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FATTY ACID PROFILE IN MILK OF BUSHA, CIKA AND SIMMENTAL BREED

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ABSTRACT

In this research the fatty acid profile in Busha's, Cika's and Simmental's milk was investigated. For research purpose 42 milk samples were collected during July (Busha, n = 15; Cika, n = 17 and Simmental, n = 10). All cows were held in outdoor system. Busha's milk had significantly ($P < 0.05$) lower content of SFA, as well as significantly ($P < 0.05$) higher content of MUFA and PUFA in regard to Cika's and Simmental's milk. Lower SFA/MUFA, SFA/PUFA and n-6/n-3 PUFA ratios, but higher content of n-6 PUFA in Busha's milk in regard to Cika's and Simmental's milk was also determined. Statistically significant differences were not found ($P > 0.05$) in cows milk in regard to n-3 PUFA content. However, in Busha's milk higher content of DHA ($P < 0.05$) in comparison to Cika's and Simmental's milk was found. Cika's milk had statistically significantly higher content ($P < 0.05$) of CLA than Busha's milk. Significant differences in fatty acid profile between Busha's milk and milk of Cika and Simmental breed were determined, but for assessment of effects of system of keeping and keeping altitude, lactation stage and parity, as well as of other possible effects on milk fatty acid profile, further investigation is needed.

Key words: cattle / dairy cows / local breeds / milk / composition / fatty acids / Slovenia / Croatia

MAŠČOBNOKISLINSKA SESTAVA MLEKA KRAV PASEM BUŠA, CIKA IN LISASTA

IZVLEČEK

Namen naše raziskave je bil določiti maščobnokislinsko sestavo mleka pasem buša in cika in jo primerjati z maščobnokislinsko sestavo mleka krav lisaste pasme. Zato smo v mesecu juliju zbrali 15 vzorcev mleka krav pasme buša, 17 vzorcev mleka krav pasme cika in 10 vzorcev mleka krav lisaste pasme. Vse živali so bile v času jemanja vzorcev na paši. V primerjavi z mlekom krav cikaste in lisaste pasme je mleko krav pasme buša vsebovalo statistično značilno ($p < 0,05$) manjši delež nasičenih maščobnih kislin (NMK) in statistično značilno ($p < 0,05$) večja deleža enkrat nenasičenih maščobnih kislin (ENMK) in večkrat nenasičenih maščobnih kislin (VNMK). V mleku krav pasme buša smo določili ožje razmerje med NMK in ENMK, NMK in VNMK ter med n-6 in n-3VNMK v primerjavi z mlekom krav cikaste in lisaste pasme. Delež n-3 VNMK v mleku se med pasmami ni statistično značilno razlikoval ($p > 0,05$). Mleko krav pasme buša je vsebovalo statistično značilno večji delež dokozaheksaenojske kisline (DHA, $p < 0,05$) v primerjavi z mlekom krav cikaste in lisaste pasme. Mleko krav cikaste pasme je vsebovalo statistično značilno ($p < 0,05$) večji delež konjugirane linolne kisline (KLK) v primerjavi z mlekom krav pasme buša. Za natančnejše ovrednotenje deležev posameznih vplivov, ki poleg pasme krav vplivajo na maščobnokislinsko sestavo mleka, kot so način reje, nadmorska višina pašnikov, stadij laktacije in zaporedna laktacija, bodo potrebne nadaljnje raziskave.

Ključne besede: govedo / krave / molznice / lokalne pasme / mleko / sestava / maščobne kisline / Slovenija / Hrvaška

INTRODUCTION

The Busha and Cika cattle are of brachycerous origin and belong to the shorthorn group of cattle, and both breeds are the autochthonous one. The Cika is the only surviving autochthonous breed of cattle in Slovenia, while Busha is Croatian autochthonous breed. The numbers of animals of both breeds are declining as a result of the crossbreeding and the introduction of high input/high output farming and intensive management schemes. The data on chemical composition, particularly fatty acid profile of milk of Busha and Cika cattle are not jet available. Milk fat contains approximately 57wt% saturated fatty acids (SFA), 25wt% monounsaturated fatty acids (MUFA) and 6wt% polyunsaturated fatty acids (PUFA) (Miller *et al*., 2007). Many factors affect milk fatty acid (FA) composition, including breed and genetics (Bobe *et al*., 2008), cows nutrition (season) and management (Lock and Garnsworthy, 2003), as well as geographic region (Iggman *et al*., 2003). The proportions of groups of FA can be changed trough modified feed composition. Milk from cows fed fresh green forage or grazing in pastures, contains lower proportion of SFA and higher proportion of MUFA and PUFA, especially n-3 PUFA and conjugated linoleic acid CLA (Elgersma *et al*., 2006). Ruminant fats are the principal dietary source of CLA. The predominant isomer in milk fat is cis-9, trans-11 CLA (rumenic acid), which is thought to be biologically active isomer, which inhibits growth of tumors at as little as 0.1 wt% of dietary CLA concentration (Parodi *et al*., 1999).

