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Original Research

Lipid Utilization Pathways Induced by Early Training in Standardbred Trotters and Thoroughbreds

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ABSTRACT

Controversial results on lipid utilization as an energy source during training in horses are found in the literature. The objective of this study was to assess blood lipid profile during different training programs in horses. Seventeen Standardbred horses (400 ± 50 kg) and 17 Thoroughbred horses (380 ± 15 kg) followed different training programs. Blood lipid profile, including triglycerides (TGs), total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL), was analyzed, and very-low-density lipoprotein (VLDL) concentration was calculated. Data were analyzed using Student *t* test, and linear regressions were done. Cholesterol and LDL decreased during training programs in Standardbred trotters ($P = .0001$ and $P = .0053$, respectively), and VLDL was found to be close to the significance level ($P = .053$). Blood lipid profile, including TGs ($P = .0014$), cholesterol ($P = .0057$), HDL ($P = .0128$), LDL ($P = .0091$), and VLDL ($P = .0014$), varied throughout the training program in Thoroughbred horses. Negative slope of blood lipids and positive slope of TG linear regression in Standardbred trotters were significant for all parameters ($P \leq .05$), whereas cholesterol and LDL regression showed poor *P* and r^2 values and HDL *P* value was slightly above the significance level ($P = .069$) in Thoroughbred horses. TGs and VLDL showed a positive linear trend in Thoroughbred horses ($P = .002$). Exercise and different training programs lead to significant variations of lipid profile and lipid utilization in horses. Lipid utilization as an energy source improved with training in Standardbred trotters, whereas this was not the case in Thoroughbred horses. Further studies on the effect of training programs using different conditions and horse breeds would be necessary to understand lipid utilization as an energy source in athletic horses.

1. Introduction

Lipids are important energy substrates for metabolism in skeletal muscle. The contribution of oxidative metabolism in contracting muscular fibers depends on different factors such as exercise duration and intensity, as well as hormonal, dietary, nutritional, and training status [1]. Lipids are water-insoluble substances and are therefore bound to lipoproteins when transported into the blood or tissues. The effect of exercise training on blood lipids, triglycerides (TGs), free fatty acids, cholesterol, very-low-density lipoproteins (VLDLs), low-density lipoproteins (LDLs), and high-density lipoproteins (HDLs) is equivocal [2]. Several animal and human studies suggest that cholesterol and VLDL are not to be considered a major source of aerobic energy during exercise [1]. Therefore, one would not expect their plasma concentration to change with exercise. Nevertheless, changes do occur: neither

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dramatic nor unequivocal, but interesting changes can be observed. According to the literature, when isolating VLDL from total serum TG, some authors found a more significant muscle uptake of circulating VLDL during exercise in humans and rodents [3,4]. Moreover, it was shown that the turnover rate of VLDL is significantly higher during exercise than at rest [5]. In humans, several studies were carried out on exercise-induced decrease of TG because lipid metabolism is related to the occurrence of atherosclerotic plaques and cardiovascular diseases [6,7]. Genetic-based or acquired alterations of lipid and lipoprotein metabolism, such as hyperlipemia syndrome, have been described in horses [8], but neither the occurrence of these pathologies nor the improvement in the knowledge on effort physiology was able to increase the interest on lipid profile in sport horses. Over the past decade, our group has been working on the trend of different blood parameters in athletic horses to understand the effect of exercise, mainly focusing on traditional training [9-16]. Understanding the factors that can improve the aerobic lipidic power in horses is of utmost importance for effective training programs in athletic horses. For this purpose, we performed a longitudinal research to assess the effect of training and of different workloads on lipid profile in Standardbred trotters and Thoroughbred horses during a 3-month preracing season training period.

2. Materials and Methods

2.1. Animals

Seventeen Standardbred horses (10 males and 7 females) and 17 Thoroughbred horses (10 males and 7 females) were enrolled in the present study. The Standardbred horses were aged 3-4 years (mean body weight: 400 ± 50 kg) and Thoroughbred horses were aged 2 years (mean body weight: 380 ± 15 kg).

2.2. Training Programs

Standardbred horses were in a standard training program on a 1,000-m track (La Favorita racetrack, Palermo, Sicily, Italy). Thoroughbred horses were in a standard training program on a 1,200-m track (Mediterraneo racetrack, Siracusa, Sicily, Italy). Eighty-day training programs (Table 1) involved training for 6 days a week and 1 day of rest. Training and general animal care were performed by professional staff who were not associated with the research team.

2.3. Diets

All horses were stabled in individual boxes at natural indoor temperature (18°C-20°C) and subjected to the same feeding schedule. The horses were fed standard rations, calculated to fulfil all the main nutritional requirements according to INRA (Institut National de la Recherche Agronomique, France) specifications [17]. The diet of Standardbred horses included hay (first-cut meadow hay, sun-cured hay, late-cut hay; 5 kg/horse × day as fed), oats (approximately 3.5 kg/horse × day as fed), barley (approximately 1 kg/horse × day as fed), and a mixed-feed "oat balancer" (1 kg/horse × day as fed). The ration was divided into two meals per day, one fed at 8 AM and the other at 5 PM. The diet of Thoroughbred horses included hay (first-cut meadow hay, sun-cured hay, late-cut hay; 5 kg/horse × day as fed), oats (4 kg/horse × day as fed), and a mixed-feed "oat balancer" (1 kg/horse × day as fed). The daily ration was divided into three meals per day, which were fed at 8 AM, 12 AM, and 5 PM. Diet composition is presented in Table 2. Water was available ad libitum.

Table 1
Weekly training program protocol for all horses

Gait	Duration (Minutes)	Speed (m/Minutes)
Standardbreds		
First and fourth day		
Walk	10	100
Slow trot	25	350
Walk	10	100
Second and fifth day		
Walk	15	100
Slow trot	25	350
Walk	10	100
Third day		
Walk	15	100
Trot	6	670
Walk	15	100
Sixth day		
Walk	15	100
Trot	Simulation race 1,600 m	
Walk	15	100
Thoroughbreds		
First and fourth day		
Walk	10	100
Trot	20	200
Canter	6	350
Walk	10	100
Second and fifth day		
Walk	15	100
Trot	20	200
Gallop	3	800
Walk	10	100
Third and sixth day		
Walk	15	100
Trot	8	300
Walk	15	100

Table 2
Chemical composition of diet

Content	Thoroughbreds	Standardbreds
	%	
Dry matter (DM)	86	87
Moisture (%)	14	13
	% of DM	
Horse digestible protein (MADC)[a]	7.4	9.1
Crude protein	11.4	12.1
Crude fiber	23.5	20.7
NDF[b]	33.8	32.5
ADF[c]	28.5	26.2
ADL[d]	8.1	7.8
Ether extract	2.5	3.4
	UFC[e]/kg DM	
Net energy	0.77	0.8

[a]Matières azotées digestibles chez le cheval.
[b]Neutral-detergent fiber.
[c]Acid-detergent fiber.
[d]Acid-detergent lignin.
[e]Unité fourragere cheval (horse feed unit).