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The response of growing quails to diets containing oligosaccharides isolated from seeds of narrow-leaved lupin (*Lupinus angustifolius)*

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ABSTRACT

The study involved 120 young quails divided into 3 equal groups. The control birds were fed a standard diet for 38 days. In group II, the standard diet was supplemented with 6 g/kg of oligosaccharides isolated from seeds of narrow-leaved lupin (*Lupinus angustifolius*) cv. Emir, in group III with flavomycin (4 mg/kg). Neither the oligosaccharides nor the antibiotic supplementation significantly affected the feed intake, feed conversion ratio or final body weight. The carcass yield was similar in all tested groups. Females fed the diet supplemented with oligosaccharides had significantly ($P \leq 0.05$) higher serum lysozyme levels in the blood serum (25.6 µg/ml) and pulmonary tissues (385 µg/ml).

It may be concluded that neither the oligosaccharides nor antibiotic supplementation of the diet affected the performance of young quails significantly, but oligosaccharides had a favourable effect on the immune system and health of quails.

KEY WORDS: lupin, oligosaccharides, antibiotic, quail, performance, lysozyme

INTRODUCTION

Interest in oligosaccharide enrichment of animal and human diets has greatly increased over recent years. The most comprehensive studies carried out so far have involved fructooligosaccharides which have been proven to inhibit colonization of intestinal walls by pathogenic microbes and to enhance growth of beneficial ones, particularly *Lactobacillus* and *Bifidobacterium* (Hidaka et al., 1986; Bailey et al., 1991; Choi et al., 1994). Studies involving fructooligosaccharide adminis-

tration in broiler diets demonstrated increased weight gain and better food utilisation as well as reduced mortality of chickens (Ammerman et al., 1988). The authors concluded that oligosaccharides, due to their positive effect on animal health, may be a good substitute for subtherapeutic doses of antibiotics.

Once a technique for extracting oligosaccharides from lupin seeds had been developed, it became possible to begin studies on non-traditional applications of lupin in poultry breeding. So far, such studies have been scarce and their results have been frequently conflicting (Błaszczyk et al., 1994; Uziębło et al., 1996; Hughes et al., quoted after Iji and Tivey, 1998). Uziębło et al. (1996) compared the effects of enriching hen diets with various lupin-derived fractions. They found that utility indices of hens fed the modified diets did not differ significantly from the control. The results obtained by Trevino et al. (1990) were similar. On the other hand, Orban et al. (1997) provided evidence that oligosaccharide enrichment of diets resulted in significant body weight gain of broiler chickens.

The conflicting evidence existing so far as well as a lack of recommendations as to the rate of enriching diets of different poultry species with oligosaccharides have necessitated further research.

The objective of this study was to compare the effect of oligosaccharides, extracted from narrow-leaved lupin seeds, with the effect of flavomycin on the utility, health, and some physiological parameters of growing quails.

MATERIAL AND METHODS

The study used oligosaccharides from seeds of narrow-leaved lupin (*Lupinus angustifolius*) cv. Emir extracted according to the procedure developed by Gulewicz (1991). The saccharide fraction was isolated from the extract by treating it with a polarity gradient of solvents and with ion-exchange chromatography on Dowex 50 Wx8 (Stobiecki and Gulewicz, 1996). The oligosaccharide fraction consisted of 50.8; 21.0; 16.4; and 11.8% stachiose, sucrose, verbascose, and raffinose, respectively.

The starter and finisher type diets were prepared according to the Nutrient Requirements of Poultry (1996). They were composed of (in %): ground maize 30, wheat 24.4, soyabean meal 19.2, meat-and-bone meal 6.3, fish meal 9.7, sojax F 8.3 and mineral-vitamin components 2.1 in the starter diet, and ground maize 30.0, ground wheat 28.7, extracted soyabean meal 22.3, meat-and-bone meal 8.0, sojax F 8.7 and mineral-vitamin components 2.32 in the finisher diet and contained 28.6 and 24.6% crude protein and 12.36 and 12.15 MJ ME/kg, respectively, in the starter and finisher diet.

One hundred and twenty one-day-old quails, with equal share of both sexes, were randomly allocated to 3 groups, each containing 4 replicates. The birds were

kept in group cages (5 females and 5 males) under controlled conditions. The control (I) group was fed unsupplemented diets, group II diets were supplemented by spraying, with 6 g of oligosaccharides per kg. The feed offered to group III contained an antibiotic, flavomycin (4 mg/kg).

Birds were fed the starter diet *ad libitum* for the first week and finisher diet until day 38 of life. Body weight and feed consumption were recorded weekly. At day 38 of life 12 males and 12 females from each group were fasted for 5 h, weighed, slaughtered, bled, plucked by hand and eviscerated. After removing the head and shanks the carcass was weighed, as well as edible giblets (liver, heart and empty stomach). Breast muscles were separated and weighed. Individual samples of blood and lung tissues were taken for determining lysozyme according to Mohrig and Messner (1968). In the individual samples of breast muscles the content of dry matter, crude protein, lipids and ash were determined by conventional methods.

