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FATTY-ACID COMPOSITION OF THE LIPIDS IN *M. LONGISIMUS DORSI* OF BOVINE AND BUFFALO CALVES AND BUFFALO COWS

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Abstract

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To study the fatty-acid profile of the lipids in meat, eight buffalo and eight bovine calves were assigned in two groups subjected to the same diet for a period of one year. At the end of the period, five animals of each group and five buffalo cows were slaughtered and test samples from *m. longisimus dorsi* taken. The results showed higher percentage of dry matter, crude fats, and crude protein in the buffalo meat (claves and cows) in comparison with the bovine calves. Compared to the bovine calves and the buffalo cows, the meat of the bubaline calves was found to have lower portion of the saturated fatty acids, with higher percentage of stearic acid and lower of palmitic and myristic. The buffalo calves have shown to produce meat with most favorable (n-6)/(n-3) ratio (7.00) compared to the bovine calves and the buffalo cows, the differences concerning the total fraction of polyunsaturated fatty acids among groups being negligible.

Key words: buffaloes, calves, fatty acids, omega PUFA

Introduction

Quality of foods in human diet is of utmost importance for solving the issue of health and vitality in view of the high incidence of an array of diseases in the recent decades in response to environmental pollution on global scale. In that context, advisory panel of the World Review of Nutrition and Dietetics (Simopoulos, 1998) urges producers to improve the lipid profile of foods of animal origin.

Therefore, the role of the fatty-acid composition of lipids has been brought to the fore with an emphasis on its dietary optimization. Until recently the relevant efforts were towards decreasing the percentage of saturated fatty acids in foods and increasing that of the unsaturated, in particular the polyunsaturated (French et al., 2000; Müller et al., 2003a,b;Peyraud et al., 2009). Nevertheless, subject of accelerating scientific interest and focus of many studies are the omega-6 and the omega-3 fatty acids (Jump et al., 1997; Kris-Etherton et al., 2002), proving their essential effect on cell function regulation. There is a recent high tendency of increase of n-6 and a decrease of n-3 in the food products because of the changing food industry, way of life and feeding (Simopoulos, 2002). The (n-6)/(n-3) ratio in the human diet at present is estimated to be as high as 10/1 or even up to 20/1 (Skjervold, 1992; Simopoulos, 2002; Hibbeln et al., 2006), which is associated with decline in health status (Devon, 1990; Pedersen, 1990; Skjervold, 1992).

That calls for bringing food production up to date with the new demands and optimizing the omega ratio in dietary lipids in due course (Skjervold, 1992). On one hand, though rumen hydrogenation skews the lipid profile of forage (Givens, 2005), this is possible through optimal feeding system, proved by an array of

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studies (Pflimlin and Todorov, 2003; Aldai et al., 2005; Ponnampalam et al., 2006) and stimulated by EU and FAO (Silvestri, 1997). On the other hand, the health and vitality issue can be solved by control over the criteria of importance characterizing meat wholesomeness, and selection of the healthiest product, in that way improving body lipid balance (Watts et al., 1988).

Buffalo meat is known to be a part of the human diet with favorable effect on vitality and incidence of diseases (Borhgese et al., 1978b, 1996; Infascelli et al., 2003; Giordano et al., 2010). This is demonstrated also by some comparative trials between buffaloes and cattle or other species (Sinclair et al., 1982; Borhgese et al., 1978a; de Mendoza et al., 2005). To date on national scale neither comparative nor independent studies have been conducted to characterize the lipid profile in meat obtained from buffaloes or cattle.

The objective of the present study was to establish the fatty-acid profile of the lipids in meat produced from bubaline and bovine calves under equal semi intensive fattening, as well as from buffalo cows.

