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Mare milk fatty acids with reference to donkey, cow, goat and human milk

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Acidi grassi nel latte di cavalla e confronto con latte di asina, bovino, caprino ed umano

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PAROLE CHIAVE
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Summary
Trials were carried out on 6 Noriker (N),12 Thoroughbred (TH), 38 Haflinger (H) and 9 Amiata donkeys milk samples collected at 30, 60 and 90 days from delivery. FA profile was investigated referring mainly to linoleic acid (LA), α-linolenic acid (ALA), LA/ALA ratio and saturated/unsaturated ratio. LA content was higher in Thoroughbred milk samples at 30, 60 and 90 days. LA/ALA ratio was 0.51, 0.49, 0.39 in Noriker samples at 30, 60, 90 days with a saturated/unsaturated ratio about 1. In Thoroughbred milk samples saturated/unsaturated ratio was 0.87, 0.71, 0.57 and in Haflinger samples 1.24, 1.09, 1.29 respectively at 30, 60, 90 days after delivery. Investigations concerned also milk FA content from Haflinger, Noriker ,Thoroughbred and Amiata milk samples collected at 60 lactation days compared with cow, goat and human milk collected at the same time. Unsaturated FA were found about 55% in mare samples, higher than cow and goat (33.49%-30.21%) and similar to human milk (54.62%). Lower levels (25.13%) were found in Amiata samples. All mare samples were rich in LA (6.22%-15.41% FA) and ALA (7.88%-12.50%). In human milk LA and ALA were 13.54% and 1.02%, respectively; LA and ALA content was high also in donkeys samples (8.17% and 6.69%) and lower in goat (2.62% and 0.63%) and in cow (1.86% and 0.57%). Saturated/unsaturated ratio range was between 0.70 and 1.09 in different horses breed samples, 3.04 in Amiata 2.30 ratio was observed in goat samples, 1.88 and 0.83 respectively in cow and in human milk samples.

Riassunto
Sono state condotte indagini sperimentali su campioni di latte appartenenti a 38 Haflinger (H), 6 Noriker (N) e 12 Purosangue inglese (PSI) e 9 asine di razza Amiatina raccolti a 30, 60 e 90 giorni dal parto. E' stato valutato il contenuto in acidi grassi con particolare riferimento ad acido linoleico (LA), acido α-linolenico (ALA) ed ai rapporti LA/ALA ed acidi grassi saturi/insaturi. Il contenuto di LA si è rivelato più alto nei campioni di soggetti PSI a 30, 60 e 90 giorni di lattazione. Il rapporto LA/ALA è risultato pari a 0,51 a 30 giorni di lattazione, e 0,49 e 0,39 rispettivamente a 60 e 90 giorni dal parto in soggetti di razza Noriker,

con un rapporto acidi grassi saturi/insaturi di circa 1. Nei soggetti di razza PSI il rapporto acidi grassi saturi/insaturi è risultato invece pari a 0,87 a 30 giorni, 0,71 a 60 giorni e 0,57 a 90 giorni di lattazione, mentre in soggetti Haflinger pari a 1,24 a 30 giorni, uguale a 1,09 a 60 giorni e pari a 1,29 a 90 giorni dal parto. Le indagini hanno inoltre considerato i contenuti di acidi grassi in campioni di latte provenienti da cavalle di razza Haflinger, Noriker, PSI ed asini di razza Amiatina raccolti a 60 giorni di lattazione confrontandoli con campioni di latte bovino, caprino e umano prelevati ai medesimi tempi dopo il parto. Gli acidi grassi insaturi sono risultati pari al 55% dell'intera composizione acidica nei campioni di latte equino, maggiori rispetto agli stessi riscontrati in campioni di latte di vacca e di capra (30,21-33,49%), simili a quelli presenti in campioni di latte umano (54,62%). Nei campioni di latte di asina il livello di acidi grassi insaturi è risultato inferiore (25.13%). Tutti i campioni di latte di cavalla esaminati sono risultati ricchi in LA (6,22%-15,41%) e ALA (7,88%-12,50%). Nei campioni di latte umano le percentuali degli stessi sono risultate pari rispettivamente a 13,54% e 1,02%. I contenuti in LA ed ALA sono risultati alti anche nei campioni di latte asinino (8.17% e 6.69%). Valori inferiori (2,62%-0,63%) sono stati riscontrati nei campioni di latte caprino e vaccino (1,86%-0,57%). Il rapporto acidi grassi saturi/insaturi ha presentato un range compreso tra 0,70 e 1,09 nei campioni di latte equino, 3,04 nel latte di asina, mentre è risultato pari a 2,30 in quelli di capra ed a 1,88 e 0,85 rispettivamente in quelli di vacca e di donna.