The aim of the study was to determine FA composition of milk of both autochthonous breeds of brachycerous origin (Busha and Cika cattle) and to evaluate differences in FA composition due to breed of cows. As a reference, FA composition of milk from Simmental cows was used.

Current research is a preliminary study in which FA composition of Slovenian Cika and Croatian Busha was determined for the first time.

MATERIAL AND METHODS

For research purpose, 42 milk samples were collected during July from 15 Busha cows in Croatia and from 17 Cika as well as from 10 Simmental cows in Slovenia. All cows were held in outdoor system. Slovenian Cika and Simmental cows were pastured at mountain Velika planina (1 400–1 600 m), while Croatian Busha was pastured at Križevačka Poljana (100–200 m). Cika cows were milked twice a day, while Busha cows were not milked. At the field, from each cow 3 milk samples were taken in Eppendorf tubes and transported to laboratory for analysis of fatty acid profiles. Fatty acids methyl esters (FAME) from collected milk samples were prepared using the method of Park and Goins (1994). FAME were analysed using an Agilent 6890 series GC instrument equipped with an Agilent 7683 Automatic Liquid Sampler, a split injector and a FID detector. FAME was separated on a fused silica capillary column Omegawax TM 320 (30 m × 0.32 mm × 0.25 μm, Supelco). Agilent GC ChemStation was used for data acquisition and processing. Separated FAME-s were identified by retention time comparison and results were calculated using response factors derived from quantitative chromatographic standards of known composition (Nu Chek Prep). All analytical results were expressed in wt% (g FA / 100g of FAs). For statistical analysis the SAS/STAT package was used (SAS Institute Inc., 2000). Duncan's Multiple Range Test was used for testing the differences between groups.

RESULTS AND DISCUSSION

Fatty acid profiles according to cattle breed are shown in Table 1.

Table 1. Least square means and standard deviations of fatty acid profile (wt%) in milk according to cattle breed

Fatty acid	Breed		
	Busha (n = 15)	Cika (n = 17)	Simmental (n = 10)
C10:0	$1.433^{a} \pm 0.532$	$2.298^{b} \pm 0.567$	$2.492^{b} \pm 0.432$
C12:0	$1.830^{a} \pm 0.516$	$2.651^{b} \pm 0.593$	$2.798^{b} \pm 0.540$
C14:0	$7.882^{a} \pm 2.180$	$9.820^{b} \pm 1.379$	$9.830^{b} \pm 1.003$
C15:0	$2.324^{a} \pm 0.567$	$1.324^{b} \pm 0.151$	$1.028^{c} \pm 0.263$
C16:0	$28.336^{a} \pm 3.677$	$26.093^{a} \pm 1.921$	$26.103^{a} \pm 2.268$
C17:0	$1.397^{a} \pm 0.288$	$0.884^{b} \pm 0.111$	$0.828^{b} \pm 0.107$
C18:0	$11.035^{a} \pm 1.918$	$13.096^{b} \pm 2.411$	$12.693^{ab} \pm 2.007$
C20:0	$0.329^{a} \pm 0.109$	$0.275^{ab} \pm 0.052$	$0.237^{b} \pm 0.068$
C14:1 n-5	$0.509^{a} \pm 0.168$	$1.108^{b} \pm 0.332$	$0.958^{b} \pm 0.275$
C16:1 n-7	$2.073^{a} \pm 0.248$	$1.138^{b} \pm 0.215$	$1.261^{b} \pm 0.307$
C17:1 n-7	$0.761^{a} \pm 0.178$	$0.009^{b} \pm 0.003$	$0.007^{b} \pm 0.001$
Σ C18:1	$31.093^{a} \pm 3.571$	$26.277^{b} \pm 3.325$	$28.369^{b} \pm 1.966$
Σ C20:1	$0.260^{a} \pm 0.077$	$0.314^{a} \pm 0.071$	$0.260^{a} \pm 0.110$
C18:2 n-6	$2.344^{a} \pm 0.381$	$1.463^{b} \pm 0.193$	$1.478^{b} \pm 0.241$
CLA	$1.009^{a} \pm 0.357$	$1.613^{b} \pm 0.698$	$1.251^{ab} \pm 0.585$
C18:3 n-3	$1.126^{a} \pm 0.240$	$1.155^{a} \pm 0.175$	$1.172^{a} \pm 0.231$
C20:4 n-6	$0.318^{a} \pm 0.220$	$0.095^{b} \pm 0.019$	$0.090^{b} \pm 0.020$
C20:5 n-3	$0.127^{a} \pm 0.045$	$0.125^{a} \pm 0.025$	$0.103^{a} \pm 0.029$
C22:6 n-3	$0.043^{a} \pm 0.021$	$0.025^{b} \pm 0.006$	$0.021^{b} \pm 0.006$
SFA	$59.136^{a} \pm 3.998$	$64.394^{b} \pm 3.075$	$63.609^{b} \pm 1.911$
MUFA	$35.280^{a} \pm 3.628$	$30.350^{b} \pm 2.601$	$31.618^{b} \pm 1.886$
PUFA	$5.585^{a} \pm 1.070$	$5.246^{ab} \pm 0.634$	$4.765^{b} \pm 0.780$
n-3 PUFA	$1.645^{a} \pm 0.360$	$1.538^{a} \pm 0.170$	$1.487^{a} \pm 0.265$
n-6 PUFA	$2.929^{a} \pm 0.642$	$2.072^{b} \pm 0.212$	$2.029^{b} \pm 0.228$