Material and Methods

For the aim of the study animals from the farm of Mekom AD, Silistra, were assigned – bovine calves of the *Bulgarian Black and White* breed and buffalo calves and cows of the *Bulgarian Murrah* breed. Two groups were formed – one of 8 buffalo calves and the other of 8 bovine calves. In a period of one year, the two groups were subjected to the same diet which consisted of 4 kg of concentrate meal and 4 kg of wheat straw per capita per day. The component composition and the nutritional value of the meal are presented in Table 1. The buffalo cows were conventionally fed roughage (silage, hey, wheat straw) of the amount of ~35 kg/d and concentrate meal with the same composition as the calves.

Five heads of each group were slaughtered – the buffalo calves at 450 kg live weight, and the bovine calves at 500 kg; the buffalo cows' slaughter weight was 580–600 kg. From each carcass meat, test samples from *m. longisimus dorsi* were taken for laboratory analyses of the components as follows:

• Mineral matter – by an atomic absorption spectrophotometer *Perkin-Elmer*;
• Crude protein – by the Kjeldahl method;
• Fats – by a *Soxhlet* extractor;
• Dry matter – by oven drying at 105°C;
• Lipid composition – by gas chromatographers *Unicom* and *Carlo-Erba*.

Table 1
Composition of the concentrate meal

Components		%
Maize		60.0
Barley		22.0
Sunflower cake		16.2
Dicalcium phosphate		0.4
Common salt		1.0
Microelement premix for cattle		0.2
Vitamin premix for ruminants #27-86CM		0.2
Nutritional value of 1 kg		
Energy for growth, MJ	5.726	
Intestinally digestible protein, g	86.0	

All the analyses were carried out at the laboratory of Trakia University – Stara Zagora.

The data were processed by the software programme STATISTICA for Windows, 1994.

Results and Discussion

The nutritional analysis (Table 2) indicates that the buffalo meat is composed of higher percentage of dry matter – 27.44 % in the calves and 28.67 % in the cows – compared to the bovine calves (24.35 %). Meat protein is also slightly higher in bubaline calves (23.87 %) and cows (23.74 %) than in bovine calves (22.64 %), which is in keeping with other comparative studies (Joksimovic and Ognjanovic, 1977**;** Giordano et al., 2010). However, expressed as a percentage out of the dry matter it is lower (86.99 and 82.80 % respectively) than in the bovine meat (92.98 %). Our results are superior compared to the meat protein levels established for Murrah buffaloes in Argentina (Rebak et al., 2010) and close to the Kundi breed in Pakistan (Talpur et al., 2007).

Crude fats composition in meat is much higher in the buffaloes – 3.92 % in the cows and 2.51 % in the calves, which is by respectively 5.7 and 3.6 times higher than the bovine calves (0.69 %). In the same

Table 2
Nutritional value of meat

Traits	Bovine calves (n= 5)		Buffalo calves (n= 5)		Buffalo cows (n= 5)	
	x ± SE	C	x ± SE	C	x ± SE	C
Water, %	75.65 ± 0.207	0.613	73.56 ± 0.426	1.298	71.33 ± 0.240	0.753
Dry matter, %	24.35 ± 0.207	1.905	27.44 ± 0.435	3.553	28.67 ± 0.240	1.873
Crude protein, %	22.64 ± 0.180	1.784	23.87 ± 0.331	3.108	23.74 ± 0.603	5.687
Crude fats, %	0.69 ± 0.111	36.087	2.51 ± 0.248	22.111	3.92 ± 0.489	27.959
Solids, %	1.03 ± 0.014	3.107	1.06 ± 0.024	5.189	1.02 ± 0.007	1.568

time, the meat from the bovine calves is marked with highest phenotypic variation of C= 36.087, and respectively with highest standard error of SE= 0.111. In the majority of cases, the SE values for the components in the meat of the studied animals are relatively low.

