RESPONSE OF YOUNG TURKEYS TO DIETS CONTAINING FLAVOMYCIN, MANNAN-OLIGOSACCHARIDE OR INULIN

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Summary. For 8 weeks, the birds were fed *ad libitum* with the mash feed mixtures containing antibiotic (flavomycin, 8 mg/kg), or 1% of two types of oligosaccharides: mannan-oligosaccharide and inulin. A control group obtained a diet without antibiotic nor oligosaccharides. At the age of 7 weeks, the birds were kept on the bedding in individual metabolic cages. The supplementation of diets with Flavomycin or oligosaccharides had no significant influence on the diet intake and feed conversion of turkeys. Coefficients of apparent digestibility (85.8-86.8%) and utilisation (46.2-51.2%) of protein were similar in all groups. In all birds, a similar concentration of dry matter and ammonia in faeces was also observed. Faeces of turkeys fed a diet supplemented with oligosaccharides (MOS and inulin) were characterised with lower pH (5.51 and 5.48, respectively) than those of turkeys from the control group (5.77) as well as with a lower activity of microbial β-glucuronidase (0.75, 0.52 and 1.01, respectively). Relatively low concentration of SCFAs was observed in faeces of the birds in all groups, especially in turkeys fed Flavomycin-containing diet.

Keywords: Mannano-oligosaccharide, inulin, feed and protein utilization, faecal parameters, turkey

JAUNŲ KALAKUTŲ REAKCIJA Į LESALUS, KURIŲ SUDĖTYJE YRA FLAVOMICINO, MANANO–OLIGOSACHARIDO ARBA INULINO

Santrauka. Iki 8 amžiaus savaičių paukščiai buvo lesinami *ad libitum* trupiniuotos struktūros lesalu, į kurio sudėtį įėjo antibiotikas flavomicinas (8mg/kg) arba 1% dviejų tipų oligosacharidai – manano–oligosacharidas ir inulinas. 7 amžiaus savaičių paukščiai buvo laikomi individualiuose medžiagų apykaitos narveliuose. Lesalai, papildyti flavomicinu arba oligosacharidais, statistiškai patikimo poveikio kalakutų lesalo suvartojimui ir lesalų sąnaudoms nedarė. Baltymų virškinimo koeficientai (85,8–86,8%) ir pasisavinimas (46,2–51,2%) visose grupėse buvo panašus. Buvo nustatyta panaši visų paukščių ekskrementų sausųjų medžiagų bei amoniako koncentracija. Kalakutų, lesinamų lesalais, papildytais oligosacharidais (MOS ir inulinu), ekskrementai buvo žemo pH – atitinkamai 5,51 ir 5,48 palyginti su kontrolinės grupės kalakutais (5,77), taip pat, kaip ir turinčių mažą mikrobinės beta gliukuronidazės aktyvumą – atitinkamai 0,75, 0,52 ir 1,01.

Visų grupių kalakutų ekskrementuose buvo gauta palyginti maža trumpųjų grandinių riebalų rūgščių koncentracija, ypač organizme kalakutų, lesintų lesalais su flavomicinu.

Raktažodžiai: manano–oligosacharidai, inulinas, lesalų ir baltymų pasisavinimas, ekskrementų parametrai, kalakutai.

Introduction. Prebiotic oligosaccharides, as probiotic strains of bacteria, are perceived as a natural biological alternative to feed antibiotics (Spring, 1999). Some studies have shown that even small doses of oligosaccharides (0.1-0.4%) added to a diet were effective in improving health and production of poultry (Savage and Zakrzewska, 1997). In our earlier experiment (Juśkiewicz et al., 2002 - 4), these small doses of oligosaccharides (inulin, mannan-and fructo-oligosaccharides) added to the diet of young turkeys (3-30 days) did not increase the microbial enzyme activity and changed other parameters of caecal digesta to a low extent (e.a. pH and SCFAs content). The assessment of the gastrointestinal tract response to a higher content of mannan-oligosaccharide or inulin in the diet (1%), compared to the content of antibiotic, was the aim of the presented experiment.

