

Serum biochemical parameters in racehorses in Senegal

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Abstract: This study allowed the establishment of reference values of some biochemical parameters in 77 male racehorses (41 local breed horses and 36 Spanish barbs). The values obtained from these sport horses, bred in the environmental and feeding conditions in Senegal, were within the range of the values of biochemical parameters reported in various previous research works. However, the values of AST and phosphorus obtained in the Spanish barbs were significantly higher than those of local horse breed ($p < 0.001$). Similarly, the values of these two previous parameters and magnesium found in horses of age group 1 (5.47 ± 1.5 years) were significantly higher than the values obtained in older ones ($p < 0.05$). The age groups played the key role in the variation of the values of the biochemical parameters as discussed in this paper.

Keywords: Biochemical parameters, local horse breed, racehorse, Senegal, Spanish barb.

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INTRODUCTION

A longtime ago, the horse was used in West Africa for agricultural work, transportation of persons and goods, and in the armies for knights and warriors of the ancient kingdoms and empires. Nowadays, horses are used in many sectors of activities and play an important socio economical role in West Africa, especially in Senegal¹. Indeed, because of low mechanization of the agriculture in Senegal, horses serve as excellent auxiliary in farm work. Horses, with extend to donkeys and draught oxen are used for land plowing for crop production, the transport of farm inputs and harvest². In urban areas, in spite of the development of cars and trucks, horses are still actively utilized for the transportation of building materials such as cement, building blocks, etc.

The socio economical role of horses in Senegal is so important that, the Government has created two national stud farms for the breeding and the improvement of the local horse breeds. A national agency is even devoted to the improvement of equine breeding and welfare (DEQUIN). This agency supports horse breeding by encouraging horse breeders, and regulates horse racing and fights against fraud and doping. According to the national statistics of Senegal, there are 529 000 horses in the country³. Senegal ranks at the second place in Africa after Ethiopia, in terms of horse population.

Since 1952, a programme of genetic improvement of local horse breeds has been implemented by the Government of Senegal^{4,5}. The programme has had significant impact on the selection of riding horses and racehorses as well as the horse racing organization⁶.

Since then, horse racing and horse riding and to some extending equine choreography has become an attractive business in Senegal⁷. Horse races are regularly organized in various towns of Senegal³. The

stake of these racings is such that exotic horses breeds are more and more imported, mostly from Europe.

In Senegal, horses are used in the equine squadron by the National Gendarmerie, as the parade horses during solemn ceremonies and memorial services. These horses are also involved in various equestrian competitions in which the "Association Sportive des Forces Armées (ASFA)" participates⁸.

The objective of the biochemical analysis of serum is to help the clinician and veterinarian to improve the diagnosis of muscle, liver, and kidney diseases in the racehorse with accuracy. It will also contribute to the welfare and improvement of racehorse performance. However, for good interpretation of these biochemical parameters, it is necessary to establish references values in apparently healthy subjects in the view to make out the physiological values from the pathological ones⁹.

The biochemical profile would substantiate the physical clinical examination together with anamnesis to provide good diagnosis of diseases (infectious or metabolic), the extent to organ lesion as well as the immune response. Nowadays, many countries have established the normal reference values of clinical, hematological and biochemical parameters for their local animal breeds¹⁰.

Furthermore, biochemical analysis could allow early detection of tissues lesion and organs damages in sport horses, even though liver and kidney impairments are not very common in horses. It also makes possible to assess the training and overtraining status and the dietary intake and nutritional status of the racehorses¹¹.

In addition, the values of biochemical parameters obtained in sport horses in Europe, America, Asia, and elsewhere in Africa, may not be fully applicable to racehorses bred locally under the conditions of Senegal because of the difference in nutritional and

breeding management system and other the environmental aspects.

The objective of this study is to establish reference values of some essential biochemical parameters in apparently healthy sport horses of Spanish barb and local horse breeds kept in the breeding conditions of Senegal. Another goal of the current study was to determine the variation of these parameters according to the age groups and the breed.

MATERIALS AND METHODS

Animal sampling

The horses sampled in this study belonged to the mounted squadron of the National Gendarmerie situated inside the military camp Samba Diéry DIALLO of Medina, Dakar. The horses were fed with dried grass and groundnut hay then supplemented with manufactured horse feed distributed twice a day. Seventy seven (77) male horses aged between 4-20 year-old were used in the study. The horses were stratified into 3 age groups : Group 1 (4-10 years), Group 2 (10-15 years) and Group 3 (15-20 years). The average age of the groups were 5.47 ± 1.5 years, 12.36 ± 1.2 years and 17.67 ± 2.7 years for the Groups 1, 2, and 3 respectively. The sample was composed by 41 local breed horses (14.15 ± 3.37 years) and 36 Spanish barbs (5.28 ± 1.23 years).