As the data in Table 3 show, the saturated fatty acids (SFA) are 43.64 to 45.83 % of all fatty acids, lower than the result for Kundi and Murrah buffaloes (Talpur et al., 2007; Rebak et al., 2010) and higher than the *Mediterranean buffalo* (Infascelli et al., 2003) and cattle (Ponnampalam et al., 2006). There is a difference between the bovine and the bubaline calves in favour of the latter, which is insignificant unlike the reported by Giordano et al. (2010) prominent superiority of buffalo meat. The majority of SFA is palmitic (C16:0) and stearic acid (C18:0), which is principally established for red meats – cattle (Fink-Gremmels, 1993; MAFF, 1998) and buffalo (Sharma et al., 1986). The meat obtained from the buffalo calves constitutes of significantly lower percentage of C16:0 (25.75 %) and higher of C18:0 (14.80 %) compared to bovine calves (28.80 and 12.43 % respectively) (P< 0.05). As for myristic acid (C14:0), it is of significantly twice lower percentage in the young buffaloes (1.57 %) than in the bovine calves (3.01 %, P< 0.01) and the adult buffaloes (2.58 %, P< 0.05). All this implies that young buffalo meat would be a healthier element of the human diet – in keeping with the observations of Infascelli et al. (2003) – in view of the less atherogenic effect of stearic compared to palmitic and myristic acid (Ovesen et al., 1998), and their relative effect on cholesterol (Grundy, 1994; Judd et al., 2002; Givens, 2005).

The unsaturated fatty acids (UFA) constitute 54.17 to 56.36 % of the total fatty acids, with significantly greater percentage in the buffalo calves compared to the bovine calves (P< 0.01). In the buffalo cows, this value is approximate to that in the bovine than in the bubaline meat. The portion of the monounsaturated fatty acids (MUFA) (40.86-42.79 %) is approximate to the upper range reported by Sharma et al. (1986). Proven to obtain protection against age-related cognitive decline (Solfizzi et al., 1999), oleic acid (C18:1) shows to be the MUFA's major component, as observed earlier in buffaloes (Sharma et al., 1986; Talpur, 2007; Rebak et al., 2010) and cattle (Ponnampalam et al., 2006). It has significantly higher percentage in buffalo calves (40.18 %) than in cattle calves (38.40 %), which is a relative difference of 4.6 per cent The other MUFA, palmitoleic fatty acid (C16:1), ranges insignificantly from 2.46 to 2.78 % of all UFA. Being desirable in the human diet because of their favorable effect on cholesterol levels (Danke, 1994), these two fatty acids are considerably higher than the values established by Rebak et al. (2010).

The variation in the polyunsaturated fatty acids (PUFA) among species and categories is little – 13.30 to 13.65 % – despite the considerable differences concerning the degree of fatness (Table 2), in view of the established negative correlation between the two criteria (Aldai et al., 2007). There are no significant differences among species and categories, linoleic acid (C18:2) being in the range of 11.65 to 12.21 %, and linolenic – 1.44 to 1.75 %. Of all PUFA, the essential C18:2 is considered most nutritionally valuable for human health (Parodi, 1999; AbuGhazaleh et al., 2002). The values established herein are two- to nearly four-fold higher than in other studies on breeds of buffaloes (Talpur, 2007; Rebak et al., 2010) and cattle (Sami et al, 2004). Nevertheless, as an omega-6 fatty acid, the percentage of C18:2 is too high in the bovine calves and the buffalo cows, thus affecting the (n-6)/(n-3) ratio.

As for the omega PUFA's, from nutritional point of view, there is an increasing scientific interest in omega-3 fatty acids as a whole (Jump et al., 1997; Kris-Etherton et al., 2002), playing favorable effect on productive performance and carcass quality in ruminants as well (Mattos et al., 2000; Ponnampalam et al., 2002). In our study a ratio of 7.00 between n-6 and n-3 was observed in young buffalo meat (Table 3), conventionally assumed as an upper limit, much higher than that of the buffalo meat in other studies (Talpur, 2007; Rebak et al., 2010). The values in the bovine calves and the buffalo cows are above this limit, the differences among the groups being statistically insignificant. The (n-6)/(n-3) ratio is very close to the ratio between C18:2 and C18:3 (from 6.65 in buffalo calves to 8.48 in buffalo cows), the main omega-6 and omega-3 fatty acid, and follows the same trend.