The data were subjected to one-way analysis of variance and Duncan's test.

RESULTS AND DISCUSSION

During the 38 days of the experiment, the three groups of quail showed a similar feed intake and feed conversion ratio (Table 1). Trevino et al. (1990) failed to observe any enhancement in performance of broiler chickens fed diets enriched with oligosaccharides isolated from sweet peas. Orban et al. (1997) showed that oligosaccharides applied at 1.5-3.0% of the diet significantly enhanced feed consumption and reduced the feed conversion ratio in broiler chickens.

TABLE 1

Effects of diets on the performance of growing quails

Item	Age, days	Group			SEM
		I	II	III	
Body weight, g	3	21.8	20.9	20.7	0.39
	10	58.9	61.5	60.1	0.97
	17	101.1^{a}	105.0^{ab}	107.2^{b}	1.75
	24	149.0	152.1	149.2	2.69
	31	180.6	182.3	180.6	3.28
	38	199.4	201.9	205.0	4.91
Feed intake, g/bird		755.8	745.4	730.2	12.2
Daily feed intake, g/bird		19.9	19.6	19.2	0.89
Feed conversion, kg/kg body weight		3.78	3.69	3.55	0.11
Deaths and sanitary culling, inds, %		2	3	0	
		5.0	7.5	0	

^{a,b} – $P \leq 0.05$

Neither the oligosaccharide addition nor the antibiotic treatment significantly affected the final body weight of the quail (Table 1). Choi et al. (1994) observed a substantial increase in body weight in chickens fed fructooligosaccharide feed, compared to the control.

The carcass yield was similar in all tested groups (Table 2). The yield varied from 68.6 to 69.3% in males and from 63.5 to 63.9% in females. The breast muscle contribution to carcass weight was similar in all groups (28.3-28.5%) as well and varied, regardless of sex. The contribution of giblets to body weight was similar in all groups, except for the group II females showing a significantly heavier stomach.

The chemical composition of the breast muscle was similar in all groups (Table 3). Only group III females showed significantly lower lipid levels, while females and males in group II had lower protein and ash contents compared to the control.

Generally, the health of quails during the experiment was good (Table 1), but the birds receiving the antibiotic-treated diet proved the healthiest. The highest mortality was recorded in the group fed the oligosaccharide-enriched diet. Choi et al. (1994) found that adding fructooligosaccharides to feeds suppressed intestinal colonization by *Salmonella typhimurium*, mainly as a result of increased lactic acid concentration in the intestine. Bailey et al. (1991) found that adding 3.5 g fructooligosaccharide per kg of feed did not reduce the *Salmonella* count in the intestine, but a substantial (12%) reduction was obtained by adding 7.5 g/kg.

TABLE 2

Slaughter results (n=12)

Item	Sex	Group			SEM
		I	II	III	
Live body weight (LBW), g	M	188.9	192.8	196.6	4.96
	F	235.0	227.2	233.6	4.84
Carcass yield, %	M	69.3	68.6	69.1	0.92
	F	63.5	63.9	63.7	1.09
Breast muscles, % of carcass	M	28.4	28.5	28.4	0.49
	F	28.3	28.4	28.5	0.46
Liver, % LBW	M	2.00	1.98	1.85	0.11
	F	2.54	2.75	2.48	0.09
Stomach, % LBW	M	2.21	2.02	2.00	0.10
	F	2.02[a]	2.33[b]	2.01[a]	0.09
Heart, % LBW	M	1.09	1.05	1.08	0.04
	F	0.89	0.96	0.93	0.03

[a, b] – P≤0.05

TABLE 3

Chemical composition of breast muscles (n=8), %

Component	Sex	Group			SEM
		I	II	III	
Dry matter	M	26.21	26.55	26.52	0.24
	F	26.55	26.13	25.92	0.17
Protein	M	23.30	22.78	23.08	0.16
	F	23.44[a]	22.53[b]	23.09[ab]	0.18
Lipids	M	2.59	2.33	2.98	0.23
	F	2.64[a]	2.88[a]	1.96[b]	0.19
Ash	M	1.46[a]	1.30[b]	1.42[ab]	0.04
	F	1.40[ab]	1.30[a]	1.44[b]	0.04

[a, b] – P≤0.05

The lysozyme content in the serum and pulmonary tissues of birds fed the control and antibiotic-supplemented diets was similar, in birds fed the oligosaccharide-supplemented diet, it was significantly (P≤0.05) higher (Table 4). Lysozyme, as a bactericide, boosts the quails' immune mechanisms. Tarasewicz (1998), who analyzed the lysozyme content in quail eggs, found that it occurs in a higher amount and was more active in groups fed diets enriched with oligosaccharides extracted from lupin seeds relative to the control. The lack of comparative data makes evaluation of those differences difficult.