All horses underwent blood sampling by jugular vein puncture in vacuum glass tubes. Blood samples were allowed to clot and serum was separated by centrifugation at 3500 rpm for 10 min and stored at -20°C till biochemical analyses were performed. The blood sampling was carried out in May 2010.

Biochemical analysis

Biochemical analyses refer to metabolites (total serum proteins, albumin, creatinine and Urea), enzymes especially aspartate aminotransferase (AST) and alanine aminotransferase (ALT), and ions (Calcium, Magnesium and Phosphorus). Biochemical analyses were performed using commercial kits (BIOSYSTEMS®, S.A., Barcelona, Spain). The experimental protocols were provided by the manufacturer. The colorimetric reactions were measured using spectrophotometer (BIOSYSTEMS BTS®, S.A., Barcelona, Spain). To ensure the accuracy of the test results, the analyzer was checked daily with control kits of known values for the different biochemical parameters.

Statistical analyses

Data were computed on Excel® and analyzed using STATA SE 9.2® software. The means and standard deviations were calculated for each biochemical parameter. Student t-test and ANOVA were used to compare mean values of biochemical

parameters in the different horse breeds and age groups. Differences were considered to be statistically significant with values of $p < 0.05$.

RESULTS

Biochemical parameters according to horse breed

The variation observed in the biochemical parameters according to horse breeds are summarized in table 1. The mean values of the various biochemical parameters obtained in the racehorses of local breed and Spanish barb in Senegal were within the range of the reference values found in horses by previous studies. However, there was significant effect of the breed on the values of AST ($p < 0.001$) and phosphorus ($p < 0.001$) (Table 2). Indeed the means values of these biochemical parameters were higher in Spanish barbs than the local breeds.

Table 1: Biochemical parameters in racehorses in Senegal.

Biochemical parameters	All breeds n=77	Reference Values	References
ALT (UI/l)	10.027 ± 8.3	$25.24-5.8^a$	Gul et al., 2007
AST (UI/l)	153.39 ± 57.6	$229.67-46.8^a$	Gul et al., 2007
Urea (mmol/l)	5.153 ± 1.1	$3.57-8.57^b$	Kaneko et al., 2008
Creatinine ($\mu\text{mol/l}$)	137.79 ± 34.9	$106-168^b$	Kaneko et al., 2008
Total proteins (g/l)	69.90 ± 6.7	$52.0-79.0^b$	Kaneko et al., 2008
Albumin (g/l)	32.45 ± 8.4	$26.0-37.0^b$	Kaneko et al., 2008
Calcium (mmol/l)	2.95 ± 1.2	$2.80-3.40^b$	Kaneko et al., 2008
Magnesium (mmol/l)	0.80 ± 0.2	$0.7-0.9^c$	Lumsden et al., 1980
Phosphorus (mmol/l)	1.17 ± 0.4	$1.00-1.81^b$	Kaneko et al., 2008

a. Gul et al., 2007, b. Kaneko et al., 2008, c. Lumsden et al., 1980

Table 2: Biochemical parameters according to horse breeds in the sport horses in Senegal.

Biochemical parameters	Local breeds n=41	Spanish barbs n=36	p-value
ALT (UI/l)	9.15 ± 7.1	11.01 ± 9.5	0.8347
AST (UI/l)	129.05 ± 53.9	181.11 ± 48.9	0.000*
Urea (mmol/l)	4.96 ± 0.9	5.37 ± 1.3	0.945
Creatinine ($\mu\text{mol/l}$)	138.55 ± 27.6	136.92 ± 42.2	0.419
Total proteins (g/l)	70.28 ± 5.3	69.46 ± 7.9	0.298
Albumin (g/l)	31.93 ± 7.2	33.05 ± 9.6	0.718
Calcium (mmol/l)	2.94 ± 1.1	2.95 ± 1.3	0.515
Magnesium (mmol/l)	0.74 ± 0.2	0.84 ± 0.2	0.985
Phosphorus (mmol/l)	1.03 ± 0.4	1.34 ± 0.5	0.001*

* Significant difference ($p < 0.05$)

Biochemical parameters according to age group

The variation in the values of AST ($p = 0.000$), magnesium ($p = 0.040$) and phosphorus ($p = 0.007$)

were significant according to the age groups of the horses. The mean values of AST, magnesium and phosphorus in horses of the group 1 were higher than those found in older animals i.e. horses of group 2 and group 3 (Table 3). However, there was no significant difference between the mean values of these 3 parameters in subjects of groups 2 and 3 ($p>0.05$).

Table 3: Variation of biochemical parameters according to age in sport horse in Senegal.