The ratio between PUFA and SFA in the meat of ruminants is usually lower than the other livestock because of the biohydrogenation of PUFA's in the rumen (Talpur, 2007). Here in the bovine calves and the two categories of buffaloes they were established to be in close range – from 0.29 to 0.31 ($P > 0.05$) – which is below the value of 0.45 recommended by Wood and Enser (1997). However, Talpur (2007) have reported much lower ratio for Kundi buffaloes fed cottonseed and alfalfa pasture. Though insignificantly, the PUFA/SFA ratio in the bovine meat is lower than that of both the young and the adult buffaloes, which is commensurate with the lower fatness too (Table 2), as the ratio has been established to be in direct dependence on the level of total fats (De Smet et al., 2004).

As the percentage of the UFA fraction was found to be higher in the meat from the buffalo calves, the calculated SFA/UFA ratio in it is most favorable (0.77), as compared to the bovine calves (0.84, $P < 0.01$) and buffalo cows (0.82, $P < 0.05$). Our result for the buffalo calves is especially lower than the results in other studies on the species (Talpur et al., 2007; Rebak et al., 2010) while for the bovine calves it is higher than the ratio reported by Ponnampalam et al. (2002).

Conclusions

The present study established higher percentage of dry matter, crude fats, and crude protein in the buffalo meat (claves and cows) in comparison with the bovine calves.

Compared to the bovine calves and the buffalo cows, the meat of the bubaline calves was found to have lower

Table 3
Fatty-acid composition in meat

Fatty acids, %	Bovine calves (1)	Buffalo calves (2)	Buffalo cows (3)	Significance of differences
	x ± SE	x ± SE	x ± SE	
Myristic C14:0	3.01 ± 0.168	1.57 ± 0.316	2.58 ± 0.159	1-2**; 2-3*
Palmitic C16:0	28.80 ± 0.145	25.75 ± 1.119	27.81 ± 0.591	1-2*
Palmitoleic C16:1	2.46 ± 0.108	2.78 ± 0.359	2.53 ± 0.162	
Margaric C17:0	1.60 ± 0.046	1.52 ± 0.035	1.52 ± 0.054	
Stearic C18:0	12.43 ± 0.318	14.80 ± 1.225	13.11 ± 0.559	1-2*
Oleic C18:1	38.40 ± 0.426	40.18 ± 0.554	38.79 ± 0.299	1-2*
Linoleic C18:2	11.79 ± 0.243	11.65 ± 0.512	12.21 ± 0.313	
Linolenic C18:3	1.51 ± 0.075	1.75 ± 0.179	1.44 ± 0.097	
Saturated fatty acids (SFA)	45.83 ± 0.287	43.64 ± 0.595	45.03 ± 0.368	
Unsaturated fatty acids (UFA)	54.17 ± 0.287	56.36 ± 0.591	54.97 ± 0.368	1-2**
Monounsaturated fatty acids (MUFA)	40.86 ± 0.407	42.79 ± 0.640	41.33 ± 0.376	
Polyunsaturated fatty acids (PUFA)	13.30 ± 0.230	13.40 ± 0.379	13.65 ± 0.525	
SFA / UFA	0.84 ± 0.010	0.77 ± 0.018	0.82 ± 0.012	1-2**; 2-3*
PUFA / SFA	0.29 ± 0.006	0.31 ± 0.010	0.30 ± 0.020	
(n-6) / (n-3)	7.90 ± 0.519	7.00 ± 0.853	8.61 ± 0.580	

** – $P < 0.01$; * – $P < 0.05$; all other insignificant ($P > 0.05$)

portion of the saturated fatty acids, with higher percentage of stearic acid and lower of palmitic and myristic.

The buffalo calves have shown to produce meat with most favourable (n-6)/(n-3) ratio (7.00) compared to the bovine calves and the buffalo cows, the differences concerning the total fraction of polyunsaturated fatty acids among groups being negligible.

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