Scientific Papers. Series D. Animal Science. Vol. LXIII, No. 1, 2020
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

SEASONAL INFLUENCE ON HEMATOLOGICAL AND BIOCHEMICAL PROFILE IN DONKEY (*Equus asinus*)

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Abstract

The hematological and biochemical profile is important to study because it provides important information on animal health. Changing the parameters beyond the normal limits negatively affects the production and quality of milk. Hematological and biochemical parameters were influenced by season, age, sex, lactation, animal nutrition and maintenance system. The total protein was in average 55.44 ± 5.14g/l in the summer season, and 76.92 ± 2.82 g/l in the winter season. Creatinine registered an average values of 99.55 ± 3.57 µmol/L in summer, while in winter was 112.00 ± 6.59 µmol/L. Cholesterol is an important parameter for the body, and his changes give us important information about the major disturbances that occur in the body. This parameter was significantly influenced by the season and it was 1.82 ± 0.14 mmol/L for summer and 1.95 ± 0.06 mmol/L in winter. The LYM in the summer season had an average value of 49.96 ± 2.72%, while in the winter season was 59.92 ± 2.19%. The values of hematological and biochemical parameters obtained in our study fall within the characteristic limits of donkeys.

Key words*: donkey, hematological and biochemical parameters, season.*

INTRODUCTION

Seasonal changes in ambient temperature, relative humidity, and air velocity influence the physiological responses of animals (Ruiz et al., 2004). In donkeys, the hematological and biochemical parameters are significantly influenced by sex, age, muscle mass, nutrition, physiological status, donkey health (Mori et al., 2003; Laus et al., 2015; Yakubu and Chafe 2008). Hematological parameters (such as PCV, RBC, MCV and MCHC) are used as indicators to evaluate animals adaptability to the environment conditions (Koubkova et al., 2002). Physical activity and work of animals is a commonly recognized stress factor, which can influence hematological parameters. Extreme hot and cold ambient temperatures can affect the animals, and this could be evidenced in the fluctuations of physiological responses to combat environmental thermal stress (Pandey et al., 2012). All biochemical and metabolic signals serve to guide normal development. The differences among studies regarding to hematological and biochemical parameters could also be due to the different exploitation techniques, the different feeding level, the health norms and the diseases that animals can suffer (Michael et al., 2013).The purpose of this study was to establish the influence of the season on the hematological and biochemical profile in the donkey.

MATERIALS AND METHODS

The donkey metabolic profile was evaluated in two different seasons (summer *vs*. winter) by determining the hematological and biochemical parameters. Blood samples were used to analyze the hematological parameters. A total of ten blood samples were used for both summer and winter seasons.

The blood was collected from animals, and immediately was centrifuged in order to separate the serum.

The serum was separated by using the high performance centrifuge with 4000 rotations per minute. Then, samples were immediately frozen in Eppendorf type vials.

Biochemical analysis

The determinations for the biochemical parameters were performed with the semi-automatic analyzer for screen point biochemistry, with reagents-STAT-Fax 1904 Plus, Global Medical Instrumentation, Ramsey Minesota, USA. It is a general purpose photometer, controlled by a macroprocessor, with 6 filters and 37ºC incubation block.

Hematological analysis

The blood samples were analyzed in order to determine hematological parameters. Parameters were determinated by using the Abacus Junior Vet automatic device, Diatron, Messtechnik.

This device is an automatic analyzer made to count the blood cells and determining the hematological parameters by adding 25 µl of each blood sample. He selected automatically the species from which the blood comes.

For all analyzes, the quality control of the measurements is performed on 6 levels.

Parameters are calculated and presented on charts and in a separate database, and also appear on the device screen.

RESULTS AND DISCUSSIONS

Hematological and biochemical parameters are influenced by sex, age, season, lactation, animal nutrition and maintenance system (Plotka et al., 1988; Raymond et al., 2003).

Tables 1 to 6 present the average values and variability of hematological and biochemical parameters in the donkey, and how this was influenced by two different seasons (summer vs. winter).

The LYM had average of 49.96 ± 2.72% in the summer season, while in the winter season was 59.92 ± 2.19%. These values fall within the characteristic limits of donkeys, and are in agreement with the data published by (Sgorbini et al., 2013).

The season and the meteorological factors can influence the dynamics of the constituent elements of the blood. Satué et al. (2010, 2011) observed that the season may change certain hematological parameters such as: red blood cells (RBC), hemoglobin (Hb) and packed cell volume (PVC).

