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# The Influence of Racing on Selected Serum Enzymes, Electrolytes and Other Constituents in Thoroughbred Horses

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## Summary

*Blood samples were collected from 26 Thoroughbred horses the day before and on the first, second, third, fourth and fifth days after racing. A number of plasma constituents were measured. Alterations of these constituents after racing varied between individuals. There was no correlation between alterations in serum biochemistry and racing performance.*

## Introduction

The effects of exercise on serum and plasma biochemistry have been widely investigated in Standardbred trotters and pacers and in endurance horses (Snow and Mackenzie, 1977; Rose *et al.*, 1979). However, due to difficulties in obtaining blood samples immediately after racing, fewer parameters have been determined in Thoroughbred racehorses. Keenan (1979) reported changes in plasma biochemical values in horses after racing and during a recovery period and found that most values had returned to their pre-race levels by one hour after racing.

The purpose of this study was to examine the reaction of some serum biochemical values for up to five days after racing.

## Materials and Methods

This study was performed during the 1978 racing season, and a total of 26 Thoroughbred horses was studied. All horses were in the same racing stable. Jugular venous blood samples were collected into plain tubes for later serum removal, the day before and on the first, second, third, fourth and fifth days after racing. All samples were collected at the same time each day.

Serum concentrations of aspartate aminotransferase (AST), creatine kinase (CK), lactate dehydrogenase (LDH), alkaline phosphatase (AP), gamma glutamyl transferase

(GGT), total protein, cholesterol, bilirubin, calcium, phosphorus, magnesium, sodium and potassium were determined using techniques described in Table 1. This table also gives details of the precision of the individual parameters measured.

The response of the various serum biochemical parameters to racing was expressed as the percentage difference from the pre-race value. To assess whether there was any relationship of post-race biochemistry and racing performance, correlations were performed.

TABLE 1. Technique and lab quality control in the determination of some blood-serum values in Thoroughbred horses.

Variable	Technique	Lab quality control		Approximated methodical error
		precision	correctness	
AST	opt. standard method * A	3.4%	-12%	5%
CK	Activator: GSH * A	9%	1%	10%
LDH	opt. standard method * A	5%	-1%	5%
AP	opt. standard method * A	8%	-1%	
GGT	Stasz kin. test * A	10%	-1%	10%
Serum protein	Biuret reaction ** C	3%	4%	
Cholesterol	Liebermann-Burchard ** B	3%	3%	
Bilirubin	Jendrassik-Grof * D	3%	-3%	5%
Calcium	Cresolphthalein complexon **** D	3.4%	-4%	5%
Phosphorus	Molybdenblue reaction ** C	2%	-1%	5%
Magnesium	Xylidblue reaction (Mann and Yol) * C	1%	-12%	5%
Sodium	Flame-photometer (Li) *** C	1%	5%	5%
Potassium	Flame-photometer (Li) *** B	1%	1%	5%

*Photometers:*

- \* Gilford
- \*\* Autolab
- \*\*\* Flame-photometer
- \*\*\*\* Auto-analyzer

*Control serums:*

- A = Precinorm
- B = Precilip
- C = Lab-Trol.
- D = Seronorm

## Results

The results (mean  $\pm$  SD) of the various serum values in the horses prior to racing are presented in Table 2. Following a race, the biochemical values responded in different ways. The serum concentrations of AST and bilirubin were increased in most horses the day after the race. The magnesium, potassium and LDH values were much more variable in their response, with some horses showing an increase and some a decrease. Values of AP, total protein and calcium remained very stable after racing, with only a few horses showing variation from pre-race values. The response of these biochemical values in the blood samples collected the day after the race is presented in Fig. 1.

