EFFECT OF PARTIAL SUBSTITUTION OF SOYBEAN MEAL WITH LUPINE SEEDS ON METABOLIC INDICES BLOOD, CARCASS VALUE AND MEAT QUALITY OF BROILERS

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Abstract

The aim of the study was to investigate the effects of different levels of free alkaloid lupine seeds in feeding broilers, on meat quality and blood metabolic indices (indices slaughter weight in regions with high commercial value housing structure, the structure of the thigh tissue and chest and chemical composition of meat). A total of 120 Ross 308 chicks were divided into four groups. Lot Lc (control) was fed a diet of corn and soy soybean. The experimental diets were used with different levels of substitution of soy protein meals lupine beans (low, medium and high for groups E_1, E_2 and E_3 respectively). The results show that when properly balanced compound feeds in energy, protein and amino acids limits, substituting soy protein meals in broiler chickens with lupine flour by up to 30% in the starter phase (1-21 days) and 60% in the growth phase (22-35 days) and finishing (36-42 days), has no adverse effect on weight gain, carcass quality and meat. Biochemical tests suggest that lupine beans does not significantly influence the metabolism of proteins, in turn have a positive effect on blood lipoprotein (HDL increases and decreases LDL). Slaughter inspection results shows overall differences statistically only for chickens, in which food was introduced lupine highest proportion both to the control group (Lc) and compared to other experimental groups were recorded lower values both carcass weight and carcass weight as chest in case structure ($p < 0,05$). Except for the liver, other internal organs, but especially goiter and gizzard showed significantly higher values in the offspring of the food groups which have used high proportions of lupines than those in the control group (Lc). Substituting soy protein meals in broiler chickens at a rate of 40% in the starter phase and 80% thereafter until slaughter, has a negative influence on the tissue structure of the housing, reducing the proportion of meat in favor of bone ($p < 0,05$), but also on the chemical composition of the meat, increasing crude ash content ($p < 0,01$).

Key words: lupine seeds, broiler, HDL, carcass value.

INTRODUCTION

Research mystery shopping assignment followed experimentation possibility of using lupine flour free of alkaloids obtained in specific climatic conditions of the area west of the country, in broiler diets. Interest in using lupine beans in broiler diets is justified primarily by high protein content (40.08% CP), and the high-energy (3030 kcal ME/kg) determined by high fat content (9.74%) (Mierlita, 2012).

In Romania, cultivation and also using white lupine seeds in feeding birds is not promoted as in other countries, though, is a viable alternative to soybean cakes from imports, both in terms of bio as well as economic and ecological. From the ecological point of view, white lupine has the advantage that it is not genetically modified, and because it can fix atmospheric nitrogen for fertilizer requires small amounts of chemical

fertilizers, is considered as a sustainable culture positive effects on soil fertility and the environment. Most studies have shown that, by introducing lupine in proportions of up to 25% in broiler chickens obtained results are similar to those provided by diets based on soybean (Centeno et al., 1990, Brenes et al. , 1993; Lettner and Zollitsch 1995 and Cermac Sitko, 1998; Egorov et al., 2001 Nalle et al., 2010; Suchy et al., 2010). Froidmont et al., (2004) concluded that to maintain growth performance of chickens, lupine flour can be inserted into food to a maximum of 30% and can not substitute completely lupine meals dietary soybean chicken. Moschini et al. (2004) and Nalle et al., (2010) concluded that broilers up to 21 days of age can not tolerate large quantities of 200 g lupine/kg feed.

Use of lupine as the sole source of protein for poultry is limited on one side of the protein biological value (low content in methionine, lysine, tryptophan and threonine - Strakova et al., 2006), and the high content in PNA (polysaccharides neamidonoase) changes affecting the digestion and recovery food (Kocker et al., 2000 Brenes et al., 2002 Steenfeldt et al., 2003 Mieczkowski et al., 2004; Choct, 2006). Research has been designed to verify to what extent soybean cakes broiler chickens can be partially replaced free of alkaloids lupine beans, watching the effect of the alternative sources of protein on blood metabolic indices, carcass value and chemical composition of meat.

MATERIAL AND METHODS

The experiment was conducted as a completely randomized experimental design consisted of four treatments involving a control diet consisting of corn - soybean (Lc) and three experimental diets (E_1, E_2 and E_3) to the protein of the cakes soy flour was replaced with lupine alkaloids free with 20%, 30% and 40% during 1-21 days and 40%, 60% and 80% in 22-42 days. By substituting made to secure a share in the structure of lupine flour fodder between 9.4 to 18.7% in the starter phase, the growth phase from 17.1 to 34.2% and from 14.7 to 29.3 % in the finishing phase. In experiment were used white lupine beans, variety Energyl (improved in France), grown in specific climatic conditions of the western part of Romania, using seed imported from Holland (Mierlita, 2012). All diets were formulated to contain similar levels of metabolizable energy, crude and limiting amino acids prteina (lysine and methionine).

