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Comparison of serum biochemical parameters between red (*Cervus elaphus*) and fallow deer (*Dama dama* L.) in Moslavina Region of Croatia

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ABSTRACT

Serum biochemical parameters in blood samples of forty-five sedated fallow deer (*Dama dama* L.), and forty-two red deer (*Cervus elaphus*) from various hunting grounds in the Moslavina region of Croatia were determined. The parameters were compared regarding species, age and sex. The comparison of results in adult red and fallow deer revealed the higher body mass, total protein, triacylglyceride, creatinine, urea and glucose concentration in red deer, and higher aspartate aminotranspherase (AST) and alanine aminotranspherase (ALT) activity and cholesterol concentration in fallow deer. The comparison of the same biochemical parameters in young animals showed higher body mass, triacylglyceride, creatinine and glucose concentration in red deer, whereas young fallow deer had higher albumin, cholesterol and urea concentration, as well as AST and ALT activity. The observed differences were probably due to the different body weight and nutritional status of animals, but the sedative used and excitement prior sedation might have also been involved. The multi-factorial analysis and the analysis of variance confirmed that physiological differences in the biochemical parameters between the two deer species exist.

Key words: red deer, fallow deer, male, female, serum biochemical parameters

Introduction

Red deer (*Cervus elaphus* L.) and fallow deer (*Dama dama* L.) are broadly distributed

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deer species in the continental hunting grounds of Croatia and the Moslavina region is situated in the north of continental Croatia. The vegetation in this part of the country is rather lush and mostly sufficient for maintaining the deer population throughout the year. However, in winter hay is provided as an additional food. An increasing interest in the management of deer game is present, and consequently the knowledge of their blood composition is becoming ever more important. The serum biochemical values of red and fallow deer have previously been reported elsewhere. In two reports from New Zealand (WILSON and PAULI, 1983; REID and TOWERS, 1985) and one from Scotland (KNOX et al., 1988) the observations of blood biochemical parameters in unsedated farmed red deer were described. In contrast, the studies in the United Kingdom on red deer (KENT et al., 1980), and fallow deer (CHAPMAN and CHAPMAN, 1980), as well as fallow deer from Croatia (SLAVICA et al., 2000; POLJIČAK-MILAS et al., 2004) and Slovenia (VENGUŠT et al., 2002) were based on samples obtained immediately after the deer had been shot. The biochemical parameters of chemically sedated red deer were presented (WOLKERS et al., 1994; MARCO and LAVÍN, 1999), as well as those of sedated fallow deer (DHINDSA et al., 1975). Studies conducted on red deer (MARCO and LAVÍN, 1999) and fallow deer (ENGLISH and LEPHERD, 1981; KOLB et al., 1995, 1996) have determined blood biochemical values of trapped and physically restrained animals.

The data comparison between all of these studies is rather difficult, because of the difference in sampling methods and handling treatment of the animals involved. Moreover, the season of sampling, age, sex, pregnancy status, different habitat conditions and nutrition also affect serum constituents. The present study was therefore performed to determine the physiological ranges of various biochemical parameters in the blood serum of deer species from the hunting grounds in continental Croatia.

Materials and methods

The study was conducted on forty-five free ranging fallow deer and forty-two red deer from different hunting grounds in the Moslavina region of Croatia. Blood samples were collected by jugular venipuncture, immediately after recumbancy under the effect of the drug combination, consisting of (2.2 mg/kg) zolazepam and tiletamine ("Zoletil®", Virbac, France) in combination with (1.5 mg/kg) xylazine hydrochloride ("Rompun", Bayer, Leverkusen, Germany). The solution was administered from distance, by means of a dist-inject CO_2 powered gun. The blood samples were taken in test tubes with a suppresser containing gel and congeal activator ("Becton-Dickinson", Meylan cedex, France) during the spring months of 2002. The age of the deer was estimated from the degree of eruption and wear of molariform teeth.

After coagulation the blood samples were centrifuged (1200 g /10min), serum was

extracted and stored at + 4 ºC until analysed, five hours after withdrawal. Biochemical parameters: glucose, total protein (TP), albumin, triacylglyceride, cholesterol, creatinine and urea concentration, was determined by standard methods on an automatic analyzer "Technicon RA-1000" (Technicon Instruments Corp., Tarrytown, New York). Reagents for all analyses were obtained from Randox Laboratories (Ardmore, Antrim, UK). Enzyme assays: aspartate aminotranspherase (AST), alanine aminotranspherase (ALT) and creatin kinase (CK) were done at 25 ºC according to INTERNATIONAL FEDERATION OF CLINICAL CHEMISTRY (1986).

