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UTILIZATION OF WHITE LUPINE SEEDS FOR DWARF RABBITS´ NUTRITION – THEIR EFFECT ON GROWTH RATE AND BLOOD INDICATORS

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INTRODUCTION

Because breeding of dwarf rabbits is becoming more popular in the Czech Republic, one of the areas of concern for feed companies is also the optimization of diet for dwarf breeds of pet rabbits. Recent studies on hybrid meat-type rabbits found that dietary inclusion of white lupin seeds (WLS) had a favourable effect on the production and quality of milk in does, on growth performance of young rabbits and fattened rabbits, on mortality and other important productive traits (Volek et al., 2014).

The aim of the present study was to assess the effect of inclusion of the meal from whole WLS in diets on the growth and selected blood indicators of young dwarf rabbits.

MATERIALS AND METHODS

In the experiment, 22 young rabbits of the Dwarf Lop breed were used. Rabbits were placed in a common hobby breeding stock, while all rabbits were housed under identical environmental conditions. After kindling, the does with their litters were subdivided into 2 dietary groups. The control (C) group of the dwarf rabbit does and their litters was fed a commercial pelleted diet intended for nutrition of dwarf rabbits in the course of the whole experimental period (up to the 15th week of kits´ age), when main protein sources used in this diet were alfalfa meal and malt sprouts. Rabbit does and their litters in the experimental (E) group were fed a pelleted diet containing 25 % proportion of meal from whole WLS of Amiga *var*. as the main protein feed component. After weaning (7th week of age), young rabbits of the C group were fed the same commercial diet as before weaning, whereas young rabbits of the E group were fed the pelleted experimental post-weaning diet containing 20 % proportion of meal from whole WLS of Amiga *var.* The ingredient and chemical compositions of the respective diets are presented in *Table 1* and *2*. In addition, rabbits were given meadow hay 3 times a week. During the experiment, rabbits had free access to drinking water. The sex ratio of the raised rabbits was approximately equal in all groups.

Table 1: Ingredient composition of pelleted diets used for the Dwarf Lop rabbits

Ingredient (g/kg of the diet)	**C diet**	**Pre-weaning E diet**	**Post-weaning E diet**
Alfalfa meal	417.0	290.0	270.0
Barley	85.0	100.0	30.0
Wheat bran	226.0	100.0	175.0
Oat	0	100.0	140.0
Oat bran	60.0	0	100.0
WLS	0	250.0	200.0
Malt sprouts	151.0	50.0	0
Sugar beet pulp	29.0	0	20.0
Chicory root	0	48.0	0
Melglyko	0	30.0	0
Mollasses	19.0	0	0
Glycerol	0	0	30.0
VMP	0	10.0	5.0
MCP	1.0	7.0	15.0
$CaCO_3$	8.5	10.0	10.0
NaCl	3.5	5.0	5.0

C = control; E = experimental; WLS = white lupin seeds *var*. Amiga; VMP = vitamin and mineral premix; MCP = monocalcium phosphate; $CaCO_3$ = calcium carbonate.

Table 2: Chemical composition of pelleted diets used for the Dwarf Lop rabbits

Nutrient (g/kg of DM)	**C diet**	**Pre-weaning E diet**	**Post-weaning E diet**
Crude protein	160.5	192.8	188.6
Crude fat	26.8	45.8	45.5
Crude fibre	173.2	160.9	140.3
ADF	233.6	229.1	187.9
NDF	420.0	344.6	316.6
ADL	53.0	60.1	45.7
Crude starch	151.9	175.2	194.1
Crude ash	86.2	77.5	80.6
Ca	11.2	10.9	10.8
P	5.7	5.5	7.7
GE (MJ/kg)	18.3	18.7	18.4

DM = dry matter; C = control; E = experimental; ADF = acid detergent fibre; NDF = neutral detergent fibre; ADL = acid detergent lignin; Ca = calcium; P = inorganic phosphorus; GE = gross energy.

Blood sampling was performed at the age of 15 weeks. The blood samples were taken from *vena saphaena lateralis*. The blood was transferred to sample tubes with heparin and transported to the laboratory. The count of red blood cells and white blood cells was determined manually using a haemocytometer, while Hayem's solution, resp. Tűrck's solution, was used as a diluting fluid. The haematocrit value was performed by the micro-haematocrit method. The haemoglobin concentration was determined using the cyanohaemoglobin method with Drabkin's solution. Then, erythrocytic indicators such as mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were calculated. Biochemical indicators were determined in the blood plasma, after centrifuging heparin-stabilised blood. Samples were analysed using a DPC KONELAB 20i analyser® (THERMO FISHER SCIENTIFIC, Finland). The following biochemical indicators were determined: total protein, albumin, glucose, total cholesterol, triacylglycerols (TAG), creatinine, urea, calcium, inorganic phosphate and the activities of aspartate aminotransferase, alanine aminotransferase (ALT), and alkaline phosphatase. Subsequently the albumin:globulin (A/G) ratio was calculated.

