RESEARCH ON THE BIOCHEMICAL PARTICULARITIES OF HORSES BLOOD SLAUGHTERED FOR HUMAN CONSUMPTION

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Abstract

In order to read and explain the physiological status it is important to know the metabolic integrity of the animals by performing hematological and biochemical examinations.

The cellular components of the blood reflect specific changes in an organ or system of the body, or most often an animal's response to certain physiological or pathological conditions.

The research was carried out on for groups L1 – young females; L2 – young males; L3 – adult females; L4 – adult males in order to appreciate the biochemical values for evaluating the morphophysiological status before slaughtering horses and improving their welfare factors.

The collection of blood samples was performed with the vacuum system. Biochemical parameters were determined by spectophotometry using the ACCENT 200.

The biochemical profile analyzed before pre-slaughter demonstrate a good maintenance status, received a proper feeding, which reflects on the final meat quality.

Key words: horse, blood, meat quality

INTRODUCTION

Meat and meat products are very important components of the human food chain. Their quality and origin are the main issues concerned by consumers, traders and government agencies.

Consumer demands have changed and changed frequently over the years, focusing on quality and food safety features from all the factors involved in their determination. [2]

People's lifestyle, religion, diet and health are some of the aspects that influence the choice of some products in the detriment of others. [3]

Haematological profile provides important information regarding the severity of the disease, response to treatment if exist and helps in diagnosis. Horses may have different haematological disorders, which makes hematology an important branch in their study. [10] [13]

Despite the widespread use of hematological analyzes in equine medicine, interpreting them can be challenging, in some cases, because they can be significantly influenced by a large number of factors. [6]

Hematological parameters may vary according to race, sex, age, reproductive status, life-long activity, feeding, circadian variation, procedure for handling animals during blood sampling, degree of arousal, and health status. [9] [14]

Blood and biochemical analysis of blood provides significant information about the health of an animal, metabolic changes that occur in its body and is often helpful in revealing the health disorders already in the preclinical stage. In horses, one of the factors that influence the blood parameters are the type of exercise, its intensity, duration and frequency. [4] [5] [12]

MATERIAL AND METHOD

For the safe and minimally invasive sampling of the blood samples, the horses taken in the study were restrained by

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mobilizing them with harnesses at the level of the head, after which was chosen the place where the puncture was made at the level of the large veins.

In order to fulfill all the objectives proposed in defining the quality of the horse meat, identification, harvesting and conserving stages were required from the main muscle groups on the horse's carcasses, these belonging to the young female, young male, adult female, adult male.

In order to determine the biochemical parameters was used the ACCENT 200 apparatus. This is a biochemistry system provided for in vitro quantitative determinations of serum, plasma, urine or cerebrospinal fluid.

RESULTS AND DISCUSSIONS

Knowledge about the normal values of the biochemical variables in the blood serum, as well as of all the physiological variables, are very important because on their basis any dysfunction of the organs or tissues in different pathological states can be evaluated, as well as for the evaluation of the respect of the animal welfare. [15]

For the groups of horses studied, the morphophysiological status was carefully monitored, the total protein concentration being determined.

Table 1 - Results and discussion regarding the proteic, lipid and energetic profile

