



Review Article

The Effect of Exercise on Plasma Leptin Concentrations in Horses



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ABSTRACT

Leptin is an adipokine released by adipose tissue. It regulates food intake, energy expenditure, breeding efficiency and the mood of horses. Exercise can influence leptin secretion via changes in the endocrine profile and energy balance. Several studies which describe exercise induced changes in plasma leptin concentrations in horses gave contradictory results. This paper presents a detailed analysis of the effect of exercise and training on plasma leptin concentrations in horses that underwent various types of physical effort. The effect of exercise depends on its intensity and duration as well as on the horse's sex and performance. Relatively intensive exercise lasting at least 45 minutes increases plasma leptin concentrations in young or irregularly trained horses but not in well trained, performing horses. In well trained horses, plasma leptin concentration does not change during a year, regardless of type of daily exercise. Training decreases the level of this adipokine in young, intensively trained horses and/or neutralizes a tendency for the circulating leptin level to increase in adult horses during a pasture season. Therefore, the level of this adipokine should be monitored, especially in young and intensively trained race horses.

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1. Introduction

In horses, as in other mammals, leptin is an adipose tissue-derived protein, classified as adipokine. The blood plasma leptin concentration reflects the body fat stores [1,2]. The concentration of this adipokine in plasma was higher in horses with a higher body condition score (BCS) than in slim, fit horses [3–5]. The circulating leptin level informs the central nervous system about the energy status of the organism and regulates appetite and energy processes (Fig. 1). Specifically, leptin inhibits appetite and food intake, and enhances the energy expenditure by increasing both the lipolysis rate in adipocytes and fatty acids oxidation in the liver [6] (Table 1). Even though the body fat mass does not change, some fluctuations in plasma leptin

concentrations occurred simply in response to short-time changes in the energy balance [7]. Thus, a decrease in the leptin level induced by feed restriction increased hunger and food intake. Moreover, a low plasma leptin concentration was associated with behavioural and metabolic disorders in horses, such as crib-biting and mortality of new born foals [8,9]. On the other hand, an elevated level of this adipokine was found in horses suffering from insulin resistance [10–12]. Leptin is also involved in the regulation of reproductive processes in mares. Lowering BCS and plasma leptin concentrations via nutrient restriction resulted in a decrease in the number of ovarian follicles and profound seasonal anovulatory period in mares [1]. An increase in body weight and/or the plasma leptin concentration increased the estradiol level [13] and induced ovarian activity [14,15]. Namely, leptin regulates reproductive function mainly by an action mediated by neuropeptide Y (NPY). Generally, NPY inhibits gonadotropin hormone (GnRH) secretion from hypothalamus. Leptin suppresses NPY release, which action increases GnRH