A total of 120 Ross 308 chicks were divided into four groups, following the body weight and feed consumption.

At the age of 42 days before slaughter blood samples were collected (n = 4/lot, 2 roosters and two chicks) in order to determine the main constant blood (glucose, total protein, urea, uric acid, triglycerides, HDL, LDL) using laboratory techniques dedicated to this purpose. At the end of the experience

productive effect, in order to assess the quantitative and qualitative meat production were sacrificed eight chickens/ group (four roosters and four chicks) by random draw. At slaughter control were determined: commercial carcass weight, carcass weight grill, table and cover the main parts of the mass transit internal organs. The boning to determine the amount of flesh on parts: chest and legs. Based on data obtained were determined: slaughter yield for housing, commercial and housing grill, grill shell weight parts, internal organs of the carcass weight and weight of commercial meat and bones in pieces to cut and cover grill. The chemical composition was determined by the method Weende raw meat of the most important portions of the case: chest and thigh.

Testing the significance of the differences between groups was done by applying ANOVA (Pallant J., 2007). Differences were declared significant at $p < 0.05$.

RESULTS AND DISCUSSION

The health of the offspring was evaluated based on biochemical tests, as determined: serum total protein, glucose, urea, uric acid, triglycerides, HDL (high density cholesterol - "good") and LDL (low density cholesterol - "bad") (Table 1). Partial substitution of soy flour cakes lupine in broiler chickens revealed no significant effects on total protein in the blood at the age of 42 days. Significant differences ($p < 0.05$) were observed for blood uric acid level, the main product of protein metabolism in birds. Uric acid in the blood was higher in offspring which in feeding lupine flour was used, the values are directly proportional to the weight recorded lupine in chickens. The results suggest that lupine proteins have a biological value lower than those from soybean cakes, confirming the findings of previous research (Rubio et al., 2003, Roth-Maier et al., 2003 Mieczkowski et al. 2005 Strakova et al., 2008), which emphasizes the need to balance the use of synthetic amino acids amino acid diets containing lupine.

Table 1

Influence of lupine seeds on the main blood biochemical indices in broilers (n = 4)

Issue	Group			
	Lc	E_1	E_2	E_3
Glucose (mg / dL)	168,4 ± 17,2	160,7 ± 32,8	156,1 ± 53,6	155,9 ± 46,3
Total protein (g / L)	29,11 ± 6,24	29,00 ± 3,47	28,01 ± 5,41	27,40 ± 2,36
Urea (mg / dL)	6,12 ± 0,51	6,24 ± 0,72	6,26 ± 0,62	6,72 ± 0,54
Uric acid (mg / dL)	$5,45 \pm 0,74^{b}$	$5,67 \pm 0,80^{b}$	$5,29 \pm 0,46^{b}$	$6,41 \pm 0,81^{a}$
Triglycerides (mmol / dl)	1,73 ± 0,47	1,59 ± 0,39	1,76 ± 0,62	1,81 ± 0,76
HDL (mmol / dl)	$1,12 \pm 0,14^{b}$	$1,05 \pm 0,21^{b}$	$1,23 \pm 0,18^{ab}$	$1,37 \pm 0,20^{a}$
LDL (mmol / dl)	$1,24 \pm 0,32^{a}$	$1,12 \pm 0,19^{b}$	$1,05 \pm 0,27^{b}$	$1,01 \pm 0,37^{b}$

Triglycerides and blood glucose level was not influenced by the inclusion of lupins in chickens, the values recorded in compliance with specific physiological broilers (Meluzzi et al., 1992). This lupins in chickens influenced the lipoprotein (HDL and LDL) in the blood serum. In chicks fed the highest level of lupine (E_3) was recorded, compared to offspring of the control group (Lc), a value significantly higher HDL fraction (1.37 vs. 1.12 mmol/dL, $p < 0.05$) and a significantly lower value for the fraction of LDL (1.01 vs. 1.24 mmol/dL, $p < 0.05$), which proves the positive influence of lupine on the health of offspring reared intensive. Results slaughter inspection made at the end of the experiment, expressed in relative values are given in Table 2. The data analyzed indicator shows overall differences statistically only for chickens in group E_3, in which food was introduced lupine highest proportion both to the control group (Lc) and from experimental E_1 and E_2.