Material and methods. The experiment was conducted on 24 eight-week-old BUT-9 turkeys randomly allocated to four groups. The basal mixture contained typical components, mainly corn and soybean meal, and nutrients (protein, energy, amino acids and minerals) according to the NRC (1994) requirements for turkeys (Table 1). For 8 weeks, the birds were fed ad libitum with the mash diets containing 98% of basal mixture, 1% of premix and 1% of maize or oligosaccharides: mannan-oligosaccharide (Bio-Mos, Alltech) or inulin (Frutafit-Inulin Tex, Holland). In control diets and oligosaccharide-enriched diets, a premix without antibiotic was applied. One diet contained Flavomycin in a dose of 8 mg/kg. At the age of 7 weeks, the birds were kept on the bedding in individual metabolic cages. The amount of feed consumed and excrements was registered for 4 successive days.

Faecal pH was measured and dry matter was determined by the difference between wet weight and dry weight on aliquots of the excrements. The ammonia extracted and trapped in a solution of boric acid was determined by direct titration with sulfuric acid (according to the standard Conway's method). The nitrogen content in the caecal digesta was determined according to the Kjeldahl's method. The faecal nitrogen was distinguished from urinary nitrogen by the method of Ekman et al. (1949). The protein digestibility and nitrogen retention were calculated for each bird.

The glycolytic activity in faeces was measured by the rate p- or o- nitrophenol release from their p- or o-

nitrophenylglucosides (Juśkiewicz et al., 2002 - 3). The reaction mixture contained 0.3 mL substrate solution (5 mM) and 0.2 mL of a faecal sample diluted (1:10 v/v) in a phosphate buffer (pH 7.0, 0.1 Mol/L). Incubation was carried out at 37^0C and the p-nitrophenol concentration was measured as the optical absorbance at 400 nm and 420 nm (o-nitrophenol concentration) after the addition of 2.5 mL of 0.25 M sodium carbonate. The glycolytic activity was expressed as μmol of a product formed per min (IU) per g of faecal digesta.

Table 1. Composition and nutritive value of basal diet

Components	Feeding period, weeks	
	1-4	5-8
Wheat, %	10.00	15.00
Maize	35.19	32.47
Soybean meal, %	43.50	41.00
Fish meal, %	3.00	3.00
Soybean oil, %	2.30	3.5
Mineral sources, %	4.20[1]	4.22[3]
Amino acids, %	0.81[2]	0.81[4]
EM, MJ/kg	11.79	11.87
Crude protein, %	26.54	25.63
Crude fibre, %	3.37	3.29
Lys, g/kg	18.1	16.5
Met + Cys, g/kg	10.6	10.7
Ca, g/kg	12.8	12.3
P available, g/kg	7.21	6.89

[1]NaCl - 0.30%, Limestone 0.95, Monocalcium phosphate 3.0%
[2]DL-methionine 99 – 0.25%, L-lysine 99 MonohydroCl– 0.54%, L Threonine – 0.02%
[3]NaCl - 0.27%, Limestone - 0.95, Monocalcium phosphate 2.8%, Acid mix S –0.20
[4]DL-methionine 99 – 0.29%, L-lysine 99 MonohydroCl– 0.41%, L Threonine – 11%

The concentration of short chain fatty acids (SCFA) in the faecal digesta was measured by gas chromatography (Shimadzu GC-14A with a glass column 2.5 m × 2.6 mm, containing 10% SP-1200/1% H_3PO_4 on 80/100 Chromosorb W AW, column temperature 110^0C, detector FID temperature 180^0C, injector temperature 195^0C). The faeces were weighed, mixed with 0.2 mL formic acid, diluted with deionised water and centrifuged at 10000×g for 5 min. Supernatant was decanted for injection in the gas chromatograph.

The results were analyzed using the one-way ANOVA test, and significant differences between groups were determined by the Duncan's multiple range test. Differences were considered significant at $P \leq 0.05$ and $P \leq 0.01$.

Results and discussion. Over the 8 weeks of the experiment, the consumption of feed mixtures by turkeys from each group was alike (Table 2). The supplementation of diets with Flavomycin or oligosaccharides had no significant influence on the growth of turkeys, only the birds from inulin-group were slightly lighter than those from the control group. Feed conversion index was also on a similar level in all groups. In the experiment of Juskiewicz et al. (2002b), diet intake by young turkeys fed a diet with a smaller dose of inulin (0.4%) was lower than that of birds fed MOS- or FOS-supplemented diet. Inulin addition to a diet could result from higher digesta and stool bulking indices of inulin than of other soluble, fermentable fibres (Cherbut 2002), which in turn could cause more pronounced feeling of satiety in birds and a lower diet intake.