Table 1. The influence of the season (summer) on the hematological profile in the donkey

Parameter	Summer (n = 10)	
	X ± sx	V%
WBC (G/l)	9.426±0.63	14.91
RBC (T/l)	7.74±0.52	14.90
Hb (g/l)	134.38±3.05	5.07
HCT (l/l)	0.39±0.04	20.35
MCV (fl)q	53.56±3.23	13.50
NEU (%)	48.26±2.34	10.86
LYM (%)	49.96±2.72	12.16
MON (%)	1.618±0.14	19.59
MON (g/l)	0.20±0.03	37.07
NEU (g/l)	4.00±0.05	2.79
LYM (g/l)	8.44±0.29	7.78
EOS (%)	5.37±0.19	7.78
PLT (G/l)	2.62±0.25	20.95
MCHC (g/l)	351.36±5.77	3.67
BAS (%)	0.2±0.02	16.96

V - variability; X - average value; n - number of blood samples.

Table 2. The influence of the season (winter) on the hematological profile in the donkey

Parameter	Winter (n = 10)	
	X ± sx	V%
WBC (G/l)	10.38±0.60	13.03
RBC (T/l)	8.42±0.33	8.83
Hb (g/l)	138.52±3.71	5.99
HCT (l/l)	0.28±0.02	13.60
MCV (fl)q	69.54±2.60	8.36
NEU (%)	39.14±1.33	7.57
LYM (%)	59.92±2.19	8.18
MON (%)	1.80±0.06	7.67
MON (g/l)	0.15±0.02	23.57
NEU (g/l)	3.95±0.06	3.34
LYM (g/l)	8.32±0.28	7.59
EOS (%)	4.76±0.19	8.98
PLT (G/l)	1.63±0.15	20.19
MCHC (g/l)	313.20±6.81	4.86
BAS (%)	0.146±0.01	15.77

V - variability; X - average value; n- number of blood samples.

Satué et al. (2011) observed in her study that rabbits had higher PCV, RBC and mean corpuscular volume (MCV) in the summer season, compared to other seasons.

The results of our study showed that the season was an external factor that controls the dynamics of the constituent elements of the blood. Similar studies regarding the season influence on the hematological parameters were also reported by Shawaf et al. (2017). The differences that exist in the literature regarding to hematological and biochemical parameters are determined by several factors such as: health status, muscle mass, type of feeding and maintenance, if used in agricultural work (Shawaf, 2017; Rico et al., 1978; Cywinska et

al., 2015). Low temperatures reduce the number of red blood cells. In horses, alterations of the osmotic fragility of erythrocytes occur during physical exercise (Hanzawa and Watanabe, 2000). Physiological changes in hematological parameters appear in response to physical exercises and workouts (Fazio et al., 2011; Krumrych, 2009). Piccione et al. (2008) observed that platelet aggregation depends on the effort**,** and the physical activity or exercise exerts an effect on the daily rate of platelets. According to (Olaifa et al., 2012) the PCV and RBC of donkeys decreased significantly, while the neutrophil/lymphocyte ratio increased significantly after donkeys were subjected to agricultural work.

The oxygen consumption and the average heart rate in the assins that circulate at maximum speed, can significantly increase the heart rate, compared to the values obtained in the assins that did not exercise such work (Mueller et al., 1994). Changes in hematological parameters induced by physical labor have been reported by Hinchcliff et al. (2002) and Lorena et al. (2006). Our results presented in the Table 3 corroborated the previous findings, that seasons can affect significantly the haematological profile in donkeys.

Table 3. Statistical interpretation of hematological parameters of blood in donkey under the influence of season

Parameter	Summer	Winter	Significance
WBC	9.43	10.38	n.s
RBC (T/l)	7.74b	8.42a	*
Hb	134.38	138.52	n.s
HCT	0.39a	0.28b	*
MCV	53.56b	69.54a	**
NEU %	48.26a	39.14b	***
LYM %	49.96b	59.92a	*
MON %	1.61b	1.80a	*
MON (G/L)	0.19a	0.15b	*
NEU (G/L)	4	3.95	n.s
LYM (G/L)	8.44	8.32	n.s
EOS (%)	5.36a	4.75b	*
PLT (G/l)	2.62a	1.63b	*
MCHC (g/l)	351.36a	313.20b	**
BAS (%)	0.20a	0.15b	*

Our results obtained for the hematological and biochemical profile in the donkey are in agreement with those published by (Mori et al., 2003). Lemma and Moges (2009) in a study realized in Ethiopia observed that clinical and hematological values were not affected by the use of donkeys in agricultural work.