Specification	Exp. lot	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Meaning of differences T-Test (2-tailed)	
Total proteins (g/dL)	L1	6.11±0.092	4.78	5.50 – 6.50	L1 – L2	t =0.87; p = 0.405$^{ns.}$
	L2	6.00±0.068	3.60	5.70 – 6.30	L1 – L3	t =-1.86; p = 0.096$^{ns.}$
	L3	6.38±0.080	3.97	5.90 – 6.70	L2 – L4	t =-2.80; p = 0.021*
	L4	6.20±0.058	2.94	5.90 – 6.50	L3 – L4	t = 1.66; p = 0.131$^{ns.}$
Albumin (g/dL)	L1	3.41±0.090	8.35	3.10 – 4.00	L1 – L2	t = 0.30; p = 0.047*
	L2	3.17±0.079	7.88	2.80 – 3.60	L1 – L3	t = -2.29; p = 0.048*
	L3	3.67±0.067	5.76	3.30 – 4.00	L2 – L4	t = -2.18; p = 0.057ns.
	L4	3.43±0.067	6.15	3.20 – 3.80	L3 – L4	t = 2.64; p = 0.027*
Cholesterol (mg/dL)	L1	79.10±2.09	8.35	68.00 – 90.00	L1 – L2	t =0.65; p = 0.531$^{ns.}$
	L2	76.90±2.13	8.74	67.00 – 87.00	L1 – L3	t = -2.09; p = 0.067$^{ns.}$
	L3	85.60±1.90	7.01	78.00 – 96.00	L2 – L4	t = -1.85; p = 0.097$^{ns.}$
	L4	83.60±2.36	8.92	75.00 – 96.00	L3 – L4	t = 0.65; p = 0.534$^{ns.}$
Triglycerides (mg/dL)	L1	20.84±0.84	12.72	17.03 – 24.10	L1 – L2	t = 1.89; p = 0.092$^{ns.}$
	L2	19.32±0.57	9.39	16.50 – 21.70	L1 – L3	t = -2.99; p = 0.015*
	L3	23.75±0.58	7.76	21.90 – 27.30	L2 – L4	t = -2.37; p = 0.042*
	L4	21.38±0.51	7.49	19.20 – 23.80	L3 – L4	t = 3.22; p = 0.011*
Glucose (mg/dL)	L1	90.30±2.86	10.03	76.00 – 105	L1 – L2	t = 1.18; p = 0.270$^{ns.}$
	L2	87.00±2.44	8.87	76.00 – 97.00	L1 – L3	t = -3.13; p = 0.012*
	L3	99.10±2.70	8.62	91.00 – 119.00	L2 – L4	t = -2.14; p = 0.061$^{ns.}$
	L4	94.60±2.60	8.71	80.00 – 105.00	L3 – L4	t = 0.95; p = 0.369$^{ns.}$
Uric acid (mg/dL)	L1	11.18±0.30	8.54	9.70 – 12.40	L1 – L2	t = 1.51; p = 0.164$^{ns.}$
	L2	10.64±0.26	7.69	9.20 – 11.90	L1 – L3	t = -2.00; p = 0.077$^{ns.}$
	L3	12.19±0.33	8.66	10.30 – 13.30	L2 – L4	t = -2.85; p = 0.019*
	L4	11.62±0.35	9.60	10.20 – 13.20	L3 – L4	t = 2.02; p = 0.074$^{ns.}$

L1 – young females; L2 – young males; L3 – adult females; L4 – adult males; T- test (2-tailed) – for each parameter analyzed. compared on experimental groups according to age and sex; ns. insignificant differences (p>0.05); * significant differences (p<0.05);** distinctly significant differences (p<0.01); *** very significant differences (p<0.001).

The analysis of the proteins from blood serum revealed minimum and maximum values that are between 6.00 ± 0.068 ÷ 6.38 ± 0.080 g/dL. obtained in groups L2 (young males) and L3 (adult females).

The literature states that for the equine species the average values are between 6.2 ÷ 6.9 g/dL. but depending on their food. their age, their water diet and last. their health status. total protein concentration can oscillated either below the limit as it is in the case of the study carried out in lots L1 and L2, but it can be located in the limit if we talk about lots L3 and L4.

The analysis of the calculated coefficient of variation gives us information on the fact that the studied groups had a good homogeneity of the studied character and fall below the 5% threshold. the averages varying between 2.94 ÷ 4.78%.

Significant statistical differences for this studied parameter were recorded only between L2 and L4 groups, while only insignificant differences were recorded between the other analyzed batches.

These differences are explained by the rest period of the slaughterhouse, the age, the sex of the horses, but most importantly the reaction of the horse's body to the stressors and their resistance or tolerance. [11]

Albumin is the main and most active component of osmotic protein in horse blood serum [16], while globulin is a fraction of a heterogeneous group of blood proteins, including transporter proteins, enzymes, immunoglobulins and other inflammatory immunoglobulins. [1]

The albumin values determined in the blood horses were between the minimum of 3.17±0.079 g/dL in the L2 group and the maximum of 3.67±0.067 g/dL in the L3 group. an upper value that slightly exceeds the limit mentioned in the literature. 3.6±0.3 g/dL.

