

USE OF SYNBIOTIC PREPARATIONS IN TURKEY DIETS AND THEIR EFFECT ON GROWTH PERFORMANCE

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Summary. The study was conducted to determinate the effects of probiotic lactic acid bacteria and lactose supplementation on the growth performance parameters of turkeys. A total of 1400 BIG6 male turkeys were randomly divided into 4 groups and raised until 18 weeks of age. The turkeys were fed basal diets (group 1) supplemented with probiotic lactic acid bacteria strain *Pediococcus acidilactici* MA 18/5M (group 2, *Bactocell*®), lactose (group 3), and the combination of these supplements (group 4). Treatment results showed that addition of probiotic significantly ($P \leq 0.05$) improved body weight of turkeys until 12 weeks of age and had no significant effect on final body weight. Feed utilization was significantly ($P \leq 0.05$) lower in the group of turkeys fed a diet with probiotic supplement. The addition of dietary lactose or lactose with probiotic negatively affected the growth rate of turkeys, but the addition of the dietary lactose in combination with probiotic bacteria had positive effect on mortality of turkeys.

Key words : turkeys, probiotic, prebiotic, lactose, growth parameters, feed conversion.

SINBIOTINIŲ PREPARATŲ PANAUDOJIMAS KALAKUTŲ RACIONUOSE IR ĮTAKA AUGIMO RODIKLIAMS

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Santrauka. Tyrimas atliktas norint nustatyti probiotinių pieno rūgšties bakterijų *Pediococcus acidilactici* MA 18/5M (preparato pavadinimas – *Bactocell*®) ir prebiotiko laktozės įtaką kalakutų kūno masės augimo dinamikai bei lesalų sąnaudoms standartiniuose kombinuotuosiuose lesaluose. BIG 6 linijų derinio 1400 kalakutų patinų buvo suskirstyti į keturias grupes ir auginti iki 18 savaičių. I grupė buvo kontrolinė, II, III ir IV – bandomosios. Į II grupės paukščių lesalus iki 12 amžiaus savaitės buvo dedama probiotinio preparato *Bactocell*®, į III – prebiotiko laktozės, o į IV – prebiotiko ir prebiotiko. Tyrimų rezultatai parodė, kad prebiotiko priedas lesaluose didino kalakutų kūno masę ($p \leq 0,05$) iki 12 savaičių, o 18 savaičių kalakutų kūno masei įtakos neturėjo, bet ženkliai sumažino lesalų sąnaudas ($p \leq 0,05$). Laktozės bei laktozės kartu su probiotiku priedai kalakutų auginimo rodikliams teigiamo poveikio neturėjo, bet laktozės ir probiotinių bakterijų kombinacijos priedas turėjo teigiamos įtakos kalakutų išsaugojimui.

Raktažodžiai: kalakutai, probiotikai, prebiotikai, laktozė, augimo dinamika, lesalų sąnaudos.

Introduction. Restrictions on use of antibiotics as growth-stimulating feed supplements imposed in many countries resulted in intensification of scientific research searching for various alternative feed supplements, which could replace those used in the past. Alternative feed supplements include enzymes, probiotic, organic acids, as well as various prebiotic and phytogetic preparations. There are a lot of scientific studies being currently conducted in order to find the most effective probiotic and prebiotic preparations or combinations of there, which are the most suitable for various kinds of animals.

Probiotics are live bacteria or yeast preparations con-

taining microorganisms of one or several kinds, which have an antagonistic effect on pathogenic bacteria in intestines as well as a positive effect on microflora in intestines and the macro organism itself (Vanbella et al., 1990). Probiotic microorganisms are not pathogenic, non-toxic, and most of them retain their vitality after passing the whole digestive tract. Long-term use of these microorganisms do not result in any negative effects, they do not accumulate in the product and pose no hazard to consumers. The mechanism of probiotic action is not fully understood, but various effects include reduction of pH in intestines, synthesis of various antagonistic and anti-

microbial factors, competition with pathogenic bacteria for nutrients and attachment to receptors on an intestine wall, as well as stimulation of the immune system in intestines (Parvez et al., 2006). Probiotic preparations stimulate microbiological and immune system of intestines, thus reducing colonization by pathogenic bacteria under unfavorable conditions (Patterson, Burkholder, 2003). They not only reduce populations of pathogenic organisms, but neutralize some of their toxins as well. Microbiological composition of intestines of various kinds of animals is very different. Microbiological balance in the intestine may be impaired by such factors as change in feed, microclimate, use of medical preparations (particularly the antimicrobial ones), diseases, stresses, infections and age (Mathew, 2002).