The osmotic fragility of erythrocytes is used to determine the level of stress in animals (Hesta et al., 2008).

In Figure 1, a-c are represented graphically the hematological parameters under the influence of the summer and winter season.

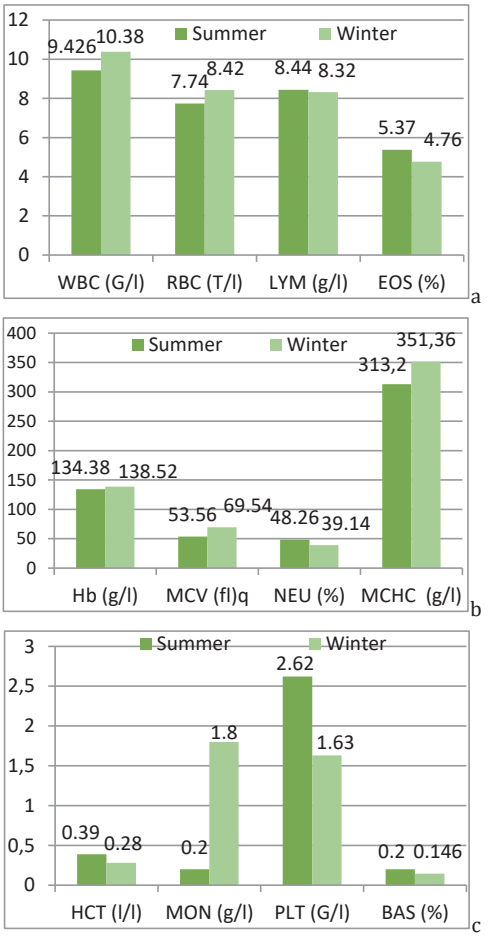


Figure 1 a-c. The average values for the hematological parameters in the summer and winter season in the donkey

The environment in which animals are raised may influence the animals' ability to maintain thermal equilibrium, which is also related to their thermal characteristics and in regulation of physiological mechanisms (Castanheira et al., 2010).

Urea was influenced by the season as follows: in the summer season urea varied between 5.93 ± 0.47 and 7.77 ± 0.59 mmol/L (Tables 4 and 5).

Table 4.The influence of the season (summer) on the biochemical profile in the donkey

Parameter	Summer (n = 10)	
	X ± sx	V%
Urea (mmol/l)	5.93±0.47	17.54
Total protein (g/l)	55.44±5.14	20.72
Glucose (mmol/l)	5.48±0.65	26.64
Albumin (g/l)	21.59±1.26	13.02
Creatinine (µmol/L)	99.55±3.57	8.02
Cholesterol (mmol/L)	1.82±0.14	16.99
Potassium (K) - (mmol/L)	4.29±0.20	10.21
Triglycerides (mmol/L)	0.45±0.05	24.23
Total calcium (mmol/L)	2.06±0.04	3.88
Sodium (Na) (mmol/L)	115.48±1.83	3.54
Total bilirubin (mmol/L)	7.82±0.12	3.45
Mg (mmol/L)	0.69±0.04	12.60
ALT (U/L)	12.96±0.46	8.00
AST (U/L)	252.02±2.60	2.31
ALP (U/L)	214.30±6.24	6.51
GGT (U/L)	84.10±2.74	7.29
CK (U/L)	196.00±2.33	2.66

V - variability; X - average value; n - number of blood samples.

Table 5. The influence of the season (winter) on the biochemical profile in the donkey

Parameter	Winter (n = 10)	
	X ± sx	V%
Urea (mmol/l)	7.77±0.59	17.10
Total protein (g/l)	76.92±2.82	8.19
Glucose (mmol/l)	6.01±0.81	29.96
Albumin (g/l)	22.5±1.53	15.22
Creatinine (µmol/L)	112.00±6.59	13.17
Cholesterol (mmol/L)	1.95±0.06	7.13
Potassium (K) - (mmol/L)	4.94±0.06	2.71
Triglycerides (mmol/L)	0.71±0.09	27.68
Total calcium (mmol/L)	2.21±0.10	10.36
Sodium (Na) (mmol/L)	135.26±2.53	4.19
Total bilirubin (mmol/L)	8.352±0.31	8.35
Mg (mmol/L)	0.71±0.09	27.74
ALT (U/L)	15.63±0.43	6.19
AST (U/L)	273.48±5.51	4.51
ALP (U/L)	230.48±3.27	3.17
GGT (U/L)	85.60±2.28	5.96
CK (U/L)	174.76±5.39	6.90

V - variability; X - average value; n - number of blood samples.

