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EFFECT OF FEEDING ON GROWTH AND BLOOD BIOCHEMISTRY OF MALE FALLOW DEER

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ABSTRACT

The aim of this experiment was to investigate the effect of the barley grain and lysine supplement in the diet of fattened fallow deer males on the growth intensity and biochemical parameters of the blood plasma. A total of 30 male fallow deer between 10 and 11 months of age were divided into three groups: G – grazing, B – grazing with barley supplement and BL – barley supplement with addition of LysiPearl ™. Body weight, daily weight gain, total protein, albumin, urea, creatinine, total bilirubin, alanine transaminase, aspartate transaminase, gamma-glutamyl transferase were determined at the end of fattening. Significantly higher ($p < 0.05$) body weight and weight gain were found in the group supplemented with barley and lysine in the diet. Supplement of grain and lysine increased significantly ($p < 0.05$) total protein, albumin and creatinine concentration in blood plasma of monitored animals. At the same time lower catalytic concentration of ALT ($p < 0.05$) and AST in supplemented groups was found.

Keywords: feeding, lysine, blood biochemistry, growth, fallow deer

INTRODUCTION

Over the last years, there has been a growing interest in meat from alternative animal species, such as fallow deer (**Volpelli *et al.*, 2003**). The demand for so-called functional food has greatly increased over the last decade with greater attention paid to the quality of products consumed.
In Cervidae, nutritional demands are mostly influenced by the ontogenetic growth and reproduction phase. Grazing on grasslands is a vital component of deer nutrition and under moderate climate, herbage from grassland represents cca 50 % of the total diet during the spring-autumn period in wild living cohorts and food choice of Cervidae is rather conservative even under altered environmental conditions (**Fischer *et al.*, 2008**). Barley is very often used as a feed for cervids. The advantage of barley is in excellent dietetics. It still has a reasonable fiber content and by animals is well received. The fiber is very beneficial for the shift of digestion and the release of nutrients, it is a significant prevention of dietary disorders. Lysine stimulates the growth and production of livestock, and this amino acid is routinely added to the rations of simple stomached species (e.g. poultry and swine) (**McDondald *et al.*, 1995**). Lysine is also one of the limiting amino acids for lactating dairy cows (**Polan *et al.*, 1991**). Since lysine has been identified as one of the top limiting amino acids for ruminants, research has expanded to also include polygastric animals, and very recently to cervids. The study of amino acid metabolism in ruminants is confounded by the fact that ruminal microorganisms degrade feed proteins and amino acids, and microbial protein is the primary source of amino acids for the animal (**Onodera, 1993; Velle *et al.*, 1998**). To estimate the nutritional status and growth performance of Cervidae, blood sampling is the most widely used method (**Säkkinen *et al.* 2001; Soppela *et al.* 2008; Gaspar-López *et al.* 2009; Rosef *et al.* 2010**).

MATERIAL AND METHODS

Animal selection and trial design

A total of 30 male fallow deer between 10 and 11 months of age were divided into three groups (ten in each) on a live weight basis on three neighboring approximately two-hectare fens. The age of animals at the end of experiment was about 17 months. All animals came from the same flock. For the first group (G), nutrition throughout the experiment was ensured only by grazing. The second group (B) was supplemented with whole barley grain besides grazing. The experiment was performed since end of April till end of October. The first 90 days of fattening was barley supplement 0,2 kg per animal and day, for the remaining period of fattening (on average 76 days), the dose was increased to 0.4 kg per animal and day. The third group (BL) was supplemented in the same way as second group, but in addition received LysiPearl ™ in an amount of 5 grams per animal and day. This product contains 50% synthetic amino acids lysine (planned dose of 2.5 g lysine per animal and day), and hydrolyzed palm oil. It is a feed supplement containing the essential amino acid in the protected a form that prevents its digestion in rumen and allows its passage in unchanged form to the abomasum. Grain was feed once a day for both fed groups into wooden trough, the length of which per one individual represented 80 cm. At the beginning and at the end of the experiment the live weights of the monitored animals were monitored. From the differences in weight, the average daily weight gain in individual groups was determined.

Sample collection procedures

After reaching the planned age, animals were slaughtered. Blood samples were collected during bleeding and stabilized with heparin. Subsequently, the blood was centrifuged and blood plasma separated. Blood plasma samples were frozen at -80°C until analysis.

Blood plasma biochemistry analysis

From the blood plasma, the levels of the following indicators of the metabolic profile were determined: total protein (TPROT), albumin (ALB), urea (UREA), creatinine (CREA), total bilirubin (TBIL), alanine transaminase (ALT), aspartate transaminase (AST), gamma-glutamyl transferase (GGT) Biochemical indicators were analysed on anT20xt automatic analyser (Thermo Fisher Scientific, Finland) with currently available commercial kits (Biovendor-Laboratorní medicína, a.s., Czech Republic).

Statistical analysis

The data are expressed as means ± SEM. Data were analyzed by one-way ANOVA for factor diet as an independent variable. ANOVA was followed by the post-hoc Fischer LSD test for pairwise comparisons, when appropriate. All statistical analyses were performed using STATISTICA 12.0 statistical software

(StatSoft Inc., Tulsa, USA). The overall level of statistical significance was defined as $p < 0.05$.

RESULTS AND DISCUSSION

Results of the growth intensity of animals depending on the nutrition presented, are shown in Table 1. It is clear, that the supplementation of grain into diet increased in groups of deer B and BL live weight at the end of fattening of about 5 kilograms compared to the grazing group. The average daily gain in fattening was for groups B and BL about 30% higher. As in our work, **Volpelli *et al.* (2003)** described the supplementation of the concentrate to the diet of fattening deer which was resulting in an increase in live weight by approximately four percent.

