated fatty acids ( $r = -0,72$ ;  $b = -28,16$ ) as well as cholesterol ( $r = -0,81$ ;  $b = -57,12$ ). Statistically significant changes were found in the average CLA percentage in the examined cheeses in the winter ( $0,53 \pm 0,11\%$ ) as well as summer ( $1,31 \pm 0,18\%$ ) period.

**Keywords:** conjugated linoleic acid (CLA), ripened cheese, fatty acids composition

### *Introduction and literature review*

There is an increasing consumption of cheeses in Poland, especially ripened, made from cow's and ewe's milk. Their production is founded on the fat, which is the most criticized milk component. The fat composition of the ruminants' milk includes conjugated linoleic acid (9-cis; 11-trans) (CLA) which has a preventive effect on the civilization diseases such as: cancers, obesity, osteoporosis and heart diseases. The aim of the present study was to examine the CLA level in the ripened cheeses offered in the sale either in the winter or summer feeding period of ruminants.

Ma *et al.* (1999) evaluated CLA level in products of animal origin in Canada. They showed that the CLA level (mg/g of fat) in different cheeses was as follows: goat -  $2,7 \pm 0,2$ ; brie -  $3,8 \pm 0,5$ ; parmesan -  $4,2 \pm 0,5$ , mozzarella -  $4,6 \pm 0,2$ ; cheddar -  $4,2 \pm 0,6$ ; imperial cheddar -  $4,7 \pm 0,2$ ; farmer -  $4,7 \pm 0,7$ . These differences resulted from the CLA level in raw milk, which fluctuated in the range of  $1,8 \pm 0,2$  to  $5,0 \pm 0,3$  and were influenced by the fat content in milk. These authors found statistically significant changes in CLA content either in raw milk and cheeses made from it due to the feeding period. Jensen (2002) analyzed percentages of CLA in total fatty acids content in cheeses made in different countries. It amounted to (in %): French cheeses: 0,6 -1,3; USA: cheddar - 0,54, colby - 0,40, cream - 0,71, feta - 0,49, monterey - 0,47, mozzarella - 0,47, parmesan - 0,30; Canada: goat - 0,27, brie - 0,38, parmesan - 0,42, imperial - 0,47; Germany: gouda - 0,40, munster - 0,62, ementaler - 1,16, blue - 0,55, gorgonzola - 0,69. Regardless the kind of cheese and its origin, higher levels of CLA were stated in summer periods (Jensen (2002)). Similar relationships were found by O'Shea *et al.* (1998), who estimated the CLA level in Irish cheeses at: natural cheeses -0,6-7,1%, processed cheeses - 3,2-8,9%, cheddar cheese - 5,1-5,4%. Pisulewski *et al.* (1999), who examined the CLA level in products of animal origin reported that Polish cheese contain on average 5,3-15,8 mg of CLA per 1 g of fat.

The aim of the present study was to examine the CLA level in the ripened cheeses offered in sale either in the winter or summer feeding period of ruminants.

### *Materials and methods*

Investigations were carried out on the samples of ripened cheeses from market places during the summer and winter period (30 samples per each period). Cheese fat was extracted according to Anderson and Kjaergaard (1962). In extracted fat the total cholesterol and fatty acids contents were estimated according to Chaluard *et al.* (1991).

### *Results and discussion*

The obtained results are shown in tables 1-3. Statistically significant changes were found in the average CLA percentage in the examined cheeses in the winter ( $0,53 \pm 0,11\%$ ) as well as in the summer ( $1,31$

<sup>1</sup> Original scientific paper – originalni naučni rad

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$\pm 0,18\%$ ) period except parmesan and goat cheeses. The level of saturated fatty acids with relation to the kind of cheese fluctuated in the range of: 46,15 – 63,49% in the summer and of 56,57 – 73,72% - in the winter. The share of the mono- and polyunsaturated fatty acids in the milk fat amounted to 23,52 - 32,05% (winter); 26,87 – 33,16% (summer) and cholesterol to: 197,15 – 258,05 mg% (winter), and to 187,70 – 250,61 mg% (summer). The level of CLA was positively related to the level of unsaturated fatty acids ( $r = 0,69$ ;  $b = 15,68$ ) and negatively related to the level of saturated fatty acids ( $r = -0,72$ ;  $b = -28,16$ ) as well as cholesterol content ( $r = -0,81$ ;  $b = -57,12$ ). Emmental and Salami cheeses were characterized with the highest CLA level during the summer period (1,45% and 1,57%, respectively), whereas during the winter period this value reached the highest level for Emmental and goat's cheeses (0,95% and 0,60%, respectively). Similar data were obtained by *Kisza and Juśkiewicz (1998)* as well as *Rowney and Christian (1996)*, who showed statistically significant differences between profile of the particular groups of fatty acids in cheeses during the pasture and winter feeding periods of ruminants.

