

## BIOACTIVE COMPONENTS OF MILK FROM DIFFERENT COW BREEDS<sup>1</sup>

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*Abstract:* It was found that milk obtained from Polish Red and Simental cows was characterized with the highest level of the certain casein fractions as well as bioactive whey proteins among all proteins. Higher level of the short-chain and medium-chain saturated fatty acids was characteristic for the milk fat from the lowland cow's breeds (70,25-73,28%) in relation to the milk obtained from Polish Red and Simental breeds (63,45-68,71%). The share of the long-chain mono- and polyunsaturated fatty acids was higher in the milk from Polish Red and Simental breeds (28,5-31%, 2,77-2,78%, respectively). Milk of these breeds was poorer in cholesterol (197,45-221,68 mg%) in relation to the milk of lowland cow's breeds (263,37-278,31 mg%).

*Keywords:* bioactive components, milk composition, cow's breed

### *Introduction and literature review*

Milk and dairy products are considered as functional food because they contain many bioactive components. The richest in bioactive compounds is the milk protein fraction, especially  $\kappa$ -casein,  $\alpha$ -laktalbumin,  $\beta$ -laktoglobulin and whey proteins. These proteins are characterised with the following functional properties: lactose catalysis, retinol, Zn, Cu, Mn, Co carrier, immunostimulating, antibacterial, antioxidative and opioid action (Vorland 1999, Creamer, MacGibbon 1996, Schlimme and Maisel 1995).

Bioactive milk compounds contain also fat fraction components i. e.: monoacylglycerols, saturated and unsaturated fatty acids, free fatty acids, cholesterol, A, D, E and K vitamins. Their biological activity concerns antibacterial, anticarcinogenic, antiatherosclerosis as well an antioxidative performance (Jahreis et al., 1999; Jainudeen and Hafez, 1993).

Grabowski i in. (1995) examined milk proteins composition and its effect on some technological characteristics of milk from Friesian cows of different varieties. It was revealed that an average total protein content amounted to not more than 3,13% and milk from cows of the New Zealand variety was characterised with the highest (3,13%) protein level, in opposite to its lowest level for milk from cows of American variety. The casein level fluctuated between 2,32 – 2,55%, in dependance on the variety of cows. Among all casein fractions the highest level was observed for  $\alpha$ -casein (1,348 – 1,448%), and the lowest for  $\kappa$ -casein (0,198 – 0,219%).  $\beta$ -laktoglobulin and  $\alpha$ -laktalbumin levels were estimated as (0,307 – 0,328%) and (0,101 – 0,107%), respectively.

Feleńczak (1997) during his investigations on the effect of improvement of Polish Red cattle with the Angler breed stated that milk of Polish Red and Angler crosses had significantly lower protein content. During the first to third lactations Polish Red gave milk richer in protein (3,36 – 3,40%) than the Polish Red and Angler crosses. Only during the fourth and fifth lactation Polish Red and Angler crosses (37,5 - 50% Angler) took advantage over Polish Red cows as regards protein content.

Sawicka (1986) emphasized the high protein content in milk from Polish Red cow's breed and considered possibility of taking this relation into account in selection. High casein content (2,53 – 2,60%) in milk of Polish Red and Angler crosses is also worth to stress. Investigations of Feleńczak (1982), who found in his previous research higher protein level in milk obtained from cow's crosses than in Polish Red cows, fully confirm this phenomena.

Pruthi and Bindal (1996) investigated total cholesterol level in the milk of Sahival cows and its crosses with Holstein-Friesian cattle. They proved that total cholesterol level increased in relation to Holstein-Friesian cattle crosses participation. Jurczak (1996) observed effect of different Holstein-Friesian bulls on the level of saturated and unsaturated fatty acids in milk of their crosses with Black and White cows. Participation of Holstein-Friesian bulls was statistically significant on fatty acids profile in milk.