In albumin concentration averages were found significant differences between L1-L2. L1-L3 and L3-L4 groups.

The cholesterol concentration observed in the four batches registered values between 76.90 ± 2.13 mg/dL in group L2 and 85.60 ± 1.90 mg/dL in group L3, these values fall within those specified by the literature 76 ÷ 88 mg/dL.

The coefficient of variation calculated for each batch revealed values below the 10% threshold representing an medium homogeneity.

Analyzing the blood serum. the mean values of the triglycerides recorded were 19.32 ± 0.57 mg/dL in the young male group and 23.75 ± 0.58 mg/dL in the adult female group.

Comparing with the literature, the minimum and maximum limits fluctuated in parameters of 16.4 ÷ 24 mg/dL. and the coefficient of variation for lots L2, L3 and L4 was below 10% representing homogeneous lots.

In order to appreciate the energetic metabolism of the horses. was studied the blood glucose concentration values that were in the quotation of the literature 83.7 ÷ 104 mg/dL.

The mean values obtained were between 87.00 ± 2.44 mg/dL in young males and the maximum of 99.10 ± 2.70 mg/dL in adult females.

The groups of horses taken in the study highlight the homogeneity of the lots because the value of the calculated coefficient of variation was less than 10.5%.

Klinkon şi Ježek (2012) mentions that the diagnosis of urea concentration in the blood is very important to detect any kidney disease. and its level depends largely on nutrition. [7]

The amounts of uric acid resulting from the determinations carried out on the horse lots are between 10.64 ± 0.26 mg/dL in the young male and the maximum of 12.19 ± 0.33 mg/dL in the adult females.

As a result of the statistical calculation were registered significant differences only in L2-L4 lots, and the rest of the analyzed lots registered insignificant differences.

Concentrations in blood aspartataminotransferase, according to the batches analyzed in horses, recorded values between 285.56 ± 7.45 ÷ 325.22 ± 12.84 U/L, values that fall within the data cited in the literature of 276.5 ± 22.0 ÷ 374.0 ± 32.0 U/L.

Batches L1, L3 and L4 have a coefficient of variability over 10% and batch L2 below 10% concluding the lack of homogeneity of the studied lots.

By applying the T test, significant results were obtained for group L2-L4, and for the rest of the groups the differences were insignificant, regarding the studied character.

Table 2 Results and discussion regarding the enzymatic and mineral profile

Specification	Exp. lot	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Meaning of differences T-Test (2-tailed)	
AST (u/L)	L1	298.00±10.60	10.70	252.00 – 348.00	L1 – L2	t = 0.71; p = 0.497$^{ns.}$
	L2	285.56±7.45	7.82	250.00 – 312.00	L1 – L3	t = -1.92; p = 0.088$^{ns.}$
	L3	325.22±12.84	11.84	268.00 – 389.00	L2 – L4	t = -2.78; p = 0.021*
	L4	321.44±11.73	10.95	290.00 – 374.00	L3 – L4	t = 0.74; p = 0.480$^{ns.}$
ALT (u/L)	L1	10.44±1.25	35.86	4.00 – 16.00	L1 – L2	t = -1.34; p = 0.213$^{ns.}$
	L2	11.56±1.06	27.15	7.00 – 17.00	L1 – L3	t = -2.10; p = 0.065$^{ns.}$
	L3	14.11±1.14	24.15	7.00 – 18.00	L2 – L4	t = -2.19; p = 0.057$^{ns.}$
	L4	14.33±1.05	22.06	7.00 – 18.00	L3 – L4	t = -0.44; p = 0.668$^{ns.}$
Alkaline phosphatase (u/L)	L1	195.22±6.67	10.25	172.00 – 241.00	L1 – L2	t = 0.32; p = 0.756$^{ns.}$
	L2	193.00±3.83	5.95	175.00 – 208.00	L1 – L3	t = -2.10; p = 0.066$^{ns.}$
	L3	211.44±4.77	6.77	189.00 – 232.00	L2 – L4	t = - 2.40; p = 0.040*
	L4	205.56±3.46	5.04	189.00 – 220.00	L3 – L4	t = 1.42; p = 0.191$^{ns.}$
Ca (mg/dL)	L1	11.24±0.24	6.34	10.20 – 12.30	L1 – L2	t = 1.05; p = 0.319$^{ns.}$
	L2	10.89±0.16	4.51	10.10 – 11.60	L1 – L3	t = -2.89; p = 0.018*
	L3	11.97±0.22	5.42	11.20 – 12.80	L2 – L4	t = -2.64; p = 0.027*
	L4	11.61±0.26	6.75	10.10 – 12.60	L3 – L4	t = 1.13; p = 0.288$^{ns.}$
Mg (mg/dL)	L1	2.28±0.072	9.51	2.00 – 2.70	L1 – L2	t = 0.44; p = 0.670$^{ns.}$
	L2	2.22±0.066	8.94	1.90 – 2.50	L1 – L3	t = -2.33; p = 0.045*
	L3	2.48±0.104	12.57	2.10 – 3.00	L2 – L4	t = -2.34; p = 0.044*
	L4	2.42±0.076	9.41	2.10 – 2.80	L3 – L4	t = 0.75; p = 0.472$^{ns.}$

