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Effect of different oils administration on oleic and linoleic serum profile in horses during standardised exercise test on treadmill

Domenico Gatta, Lucia Casini, Livio Magni, Gian Battista Liponi

Dipartimento di Produzioni Animali, Università di Pisa, Italy

Corresponding author: Domenico Gatta. Dipartimento Produzione Animali, Università di Pisa. Viale Piagge 2, 56124 Pisa, Italy - Tel. +39 050 2216891 - Fax +39 050 2216901 - Email: dgatta@vet.unipi.it

ABSTRACT - Because of its energy density, fat is often added to the diet for exercising horses; however, little attention has been given to the effect of dietary fatty acid composition. The aims of this study were to compare the effect of two diets containing different oils on the fatty acids haematic profile during and after an aerobic exercise test on treadmill. Four adult trained gelding Standardbred (mean BW=481±27 kg) were used in a two replicated 2x2 Latin Square design. Mixed hay-concentrate diets contained corn oil (CORN) or a mix of mono-di and triglycerides of olive oil (MDTO) were administrated. The horses received the diets for a period of four weeks. At the end of the adaptation period an aerobic exercise test on treadmill (30-min long) was carried on. Blood samples were collected at rest, after 15' and 30' of exercise and during recovery period (at 10', 30' and 60'). Serum fatty acid concentration was determined. MDTO supplemented horses showed an higher percentage of Oleic acid during and after the exercise test; whereas Linoleic acid showed a significant difference ($P<0.05$) between groups with the highest value at 10' and 30' after exercise in the CORN supplemented group.

Key words: Horse, Fatty acids, Exercise, Nutrition.

Introduction - Addition of dietary fat to improve the caloric density of horse mixed feed is a common practice. Fat supplement reduces the negative effect of excessive starch fermentations in large intestine and provide a large amount of energy. The most common fats used in horse diets are corn oil and soybean oil, although animal fat has been used. Dietary fat sources modify blood triglycerides and fatty acid profile of blood, adipose and lean tissues in animals and humans. The fatty acids composition of subcutaneous and intramuscular fat of pigs reflects the fatty composition of the diet (Mitchaothai *et al.,* 2008). Viveros *et al*. (2009) found that the fatty acid pattern of abdominal fat in chickens reflected the dietary fat profile. Prolonged muscle work is responsible for a clear increase in free fatty acids (FFA). In fact, the adipic tissue provides the muscles with the majority of its energy. Few studies have reported the effect of the different oils supplementation in horses during exercise. The aim of this study was to compare the effect of two diets containing different oils on the plasma fatty acids profile during and after an aerobic exercise test on treadmill.

Material and methods - Four adult trained gelding Standardbred (mean BW=481±27 kg) were used in a two replicated 2x2 Latin Square design. Mixed hay-concentrate diets contained corn oil (CORN) or a mix of mono-di and triglycerides of olive oil (MDTO) (Baby oil olive, SILO srl) were administrated. Oils composition is shown in Table 1**.** Diets were formulated to be isocaloric and isoprotein (Table 2). All horses received a hay-concentrate balanced ration formulated according to NRC (1989) requirements for intense work. The horses were randomly assigned to two groups. Animals were exercised daily on treadmill. In

order to adapt to experimental diets, one group received CORN as supplement while the other group received the diet with MDTO for a period of four weeks. The horses were fed twice a day and housed in box stalls with water *ad libitum*. After the four weeks adaptation period all horses performed an exercise test on treadmill consisting of a 5-min warm up at 1.8 m/s followed by a 30-min step test on a 8% grade at incremental speed of 3.5 to 7 m/s. Heart rate was continuously monitored and horse performed the exercise at max 160 beat/min. Blood samples were collected at rest, after 15' and 30' of exercise and during recovery period (at 10', 30' and 60'). Then the groups were switched. Serum fatty acid concentration was determined by gas-chromatography as suggested by method C41-B (N.G.D. 1976). Data, subjected to a repeated measures ANOVA, were analysed using the JMP software package (SAS, 2002).

Table 1. Fatty acid composition of oils (as percent).

Fatty Acid	CORN	MDTO	Fatty Acid	CORN	MDTO
C14:0 (myristic)	0.04	0.08	C20:4 (arachidonic)	0.01	0.00
C16:0 (palmitic)	10.23	13.21	C20:5 (eicosapentanoic)	0.02	0.00
C16:1 (palmitoleic)	0.02	0.04	SFA	11.36	17.46
C18:0 (stearic)	1.09	4.17	MUFA	28.43	68.49
C18:1 (oleic)	28.41	68.45	PUFA	54.29	9.85
C18:2 (linoleic)	54.24	9.85	SFA/MUFA+PUFA	0.14	0.23
C18:3 (linolenic)	0.02	0.00			

Table 2. Diets composition (/100 kg BW).