Prebiotics – are indigestible carbohydrates, which pass through small intestines and are broken down in the colon. A macroorganism does not produce enzymes for breaking down of prebiotics. They are digested by bacteria of the digestive tract living in the colon. This action results formation of short-chain fatty acids, which in turn reduce pH in the colon, create unfavorable conditions for development of pathogenic bacteria and facilitates resorption of minerals. Avian species can not digest lactose because they lack of endogenous lactase, hence lactose present in the feed is being digested by intestine bacteria (Siddons, Coates, 1972). In the course of these microbial processes more volatile fatty acids and lactic acid are released and more microbial proteins are produced (Hinton et al., 1990). Many studies have shown that, in contrast to other carbohydrates, lactose changes microbiota of large intestines by creating an acidic environment. Lower pH reduced the number of pathogenic bacteria, more ammonia is used for biosynthesis of microbial proteins and less gets into the blood (Chambers et al., 1997; Simoyi et al., 2006). It has been noticed that when lactose is used as prebiotic, the number of *Lactobacillus reuteri* bacteria in cul-de-sacs increases (Edens et al., 1991; Parkhurst et al., 1991) and the number of *Salmonella* bacteria in digestive tract of birds decreases (Corrier et al., 1997; Edens et al., 1991).

Many scientific studies are being conducted in order to find the most effective probiotic and prebiotic supplements and to achieve a synbiotic action by using them in combination. Synbiotics are characterized by antimicrobial, anticarcinogenic, antiallergic, and immunity-stimulating action. They also improve absorption of minerals, protect from diarrhea, and optimize nutrient digestion processes (Gružauskas et al., 2004). The impact of probiotic, prebiotic and synbiotic preparations is the most pronounced when they are used at the beginning of growth, when intestine microflora is being formed, or after such stressful periods as antibiotic treatments, vaccinations, etc. During later stages of bird growth the positive impact of these preparations is less pronounced. Results of studies of various combinations of synbiotic, probiotic, and prebiotic preparations have yielded widely varying results and the mechanism of action of these preparations is not yet fully understood.

The purpose of the present study is to investigate the

effects of probiotic and prebiotic preparations on turkey productivity and feed consumption per unit of output.

Materials and methods. The scientific study has been conducted in accordance with the Law on Care, Keeping, and Use of Animals No.8-500 of the Republic of Lithuania adopted on November 6th, 1997 (Newspaper, November 28th, No. 108) and the relevant legislative regulations – State Veterinary Service of the Republic of Lithuania orders Concerning Veterinary Requirements for Breeding, Reproduction, Keeping, and Transportation of Laboratory Animals (December 31st, 1998, No. 4-361) and Concerning Use of Laboratory Animals for Scientific Tests (January 18th, 1999, No. 4-16).