The tested animals were divided into a group of young (animals younger than 18 months), and a group of adults (older than 18 months). The animals were further divided according to gender and species affiliation. Distribution of each variable was tested by Shapiro-Wilks' W test. The test indicated normal distribution of data for each variable. Mean values, standard deviation and 95% confidence limits for mean of each parameter, comparisons of mean values for species and age, as well as multi-factorial analysis of variance were carried out with STATISTICA 6 (Stat soft, USA, 2004.).

Results

The biochemical parameters were compared with regard to species, age and sex. Statistically significant differences were found for serum total protein, glucose, albumin, cholesterol, creatinine and urea concentration between young and adult red deer, as well as for TP, triacylglyceride and cholesterol concentration between young and adult fallow deer (Table 1.). In young animals, fallow deer males had higher body mass than females, whereas red deer males had higher TP, but lower cholesterol and creatinine concentration as well as ALT activity, than red deer females. In adult animals, fallow deer males had higher albumin and cholesterol concentration, as well as higher AST, ALT, and CK activity, but lower triacylglyceride concentration than female animals. Adult red deer males had higher creatinine concentration and CK activity, but lower albumin concentration than female animals (Table 2.).

Among the group of adult animals, the comparison of serum biochemical parameters between red and fallow deer revealed further differences. The adult red deer had higher body mass, TP, triacylglyceride, creatinine, urea and glucose concentration, whereas adult fallow deer had higher AST, ALT activity and cholesterol concentrations. When comparing the results between the young animals, higher body mass, triacylglyceride, creatinine and glucose concentration were found in red deer, whereas young fallow deer had higher albumin, cholesterol and urea concentration, as well as AST and ALT activity (Table 1.).

Table 1. Comparison of serum biochemical parameters between young and adult red and fallow deer

Biochemical parameters	Red deer		Fallow deer	
	Young n=8	Adult n=34	Young n=8	Adult n=37
Body mass (kg)	70.50±5.63	81.18^{*a}±17.4	37.31^{*A}±8.64	49.28^{*bB}±12.10
Glucose (mmol/l)	14.54±1.11	13.04^{*a}±4.43	7.39^{*A}±2.30	8.53^{*B}±2.68
Total protein (g/l)	68.57±3.99	74.34^{*a}±4.35	67.38±5.55	71.38^{*bB}±8.03
Albumin (g/l)	29.76±1,22	38.52^{*a}±5.12	37.37^{*A}±4.37	38.704.34
Triacylglyceride (mmol/l)	0.50±0.13	0.61±0,29	0.21^{*A}±0.07	0.29*^{bB}±0.11
Cholesterol (mmol/l)	1.38±0.21	1.69^{*a}±0.37	1.93^{*A}±0.33	2.30*^{bB}±0.56
Creatinine (µmol/l)	164.62±16.65	142.21^{*a}±21.91	137.25^{*A}±19.49	133.62*^{B}±16.68
Urea (mmol/l)	5.44±1.76	9.28^{*a}±2.08	8.46^{*A}±2.80	7.49*^{B}±3.23
AST (µkat/L)	0.92±0.40	1.18±0.51	1.58^{*A}±0.87	1.59*^{B}±1.37
ALT (µkat/L)	0.43±0.07	0.41±0.11	0.71^{*A}±0.14	0.61*^{B}±0.27
CK (µkat/L)	6.28±2.39	4.81±3.26	7.61±7.65	6.16±5.51

Data are expressed as mean ± standard deviation; *P<0.05

^{a}between young and adult red deer; ^{b}between young and adult fallow deer;

^{A}between young red and fallow deer; ^{B}between adult red and fallow deer.