Discussion

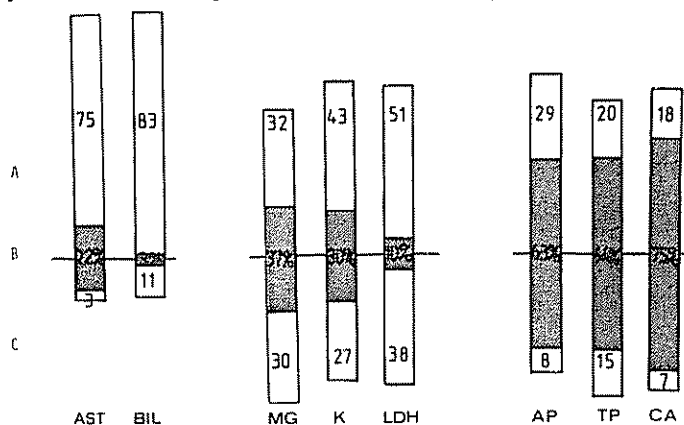
There were large differences in the way in which individual horses responded to the stress of racing. In some horses bilirubin and some enzymes were found to have increased by 100 to 160% over pre-race values on the first or second day after racing. After nearly five days all values had returned to pre-race levels.

It was found that the alteration in serum biochemistry, following a race, had no correlation with the racing performance of the individual horse.

TABLE 2. Serum enzyme activity, metabolite and mineral content in 26 Thoroughbred horses one day before racing.

Serum		Average		Range
		Mean	SD	
AST	U/l	155		88-310
CK	U/l	35		7-85
LDH	U/l	274		120-433
AP	U/l	228		104-330
GGT	U/l	31		9-115
Protein	g/l	60.0 ± 5.0		52-78
Cholesterol	mmol/l	28 ± 4		20-40
Bilirubin	mmol/l	428 ± 103		188-804
Calcium	mmol/l	2.9 ± 0.2		2.4-3.3
Phosphorus	mmol/l	1.2 ± 0.2		0.8-2.0
Magnesium	mmol/l	0.9 ± 0.1		0.7-1.4
Sodium	mmol/l	141 ± 17		122.6-163.5
Potassium	mmol/l	3.8 ± 0.55		2.37-5.89

FIGURE 1. Percentage of horses with increased, decreased and constant blood components one day after the race, compared to their values one day before the race.



- A: percentage of horses with increased values one day after the race.
- B: percentage of horses with constant values (± methodical error) one day after the race.
- C: percentage of horses with decreased values one day after the race.

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# Preliminary Studies on the Relationship of Red Blood Cell Potassium Concentration and Performance

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## Summary

*No correlation was found between plasma and red blood cell potassium concentration, when samples taken from about 200 horses were examined. In 43 horses, the relationship between red blood cell potassium concentration and performance was evaluated. Of 11 horses that were considered to have a low red blood cell potassium concentration, 9 were performing unsatisfactorily on the racecourse. It is suggested that a low red blood cell potassium concentration correlates to a low muscle potassium concentration.*

## Introduction

Several motives incited us to examine the potassium status in racehorses and to look for a possible relationship with fitness.

### *Normal individuals*

1. According to Williamson (1974) the serum  $K^+$  in winning horses varies between 3.7 and 4.0 mmol/l.
2. During muscular exercise the  $K^+$ -ions released from the muscle cells are among the most potent arteriolar vasodilators (Ganong 1977).
3. The work-induced  $K^+$ -release stimulates C fibres which mediate the increase in cardiorespiratory reflex activity (Schumacher *et al.*, 1979).
4. There exist close correlations between extracellular increases in potassium, the increase in muscle blood flow, the increase in oxygen consumption and the increase in muscle performance (Hirche *et al.*, 1980).

### *Potassium-depleted individuals*

1. Bilbrey *et al.* (1973) demonstrated that in  $K^+$ -deficient dogs, a decreased potassium release from contracting muscles was associated not only with a marked impairment of exercise hyperaemia but also with necrosis of skeletal muscle.
2. The force-velocity relationships of  $K^+$ -depleted cat papillary muscles were sharply depressed and the reduced tension development was clearly correlated with a decrease in calcium (Ca) binding capacity of the sarcoplasmic reticulum (Sack *et al.*, 1974).