The study was conducted with 1400 BIG6 male turkeys. Birds were divided into 4 groups of 350 birds in each. The 1st group was the control group and the 2nd, 3rd, and 4th groups were experimental groups. Probiotic *Bactocell*[®] was added to combined feed of the 2nd group of turkeys at the following ratios: during the 1st-4th week – 5×10^6 CFU/g, during the 5th-8th week – 3×10^6 CFU/g, during 9th-12th week – 1×10^6 CFU/g of standard combined feed. Turkeys belonging to the 3rd group had lactose added to their feed at the following ratios: during the 1st-4th week – 0.5 percent, during the 5th-8th week – 0.3 percent, during the 9th-12th week – 0.15 percent. Feed of the 4th group of turkeys was supplemented by the probiotic *Bactocell*[®] and prebiotic lactose at the following ratios: during the 1st-4th week – *Bactocell*[®] 5×10^6 CFU/g and 0.5 percent of lactose, during the 5th-8th week – 3×10^6 CFU/g *Bactocell*[®] and 0.3 percent of lactose, during the 9th-12th week – 1×10^6 CFU/g *Bactocell*[®] and 0.15 percent of lactose. The afore mentioned supplements were used in turkey feed up till the age of 12 weeks, because their effect was hardly noticeable in later period of turkey growth. The turkeys were being kept at individual pens on deep bedding, 25 birds in each pen. Turkeys were fed ad libitum from tube feeder, also each pen was equipped with automatic water found. Feeding study has been conducted with birds aged 1-18 weeks. Qualitative parameters of the feed conformed to recommendations issued for the BIG6 turkeys (NRC, 1994).

The following parameters were being measured during the feeding study: Individual turkey body weight at 4, 8, 12, and 18 weeks of age; consumption of feed per 1 kg of gained weight at 4, 8, 12, and 18 weeks of age; mortality of birds.

„Bactocell[®]“ is a preparation made of the probiotic lactic acid bacteria strain *Pediococcus acidilactici* MA 18/5M 1×10^{10} CFU/g. The preparation was used in the form of fine, white powder, which is stable in technological processes under temperatures of up to 80 °C.

The lactic acid bacteria strain *Pediococcus acidilactici* MA 18/5M contained in the preparation is registered at the collection of the Pasteur Institute (CNM) in Paris, No. MA 15/5M (EU number: 9). This preparation had been approved for use in many countries (European Union, USA, etc.). The preparation is permitted for use on the basis of the European Union Commission Directive 94/40 EC. The preparation had been manufactured by Lallemand SAS in France.

Lactose is a lactic sugar (lactose monohydrate). Lactose is a disaccharide composed of β -D-galactose and β -D-glucose. White powder, ingredients: lactose min. 99 %, proteins <1%, humidity <1%.

Statistical analyses were conducted using analysis of variance on the SAS 6.0. Significance of differences be-

tween groups was determined using the Duncan test for post-hoc comparisons. Differences were considered significant if $P \leq 0.05$.

The composition and nutritive value of the combined feed used for feeding of turkeys are presented in the table 1.

Table 1. **Composition and Nutritive Value of the Combined Feed, %**

Composition	Feeding phase, weeks			
	0-4	5-8	9-12	13-16
Wheat	20.38	27.71	27.73	31.15
Triticale	-	-	10.00	15.00
Maize	25.00	25.00	20.00	20.00
Soya, 46 % crude protein	42.70	38.10	34.48	25.90
Potato protein	5.00	2.00	-	-
Soya oil	2.19	1.99	2.87	2.40
Animal fat	-	1.00	1.50	2.50
Salt	0.26	0.21	0.15	0.15
Sodium bicarbonate	0.15	0.15	0.15	0.15
Limestone	1.23	1.09	0.98	0.90
Phosphorus	2.55	1.94	1.48	1.28
Choline chloride	0.07	0.07	0.07	0.07
DL-Methionine	0.16	0.18	0.10	0.08
L-Lysine HCL	0.06	0.27	0.24	0.11
L-Threonine	-	0.04	-	0.06
Vitamin-mineral premix	0.25	0.25	0.25	0.25
Nutritional value of 1 kg combined feed:				
Metabolisable energy, MJ/kg	11.72	12.14	12.56	12.98
Crude protein	28.0	24.5	22.0	19.0
Lysine	1.60	1.50	1.30	1.00
Methionine	0.57	0.52	0.41	0.35
Methionine /Cystine	1.05	0.95	0.80	0.69
Threonine	1.06	0.95	0.80	0.75
Calcium	1.20	1.00	0.85	0.75
Available phosphorus	0.60	0.50	0.42	0.38
Sodium	0.17	0.15	0.12	0.12

Results of the Study. Experimental periods, during which turkey growth parameters and feed consumption per 1 kg of gained weight were measured, were 1st- 4th,

5th- 8th, 9th-12th and 13th-18th week of age. Turkey body weight growth dynamics are presented in the table 2.