Regarding the deer species, multi-factorial analysis of variance indicated statistically significant differences between adult and young animals (λ=0.069, P=0.001; λ=0.005, P=0.032), respectively. Between adult animals, significant differences were observed related to species for body weight (F=81.22; P=0.001), ALT activity (F=17.16; P=0.001), triacylglyceride (F=40.76; P=0.001), cholesterol (F=27.75; P=0.001), urea (F=7.55; P=0.008) and glucose concentration (F=27.47; P=0.001). Furthermore, analysis of

variance showed significant differences between young animals, related with species for body weight (F=82.85; P=0.001), albumin (F=22.48; P=0.001), triacylglyceride (F=30.28; P=0.001), cholesterol (F=15.59; P=0.001), creatinine (F=9.12; P=0.009), urea (F=6.68; P=0.02) and glucose concentration (F=62.94; P=0.001), as well as ALT (F=13.31; P=0.003) activity.

Table 2. Comparison of serum biochemical parameters between red and fallow deer regarding the gender

Biochemical parameters	Red deer				Fallow deer			
	Male		Female		Male		Female	
	Young n = 4	Young n = 5	Adult n = 23	Adult n = 23	Young n = 5	Adult n = 14	Young n = 3	Adult n = 23
Body mass (kg)	73.0 ±4.16	96.8 ±7.02	68.0 ±6.32	75.34*b ±10.03	41.5 ±7.81	61.50 ±9.56	30.33*c ±4.72	41.85*d ±5.75
Glucose (mmol/l)	14.62 ±1.01	14.15 ±1.20	14.45 ±1.35	11.74 ±3.03	7.49 ±2.68	8.90 ±1.57	6.47 ±1.44	8.30 ±3.19
TP (g/l)	66.05 ±2.39	77.3 ±4.56	71.1*a ±3.81	74.41 ±4.38	68.60 ±6.35	71.42 ±7.09	65.33 ±4.16	71.35 ±8.71
Albumin (g/l)	29.02 ±0.10	30.8 ±1.62	30.5 ±1.05	39.82*b ±4.31	39.80 ±3.03	40.71 ±3.36	33.33 ±3.05	37.48*d ±4.47
Triacylglyceride (mmol/l)	0.54 ±0.15	0.45 ±0.17	0.47 ±0.13	0.58 ±0.29	0.19 ±0.07	0.20 ±0.07	0.24 ±0.07	0.35*d ±0.09
Cholesterol (mmol/l)	1.25 ±0.19	1.81 ±0.27	1.51*a ±0.14	1.66 ±0.36	2.09 ±0.24	2.58 ±0.48	1.66 ±0.30	2.12*d ±0.54
Creatinine (µmol/l)	152.5 ±13.23	173.0 ±10.11	176.75*a ±8.9	135.45*b ±13.76	139.00 ±15.89	130.43 ±17.27	134.33 ±28.36	135.56 ±16.40
Urea (mmol/l)	4.72 ±0.74	9.57 ±1.32	6.15 ±2.3	9.76 ±1.72	9.36 ±2.20	7.96 ±2.66	6.96 ±3.53	7.21 ±3.56
AST (µkat/l)	0,81 ±0,21	0,79 ±0,18	1,03 ±0,54	1.16 ±0.46	1.87 ±1.01	2.38 ±1.88	1.11 ±0.25	1.11*d ±0.59
ALT (µkat/l)	0,39 ±0,04	0,31 ±0,05	0,48*a ±0,07	0.39 ±0.11	0.76 ±0.16	0.82 ±0.31	0.62 ±0.25	0.49*d ±0.14
CK (µkat/l)	5,24 ±1,94	8,9 ±2,93	7,31 ±2,59	4.25*b ±3.19	10.07 ±9.03	9.68 ±6.67	3.51*c ±1.19	4.01*d ±3.26

Data are expressed as mean ± standard deviation; *P<0.05;

[a]between young male and female red deer; [b]between adult male and female red deer;

[c]between young male and female fallow deer; [d]between adult male and female fallow deer.

Discussion

The glucose concentration in fallow deer in our research was rather similar to the results of studies on fallow deer species (DHINDSA et al., 1975; ENGLISH and LEPHERD, 1981; SLAVICA et al., 2000), but on the other hand, KNOX et al. (1988) and MARCO and LAVÍN (1999) reported lower glucose concentration in red deer than noted in our study. NIMITSUNTIWONG et al. (2000) connected higher concentration of blood glucose with the temperamental reaction of the animals, particularly when physical restraint was applied. Furthermore, the concentration of glucose in deer depends on the degree of sedation, and also xylazine causing hyperglycemia (BUBENIK, 1982). Combination of sedative dose used, coupled with the more vigorous reaction of red deer in the time prior to the sedative recumbence, possibly contributed to the blood glucose raising. However, analysis of variance and multi-factorial analysis undoubtedly indicate species differences regarding glucose concentration.