Table 2. Turkey growth, feed and protein utilisation and faecal parameters

Parameter	Diet				SEM
	Control	Flavomycin	M-OS	INULIN	
Body weight at 8 week, kg	3.59	3.65	3.69	3.57	0.19
Diet intake, kg/8 weeks	6.72	6.92	7.03	7.10	0.34
Feed conversion, kg/kg BWG	1.88	1.93	1.94	1.99	0.10
Apparent coefficient of protein digestibility, %	86.4	86.4	85.8	86.8	0.32
Apparent coefficient of nitrogen retention, %	46.2	46.3	48.3	51.2	0.91
Faecal parameters:					
- dry mater, %	18.36	19.41	18.20	19.67	0.43
- pH	5.77[a]	5.65[ab]	5.51[b]	5.48[b]	0.04
- ammonia, mg/g	1.57	1.56	1.43	1.51	0.05

a, b, c - $P \leq 0.05$ A, B, C -$P \leq 0.01$

Coefficients of apparent digestibility and utilisation of proteins were similar in all groups and corresponded to the results reported in experiments of other authors (Mikulski et al., 1997). Similar percentage of dry matter in faeces and concentration of ammonia were observed in all experimental groups. No increase observed in the amount of ammonia produced after the addition of mannan or inulin, compared to the control group or group receiving a diet with antibiotic, may prove beneficial fermentation in the posterior part of the turkey gastrointestinal tract. It may be confirmed by decreased pH values of faeces in groups with MOS and inulin, compared with the control group. In the above-cited study of Juśkiewicz et al., (2002b), a 0.4% addition of MOS or inulin to the mixture for young turkeys beneficially lowered the ammonia concentration in their caecal digesta, without decreasing the pH of digesta as compared to the control group.

The activity of glycolytic enzymes: α- and β-glucosidase and α- and β-galactosidase, despite negligible differences within groups, was on a similar level. While the activity of faecal β-glucuronidase decreased in the experimental groups, especially in these with antibiotic or inulin addition (Table 3). A high activity of β-glucuronidase is potentially harmful to the host, as that enzyme is involved in the generation of toxic and carcinogenic metabolites in the hindgut.

Table 3. Microbial glycolytic activity and SCFAs concentration in faeces of turkeys

Parameter	Diet				SEM
	Control	Flavomycin	M-OS	INULIN	
Enzyme activity, U/g					
- α-glucosidase	0.425^{Aab}	0.302^{Bc}	0.460^{Aa}	0.384^{ABbc}	0.017
- β-glucosidase	0.071	0.083	0.079	0.051	0.007
- α-galactosidase	1.517	1.371	1.378	1.825	0.146
- β- galactosidase	1.213	1.359	1.328	1.732	0.120
- β-glucuronidase	1.007^{a}	0.439^{b}	0.751^{ab}	0.520^{b}	0.113
SCFAs concentration:					
- Total SCFAs, μmol/g	20.58^{ab}	16.92^{b}	20.79^{ab}	26.75^{a}	0.50
- Acetate, μmol/g	11.21^{ab}	7.49^{b}	12.50^{ab}	19.34^{a}	1.73
- Propionate, μmol/g	4.51^{a}	3.84^{ab}	3.17^{ab}	2.80^{b}	0.25
- Isobutyrate, μmol/g	0.99^{A}	0.58^{B}	0.63^{B}	0.70^{B}	0.05
- Butyrate, μmol/g	3.87	5.01	4.49	3.91	0.21
C_2:C_3:C_4 profile, μmol/100μmol of total SCFA	54^{ab}:22:19^{b}	44^{b}:23:30^{a}	60^{ab}:15:22^{ab}	72^{a}:10:15^{b}	-

a, b, c - P≤0.05 A, B, C -P≤0.01

Relatively low concentration of SCFAs in faeces was observed in all turkeys, especially in the antibiotic-group. Total, as well as acetate concentration was the highest in turkeys fed a diet with inulin, and the lowest after flavomycin addition. Compared to the control group, inulin supplementation gave more acetate and less propionate type of fermentation. In the mannan-group, the faecal total concentration of SCFAs was on the level observed in the control group, but mannan addition gave more butyrate and less propionate. In birds, fermentation proceeds mainly in caeca, and SCFAs produced are actively and quickly absorbed trough the caecal wall or used by caecal cells. Therefore, low concentration of SCFAs does not prove a low production of volatile fatty acids, but their fast absorption in the posterior part of the gastrointestinal tract.

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