Table 2. **Turkeys Growth Dynamics**

Age, week	Turkeys body weight, kg			
	group I	group II	group III	group IV
4	1.14±0.12 ^a 100 %	1.17±0.11 ^{Bb} 103 %	1.15±0.11 101 %	1.14±0.12 ^A 100 %
8	4.70±0.44 ^A 100 %	4.82±0.44 ^{Bb} 102 %	4.75±0.40 ^a 101 %	4.67±0.42 ^{Ac} 99 %
12	9.78±0.72 ^C 100 %	9.93±0.65 ^D 102 %	9.63±0.70 ^B 98 %	9.45±0.80 ^A 97 %
18	17.84±1.28 ^{Bb} 100 %	17.87±1.23 ^{Bb} 100 %	17.61±1.35 ^a 99 %	17.51±1.34 ^A 98 %

Means within the same line with no common superscripts differ: ^{a-c} = $P \leq 0.05$; ^{A-D} = $P \leq 0.01$.

The data presented in the table 2 shows that, compared to the control group, at 4 weeks of age body weight of turkeys from the 2nd group was higher by 3 percent ($P \leq 0.05$), body weight of those from the 3rd group was higher by 1 percent ($P \geq 0.05$), while body weight of turkeys belonging to the 4th group remained the same, as body weight of those belonging to the control group. At 8 weeks of age, weight of turkeys in the 2nd group was higher by 2 percent ($P \leq 0.01$), than weight of turkeys in the control group, while weight of turkeys assigned to the 3rd group exceeded that of turkeys in the control group by 1 percent. Weight of turkeys in the 4th group was 1 percent lower ($P \geq 0.05$) than in the control group. Later, at the age of 12 weeks, body weight of turkeys assigned to

the 2nd group exceeded that of turkeys belonging to the control group by 2 percent ($P \leq 0.01$) and at the age of 18 weeks the difference in body weight between the 2nd group and the control group disappeared. At 12 weeks of age body weight of turkeys in the 3rd group was 2 percent higher ($P \leq 0.01$) than the body weight of birds belonging to the control group, while at 18 weeks of age the body weight of turkeys belonging to the control group was 1 percent higher ($P \leq 0.05$) than the body weight of turkeys belonging to the 3rd group. In the 4th group, at 12 weeks of age weight gain was 3 percent ($P \leq 0.01$) lower and at 18 weeks of age – 2 percent ($P \leq 0.01$) lower than that of birds belonging to the control group.

Table 3. Turkey Feed Consumption per 1kg of Body Weight Gain

Rearing period, weeks	Feed consumption per 1kg of body weight gain, kg (X±SD)			
	0-4	1.51±0.04 ^b 100 %	1.47±0.05 ^{Aa} 97 %	1.52±0.04 ^B 100 %
0-8	1.84±0.05 100 %	1.82±0.07 99 %	1.87±0.06 102 %	1.86±0.04 101 %
0-12	2.18±0.05 ^a 100 %	2.14±0.06 ^A 98 %	2.18±0.05 ^a 100 %	2.25±0.14 ^{Bb} 103
0-18	2.90±0.09 ^b 100 %	2.81±0.10 ^{Aa} 97 %	2.89±0.08 ^b 100 %	2.96±0.12 ^B 102 %

Means within the same line with no common superscripts differ: ^{a-b} = $P \leq 0.05$; ^{A-B} = $P \leq 0.01$.