The concentration of total serum proteins (TP) and albumin, in fallow deer from the present study, were very similar to the values already obtained from the same species (DHINDSA et al., 1975; CHAPMAN and CHAPMAN, 1980; SLAVICA et al., 2000). Also, TP and albumin value in red deer correspond the values referred to red deer (KENT et al., 1980; KNOX et al., 1988; HAIGH and HUDSON, 1993; MARCO and LAVÍN, 1999). An increase in mean TP with age was observed in both investigated species, which supports the previously noted trends (CHAPMAN and CHAPMAN, 1980; KENT et al., 1980). Discussing the results of TP and albumin determinations, the use of anesthetic drugs, kidney and liver failure and nutrition have to be considered. The use of anesthetic drugs may alter capillary permeability, and cause a certain degree of haemodilution; loss of proteins, particularly albumin (WOLKERS et al., 1994). It is possible, that low albumin concentration in the blood of young red deer was the consequence of the sedative dose used.

Serum aspartate aminotranspherase and alanine aminotranspherase activities in red deer were similar to those found by MARCO and LAVÍN (1999) on sedated red deer, higher than the value reported in shot red deer (KENT et al., 1980), and lower than in farmed red deer (KNOX et al., 1988). The AST and ALT values in fallow deer correspond with literature data for fallow deer (KITCHEN, 1978) and fallow deer yearlings (SLAVICA et al., 2000). Again, CHAPMAN and CHAPMAN (1980) found rather low AST activity in the serum of shot fallow deer animals. ENGLISH and LEPHERD (1981) reported very high AST and ALT activities for trapped and transported fallow deer females, and they attributed high transaminase activity to muscle damages during capture, resistance and transportation. Comparison of these results is difficult due to the wide individual differences in enzyme activities and documented differences depending on capture methods (CHAPMAN, 1977), season (KOLB et al., 1996; KENT et al., 1980) and sex (NIMITSUNTIWONG et al., 2000).

The AST and ALT activities in the present study ranged over the physiological values for sedated animals for both investigated species. Analysis of variance showed that species significantly influenced the transaminase activity (F=4.68, P=0.03 for AST; F=25.62, P=0.001 for ALT). Furthermore, in the groups of young red and young fallow deer the significant positive correlation between AST and ALT activity with TP, albumin and blood urea concentration as well as CK activity were found, indicating that nutrition and muscle protein degradation also influenced the rate of a transamination reaction.

The results for CK activities in red deer were similar to the values reported in the farmed red deer (KNOX et al., 1988), and lower compared with values in the same species when trapped (MARCO and LAVÍN, 1999). Extremely low CK values were estimated for killed red deer (KENT et al., 1980). The similar differences in CK activities were found in fallow deer, depending on the capture method (CHAPMAN and CHAPMAN, 1980; ENGLISH and LEPHERD, 1981). It is obvious that CK activity grossly depends on the handling process at the time of sampling, because proper treatment decreases the rate of the animal's tissue damage.

The triacylglyceride concentration in the serum of red deer was higher in both the young and adult group, than in the serum from the corresponding fallow deer groups. Moreover, the triacylglyceride concentration in red deer in present study was higher than values obtained on sedated and trapped red deer (MARCO and LAVÍN, 1999). On the other hand, the triacylglyceride concentration of fallow deer in this study was lower than in fallow deer from the Brijuni Islands (SLAVICA et al., 2000; POLJIČAK-MILAS et al., 2004). The authors attributed those values to insufficient grazing and reinforced nutrition, mainly by corn. It is our belief that the triacyglyceride concentration partly reflects the nutritional status, but we could also presume that physiological differences are the results of variations in triacylglyceride concentration between the two species, which was proved by the results of multi-factorial analysis (P=0.001) and analysis of variance (P=0.001).