Hay (kg as fed)	1.26
Concentrate (kg as fed)	0.84
Oils (kg as fed)	0.10
D.E. (MJ)	21.77
Crude protein (g)	207
Fat (g)	151

Results and conclusions - As reported in table 1, MDTO supplementation had a higher percentage of monounsatured fatty acids (Oleic acid) than CORN supplementation. On the contrary CORN show an high percentage of C18:2 acid (Linoleic acid ω-6). Results are showed in table 3 and in graphic 1 and 2. MDTO supplemented horses showed an higher percentage of Oleic acid during and after the exercise test (Table 3). The highest value is showed at 10' after exercise and reveal a significant difference ($P<0.05$) in comparison with the basal. Linoleic acid showed a significant difference ($P<0.05$) between groups with the highest value at 10' and 30' after exercise in the CORN supplemented group (Table 3).

Different authors reported how different oils in diet can influence the selective incorporation of fatty acids in phospholipid and triacylglycerols and, moreover, the fatty acids composition of subcutaneous and intramuscular fats in pigs and chickens (Mitchaothai *et al*., 2008; Viveros *et al*., 2009). Trained rats sup-

Table 3. Relative serum C18:1 and C18:2 (as percent) during and after exercise test (means±SE).

	At rest	15'	30'	10' recovery	30' recovery	60' recovery	P
C18:1							
MDTO	14.66±0.42	15.78±1.91	15.88±1.85	17.18*±1.18	16.59±0.72	16.42±0.61	0.37
CORN	14.12±0.25	14.22±0.28	14.22±0.54	14.43±0.43	14.95±0.84	15.13±0.28	
C18:2							
MDTO	31.17±0.40	29.88±0.51	30.42±0.70	30.90^{a}±0.61	30.88^{a}±0.68	30.65±0.68	0.04
CORN	30.90±0.38	30.27±0.78	31.19±0.69	31.96^{b}±0.54	31.89^{b}±0.23	30.81±0.30	

*$^{a, b}$: $P<0.05$; *mean significant difference vs the rest value: $P<0.05$.*

plemented with virgin olive oil showed higher monounsatured fatty acids (MUFA) proportion related with the groups with sunflower oil (Quiles *et al*., 2003). The influence of diet oils on plasma fatty acid profile was pointed up in horses too (Bergero *et al*., 2002; Gatta *et al*., 2005; O'Connor *et al*., 2007). The avalaible literature shows that, in addition to modifying the concentrations of animal and human tissues, exercise also changes their fatty acid profile. However, there is not reports as oil supplementation can effect the plasma fatty acid profile during acute exercise in horses. An increase in the relative amount of unsatured, especially MUFA, in plasma of animals and humans after acute exercise is reported by Nikolaidis and Mougios (2004). In rats chronic exercise (long term training) seems to increase the proportion of polyunsatured fatty acids while decreasing the proportion of MUFA in adipose tissue (Nikolaidis *et al*., 2004). But we know very little about whether and how exercise affects these processes. Our results seem to confirm the effect of exercise on haematic fatty acid profile in horses as showed in Graphic 1 and 2. In conclusion the different fatty acids mobilization during exercise could be influenced by the different source oils in diets. However further studies are warranted to delineate the physiological implications of the different fatty acids to asses an useful diet in sporting horses.

Figure 1. Unsatured fatty acids (as percent).

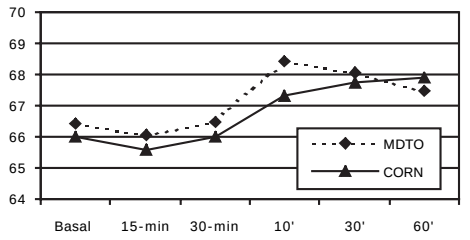
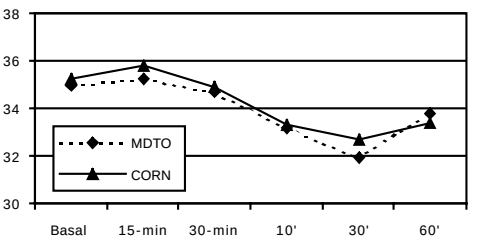


Figure 2. Satured fatty acids (as percent).



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