Values within the same line marked with the different letter are significantly different ($P < 0.05$)

In milk samples taken from Busha cows, 4–5 wt% less of SFA ($P < 0.05$) were determined in comparison to Cika's and Simmental's milk. In Busha's milk, slightly higher, but not statistically significant, concentration of palmitic acid (C16:0, $P > 0.05$), and slightly lower concentration of stearic (C18:0, $P < 0.05$) as well as of myristic (C14:0, $P < 0.05$) acids in regard to milk of Cika and Simmental cows were also determined. The sum of isomers of oleic acid (ΣC18:1, OA) were fatty acids with the highest proportion in cows milk. Statistically significant higher concentration of OA ($P < 0.05$) was determined in Busha's milk in comparison to milk of other analyzed breeds. Also, Busha's milk contained statistically significant higher proportion of MUFA ($P < 0.05$) in regard to Cika's and Simmental's milk. Differences in PUFA content were determined between Busha's and Simmental's milk ($P < 0.05$). However, in milk samples of compared breeds, no significant difference ($P > 0.05$) in n-3 PUFA content was determined. Statistically significant difference ($P < 0.05$) in PUFA content is consequence of higher linoleic (C18:2n-6, LA, $P < 0.05$) as well as arachidonic (C20:4n-6, AA, $P < 0.05$) acid contents in Busha's milk in comparison to Cika's and Simmental's milk. In addition, in Busha's milk nearly twice higher proportion of docosahexaenoic acid (C22:6n-3, DHA, $P < 0.05$) was obtained. The highest content of CLA, for which anticarcinogenic effect is presumed, was determined in Cika's milk (1.613wt%). Significantly lower ($P < 0.05$) content of CLA was determined in Busha's milk (1.009wt%). In this study, slightly higher content of MUFA and SFA, as well as similar content of PUFA as in study of Jensen (2000) were determined.