The highest values of the indices of slaughter analysis in the control register (Lc) and the lowest in group E_3, which leads to the conclusion that partial substitution of soybean cakes with lupine flour had a negative influence on the characteristics housing. Thus, compared to the group Lc, commercial carcass yield and carcass grill was lower by 2.48% (75.69 vs. 73.81%) and 2.70% (68.65 vs. 66.80%) in the offspring of E_3, the differences being statistically ($p < 0.05$). Except chest share of housing structure, which recorded significantly higher in group Lc ($p < 0.05$), other portions trans housing showed no significant differences in the experimental groups compared to the control group.

Table 2

Influence of partial substitution of soy bean cakes lupines on carcass characteristics in broilers (n = 8; 4♂ + 4♀).

Issue		Group			
		Lc	E_1	E_2	E_3
Live weight (g)		$2617,4 \pm 81,36^{a}$	$2583,71 \pm 53,34^{a}$	$2554,63 \pm 68,1^{ab}$	$2520,17 \pm 98,26^{b}$
Carcass -%:					
	- commercial	$75,69 \pm 7,31^{a}$	$74,60 \pm 5,12^{a}$	$74,16 \pm 6,18^{a}$	$73,81 \pm 3,12^{b}$
	- grill	$68,65 \pm 4,73^{a}$	$67,77 \pm 8,14^{a}$	$67,07 \pm 3,72^{a}$	$66,80 \pm 5,41^{b}$
% - breast grill	Chest	$35,72 \pm 1,72^{b}$	$35,80 \pm 0,94^{b}$	$35,43 \pm 0,43^{b}$	$34,67 \pm 1,95^{a}$
	Legs	$30,81 \pm 1,10$	$31,14 \pm 1,71$	$30,70 \pm 0,84$	$30,95 \pm 1,38$
	Wings	$11,74 \pm 2,15$	$11,53 \pm 0,93$	$12,01 \pm 1,62$	$11,71 \pm 0,78$
	Beack	$21,73 \pm 1,58$	$21,50 \pm 2,91$	$21,86 \pm 1,70$	$22,67 \pm 2,09$
% -commercial carcass	Neck	$1,32 \pm 0,08^{b}$	$1,30 \pm 0,17^{b}$	$1,42 \pm 0,09^{a}$	$1,30 \pm 0,11^{b}$
	Liver	$1,69 \pm 0,17$	$1,66 \pm 0,15$	$1,71 \pm 0,23$	$1,74 \pm 0,20$
	Heart	$0,59 \pm 0,09^{b}$	$0,61 \pm 0,09^{b}$	$0,70 \pm 0,11^{a}$	$0,70 \pm 0,06^{a}$
	Chin	$0,31 \pm 0,05^{c}$	$0,35 \pm 0,07^{ab}$	$0,39 \pm 0,06^{b}$	$0,48 \pm 0,07^{a}$
	Gizzard	$1,48 \pm 0,17^{c}$	$1,58 \pm 0,36^{c}$	$1,74 \pm 0,09^{b}$	$1,93 \pm 0,20^{a}$
	Total organ	$7,04 \pm 0,42$	$6,83 \pm 0,71$	$7,09 \pm 0,38$	$7,01 \pm 0,68$

Total weight of organs in commercial carcass structure, no significant differences in the experimental groups compared with the control group. It is worth noting that except liver, all other organs, but especially crop and gizzard showed significantly higher values in offspring of experimental E_2 and E_3, to those in the control group (Lc). Our results indicate that inclusion of lupine flour in large proportions of meat chickens (40% of soy protein meals provided by the first growth phase and 80% in the other two phases of growth - if the batch E_3) can be a negative effect on performance indicators and housing value. The results are in agreement with findings reported by Egorov et al. (2001) who found that the best results were obtained when lupine flour was up 20% in diets for broilers structure. Similar studies with similar conclusions were made RothMaier and Paulicks (2003) and Suchy at al. (2010).

The introduction of lupine flour in fodder structure did not affect the breast and thigh tissue structure and report that meat:bone registered at this port trans case (Table 3). Exceptions are the offspring of E_3, where the proportion of the breast meat was significantly lower ($p < 0.05$), which means that substituting soy protein meals in broiler chickens at a rate of 40% during starter and 80% thereafter until slaughter, has a negative influence on the tissue structure of the carcass.

Table 3

The proportion of meat and meat report: bone in the main body regions of the carcass.