The total protein concentration did not show major changes compared to the results published on this topic (Tomenendalova et al., 2014; Kuttner and Wiesner, 1987; Gupta et al., 2005).

The total protein was 55.44 ± 5.14 g/l in the summer season and 76.92 ± 2.82 g/l in the winter season (Tables 4 and 5).

Creatinine showed an average values of 99.55 ± 3.57 µmol/L in summer and, 112.00 ± 6.59 µmol/L in winter. Cholesterol is an important parameter for the body, and his changes give us important information about the major disturbances that occur in the body. This parameter was significantly influenced by the season, and it was 1.82 ± 0.14 mmol/L in summer, and 1.95 ± 0.06 mmol/L in winter (Tables 4 and 5).

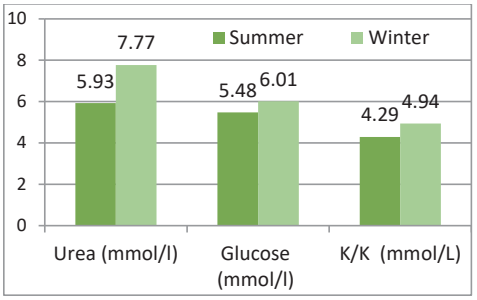
Similar results with our study were reported by Zinkl et al. (1997), Jordana et al. (1998), Alves (2008), Etana et al. (2011), Girardi et al. (2013) and Sgorbini et al. (2013). However, serum biochemical parameters, with the exception of total protein, were significantly affected by the fact that the animals were used in agricultural work (Hanzawa and Watanabe, 2000; Koubkova et al., 2002).

Table 6. Statistical interpretation of the biochemical parameters of the blood under the influence of the season

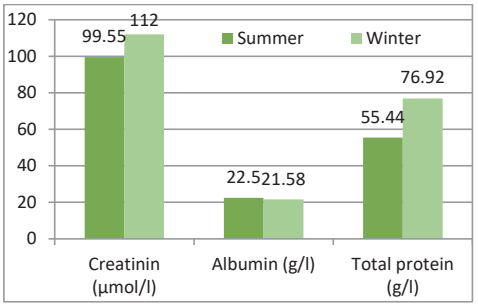
Parameter	Summer	Winter	Significance
Urea (mmol/l)	5.93b	7.76a	***
Total protein (g/l)	55.44b	76.92a	**
Glucose (mmol/l)	5.48	6.01	n.s.
Albumin (g/l)	21.58	22.5	n.s.
Creatinine(µmol/L)	99.55	106.98	n.s.
Cholesterol (mmol/L)	1.81	1.95	n.s.
Potassium(K) (mmol/L)	4.29b	4.94a	*
Triglycerides (mmol/L)	0.44b	0.71a	*
Total calcium (mmol/L)	2.05	2.13	n.s.
Sodium (Na) (mmol/L)	115.48b	135.26a	**
Total bilirubin (mmol/L)	7.81b	8.58a	*
Magnesium (Mg) (mmol/L)	0.67	0.71	n.s.
ALT/ALT (U/L)	12.96b	15.63a	**
AST/AST (U/L)	252.02b	273.48a	**
ALP/ALP (U/L)	214.30b	230.48a	*
GGT/GGT (U/L)	84.1	85.6	n.s.
CK/CK (U/L)	196.00a	174.76b	**

The statistical interpretation of the results regarding the influence of the season on the

biochemical profile in the donkey is shown in Table 6.



a



b

Figure 2 a-b. The average values for the biochemical parameters in the summer and winter season in the donkey

In figure 2 a-b are shown the average values for the biochemical parameters of the blood in the donkey depending on the season.

CONCLUSIONS

The season (summer *vs*. winter) had a significant influence on the hematological and biochemical parameters in the donkey (*Equus asinus*). Most hematological and biochemical parameters had the highest average values in the winter season than summer season.

ACKNOWLEDGEMENTS

This project was funded by the Ministry of Research and Innovation through Program 1-Development of the National Research and Development System, Subprogram 1.2-Institutional Performance-Projects for Financing the Excellence in CDI, Contract no. 37PFE/06.11.2018. Title of the project: "Increasing the institutional performance through consolidation and development of research directions within the USAMVCN".

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