Contrary to the triacylglyceride concentration, higher cholesterol concentrations were established in both age groups of fallow deer compared with red deer. The measured cholesterol concentration in red deer was closely similar to the results of KNOX et al. (1988) and MARCO and LAVÍN (1999). Also, the cholesterol value in the sera of fallow deer corresponded with literature data for adult fallow deer (DHINDSA et al., 1975) and fallow deer yearlings (SLAVICA et al., 2000). BARTLEY (1980) reported that cholesterol concentration is strictly regulated, showing only slight annual variation related to dietary changes. Analysis of variance and multi-factorial analysis pointed to the species differences regarding cholesterol concentration (P=0.001). Taking all factors into consideration, we may presume that fallow deer had physiologically higher cholesterol level than red deer.

The assessment of blood parameters in deer game is becoming highly important in

monitoring the health status of animals. We should point out that for the proper evaluation of the results it is highly important to have in mind all factors which could influence the variations of biochemical parameters such as the use of anesthetic drugs, fear and excitement prior to sedative recumbence, muscle and protein degradation, and also nutritional status. In our research, the deer were observed during a short period in the spring time to reduce the ecological influence, climate and nutritional changes. However, to complete the nutritional and metabolic profile assessment in deer and for the sake of comparison simplicity of the results, fodder analyses might be included in future research.

References

BARTLEY, J. C. (1980): Lipid metabolism and its diseases. In: Clinical biochemistry of domestic animals. (Kaneko, J. J. Ed.). Academic Press, New York, USA, pp. 106-141.

BUBENIK, G. A. (1982): Chemical immobilization of captive white-tailed deer. In: Immobilization of North American wildlife. (Nielsen, L., J. C. Haigh, M. E. Fowler, Eds.). Wisconsin Humane Society, Inc., Milwaukee, WI, USA, pp. 334-354.

CHAPMAN, D. I. (1977): Haematology of the deer. In: Comparative clinical haematology. (Archer, R. K., L. B. Jeffcott, Eds). Oxford, Blackwell Science Publication, UK, pp. 345–364.

CHAPMAN, D. I., N. G. CHAPMAN (1980): Some serum constituents of fallow deer (*Dama dama*). Res.Vet. Sci. 29, 105-107.

DHINDSA, D. S., T. H. COCHRAN, A. CASTRO, J. R. SWANSON, J. MATCALFE (1975): Serum biochemical and electrophoretic values from four deer species and from Pronghorn antelope. Am. J. Vet. Res. 36, 1455-1457.

ENGLISH, A. W., E. E. LEPHERD (1981): The haematology and serum biochemistry of wild fallow deer (*Dama dama*) in New South Wales. J. Wildl. Dis. 17, 289-295.

HAIGH, J. C., R. J. HUDSON (1993): Farming Wapiti and Red Deer, 2nd edn. Mosby-Year Book, St. Louis, Missouri, USA, pp. 344-354.

INTERNATIONAL FEDERATION OF CLINICAL CHEMISTRY (1986): International Union of Pure and Applied Chemistry Technological Report, IFFC recommendation.

KENT, J. E., D. I. CHAPMAN, N. G. CHAPMAN (1980): Serum constituents of red deer (*Cervus elaphus*). Res.Vet. Sci. 28, 55-57.

KITCHEN, H. (1978): Hematological values and blood chemistries for a variety of artiodactylids. In: Zoo and Wild Animal medicine. (Fowler, M. E. Ed.). W. B. Saunders Company, Philadelphia, London, Toronto, pp. 815-830.

KNOX, D. P., W. A. C. McKELVEY, D. G. JONES (1988): Blood biochemical reference values for farmed red deer. Vet. Rec. 30, 109-111.

KOLB, E., R. LIPPMANN, A. ALAWAD, S. EICHLER, M.LEO, M. WAHREN (1995): Untersuchungen beim Damwild (*Dama dama* L). 1. Der Gehalt an Glukose, Cholesterol, Gesamtprotein, Harnstoff, Askorbinsäure und Vitamin E im Blutplasma von Hirschkälbern, Wildkälbern, Muchsen, Kastraten und Alttieren. Tierärztl. Umschau 50, 490-494.

KOLB, E., R. LIPPMANN, S. EICHLER, M. LEO, P. SIEBERT (1996): Untersuchungen beim Damwild (*Dama dama* L). 3. Die Aktivität der alkalischen Phosphatase, der Aspartat-Aminotransferase, der Alanin-Aminotransferase und der Adenosindesaminase im Blutplasma von Hirschkälbern, Wildkälbern, Muchsen, Kastraten und Alttieren. Tierärztl. Umschau 51, 7-13.