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*Jaworski et al. (1997)* proved higher level of long-chain saturated fatty acids in the milk fat of Black and White cows than in milk of Polish Red cows. *Polidori et al. (1993)* showed statistically high differences between polyunsaturated fatty acids level in the milk of Holstein-Friesian and Swiss Brown cows. The changes in fat content could occur in the milk of different cow's strains of the same breed. *Bittman et al. (1995)*, proved that milk from Jerseys cows of Danish strains contains more total cholesterol and less polyunsaturated fatty acids in relation to the milk fat of Jerseys cows of US strain.

The aim of the study was to examine a genetic effect of Polish cow's breeds on the level of bioactive milk components.

#### Materials and methods

Investigations were carried out on 200 cows of Black and White, Red and White, Polish Red and Simmental breeds (50 pieces of each) being in second lactation. Milk was collected from 30 to 120 day of lactation. In milk samples following investigations were done:

- quantitative elevation of the protein fraction using densitometer – fluor S -Biorad, type D4, Germany,
- milk proteins composition by the SDS – PAGE method (*Farot 2001*).

The milk fat was extracted according to *Anderson and Kjaergaard (1962)*. In extracted fat the total cholesterol level and fatty acids content were estimated according to *Chaluard et al. (1991)* by chromatographic methods. Free fatty acids level was estimated according to *Dole's method* in modification of *Deeth (1976)*.

#### Results and discussion

Cow's breed is a genetic factor highly influencing content and composition of bioactive components of milk protein fraction. Statistically significant differences were found in the level of total protein, casein,  $\alpha$ -casein,  $\beta$ -lactoglobulin and  $\alpha$ -lactoalbumin in milk of Black and White, Polish Red and Simmental cows.  $\kappa$ -casein and  $\beta$ -casein level was also significant in milk of Black and White as well as Red and White cows (table 1).

Table 1. Bioactive components of protein fraction in milk of different cow's breeds.

Parameters	Cow's breed			
	Black and White	Red and White	Polish Red	Simmental
	1	2	3	4
Total protein [%]	2,95 ± 0,03 A	3,14 ± 0,04 b	3,52 ± 0,05 A, b	3,20 ± 0,04 A, b
Casein [%]	2,37 ± 0,02 a	2,41 ± 0,03 b	2,65 ± 0,04 a, b	2,55 ± 0,03 a, b
$\kappa$ -casein [%]	0,350 ± 0,02 A, a, b	0,280 ± 0,04 a	0,220 ± 0,03 A	0,250 ± 0,03 b
$\beta$ -casein [%]	0,662 ± 0,002 A, a, b	0,733 ± 0,004 a	0,801 ± 0,004 A	0,755 ± 0,003 b
$\alpha$ -casein [%]	1,36 ± 0,012 a, b	1,40 ± 0,010	1,63 ± 0,013 a	1,53 ± 0,011 b
$\beta$ -laktoglobulin [%]	0,342 ± 0,003 a, b	0,364 ± 0,002	0,418 ± 0,005 a	0,392 ± 0,004 b
$\alpha$ -laktoalbumin [%]	0,100 ± 0,002 a	0,107 ± 0,001	0,110 ± 0,003 a	0,108 ± 0,002

a, b -  $p < 0,05$   
A, B -  $p < 0,01$

High level of saturated short and middle-chain fatty acids (63,45% - 73,28%) in comparison to the low share of unsaturated fatty acids (2,45% - 2,78%) was found in milk of each cow's breed. Differences in percentages of certain fatty acids groups in milk from different cow's breeds were statistically significant. Simmental and Polish Red cows gave milk the richest in bioactive fat components (fatty acids) and

simultaneously the poorest in cholesterol. Milk of these cow's breeds seem to be also less susceptible to lipolysis (low level of free fatty acids) (table 2).

Table 2. Bioactive components of fat fraction in milk of different cows' breed.