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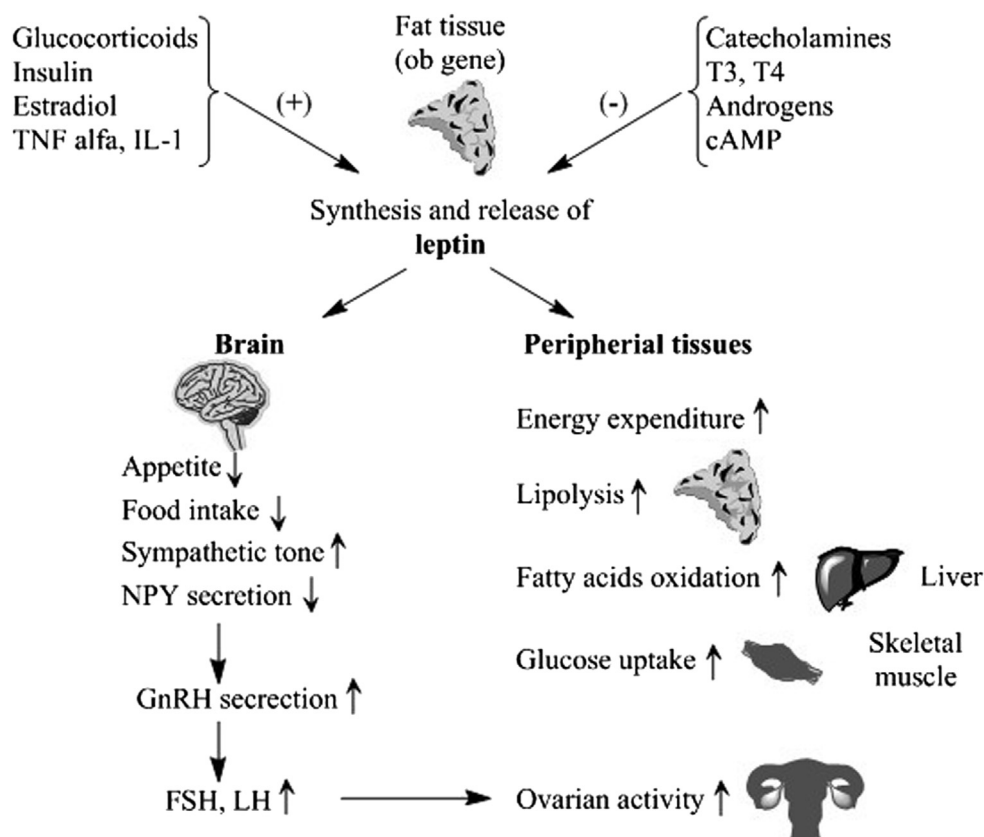


Fig. 1. Regulation of leptin synthesis and action of leptin on the brain and peripheral tissues.

release and FSH and LH release from hypophysis (Fig. 1). Thus, the influence of leptin on the horse's organism has multidirectional character. Changes in plasma leptin concentration in horses can influence their mood, food intake, energy balance and breeding efficiency. Horses are domestic animals generally used for different kinds of work, such as classic horsemanship, races, endurance rides, work in harness and many others. However, only few studies have been focused on the influence of physical exercise on leptin release (Table 2). Due to the importance of biochemistry of physical exercise on horses themselves as well as on economic use of these animals this paper aims at the review and analysis of available knowledge related to the effect of exercise and training on plasma leptin concentrations in working horses.

Table 1

Metabolic effects of changes in leptin level.

Metabolic Effects	Decrease in Leptin Level	Increase in Leptin Level
Appetite and food intake	↑	↓
Energy expenditure	↓	↑
Lipolysis rate	↓	↑
Fatty acids oxidation	↓	↑
Glucose utilization	↓	↑
Ovarian activity	↓	↑
Mood	↓	↑

2. Hormonal Regulation of Leptin Synthesis and Release

Body fat mass is not the only factor which influences plasma leptin concentration. Daily fluctuations in energy status involved transient changes in circulating leptin levels, while body weight and body fat mass remained unchanged [7]. Plasma leptin concentrations decreased in response to feed deprivation, and increased following a meal [7,31,32]. This means that leptin concentrations in circulating blood are not only a simple function of body fat mass. Leptin release by adipose tissue responds to changes in body energy balance because it is controlled by hormones, which regulate energy metabolism: corticosteroids, insulin and catecholamines [33]. Corticosteroids and insulin stimulate leptin synthesis and release, whereas adrenaline plays an opposite role. However, the *in vitro* studies found only a small stimulatory effect of insulin on leptin release from adipocytes in comparison to the marked increase in leptin synthesis and release due to corticosteroids [34]. In *in vivo* studies, the infusion of dexamethasone (a synthetic corticosteroid similar to natural cortisol) in therapeutic doses always induced an increase in the plasma leptin concentration in horses [18,35–37]. A rise in cortisol secretion after endotoxin treatment or feed intake also resulted in increased leptin secretion [38,39]. Moreover, feed restriction decreased cortisol as well as leptin levels in horses [40].

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