MARCO, I., S. LAVÍN (1999): Effect of the method of capture on the hematology and blood chemistry of red deer (*Cervus elaphus*). Res. Vet. Sci. 66, 81-84.

NIMITSUNTIWONG, W., S. HOMSWAT, U. BOONPRAKOB, S. KAEWMOKUL, A. SCHMIDT (2000): Hematological and plasma biochemical values in captive Eld's-Brow antlered deer (*Cervus eldi thamin*) in Thailand. J. Vet. Med. Sci. 62, 93-95.

POLJIČAK-MILAS, N., A. SLAVICA, Z. JANICKI, M. ROBIĆ, M. BELIĆ, S. MILINKOVIĆ-TUR (2004): Serum biochemical values in fallow deer (*Dama dama* L.) from different habitats in Croatia. Eur. J. Wildl. Res. 50, 7-12.

REID, T. C., N. R. TOWERS (1985): Blood parameters of normal farmed deer. In: Biology of Deer Production. Royal Soc. N. Z. Bull. 22, 73-76.

SLAVICA, A., Z. JANICKI, R. BARIĆ RAFAJ, E. KOLIĆ, L. MANOJLOVIĆ, D. DEŽĐEK (2000): Biochemical blood analysis of the fallow deer (*Dama dama* L.) from the Brijuni islands, Croatia. Vet. arhiv 70 (suppl.), 193-199.

VENGUŠT, G., M. KLINKON, A. VENGUŠT, A. BIDOVEC (2002): Biochemical parameters in blood of farmed fallow deer (*Dama dama*). Z. Jagdwiss. 48, 226-233.

WILSON, P. R., J. V. PAULI (1983): Blood constituents of farmed red deer (*Cervus elaphus*), II. Biochemical values. N. Z. Vet. J. 30, 174-176.

WOLKERS, J., T. WENSING, G. W. T. A. GROOT BRUINDERINK (1994): Sedation of wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*) with medetomidine and the influence on some hematological and serum biochemical variables. Vet. Quart. 16, 7-9.

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POLJIČAK-MILAS, N., A. SLAVICA, Z. JANICKI, T. S. MARENJAK, E. KOLIĆ: Usporedba biokemijskih pokazatelja u serumu crvenog jelena (*Cervus elaphus*) i jelena lopatara (*Dama dama* L.) iz područja Moslavine, Republika Hrvatska. Vet. arhiv 76, S229-S238, 2006.

SAŽETAK

Određeni su biokemijski pokazatelji u uzorcima krvi četrdeset pet sediranih jelena lopatara (*Dama dama* L.) i četrdeset i dva crvena jelena (*Cervus elaphus*) iz različitih lovišta u Moslavini, Republika Hrvatska. Mjereni biokemijski pokazatelji uspoređeni su s obzirom na vrstu, dob i spol istraživanih životinja. Usporedba rezultata mjerenja biokemijskih pokazatelja između odraslih crvenih jelena i jelena lopatara pokazala je da su crveni jeleni bili veće tjelesne mase, imali su veću koncentraciju ukupnih bjelančevina, triglicerida, kreatinina, ureje i glukoze, dok su jeleni lopatari imali veću aktivnost AST i ALT enzima te veću koncentraciju kolesterola.

Usporedba rezultata mjerenja biokemijskih pokazatelja u mladih životinja pokazala je da su mladi crveni jeleni imali veću tjelesnu masu, koncentraciju triglicerida, kreatinina i glukoze, dok su mladi jeleni lopatari imali veću koncentraciju albumina, kolesterola i ureje te veću aktivnost AST i ALT enzima. Ustanovljene razlike vjerojatno su bile posljedica različite tjelesne mase i hranidbenog statusa istraživanih životinja, no sastav i količina upotrijebljenog anestetika te uzbuđenje prije sedacije također su mogli utjecati na vrijednosti biokemijskih parametara. Provedena višečimbenička analiza i analiza varijance potvrdila je da su postojale fiziološke razlike u vrijednostima biokemijskih pokazatelja između dviju istraživanih vrsta jelena.

Ključne riječi: crveni jelen, jelen lopatar, mužjaci, ženke, biokemijski pokazatelji u serumu