Parameters	Cow's breed			
	Black and White 1	Red and White 2	Polish Red 3	Simental 4
Total fat (%)	3,38 ± 0,04 A	3,75 ± 0,06 b	4,35 ± 0,08 A, b	4,75 ± 0,05 A, b
Short- and medium-chain saturated fatty acids [%]	73,28 ± 2,97 A	70,25 ± 3,62 b	63,45 ± 2,86 A, b	68,71 ± 3,25 A, b
Long-chain monounsaturated fatty acids [%]	24,20 ± 1,06 A	27,02 ± 0,95 b	31,77 ± 0,99 A, b	28,52 ± 1,07 A, b
Long-chain polyunsaturated fatty acids [%]	2,45 ± 0,31 A	2,73 ± 0,28 b	2,78 ± 0,17 A, b	2,77 ± 0,15 A, b
Cholesterol [mg/100g of fat]	278,31 ± 28,16 A	263,37 ± 25,36 b	197,45 ± 32,16 A, b	221,68 ± 20,19 A, b
Free fatty acids [ $\mu$ Eq/cm <sup>3</sup> ]	1,66 ± 0,07 A	1,48 ± 0,10 b	0,87 ± 0,05 A, b	0,92 ± 0,07 A, b

A – p < 0,01,  
a – p < 0,05

Similar conclusions were drawn by *Grega et al. (2000)*, who stated a high share of bioactive fat as well protein components in milk of Polish Red and Simental cows in comparison to their low level in milk of lowland cows.

#### Conclusions

1. Milk of Simental and Polish Red cows is the richest in bioactive components of the protein and fat fraction.
2. The genetic potential of cattle can improve biological activity of milk.

## BIOAKTIVNE KOMPONENTE MLEKA KRAVA RAZLIČITIH RASA

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#### Rezime

Pošto mleko sadrži bioaktivne komponente ono se samo po sebi ili kao mlečni proizvod može smatrati funkcionalnom hranom. Proteini, posebno frakcija surutke i komponente mlečne masti (nezasićene masne kiseline, FFA, CLA, holesterol) se smatraju bioaktivnim komponentama mleka. Ova jedinjenja čine konzumaciju mleka preventivnom čak i terapijskom za određene bolesti 21. veka.

Cilj ovog istraživanja je bio ispitivanje rase krave kao genetskog faktora na nivo bioaktivnih komponenti mleka. Istraživanja su urađena na uzorcima mleka od krava 4 različite rase (crno-bela, crveno-bela, poljska crvena i simentalska rasa), u kojima su određivani nivo sirovog proteina, nivo kazeina i njegovih frakcija ( $\alpha$ ,  $\beta$ ,  $\kappa$ ),  $\alpha$ -laktoalbumin,  $\beta$ -laktoglobulin nivoi, sastav mlečne masti (nivo ukupne masti, ukupni sadržaj zasićenih masnih kiselina kratkog i srednjeg lanca, mono-nezasićene masne kiseline dugačkog lanca i poli-nezasićene masne kiseline, holesterol i slobodne masne kiseline). Utvrđeno je da mleko dobijeno od krava rase poljska crvena i simental ima najveći nivo određenih frakcija kazeina ako i bioaktivnih proteina surutke od svih proteina. Viši nivo zasićenih masnih kiselina kratkog i srednjeg lanca je bio karakterističan za

mast mleka dobijenog od krava nizijskih rasa (70,25-73,28%) u pređenju sa mlekom dobijenim od poljske crvene i simentalске krave (63,45-68,71%). Procenat mono-nezasićenih masnih kiselina dugačkog lanca i poli-nezasićenih masnih kiselina je bio veći kod mleka poljske crvene i simentalске rase krava (28,5-31%, 2,77-2,78%, respektivno). Mleko dobijeno od ovih rasa je sadržavalo manje holesterola (197,45-221,68 mg%) u poređenju sa mlekom nizijskih rasa krava (263,37-278,31 mg%). Nivo lipolize (slobodne masne kiseline) je bio niži u mleku dobijenom od krava poljske crvene i simentalске rase nego kod mleka od nizijskih rasa krava. Suprotan odnos je utvrđen u pogledu nivoa bioaktivnih komponenti bilo u prtoeinu ili frakcijama masti.

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