Serum enzyme activities in reindeer

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Summary: The enzyme activities of CK, ALD, LDH, HBDH, MDH, GLDH, GGT, LAP, AP, CHE and GSHPx were measured by standard methods in reindeer serum during autumn 1986. No significant sex differences in enzyme activities were detected in calves. Young and adult reindeer of both sexes had slightly lower ALD, LDH, HBDH, MDH and significantly lower AP values than calves.

Keywords: reindeer, enzymes, age, sex

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Yhteenveto: Syksyllä 1986 mitattiin CK, ALD, HBDH, MDH, GLDH, GGT, LAP, AP, CHE ja GSHPx entsyymien aktiivisuudet poron seerumista vakiomenetelmin. Aktiivisuuksissa ei ollut eroa eri sukupuolten välillä. ALD, LDH, HBDH, MDH entsyymien aktiivisuudet olivat hieman alhaisemmat ja AP entsyymin aktiivisuus merkitsevästi alhaisempi aikuisilla poroilla kuin vasoilla.

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Introduction

The heamatology and blood chemistry of domestic animals with respect to age, breed, nutrition and season have been thoroughly investigated. Much attention, moreover, has been paid to the problem of measuring physiological condition in freely grazing wild ungulates. In Finland, semi-domesticated reindeer still graze almost like their wild ancestors, roaming freely in forests or subarctic mountain areas north of latitude 65°N. They show many adaptations to these conditions (e.g. Nieminen 1980). Reindeer eat mainly green vegetation in summer and carbohydrate rich lichens during the long winter. Serum concentrations of protein, lipid and mineral are highest during autumn when the reindeer are in the best condition. In freely grazing hinds and calves concentrations fall during winter; lowest values are usually found in starving hinds and calves during early spring (Nieminen and Timisjärvi 1981, 1983).

Material and methods

The study was carried out in Kaamanen reindeer research station in Northern Finland in November 1986. Fifty-two semi-domesticated reindeer (*Rangifer tarandus tarandus* L.) aged from 5 months to over 3 years were divided into 6 groups according to sex and age. All the animals grazed freely on good pastures for six months before sampling. They were captured by hand one at a time during the regular autumn round-up. No immobilizing or sedative drugs were used.

Blood was collected by jugular veinipuncture within 2 minutes of capture. Samples were cooled to +4°C and the serum was separated from coagulated blood by centrifugation within 1 hr. The serum samples were stored at –70°C until analysed.

The serum creatine kinase (CK) (EC 2.7.3.2), fructose –1,6 – diphosphate aldolase (ALD) (EC 4.1.2.13), lactate dehydrogenase (LDH)

(EC 1.1.1.27), alpha hydroxybutyrate dehydrogenase (HBDH) (EC 1.1.1.30), malate dehydrogenase (MDH) (EC 1.1.1.37), glutamate dehydrogenase (GLDH) (EC 1.4.1.3), gammaglutamyl transferase (GGT) (EC 2.3.2.2), leucine aminopepditase (LAP) (EC 3.4.11.1), alkaline phospatase (AP) (EC 3.1.3.1), cholinesterase (CHE) (EC 3.1.1.8) and glutathione peroxidase (GSHPx) (EC 1.11.1.9) were analysed by the methods recommed by the committee on Enzymes of the Scandinavian Society for clinical chemistry and clinical physiology (1974) using standard reagents Boehringer GmbH, Mannheim).

Results and discussion

The results are given in Table 1. There where no significant sex differences in serum enzyme activities of 5 months old calves or young reindeer (age 17 months) (Student's t-test). Young and adult females had slightly lower ALD, LDH, HBDH, MDH and significantly lower ($P<0.001$) AP values than female calves. Young and adult males had also lower enzyme activities than male calves during autumn.

Alkaline phosphatase (AP) is concentrated intracellularly in osteoblasts, renal tubules and the intestinal mucosa. An increase in serum AP activity is observed in bone with an increased activity of the osteoblasts during growth and pregnancy. Lowered levels can indicate malnutrition. Serum AP was high in calves during autumn, but the activity was slightly lower than in the previous studies (see Nieminen 1980, Nieminen and Timisjärvi 1983).