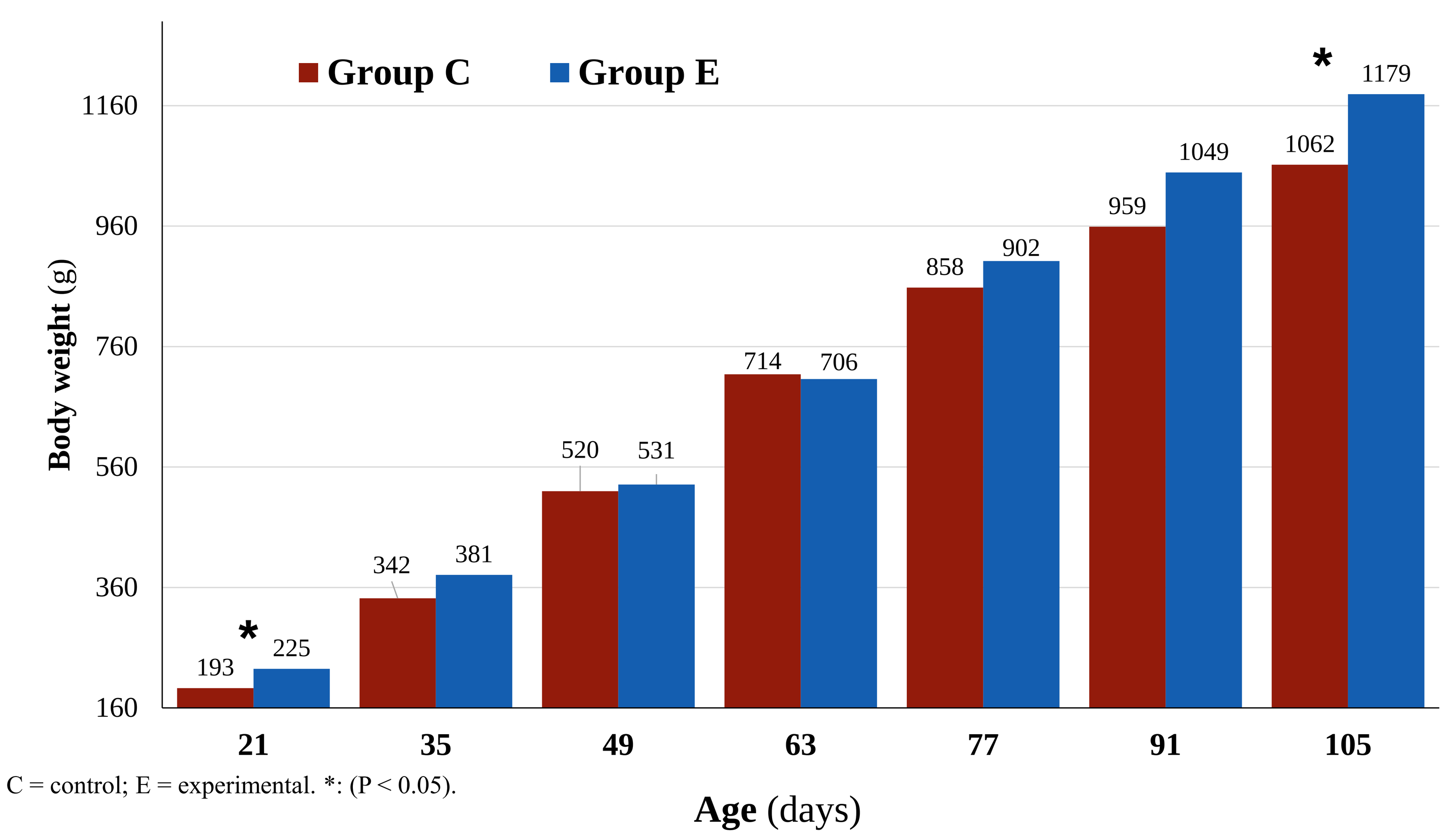
Statistical analyses were performed using the STATISTICA CZ version 10 software. An arithmetic mean and 95% confidence interval were determined for the monitored blood indicators. ANOVA was used to determine differences in the body weight (BW) and monitored blood indicators.