Biochemical parameters	Group 1 n=38	Group 2 n=24	Group 3 n=15	p-value
ALT (U/l)	10.91± 9.3	8.69±6.8	9.93±8.1	0.597
AST (U/l)	181.89±48.9	125.02± 57.1	126.57±44.1	0.000*
Urea (mmol/l)	5.32±1.4	5.04±0.9	4.91±0.8	0.407
Creatinine (mmol/l)	137.03±41.1	139.73±27.7	136.62±29.8	0.948
Total Proteins (g/l)	69.55±7. 8	71.47±4.5	68.3±6.4	0.320
Albumin (g/l)	32.97±9.5	32.23±7.5	31.53±6.9	0.845
Calcium (mmol/l)	2.99±1.3	3.04±1.1	2.68±1.1	0.617
Magnesium (mmol/l)	0.84±0.2	0.70±0.2	0.82±0.3	0.040*
Phosphorus (mmol/l)	1.32±0.5	1.07±0.4	0.95±0.3	0.007*

*Significant difference ($p<0.05$)

DISCUSSION

Biochemical parameter values are obtained from racehorses belonging to local breeds and Spanish barb which are bred in the same conditions. In general, all the average values of the serum biochemical parameters determined from both horse breeds remained in the range of references values reported from various previous studies in horses¹²⁻¹⁴.

However, the values of AST and phosphorus in the Spanish barbs were significantly higher than the values of these two biochemical parameters in local horse breeds ($p=0.000$). The variation of AST could be explained by the difference in muscular activities amongst the two groups of horses. The Spanish barbs were much younger than the local horses. The young horses were submitted to a more intense training and endurance than the older ones (recording to the anamnesis) and therefore the muscular activities were important. It has been demonstrated that AST shows its maximum activity in skeletal muscle¹⁵. Another study carried out Trigo et al.¹⁶ showed that as muscular activities increased, the level of AST in plasma is augmented. In this study it has been demonstrated that the mean values of AST in horses is related to riding distance. Furthermore, it has been

reported that the value of AST in over trained healthy horses could be higher than 500 UI/l^{17,18}.

The activity of AST may increase in skeletal muscle destruction due to intensive training and endurance^{19,20}. According to Anderson²¹ a transitory selective change occurs in membrane permeability due to the exertion of skeletal muscle which allows intracellular enzymes to cross the plasmatic membrane. Serum AST activity is readily available on the biochemical profile, and has a longer blood half-life than other enzymes such as sorbitol dehydrogenase and creatine kinase, and is stable for days in serum at room temperature, refrigerated, or frozen²². The half-life of AST has been reported to be as long as 7 to 8 days in horses²³.

The mean value of phosphorus in Spanish barbs was higher than the value in local horse breeds ($p<0.001$). This variation is common in horse breeds, and it is not necessarily due to muscular activity like training or overtraining²⁴. It has been reported that muscular activities do not make significant variation in horse plasma phosphorus and calcium concentrations^{25,26}.

The values of AST, magnesium and phosphorus were higher in the strata of young horses, group ($p<0.05$) than those of the two other groups. There was no significant variation between the values of the various biochemical parameters in horses of the groups 1 and 2. The higher values of AST in the youngest horses (group1) corroborated the variation observed in Spanish barbs. Once again the higher value of phosphorus in group 1 depends on the breed commented above. Indeed all subjects in group 1 are Spanish barb breeds. In a study involving 40 thoroughbreds of 2-3 year-old, Harris et al.²⁷ reported that age had a significant influence on the value of AST in sport horses.

Previous studies have demonstrated that phosphorus concentration in serum decreased significantly with age in horses, donkeys, and other domestic pets^{11,28,29,30}. These studies suggested that age-related decrease probably reflects decreased bone metabolism as animals grow older. Furthermore, Braithwaite³¹ has shown that younger animals absorb dietary calcium and phosphorus more efficiently and achieve much higher maximum rates of absorption for both in comparison with older animals. Our data is in disagreement with those reported in donkeys by Sow et al.³². These authors have found that there was no significant variation in the mean values of plasmatic phosphorus concentration within the different age groups in Burkinabese local donkey breeds.

However, our results were similar to those of Sow et al.³² regarding the significant variation of magnesium according to the age groups. Magnesium

is an essential component of animal diet, and green plants contain great amounts of magnesium because of its abundance in chlorophylls and in the seeds of cereals^{33,34}. Magnesium is an essential macroelement that is required for cellular energy-dependent reactions involving adenosine triphosphate and for the regulation of calcium channel function³⁵. Therefore, there is a strong positive correlation between intracellular magnesium ions (Mg^{2+}) and ATP concentrations in red blood cells from various species because of the presence of the Mg^{2+} -ATP complex within cells³⁶. In contrast, Gurgoze and Icen¹¹ reported that there is no apparent effect of ageing on magnesium level in Pure-bred Arabian Mares.

This study has provided invaluable reference values of biochemical parameters of two breeds of racehorses bred locally in Senegal. These results would help veterinarians to assess the fitness and the performance of racehorses by good interpretation of biochemical analyses. These data could be useful in the diagnosis of muscles damages of training and overtraining of the racehorses as well as common liver, kidney and muscle diseases.

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