Introduction

Fatty acids (FA) play an important role in human nutrition moreover by regulating several biological and methabolic processes. Dietary fat is a very important factor influencing human health, particularly cardiovascular diseases (1-2). Health quality would really be improved not only by a general reduction in fat dietary intake, but with a accurate evaluation on saturated/unsaturated fatty acids ratio in favour of the latter (1). Equine milk's composition has been recently investigated moreover for protein composition (3). Some characteristic protein fractions suggested an utilization of this product, more similar to human milk than cow's, in diets to cow's milk allergic children (4-5), in the opposite to what happens with goat milk, where a certain cross-reactivity between cow and goat milk has been demonstrated (6). Mare and donkey's milk are also important for fat composition, particulary for fatty acid content, that in fact plays an important role in several biological processes; in medicine an increase of blood saturated/unsaturated fatty acid ratio is considered an important risk factor; PUFA are furthemore basic components of cellular membranes (2-7). Equine milk seems to contain remarkable amounts of alpha-linolenic (ALA) and linoleic (LA) acids, usually called essential fatty acids (EFA) and respec-

tively precursors of n-3 and n-6; they are much higher than in cow milk (6), although its contents of long-chain polyunsaturated FA seem to be limited. LA and ALA are precursors of eicosanoids, whose imbalanced synthesis has also implicated in various pathological conditions including cardiovascular diseases and are considered cardioprotective factors. LA and ALA are not synthesized in the human body or are synthetized at such as slow rate that they must be supplied by the diet. Infants may benefit from long chain polyunsaturated fatty acids unsupplemented formulae containing high ALA amounts, since recent studies (8) demonstrate that preterm infants are able to form arachidonic (AA) and docosahexaenoic acid (DHA). DHA can be synthetized by a complex series of chain elongation-desaturation reactions from ALA and plays an important function in infant nutrition, because of unusually concentrations found in their brain. Plasma DHA is available for developing brain and retina and is involved in dopamine and serotonine metabolism (9). A n-6 EFA deficit leads an inflammatory skin condition both in animals and in humans; in atopic dermatitis a low blood EFA concentration was pointed out. Mare's milk fat content is lower compared to human and moreover dairy cow's and FA composition showed smaller amounts of stearic and palmitoleic acids and higher quantities of oleic, linoleic and linolenic acids (10, 11). High FA unsaturated/saturated ratio, as found in equine milk, contributes to a lower fat melting temperature, higher iodine number and higher antimicrobial activity in comparison to cow milk (12).

Some our previous work (13) evaluated FA amounts in the first months of lactation in Thoroughbred and Haflinger mares, considering mainly the changes on milk fat content due to lactation period, as reported also by some other authors (14-16); only a few number of studies concerns the influence of lactation on fatty acids composition in equine milk (7, 13, 14). Since unsaturated fatty acids amounts in mare's milk seem to be higher than in cow milk, interesting was to study in detail an approach to evaluate differences between different equine breeds and compare fatty acids composition with cow's, goat's and human milk amounts.

Material and methods

Mare samples from 6 Noriker (N),12 Thoroughbred (TH), 38 Haflinger (H), 5 Trotter (T) pluriparious mares aged 4-10 years were correlated at 30, 60 and 90 days from delivery .Milk samples from 9 Amiata donkeys were also collected. Haflinger and Noriker were located in the same breeding and were fed with the same pasture (Tab. 3) Thoroughbred come from a different breeding center and were fed with hay and concentrate. Donkey received only hay with LA and ALA respectively 7.02 and 4.48 (% total FA). Trotter samples were compared only at 60 days. (Tab. 2). Every sample was obtained as a pool of two milkings before feeding time from every mare and donkey. All samples were frozen at -20°C. FA composition was performed according to Roese-Goettlieb extraction (FIL-IDF:1D-1996) by using capillary chromatographic investigation for methyl esters (FAME), with a HP 23 cis-trans polar column (30 m. length), according to FIL-IDF, 182-1999 method (CE Instruments GC 8000). Gas-chromatographic analysis was also carried out for animal feeds by using 100 m x 0.25 mm capillary column. Manova with repeated measures for LA and ALA was performed by JMP (SAS Inst., 1994) to evaluate significant differences.

Results and discussion

In the table 1 we observe that LA was higher in Thoroughbred milk

Table 1 - Linoleic acid (LA), α-linolenic acid (ALA), LA/ALA and saturated/unsaturated (SAT/UNSAT) ratio at different sampling time (30, 60, 90 days from birth) (% total FA) in Thoroughbred (TH), Haflinger (H), Noriker (N) and Amiata (A) milk samples.

