

BIOCHEMICAL AND PHYSIOLOGICAL PARAMETERS AND ESTIMATED WORK OUTPUT IN DRAUGHT HORSES PULLING LOADS FOR LONG PERIODS

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ABSTRACT

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A study was undertaken in five draught horses of 648 ± 33 kg body weight to find the effects of continuously pulling loads on their cardiovascular, respiratory and metabolic responses. A cart equipped with an odometer, for measuring distance, and a hydraulic dynamometer, for measuring draught force, was used. Heart and respiration rates and rectal temperatures were recorded. Blood samples for measuring arterial and venous pH and blood gases, haemoglobin, glucose and lactic acid concentrations and the serum activity of the enzymes creatine phosphokinase (CK), lactate dehydrogenase, aspartate aminotransferase and alkaline phosphatase were taken before exercise and immediately after each journey (morning and afternoon) of the daily work.

Draught exercise, with loads which generated forces of between 0.57 and 0.59 kN, at speeds of 1.60 to 2.11 m/s, for 8 h daily for five consecutive days, with resting intervals of 10 min each hour, was well tolerated. Exercise tolerance was evaluated from the recovery from the changes observed in the biochemical and physiological parameters induced by the work. The analysis of these showed that, when the horses were subjected to prolonged periods of resting, their loss of fitness for work was shown by significant increases in the serum activity of muscle-derived enzymes and in blood lactate concentrations during the first day of work. However, over the following days the horses adapted to the work, so that the decreases in serum enzyme activities and blood lactate concentrations were reduced. Since similar observations have been described for racehorses, the determination of blood lactate concentrations and the serum activities of muscle-derived enzymes, specifically CK, seem to be good indicators of fitness in draught horses.

Keywords: biochemistry, draught animals, exercise, horses, physiology, respiration, serum, work

INTRODUCTION

The horse is the only large working animal in which the physiological and metabolic responses to exercise have been studied in any detail. Measurements of cardiovascular and respiratory responses to exercise, and detailed studies on the blood and muscle metabolites, have enabled an understanding of the physiological changes associated with a wide range of different activities (Pearson, 1985). However, most of the information is concerned with leisure horses and information on draught horses is scarce. Moreover, few data exist on the physiological adaptation of draught horses to different degrees of work.

Physical work performed by draught horses requires strength for pulling and endurance for continuous work. Endurance has been defined as the ability to perform muscular work maintaining high work intensity for long periods (Engelhardt, 1977).

Under conditions of heavy muscular work, the principal limiting factors are the oxygen-transporting functions of the cardiovascular system and oxygen utilization in muscles (Engelhardt, 1977; Rose, 1986). Draught exercise is principally performed under aerobic conditions at slow speeds. Recently, however, it has been suggested that not only aerobic processes but also glycolysis with lactate accumulation and phosphagen breakdown are important pathways for energy release during incremental loading at low trotting speeds by standardbred horses on treadmills (Gottlieb *et al.*, 1988). Most of the characterization of cardiovascular, respiratory and metabolic responses to exercise has been performed under laboratory conditions and using racehorses. Knowledge of these responses in draught horses during work is also needed.

Research has been undertaken in our laboratory to evaluate the cardiovascular, respiratory, metabolic and biochemical responses of the Chilean crossbred draught horse subjected to short-term load-pulling exercise. The results showed changes in cardiovascular and respiratory variables, with increases in blood lactate concentration and modifications to the acid-base status of the blood (Perez *et al.*, 1992) associated with increases in the serum activity of some muscle enzymes (Islas *et al.*, 1992). These changes were directly proportional to the draught force and the duration of exercise. The greater the intensity and duration of the work load, the greater the stress evidenced through increases in serum cortisol levels and changes in neutrophil numbers and serum glucose concentration (Perez *et al.*, 1991).

The aims of the present study were to determine the cardiovascular, respiratory, metabolic and acid-base status of the blood of draught horses when they were subjected to continuous work by pulling a standardized load.

MATERIALS AND METHODS

Animals

Five healthy Chilean crossbred draught horses, 5 to 14 years old and 648 ± 33 kg body weight, were selected according to their draught aptitude as evaluated by means of the formula $A = C^2/T$ where A is the draught aptitude, C is the thoracic perimeter and T is the height at the withers (Leigh, 1985). A factor greater than 2.125 was established to accept a horse as being of the draught type. Each horse was carefully examined and found to be healthy from the clinical, haematological and electrocardiographic aspects.

In order to standardize the horses' physical activity and to reduce the variation due to different conditions of fitness and training, they were maintained without work for 1 month before the start of the experiment.

Preparation of animals for blood samples

In the evening of the day before the first exercise was performed, a 20G Teflon branule (Japan Medical Supply, Hiroshima, Japan) was inserted into the facial artery of each horse under local anaesthesia with 2% of lignocaine (Lydocain, Chile Laboratories). Another 18G Teflon branule was inserted into the jugular vein. Both