RESULTS

At the age of 21 days, rabbit kits of the E group displayed a higher average BW as compared to those in the C group ($P < 0.05$; *Figure 1*). This finding indirectly indicates on higher milk production of does in the E group, which is in accordance with results recently observed in meat-type rabbit does, when they were fed a diet partially consisting of WLS (Volek et al., 2014). The higher milk production of does in the E group was likely associated with the higher crude fat content in the diet, which was recently confirmed in the meat-type rabbit does (Pascual et al., 2003). Generally, WLS are considered as an important source of dietary high-quality oil which contains a beneficial profile of fatty acids. Afterwards, at the age of 35, 49, 63, 77 and 91 days, no significant differences were found in BW between the E and C groups. However, at the end of the experiment (105th day of age), rabbits of the E group showed a higher BW as compared to those in the C group (1179 vs. 1062 g, respectively; $P < 0.05$).

Blood examination in the 105-day old dwarf rabbits revealed that the E group showed the decreased level of albumin and the value of A/G ratio in the plasma as compared to the C group ($P < 0.01$; *Table 3*). In addition, rabbits of the E group displayed the lower TAG plasma level and the lower activity of ALT in the plasma as compared to those in the C group ($P < 0.05$). These findings are in agreement with results of our previous study conducted on dwarf rabbits. In that study, dietary inclusion of meal from WLS of Dieta *var.* significantly influenced the selected plasma indicators of protein metabolism (Šimek et al., 2018). Moreover, the partial dietary inclusion of meal from WLS in the present study also had ALT-lowering effect, which can be considered as beneficial in terms of health maintenance in companion animals.

Figure 1: Average body weight of growing Dwarf Lop rabbits in relation to dietary group



C = control; E = experimental. *: (P < 0.05).

Table 3: Blood indicators of 15-week-old Dwarf Lop rabbits in relation to dietary group

Indicator (unit)		**C group** (n =10) mean	CI	**E group** (n =12) mean	CI	***P***
Haematological examination						
Red blood cells	($\times10^{12}$/l)	6.3	5.79-6.88	5.6	5.01-6.26	ns
White blood cells	($\times10^{9}$/l)	6.5	4.75-8.31	5.5	3.82-7.22	ns
Haematocrit value	(l/l)	0.36	0.32-0.39	0.34	0.32-0.36	ns
Haemoglobin	(g/l)	116.2	105.36-126.97	115.9	108.42-123.36	ns
MCV	(fl)	56.9	51.26-62.67	60.9	54.70-67.15	ns
MCHC	(pg)	327.5	295.68-359.27	342.9	337.22-348.67	ns
Plasma biochemistry						
Total protein	(g/l)	51.4	48.73-53.97	52.2	48.94-55.52	ns
Albumin	(g/l)	29.8	26.42-33.26	23.6	21.19-26.04	**
Globulin	(g/l)	21.5	19.00-24.02	28.6	24.70-32.52	**
A/G		1.4	1.15-1.73	0.87	0.66-1.07	**
Glucose	(mmol/l)	5.9	5.57-6.25	6.3	5.62-7.06	ns
Total cholesterol	(mmol/l)	1.3	1.08-1.61	1.2	0.90-1.63	ns
Triacylglycerols	(mmol/l)	0.78	0.59-0.98	0.53	0.37-0.69	*
Creatinin	(µmol/l)	80.0	66.94-93.11	82.9	67.39-9852	ns
Urea	(mmol/l)	5.7	4.94-6.54	4.9	3.73-5.99	ns
ALP	(µcat/l)	1.7	1.15-2.32	1.4	0.79-2.01	ns
ALT	(µcat/l)	1.7	0.73-2.61	0.76	0.59-0.93	*
AST	(µcat/l)	0.57	0.21-0.93	0.49	0.29-0.69	ns
Calcium	(mmol/l)	2.9	2.74-2.99	2.7	2.50-2.82	*
Inorganic phosphate	(mmol/l)	1.7	1.53-1.99	1.8	1.36-2.31	ns

C = control group; E = experimental group; CI = 95% confidence interval; MCV = mean corpuscular volume; MCHC = mean corpuscular haemoglobin concentration; A/G = albumin/globulins ratio; ALP = alkaline phosphatase; ALT = alanine aminotransferase; AST = aspartate aminotransferase.

ns = non-signifcant; * = P < 0.05; ** = P < 0.01.

Figure 2 and 3: Young Dwarf Lop rabbits with their does receiving the experimental diets

CONCLUSIONS

Inclusion of the 25 % proportion of meal from whole WLS in the diet intended for lactating does led to the favourable increase in BW of suckling dwarf rabbit kits. Feeding the experimental post-weaning diet with 20 % proportion of meal from whole WLS resulted in favourable growth intensity of raised dwarf rabbits, while at the end of the experimental period these rabbits gained higher BW.

Moreover, the experimental post-weaning diet had the significant effect on protein metabolism and the significant TAG-lowering effect was observed in blood plasma of 105-day old rabbits. Also the positive effect of the experimental post-weaning diet on the activity of ALT in blood plasma was found in these rabbits.

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