	30 days				60 days				90 days			
	TH	H	N	A	TH	H	N	A	TH	H	N	A
LA	15.06a	9.89b	8.23c	8.26c	15.41a	10.64b	6.22c	8.17d	16.29a	8.81b	9.49c	9.32d
ALA	8.20 a	6.06b	15.82c	6.64d	9.11a	7.88b	12.50c	6.69d	10.58a	6.70b	24.14c	6.05d
LA/ALA	1.89	1.80	0.51	1.36	1.70	1.55	0.49	1.40	1.60	1.27	0.39	1.42
SAT/UNSAT	0.87	1.24	1.01	2.89	0.71	1.09	0.74	3.04	0.57	1.29	0.98	3.18
FAT %	1.80	2.12	2.84	2.20	1.05	1.92	2.06	1.84	1.06	1.79	2.10	1.72

a, b, c = P < 0.05

at 30, 60 and 90 days. In Noriker samples ALA was always higher versus Thoroughbred and Haflinger, underlining an interesting genetic characteristic. LA/ALA ratio was 0.51, 0.49, 0.39 in Noriker at 30, 60, 90 days with a sat/unsat ratio about less than as average 1. In Thoroughbred LA amounts were about 15-16% in all periods while ALA amount were respectively 8.20, 9.11, 10.58 % total FA; sat/unsat ratio was 0.87, 0.71, 0.57. In Haflinger samples the same was 1.24, 1.09, 1.29.

In the table 2 are reported LA and ALA composition of different administered feed.

In the table 3 are reported 60 days milk sanples composition from 4 different horse breeds compared with cow, goat and human's.

Unsaturated FA were found about 55% in mare samples, higher than cow and goat (33,4%-30,21%) and similar to human, but lower in donkey's samples (25.13%) Sat/Unsat ratio was lower than 1 in mare milk, 1.88 in cow and 2.30 in goat and about 3 in donkey. All mare samples were rich in LA (6.22%-15.41% FA) and ALA (7.88%-12.50%). Rich were found also donkey's samples. In human milk LA and ALA were 13.54% and 1.02%; LA values riched 13.0%, ALA 1.40 % from Literature (16). Lower values were found in goat (2.62% and 0.63%); data from Literature (17) reported 1.03% and 0.32% respectively. Lower values were also found in cow samples (1.86% LA and 0.57% ALA); 1.6% and 1.8% (16). Sat/Unsat ratio was between 0.70 and 1.09 in horses (0.81 as average), 3.04 in donkey, 2.30 in goat, 1.88 in cow and 0.83 in human milk.

Table 2 - LA and ALA (% total FA) composition of feed

	TH		H, N	
	LA	ALA	LA	ALA
Hay	7.96	3.98	-	-
Concentrate	21.61	1.60	-	-
Pasture	-	-	5.01	9.16

Conclusion

Linoleic acid was significantly higher in Thoroughbred's milk at 30, 60 and 90 days but very interesting amounts were also found in

Table 3 - Linoleic acid (LA), α-linolenic acid (ALA), LA/ALA and saturated/unsaturated (SAT/UNSAT) ratio at 60 days from birth in Thoroughbred (T), Trotter (T), Haflinger (H), Noriker (N) and Amiata (A) samples and cow, goat, human (> 30 days from delivery) compared with cow, goat, human from Literature, (1)17 - (2)18

	TH	T	H	N	A	Cow	Goat	Human	Cow (1)	Goat (2)	Human (1)
LA	15.41	17.95	10.64	6.22	8.17	1.86	2.62	13.54	1.60	1.03	13.00
ALA	9.11	8.39	7.88	12.50	6.69	0.57	0.63	1.02	1.80	0.32	1.40
LA/ALA	1.70	2.14	1.55	0.49	1.40	3.61	4.15	13.23	0.89	3.22	9.29
SAT	41.86	41.30	51.14	42.13	75.07	60.39	69.47	45.24	-	-	-
UNSAT	58.14	58.70	48.86	57.87	25.13	33.49	30.21	54.62	-	-	-
SAT/UNSAT	0.70	0.71	1.09	0.74	3.04	1.88	2.30	0.83	-	-	-

Haflinger and Noriker mares and in Amiata donkey's samples. Linolenic acid (ALA) was significantly higher in Noriker mares not only versus Thoroughbred but also versus Haflinger's living in the same breeding and nutrition conditions, and so we suggest an interesting genetic characteristics of those horse breed. This last conditions makes LA/LA ratio about 0.51, 0.49 and 0.39 in Noriker milk samples at 30, 60 and 90 days of lactation with a saturated /unsaturated fatty acids ratio less than 1; in the other two breeds we observe a LA/ALA and saturated /unsaturated very interesting for human nurition. Mare LA and ALA amounts were generally higher both in mare's and donkey's milk then in goat and cow's and total unsaturated FA levels were also higher in mare's milk. Donkey's milk samples were generally rich both in LA and in ALA but total saturated fatty acids were generally higher than in mare 's samples. And also sat/ unsat ratio was higher. Donkey milk fat high variability was also confirmed in precedent studies (19) and needs further investigations. In human milk LA level resulted similar as in mare's while ALA was lower. Unsaturated FA and sat/unsat FA ratio appeared similar in human and equine milk and lower than saturated FA. In goat and cow samples saturated FA were predominant.

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