TABLE 4

Lysozyme content in blood serum and lungs (n=10), μg/ml

Item	Sex	Group			SEM
		I	II	III	
Blood serum	F	15.0[a]	25.6[b]	16.6[a]	2.62
Lungs	F	283[a]	385[b]	271[a]	13.80

[a, b] – P≤0.05

CONCLUSIONS

It seems that neither oligosaccharide nor flavomycin supplementation of diets exerted any significant effect on the performance of young quails, however, oligosaccharides positively affected the serum lysozyme content and pulmonary tissue of females.

REFERENCES

Ammerman E., Quarles C., Twining P.V., 1988. Broiler response to the addition of dietary fructooligosaccharides. Poultry Sci. 67, Suppl. 1, 67 (Abstr.)

Bailey J.S., Blankenship L.C., Cox N. A., 1991. Effect of fructooligosaccharide on *Salmonella* colonization of the chicken intestine. Poultry Sci. 70, 2433-2438

Błaszczyk B., Stobiecki M., Kowalczyk-Bronisz S.H., Gulewicz K., Szymaniec S., 1994. Immunotropic activity of lupin seeds extracts and fractions from *Lupinus angustifolius* and *Lupinus albus*. Arch. Immunol. Ther. Exp. 42, 147-153

Choi K.H., Namkung H., Paik I.K., 1994. Effects of dietary fructooligosaccharides on the suppression of intestinal colonization of *Salmonella typhimurium* in broiler chickens. Korean J. Anim. Sci. 36, 271-284

Gulewicz K., 1991. Method of dibittering of lupin seeds (in Polish). Polish Patent 152, 748, Poznań (Poland)

Hidaka H., Eida T., Takizawa T., Tokunaga T., Tashiro Y., 1986. Effects of fructooligosaccharides on intestinal flora and human health. Bifidobacteria Microflora 5, 37-50

Iji P.A., Tivey D.R., 1998. Natural and synthetic oligosaccharides in broiler chicken diets. World Poultry Sci. J. 54, 129-143

Mohrig W., Messner B., 1968. Immunoreactionen bei Insekten. 1. Lysozym als grundlegender antibacterieller Factor in humoralen Abwehrmechanismus der Insek. Biol. Zbl. 87, 439-470

Nutrient Requirement of Poultry. Reccommendations and Nutritive Value of Feedstuffs (in Polish), 1996. 3rd revised Edition. The Kielanowski Institute of Animal Physiology and Nutrition (Editor), Jabłonna (Poland)

Orban J.I., Patterson J.A., Sutton A.L., Richards G.N., 1997. Effect of sucrose thermal oligosaccharide caramel, dietary vitamin- mineral level and brooding temperature on growth and intestinal bacterial populations of broiler chickens. Poultry Sci. 76, 482-490

Stobiecki M., Gulewicz K., 1996. Polish Patent No 169914B1, Poznań (Poland)

Tarasewicz Z., 1998. Biological assessment of oligosaccharides isolated from lupin variety Emir *(Lupinus angustifolius)* seeds in feeding of a reproductive quail stock (in Polish). Thesis No 186, Agricultural University of Szczecin (Poland)

Trevino J., Centeno C., Brenes A., Yuste P., Rubio L., 1990. Effect of dietary oligosaccharides on the digestion of pea starch by growing chicks. Anim. Feed. Sci. Tech. 30, 313-319

Uziębło L., Gulewicz K., Tarasewicz Z., Bednarczyk M., Szczerbińska D., Ligocki M., 1996. Effect of lupin alkaloid fractions level on performance and blood parameters in chickens. J. Anim. Feed Sci. 5, 261-271

STRESZCZENIE

Wpływ dodatku oligosacharydów wyizolowanych z nasion łubinu wąskolistnego do diet na wyniki produkcyjne rosnących przepiórek

Badania przeprowadzono na 120 przepiórkach rzeźnych, podzielonych na 3 grupy i żywionych w ciągu 38 dni tuczu dietą o standardowym składzie, nieuzupełnioną (grupa I – kontrolna) lub z dodatkiem 6 g/kg diety oligosacharydów wyizolowanych z nasion łubinu wąskolistnego odmiany Emir (grupa II), albo z dodatkiem 4 mg/kg diety antybiotyku flawomycyny (grupa III).

Podawanie oligosacharydów i antybiotyku nie wpłynęło w istotny sposób na spożycie paszy, jej wykorzystanie i na końcową masę ciała ptaków. Wydajność rzeźna była zbliżona we wszystkich grupach doświadczalnych. Istotnie większą zawartość lizozymu w surowicy krwi (25,6 mg/ml) i w tkance płucnej (385 mg/ml) stwierdzono u samic z grupy II.

Wydaje się, że dodatek oligosacharydów lub antybiotyku do paszy nie wpływa na cechy użytkowe przepiórcząt rzeźnych, lecz oligosacharydy korzystnie oddziałują na odporność i zdrowie ptaków.