L1 – young females; L2 – young males; L3 – adult females; L4 – adult males; T- test (2-tailed) – for each parameter analyzed. compared on experimental groups according to age and sex; ns. insignificant differences (p>0.05); * significant differences (p<0.05);** distinctly significant differences (p<0.01); *** very significant differences (p<0.001)

The concentration in blood alaninaminotransferase, according to the batches analyzed in horses, was between 10.44 ± 1.25 ÷ 14.33 ± 1.05 U/L, in the adult female and male youth groups, concentrations that fall within the specified limits in the literature.

The calculation of the coefficient of variability reveals that the lots do not have homogeneity, the value of the coefficient V> 15%.

Alkaline phosphatase (ALP) was found in the intestines. Liver, kidneys and bones. The serum activity of ALP is higher in young animals than in adults and decreases with age. [8]

Alkaline phosphatase activity is increased if the animal suffers from acute and chronic liver disease. as well as rickets or other diseases affecting the bones.

The variability of blood serum alkaline phosphatase concentration by sex and age is shown in the table below. The lowest values were registered in the young horse, male. 193.00 ± 3.83 U/L, and the highest values in the adult female horses 211.44 ± 4.77 U/L. The batches showed good homogeneity due to the fact that the variability was below 10% with the exception of batch L1 with a value of 10.25%.

The statistical calculation by applying the T test revealed significant differences only in the L2-L4 groups. while in the other groups studied the differences were insignificant.

Depending on the health and maintenance condition of the horses. the concentration of calcium content in their blood showed values between the minimum of 10.89 ± 0.16 mg/dL in young males and the maximum of 11.97 ± 0.22 mg/dL in adult females. The homogeneity of the studied lots is good given that the value of the coefficient of variation V <10%.

Analyzing the statistical calculation resulted after applying the T test in young

males and adult females or recorded significant differences. and in young females and adult males it did not show any significance.

The blood magnesium concentration according to the analyzed groups is between 2.22 ± 0.066 mg/dL and 2.48 ± 0.104 mg/dL.

Analyzing the concentration of magnesium this is homogeneous because the value below 10% of the variation index is observed for lots L1, L2 and L4, except for lot L3 with a value of 12.57%. The values are in the middle of the limits specified in the literature. 2 ÷ 2.8 mg/dL.

The statistical calculation revealed insignificant differences for groups L1 and L4 and for groups L2 and L3 the statistical results showed significant differences.

CONCLUSIONS

The biochemical profile made before slaughter allowed us a thorough analysis of the nutritional status of the animals, the females having an increased lipid profile compared to the males.

The biochemical profile analyzed before pre-slaughter, highlights a good maintenance status which have benefited from proper feeding to animals which affects the quality of the meat.

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