Issue		Group							
		Lc	V%	E_1	V%	E_2	V%	E_3	V%
Chest	Meat -%	85,49±0,72^b	1,29	85,07±0,53^b	2,42	85,65±1,03^b	1,74	83,31±1,37^a	1,91
	Bones -%	14,51±0,23^b	3,71	14,93±0,59^b	2,76	14,35±4,71^b	5,14	16,69±2,40^a	6,17
	Meat: Bone	5,89/1±0,24^b	0,97	5,70/1±0,28^b	1,31	5,97/1±0,3^b	1,64	4,99/1±0,18^a	2,10
Thigh	Meat -%	70,48±1,72	3,08	70,15±1,43	2,01	70,02±0,91	1,05	69,48±1,39	2,94
	Bones -%	29,52±2,18	5,43	29,85±3,78	5,82	29,98±4,07	7,31	30,52±3,95	6,41
	Meat: Bone	2,39/1±0,19	1,06	2,35/1±0,22	0,83	2,33/1±0,55	0,70	2,27/1±0,65	0,99

Reduce the proportion of meat in favor of bone, registered in the chest is probably due to amino acid imbalance caused by lupine beans. The use of lupine flour in large proportions in broiler chickens, involves a balancing analysis and fodder in amino acids. Substitution of soy protein meals in broiler chickens with lupine flour by up to 30% in the starter phase (1-21 days) and 60% in the growth phase (22-35 days) and finishing (36-42 days), virtually no change in carcass meat proportion and ratio meat: bones, these parameters are identical to those registered for chickens in the control group (Lc) in food which have been used only as a source of soybean meals protein.

Partial replacement of soybean cakes with lupine flour in broiler chickens resulted in no significant differences ($p > 0.05$) in the chemical

composition of breast and thigh muscles. Except for the content of crude ash, which increased significantly ($p < 0.01$) in the offspring of E_2 and E_3 groups compared with those in the control group (Lc) and E_1 group (Table 4).

Table 4

Chemical composition of meat (muscle) breast and thigh (g/kg DM).

Issue		Group			
		Lc	E_1	E_2	E_3
Chest	Crude protein	855,06 ± 19,57	867,91 ± 16,48	859,09 ± 21,33	862,45 ± 27,69
	Crude fat	86,10 ± 8,63	83,95 ± 15,07	84,71 ± 13,27	91,19 ± 17,04
	Ash	41,55 ± 1,81^{b}	40,07 ± 1,34^{b}	43,95 ± 1,04^{a}	44,76 ± 1,17^{a}
Thigh	Crude protein	688,45 ± 57,61	693,20 ± 38,76	681,09 ± 49,72	675,16 ± 33,68
	Crude fat	252,15 ± 51,85	253,72 ± 68,88	265,87 ± 37,83	277,86 ± 94,58
	Ash	37,15 ± 2,56^{c}	38,94 ± 1,27^{b}	40,17 ± 2,94^{a}	39,25 ± 2,08^{ab}

The results are in agreement with the findings of Suchy et al. (2010) who reported that by replacing soybean nitrogen by up to two-thirds do not affect the content of breast and thigh muscles in protein and fat, but only raw ash content increases in the chest. Contrary to our results, Suchy et al. (2010) recorded a decrease in raw ash content of the muscles of the thigh.

CONCLUSIONS

The results show that when properly balanced compound feeds in energy, protein and amino acids limits, substituting soy protein meals in broiler chickens with lupine flour by up to 30% in the starter phase (1-21 days) and 60% in the growth phase (22-35 days) and finishing (36-42 days), has no adverse effect on weight gain, carcass quality and meat chemical composition.

Biochemical tests suggest that lupine proteins have a biological value lower than those from soyben meals, emphasizing the need to balance the use of synthetic amino acids diets containing lupine. Lupine grains does not significantly influence the metabolism of proteins, in turn have a positive effect on blood lipoprotein (HDL increases and decreases LDL).

Slaughter inspection results shows overall differences statistically only for chickens, in which food was introduced lupine highest proportion both to the control group (Lc) and compared to other experimental groups. Except for the liver, other internal organs, but especially goiter and gizzard showed significantly higher values in the offspring of the food groups which have used high proportions of lupines than those in the control group (Lc). Substituting protein soyben meals in broiler chickens at a rate of 40% in the starter phase and 80% thereafter until slaughter, has a negative influence on the tissue structure of the carcass, reducing the proportion of meat in favor

of bone ($p < 0,05$), but also on the chemical composition of the meat, increasing crude ash content ($p < 0,01$).

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