Table 1. Percentage level of different groups of fatty acids and cholesterol in cheeses during summer and winter period.

| Item (%)                          | Summer period | Winter period |
|-----------------------------------|---------------|---------------|
| Short- and medium-chain saturated | 46,15-63,49   | 56,57-73,72   |
| Long-chain monounsaturated        | 24,93-30,21   | 20,81-28,92   |
| Long-chain polyunsaturated        | 2,15-3,65     | 1,67-2,82     |
| CLA                               | 0,61-1,57     | 0,20-0,95     |
| Total cholesterol (mg%)           | 187,70-250,61 | 197,15-258,05 |

Table 2. Correlation between CLA and different groups of fatty acids and cholesterol level in experimental cheeses.

| Item (%)                         | CLA (%)                        |
|----------------------------------|--------------------------------|
| Short and medium chain saturated | $r = -0,728^*$<br>$b = -28,16$ |
| Long chain monounsaturated       | $r = 0,58^{**}$<br>$b = 11,43$ |
| Long chain polyunsaturated       | $r = 0,69^{**}$<br>$b = 15,68$ |
| Total cholesterol (mg%)          | $r = -0,81^*$<br>$b = -57,12$  |

\*  $p < 0,05$     \*\*  $p < 0,01$

Table 3. Percentage level of CLA in experimental cheeses in the summer and winter period

| Item              | Summer period        | Winter period        |
|-------------------|----------------------|----------------------|
| Emmental          | 1,457 $\pm$ 0,026 a  | 0,951 $\pm$ 0,015 a  |
| Włoszczowski      | 1,462 $\pm$ 0,018 A  | 0,255 $\pm$ 0,018 A  |
| Edamski           | 1,246 $\pm$ 0,021 A  | 0,204 $\pm$ 0,022 A  |
| Salami            | 1,571 $\pm$ 0,025 a  | 0,197 $\pm$ 0,12 a   |
| Port Salut        | 1,060 $\pm$ 0,032 A  | 0,243 $\pm$ 0,013 A  |
| Tylżycki          | 1,004 $\pm$ 0,025 A  | 0,289 $\pm$ 0,017 A  |
| Gryficki          | 1,406 $\pm$ 0,028 A  | 0,625 $\pm$ 0,011 A  |
| Zamojski (smoked) | 1,192 $\pm$ 0,028 A  | 0,351 $\pm$ 0,019 A  |
| Cheddar           | 0,747 $\pm$ 0,013 a  | 0,327 $\pm$ 0,017 a  |
| Parmesan          | 0,661 $\pm$ 0,015 NS | 0,511 $\pm$ 0,023 NS |
| Rokpol (mould)    | 0,610 $\pm$ 0,018 a  | 0,334 $\pm$ 0,019 a  |
| Camembert         | 0,784 $\pm$ 0,011 a  | 0,363 $\pm$ 0,018 a  |
| Mozarella         | 0,958 $\pm$ 0,022 a  | 0,464 $\pm$ 0,020 a  |
| Goat              | 0,891 $\pm$ 0,014 NS | 0,687 $\pm$ 0,015 NS |
| Feta              | 1,542 $\pm$ 0,022 A  | 0,241 $\pm$ 0,014 A  |

NS – not significant    A –  $p < 0,05$ ; a –  $p < 0,01$

### Conclusions

1. The feeding period has a substantial effect on the CLA level in the ripened cheeses and decides on the functional character of these products.
2. The highest level of the CLA was stated during the pasture period in every kind of examined cheeses.

## SEZONSKIE PROMENE U NIVOU KONJUGOVANE LINOLNE KISELINE (CLA) U ZRELIM SIREVIMAIN RIPENED CHEESES

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### Rezime

Potrošnja sireva u Poljskoj je u porastu, posebno zrelih sireva proizvedenih od kravljeg ili ovčijeg mleka. Proizvodnja ovakvih sireva se zasniva na masti koja predstavlja komponentu mleka koja je najviše kritikovana. Sastav masti mleka preživara uključuje i konjugovanu linolnu kiselinu (9-cis; 11-trans) (CLA) koja ima preventivno dejstvo kod svih modernih bolesti ljudske populacije kao što su: rak, srčana obolenja, osteoporoza i gojaznost.

Cilj ovog rada je bio ispitivanje nivoa CLA u zrelih sirevima koji se nalaze na ponudi u maloprodaji, u zimskom i letnjem periodu ishrane preživara. Ocena nivoa zasićenih, mono i poli nezasićenih masnih kiselina uključujući CLA (9-cis; 11-trans) i ukupnog holsterola je urađeno hromatografskom metodom. Statistički signifikantne promene su utvrđene u prosečnom učešću CLA u ispitivanim sirevima u zimskom periodu ( $0,53 \pm 0,11\%$ ) kao i letnjem ( $1,31 \pm 0,18\%$ ) periodu. Nivo zasićenih masnih kiselina u odnosu na vrstu sira je varirao između 46,15 – 63,49% u leto i 56,57 – 73,72% - u zimu. Procenat/udeo moni i poli nezasićenih masnih kiselina u mlečnoj masti je bio 23,52 - 32,05% (zima); 26,87 – 33,16% (leto) i holesterola do: 197,15 – 258,05 mg% (zima) i do 185,70 – 250, 61 mg% (leto). Nivo CLA je imao pozitivan uticaj na nivo nezasićenih masnih kiselina ( $r=0,67$ ;  $b=15,62$ ) i negativno na nivo zasićenih masnih kiselina ( $r=-0,72$ ;  $b=-28,16$ ) kao i sadržaj holesterola ( $r=-0,81$ ;  $b=-57,12$ ). Sirevi ementaler i salami su imali najveći nivo CLA tokom letnjeg perioda (1,45% i 1,57%, respektivno), dok je tokom zimskog perioda ova vrednost dostigla najviši nivo kod ementalera i kozijeg sira (0,92% i 0,64%, respektivno).

Sezona ishrane je imala značajan uticaj na nivo CLA u zrelih sirevima proizvedenim od mleka preživara i na funkcionalni karakter ovih proizvoda.

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