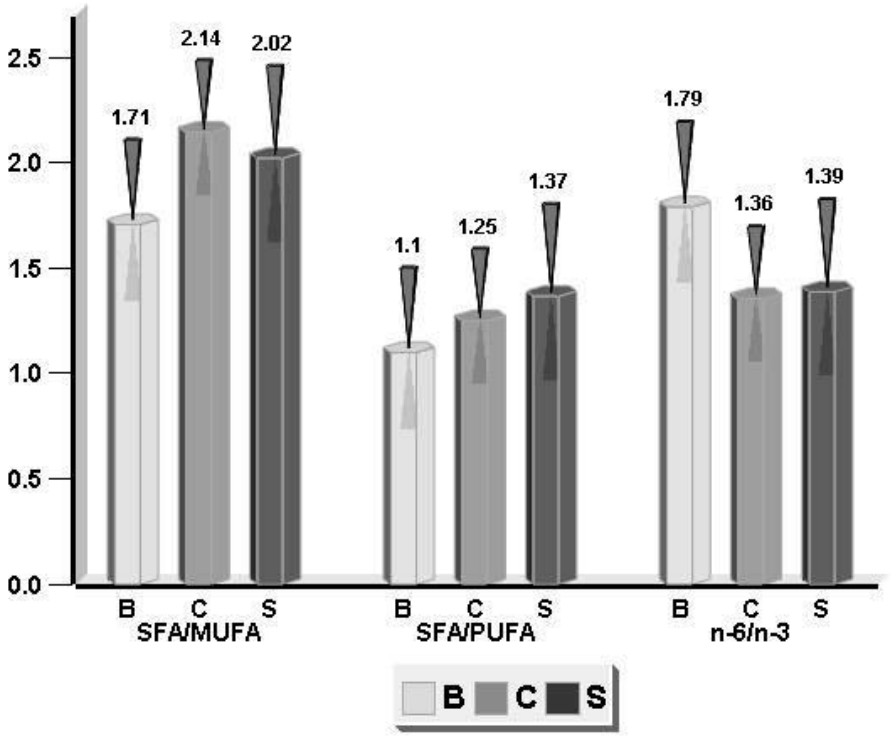

Figure 1. SFA/MUFA, SFA/PUFA ($*10^{-1}$) and n-6/n-3 PUFA ratios according to breeds: B – Busha; C – Cika; S – Simmental (means – histograms with values and standard errors as triangles).

SFA/MUFA, SFA/PUFA ($*10^{-1}$) and n-6/n-3 PUFA ratios according to breeds are shown in Fig. 1. Optimal and significantly lower ($P < 0.05$) ratios of SFA/MUFA and SFA/PUFA in Busha's milk in regard to milk of Cika and Simmental cows were determined. Conversely, significantly lower ($P < 0.05$) n-6/n-3 PUFA ratio was obtained in Cika's and Simmental's milk in comparison to milk samples taken from Busha. Based on current trends in human nutrition, n-6/n-3 PUFA ratio in balanced diet should be less than 4:1 (Simopoulos, 2001). In milk samples of all analysed cattle breeds' preferable n-6/n-3 PUFA ratio was determined. Nevertheless, SFA/MUFA/PUFA ratios in milk fat of investigated cattle breeds do not fit to nutritional trends, which suggest ratio of 1:1:1 as optimal (Simopoulos, 1998). However, analysed milk contains significant percentage of CLA (from 1.0wt% to 1.6wt%) which is biologically the most active CLA isomer and has anticarcinogenic effect even in small amounts (Parodi *et al*., 1999).

The Busha and Cika cattle are low-yielding autochthonous breeds bred in Croatia and Slovenia, with the same origin. Milk samples were collected during July in Croatia (Busha) and Slovenia (Cika and Simmental) from cows held in similar conditions (outdoor system). Taking into account that significant differences in fatty acid profile were found between Busha's and other breeds (Cika and Simmental) milk, it could be presumed that botanical composition of pasture, way of keeping and keeping altitude have more significant effect on fatty acid composition than cattle breed. Significant effect of botanical composition of pasture, way of keeping and geographical area was also reported by Lock and Garnsworthy (2003) as well as by Iggman *et al*. (2003).

Conducted research is a preliminary study in which FA composition of Slovenian Cika and Croatian Busha was determined. With purpose of evaluating effects of pasture composition, keeping altitude and way of keeping, lactation stage and parity as well as other possible effects further investigation is needed.

CONCLUSIONS

Based on results from fatty acid profile in Busha's, Cika's and Simmental's milk research, following could be concluded:

- Busha's milk contained significantly lower content of SFA, higher content of MUFA and PUFA, lower SFA/MUFA and SFA/PUFA, but higher content of n-6 PUFA and higher n-6/n-3 PUFA ratio in regard to Cika's and Simmental's milk.
- Statistically significant differences were not found in cow's milk in regard to n-3 PUFA content. However, in Busha's milk higher content of DHA in comparison to Cika's and Simmental's milk was found.
- Cika's milk contained statistically significantly higher content of CLA than Busha's milk.

Before making a final conclusion, further investigation that will evaluate effects of pasture composition, keeping altitude and way of keeping, lactation stage and parity as well as other possible effects is needed.

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