Table 1 Live weight at the beginning, at the end and daily weight gain of fallow deer males according to group of diet

	Group						
	G		B		BL		
n	10		10		10		
	mean	SE	mean	SE	mean	SE	p value
Live weight at the beginning (kg)	**28.4**	0.709	**28.0**	0.422	**28.1**	0.661	0.642
Live weight at the end (kg)	**45.6**^{a}	0.593	**50.2**^{b}	0.739	**51.4**^{b}	1.078	<0.001
Daily weight gain (g.day^{-1})	**97.9**^{a}	0.004	**127.4**^{b}	0.004	**133.9**^{b}	0.004	<0.001

Table 2 shows the results of the mean values of blood plasma parameters within the monitored groups. One-way ANOVA results determined significant differences in plasma albumin concentration ($F(2, 27) = 13.344$, $p < 0.001$). Concentration of albumin showed the highest average values in the group with addition of barley and lysine (BL). This value was significantly higher compared to the barley (B) group and the group of animals receiving only grazing (G). A similar trend was observed for the total protein concentration ($F(2, 27) = 3.1903$, $p = 0.047$), but only the concentration between G and BL groups were significantly different. The highest blood urea value of the monitored animals was recorded in group G, but without significant difference. Conversely, creatinine concentration ($F(2, 27) = 6.1667$, $p = 0.006$) was significantly lowest in this group. No significant differences in total bilirubin concentration, AST and GGT catalytic concentration were found between the groups of animals. Another difference show also results of one-way ANOVA ($F(2, 27) = 4.0357$, $p = 0.029$) for the ALT concentration within the groups. The ALT catalytic concentration in G group was significantly highest.

Table 2 Blood plasma metabolites concentration of fallow deer males according to group of diet

	Group						
	G		B		BL		
n	10		10		10		
	mean	SE	mean	SE	mean	SE	p value
Albumin (g.l^{-1})	**32.88**^{a}	0.572	**34.76**^{b}	0.579	**37.20**^{c}	0.624	<0.001
Total protein (g.l^{-1})	**59.84**^{a}	1.161	**60.17**^{sb}	0.634	**62.69**^{b}	0.729	0.047
Urea (mmol.l^{-1})	**8.44**	0.216	**7.52**	0.259	**7.37**	0.696	0.202
Creatinine (μmol.l^{-1})	**102.8**^{a}	5.378	**122,4**^{b}	4.365	**123,8**^{b}	4.357	0.006
Total bilirubin (μmol.l^{-1})	**1.89**	0.793	**3.08**	0.668	**2.01**	0.300	0.139
ALT (μkat.l^{-1})	**1.43**^{a}	0.080	**1.10**^{a}	0.088	**1.14**^{a}	0.096	0.029
AST (μkat.l^{-1})	**2.47**	0.137	**2.32**	0.145	**2.08**	0.212	0.258
GGT (μkat.l^{-1})	**0.70**	0.054	**0.69**	0.061	**0.87**	0.087	0.142

Nutritional status is primarily evaluated in deer taking serum nitrogenous compounds into consideration (**Phillip *et al.*, 2007**) which is depend on the condition that these animals can conserve nitrogen when protein restriction occurs via increased renal re-absorption and urea recycling, thus limiting urinary nitrogen loss (**Robbins *et al.*, 1974**). Total protein concentration increases with aging in deer and reaches a plateau at about ten months of age (**Thrall, 2004**). Our results correspond to findings that elevated dietary protein content can significantly increase serum protein concentration (**Soppela *et al.*, 2008**). Total protein as well as albumin concentration increased in supplemented groups. In addition, our results show that lysine supplementation increases the amount of total protein and albumin in blood plasma. **Säkkinen *et al.* (2001)** proposed serum urea and creatinine and their quotient to estimate protein and energy intake. Digestible protein load increases serum urea concentration, which may as well occur if low protein supply is coupled with energy restriction (**Warren *et al.* 1982**). However, an increase in urea concentration may also be result of insufficient energy supplementation in the diet when the organism obtains the necessary amount of energy by degradation of muscle proteins (**Seglar, 1997**). This assumption corresponds to the findings in our study, where higher urea concentrations were determined in animals without grain supplementation. Contrary to **Säkkinen *et al.* (2001)** who showed that feed restriction increases serum creatinine levels in deer, creatinine concentration was in our study lowest in the group without grain supplementation. Variation of creatinine concentration has been found to be related to changes of muscle mass and the excretion of creatinine (**DelGiudice *et al.*, 1992**; **Wolkers *et al.*, 1994**). It means that serum creatinine concentration is directly proportional to the muscle mass of the organism, and for this reason we assume, that significantly higher creatinine in group B and BL is due to higher live weight of monitored animals. Serum ALT and AST activities are elevated during muscle or liver damage in bovine and other species and their high activities occur 24 – 48 hours after injury (**Meyer *and* Harvey, 1998**). The fluctuation of these enzymes activity in blood is also explained as being caused by the changing quality of food that accelerated the protein (enzyme) synthesis. We only found significant differences in ALT activity in our study. Despite of the fact that the concentration was highest in group G, this value was still within the physiological range. Although no significant difference in AST catalytic concentration was found the highest value was determined in group G. We can assume that the lower activities of these enzymes in groups B and BL are due to lower energy demands recovery from the reserves because of dietary grain supplementation.

CONCLUSION

Based on the results obtained, we can state that the supplementation of barley to the diet of fattened fallow deer together with addition of lysine increases the growth rate of these farmed animals. The determined blood biochemistry parameters provide important information on the nutritional status of the monitored animals. It is obvious that the supplementation of energy in the form of grain and the addition of lysine positively influences the nitrogen metabolism parameters and eliminates the load related with obtaining energy from body reserves.

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