Fatty acid composition of Mediterranean buffalo milk fat

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ABSTRACT: The purpose of this research was to investigate the variation in fatty acid composition of milk fat from four buffalo (*Bubalus bubalis*) herds under different feeding management and ration composition. Changes in milk fatty acid composition were monitored on a weekly basis. Saturated fatty acids (65.5%) predominated in buffalo milk fat; monounsaturated and polyunsaturated fatty acids were 27.0% and 4.5%, respectively. Of saturated fatty acids, the content of palmitic acid was the highest (30.6%) followed by stearic acid (12.0%) and myristic acid (10.7%). Of the unsaturated fatty acids the content of oleic acid was the highest (26.6%). The average content of conjugated linoleic acid (0.76±0.33) was higher than the maximal values generally reported for dairy cow.

Key words: Bubalus bubalis, Fatty acid profile, Milk fat.

INTRODUCTION – Average milk production of Italian buffalos (*Bubalus bubalis*) is the highest in the world and the fat percentage averages 8.3%, but can reach 15% under favourable conditions. Milk fat has been criticised by dieticians since it contains substantial concentration of C14:0 and C16:0 and relatively low concentrations of monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids (Kennelly, 1996). However, there are several components in milk fat that could influence health positively. The effects of, for example, omega-3 fatty acids against heart disease are well documented, as is the anticarcinogenic effect of conjugated linoleic acid (CLA) and butyric acid (Molkentin, 2000). Studies on milk fatty acid composition of Italian buffalo are limited and discontinuous (Polidori *et al.*, 1997; Bergamo *et al.*, 2003). The purpose of this research was to investigate the range of variation throughout the year of the major fatty acids of buffalo milk fat from four herds under different feeding management and ration composition. This paper presents the results concerning the herd effect on milk fatty acid composition.

MATERIAL AND METHODS – The study was carried out at four (A, B, C, and D) commercial dairy buffalo herds in southern Italy, and lasted one year (May – April). Three herds adopted the total mixed ration (TMR) system: in herd A, a commercial product containing calcium salts of fatty acids (ether extract 84%DM; 46% C16:0, 38% C18:1, 11% C18:2, 7% other saturated fatty acids) was used all year round (on average 0.15±0.05 kg/d); in herd B the same commercial product was used all year round (on average, 0.19±0.03 kg/d) together with whole cottonseeds (on average, 1.53±0.21 kg/d; ether extract 22%DM; 46% C18:2, 28% C16:0, 20% C18:1); in herd C neither oilseeds nor protected fat were used. A traditional feeding system was adopted for herd D providing commercial concentrates in the milking parlour and forages (meadow or alfalfa hay, wheat straw) in the feed bunk. For each herd, bulk milk samples from a consecutive morning and evening milking were collected every week; milk yield and diets administered were also recorded. Additionally, monthly bulk milk samples were taken along with the collection of feed samples. Analysis of fatty acids was determined in each of the weekly milk samples and was carried out by mean of a transestherification reaction using capillary gas chromatography. The fresh milk samples collected every month were analysed for fat and protein (NFS - Milkoscan 605, Foss Electric, Sweden) and somatic cell count (SCC- Fossomatic 250, Foss Electric, Sweden). Fatty acid data were analysed by ANOVA by using the herds as source of variation. Orthogonal contrasts were used to examine differences between herds.

Table1. Milk traits and diet characteristic for the four herds.

		Herd							
		A		B		C		D	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lactating cows	(n)	110	10	106	17	287	48	57	17
Milk production	(kg/d/head)	8.1	0.5	9.0	1.3	7.8	1.4	8.5	0.9
FPCM1 production	(kg/d/head)	8.5	0.9	9.3	1.0	7.6	1.1	7.8	1.2
Fat	(%)	8.8	1.3	8.8	1.0	8.0	0.8	7.4	1.0
Protein	(%)	4.7	0.1	4.7	2.0	4.7	0.1	4.3	0.3
$SCC_{(log10)}$		5.2	0.5	5.4	0.6	5.3	0.2	5.4	0.5
Diet characteristics									
DM intake	(kg/d)	16.9	0.8	15.3	0.9	18.1	0.9	18.6	0.8
Crude Protein	(g/d)	2532	454	2767	614	2527	478	2389	545
NEL	(MJ)	101	2.9	101	4.0	115	9.6	103	10
Fat	(g/d)	454	38	614	59	478	79	546	86

[1]Fat (8.3%) and Protein (4.5%) Correct Milk (Bartocci *et al.*, 2002).

Table 2. Milk fatty acid composition for the four herds.