Creatine kinase (CK) is present in skeletal muscle, heart and brain, and it is a potential indicator of physical stress, trauma and perhaps malnutrition. Elevated CK levels have been recorded associated with the capture of game animals and reindeer (e.g. Hyvärinen *et al.* 1976, Gericke *et al.* 1978) and in cattle with paratuberculosis, in selenium (Se) deficiency, or in stress (Szilágyi *et al.* 1982, 1986). Serum CK activities of reindeer calves and females were in physiologic range in present study indicating neither severe handling stress during sampling nor other cell membran damages in individuals. However, the CK levels in reindeer appear to be higher than in domestic animals (Szihágyi *et al.* 1986, 1987).

The activity of *lactate dehydrogenase* (LDH) of calves and adult reindeer was also low in present study. High levels of LDH are usually associated with tissue breakdown. High serum urea and CK, LDH and AP activities have been found in undernourished reindeer hinds during late winter and spring (Nieminen 1980).

Activities of ALD, HBDH, MDH, GLDH, GGT, CHE and GSHPx have not been measured previously in reindeer. *Aldolase* (ALD) takes part in glycolytic process. It is present in many organs such as the liver and heart but the

Table 1. Serum enzyme activities (IU/l, $\bar{x}\pm$S.E.) in reindeer.

Reindeer	Age	n	CK	ALD	LDH	HBDH	MDH	GLDH
Female calves	5 months	11	165± 66	12.0±2.7	684±143	493±115	397±79	1.78±1.1
Males calves	5 months	8	119± 45	10.4±2.0	495± 89	347± 58	295±74	1.25±0.7
Females	17 months	7	160± 48	9.0±3.5	433± 62	309± 42	256±30	2.10±0.7
Males	17 months	5	118±102	8.1±1.3	367± 66	267± 31	231±47	1.80±1.7
Females	>3 years	19	141± 87	7.7±2.9	446± 90	320± 65	259±58	1.15±0.8
Males	>3 years	2	73± 1	7.5±1.6	410± 45	312± 3	245± 9	2.10±1.3

Reindeer	Age	n	GGT	LAP	AP	CHE	GSHPx
Female calves	5 months	11	13.4±3.9	11.9±4.4	260±59	241±53	144±37
Males calves	5 months	8	10.4±2.7	11.6±2.2	291±65	223±35	103±23
Females	17 months	7	10.1±3.5	10.7±2.7	181±51	204±47	151±42
Males	17 months	5	11.1±4.0	9.6±2.1	205±26	174±15	144±21
Females	>3 years	19	6.9±2.8	10.9±3.8	74±18	208±31	140±36
Males	>3 years	2	11.8±4.6	11.4±0.6	124±86		138±74

highest concentrations are found in the skeletal muscle. Aldolase is elevated in muscular dystrophy and acute muscular necrosis, associated with e.g. high stress susceptability or Se deficiency (Szilágyi *et al.* 1981). Damage to heart muscle, altered erythropoiesis and extreme damage to other tissue could lead to increased *alpha hydroxybutyrate dehydrogenase* (HBDH) activity. *Malate dehydrogenase* (MDH) is one enzyme of the citrate cycle. Its greatest concentration occurs in heart, skeletal muscle and liver. *Glutamate dehydrogenase* (GLDH) plays an important role in N-metabolism. It is exclusively a mitochondrial enzyme, principally found in the cells of the liver, heart, and kidney. A rise in the enzyme usually signifies cellular necrosis.

Gamma glutamyl-transpeptidase (GGT) catalyzes the hydrolysis of peptides and the simultaneous transfer of the glutamyl group. It is present in liver, pancreas, and kidneys, and hepatobiliary and pancreatic disease is the usual cause for serum enzyme increase. *Cholinesterase* (CHE) is formed in the liver. It hydrolyzes acethylcholine to choline and acetic acid. Cholinesterase activity is another diagnostic test for liver disease. It is very useful in detecting poisoning by organic phosphate insecticides or some drugs as in anesthesia. *Leucine aminopeptidase* (LAP) hydrolyzies amino acids containing alpha amino groups. The highest concentration of leucine aminopeptidase is usually found in the pancreas and liver.

The activity of serum *glutathione peroxidase* (GSHPx) in present study was rather high and may be associated with the high concentration of selenium in reindeer meat (mean 1.02 mg/kg dry weight in adult hinds). This value is about 20 times higher than in Finnish cows (see Nieminen et al. 1986). The nutritional importance of selenium and its relation to vitamin E is well known. Its specific biochemical role, however, is uncertain (see Rotruck et al. 1973). Selenium acts at the active site of GSHPx, which catalyses the conversion of peroxidized fatty acids to hydroxy fatty acids, thereby preventing lipid free radical chain reactions (Hafeman et al. 1974).

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