	Herd				SE	Effect (P)
	A	B	C	D		
C4	3.48	3.30	3.44	3.36	0.073	0.133
C6	1.93^{a}	1.78^{ab}	1.92^{a}	1.65^{b}	0.061	0.0005
C8	0.97^{a}	0.88^{b}	1.10^{c}	0.88^{b}	0.030	0.0001
C10	1.78^{ac}	1.66^{a}	2.35^{b}	1.84^{c}	0.047	0.0001
C12	2.48^{a}	2.26^{b}	2.90^{c}	2.34^{ab}	0.070	0.0001
C14:0	10.77^{a}	9.97^{b}	11.45^{c}	10.48^{a}	0.144	0.0001
C14:1t	1.15^{a}	0.93^{b}	1.10^{a}	1.23^{ac}	0.033	0.0001
C15	1.11^{a}	0.93^{b}	1.00^{c}	1.16^{a}	0.021	0.0001
C16:0	32.39^{a}	29.36^{b}	29.99^{b}	30.16^{b}	0.382	0.0001
C16:1c	1.88^{a}	1.43^{b}	1.63^{c}	1.80^{a}	0.053	0.0001
C18:0	10.34^{a}	14.00^{b}	11.49^{c}	12.16^{c}	0.287	0.0001
C18:1t	1.79^{a}	1.98^{ab}	2.00^{b}	2.09^{b}	0.073	0.0116
C18:1c	21.26^{a}	22.54^{b}	20.20^{c}	22.02^{a}	0.274	0.0001
CLA	0.80^{a}	1.06^{b}	0.64^{c}	0.51^{d}	0.038	0.0001
C18:2	2.34^{a}	2.90^{b}	2.91^{b}	1.97^{c}	0.083	0.0001
C18:3	1.38^{a}	1.15^{b}	1.17^{b}	0.96^{c}	0.040	0.0001
Short chain FA	8.17^{a}	7.63^{b}	8.82^{c}	7.76^{ab}	0.169	0.0001
Medium chain FA	51.05^{a}	45.99^{b}	49.26^{c}	48.48^{c}	0.532	0.0001
Long chain FA	38.13^{a}	43.81^{b}	38.62^{ac}	39.94^{c}	0.615	0.0001
Saturated	65.99^{a}	64.78^{b}	66.34^{a}	64.84^{b}	0.387	0.0039
MUFA	26.84^{a}	27.54^{a}	25.63^{b}	27.86^{b}	0.305	0.0001
PUFA	4.52^{a}	5.11a^{b}	4.71^{c}	3.45^{c}	0.119	0.0001
Atherogenicity index	2.46^{ab}	2.15^{c}	2.61^{a}	2.34^{b}	0.055	0.0001

^{a,b} $P<0.05$.

RESULTS AND CONCLUSIONS – A total of 203 milk samples were analysed. For the given chromatographic condition, 21 fatty acids were separated and quantified, but the influence of the herd was only studied for the major fatty acids (>1%), with the exception of CLA. The five most important fatty acids in quantitative terms were C16:0 (on average, 30.6±3.0), C18:1c (21.4±2.0), C18:0 (12.2±2.4), C14:0 (10.6±1.1) and C4 (3.4±0.5), which accounted for more 78% of total fatty acids. This order was substantially the same regardless of the herd. Individually, these percentages were comparable to those reported by other authors for buffalo milk fat. The composition of fatty acids in milk fat differed with respect to the herd, although most of the differences were rather small in absolute quantitative terms (Table 2). As regards the short-chain fatty acids (C4-C10), C4 content did not vary between herds, whereas the largest differences were observed for C10:0. A significantly higher content in short-chain fatty acids was observed in herd C. Protected fats with high C16:0 content was fed to buffalo cows of herds A and B all year round. The highest concentration of this fatty acid was found for herd A, whereas the value observed for herd B was no different from those observed in herds that did not use protected fats. These results seem to indicate an effect of the commercial product used to a less desirable fatty acid profile which was attenuated by the presence of cottonseeds in the rations of herd B. The highest percentage of C14:0 was observed for herd C. With respect to long-chain fatty acids (from C18-C24) and PUFA, the highest values were observed for herd B. The atherogenicity index, calculated according to Chillard *et al.* (2003), was significantly lower for herd B. As regard the CLA content the highest value was observed for herd B. In this herd CLA concentration rose from November to January when a ration including a larger quantity of cottonseed was used (data not presented). High CLA levels were also observed for milk produced by herd A. The CLA contents of herds C and D, although much lower compared to those of herds A and B, were higher than the values generally reported for dairy cow. Overall, significant differences were found in buffalo milk fat composition between the four herds. Although some effects of milk yield and stage of lactation can be assumed, these differences seem to be related to variations in animal nutrition. Whole cottonseeds positively influenced the fatty acid profile, while protected fats increased the level of C16:0 on herd A. Given the tendency towards widespread supplementation of buffalo cow diets with fats, our results can provide useful indications for selecting fat source with a desirable fatty acid profile from a human health perspective.

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