The data presented in the table 3 indicates that compared to the feed consumption of the control group, feed consumption per 1 kg of weight gain by turkeys belonging to the 2nd group at the age of up to 4 weeks were lower by 3 percent ($P \leq 0.05$), at the age of up to 8 weeks feed consumption in this group was lower by 1 percent ($P \geq 0.05$), at the age of up to 12 weeks – lower by 2 percent ($P \geq 0.05$), and at the age of up to 18 weeks – lower by 3 percent ($P \leq 0.05$). In case of the 3rd group, which was fed the feed supplemented by a prebiotic – lactose, only in the 2nd period between 4 and 8 weeks of age feed consumption exceeded that of the control group by 2 percent ($P \leq 0.05$), while during other periods feed consumption per 1 kg of weight gain did not differ from that of the con-

rol group. In case of the 4th group, feed consumption was the same as in the control group during the period of up to 4 weeks of age. Later, during the period of up to 8 weeks of age, feed consumption by the 4th group was by 1 percent ($P \geq 0.05$), from 8 up to 12 weeks of age this difference jumped to 3 percent ($P \leq 0.05$) and during the period of up to 18 weeks of age this difference remained at the level of 3 percent higher, that feed consumption in control group ($P \leq 0.05$).

Compared to the control group, mortality of turkeys throughout the whole period was the lowest in the 4th group, in which combined feed was supplemented by a probiotic and lactose in combination. The data is presented in the table 4.

Table 4. Viability of Turkeys

Rearing period, weeks	Viability of turkeys, %			
	0-4	94.99	94.17	93.09
0-8	92.76	91.06	92.26	94.18
0-12	91.92	91.67	91.44	93.63
0-18	90.25	91.39	90.61	93.07

Results of the study suggest that probiotic and prebiotic preparations have a bigger impact during the first stage of bird growth and it would be more expedient to use them during the starting and the first period of growth, when formation and stabilization of intestine mi-

cro flora is taking place. Use of probiotics and prebiotics during these periods of growth would be beneficial from both physiological and economical points of view.

Discussion and Conclusions. Various authors have noted that probiotics improve birds growth parameters

(Kralik et al., 2004; Torres-Rodriguez et al., 2007). Probiotics stimulate the immune system of an organism, increasing its protective capacity against pathogenic bacteria, as well as stimulating production of certain digestion enzymes, vitamins and other biologically active substances, all of which affect organism's health via its digestive tract (Grajek et al., 2005). Probiotics and prebiotics play an important role in formation of stable intestine microflora and affect both health and development of the intestine. Intestine microflora plays an important role in feed digestion and conversion. Use of probiotics in poorer industrial bird production conditions or for weaker bird groups may produce higher productivity effect (Torres-Rodriguez et al., 2007).

The probiotic preparation *Bactocell*[®] (group 2) had a higher impact on turkey growth dynamics during the initial periods of growth and resulted lower feed consumption throughout the whole feeding period. It is only at the end of feeding that the difference in body weight between the experimental group 2 and the control group disappeared. Studies reported in the literature indicates that high amounts of lactose may reduce weight gain and cause diarrhea, but quantities under 10 percent do not have any negative effects on growth of birds (Rutter et al., 1953). Prebiotic effect of lactose had a positive effect on growth of turkeys during the first two periods of growth. During the later periods, no positive effect on productivity was found, possibly, due to low dosage.

1. Under the influence *Bactocell*[®], weight of turkeys during the initial periods exceeded those of birds assigned to the control group by 3 percent during the rearing period between the 1st and the 4th week, by 2 percent during the period between the 5th week and the 8th week, and by 2 percent during the period between the 9th week and the 12th week.

2. Feed consumption per 1 kg of weight gain, in the experimental group 2 was consistently lower than in the control group: during the period between the 1st and the 4th week – by 3 percent, during the period between the 5th and the 8th week – by 1 percent, during the period between the 9th and the 12th week – by 2 percent, during the period between the 13th and the 18th week – by 3 percent, and during the whole rearing period by 3% lower.

3. Under the influence of the prebiotic lactose turkey body weight was higher by 1 percent during the first and the second rearing period and lower during the subsequent periods, compared to the control group. Feed consumption per 1 kg of body weight gain were 2 percent higher only during the second rearing period, that is, between the 5th and the 8th week of growth, while during other periods they did not differ from the control group.

4. The synbiotic combination (group 4) of the aforementioned preparations had no positive effect on productivity of birds, but bird survival in this group was 3 percent higher, compare to the the control group.

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Received 30 January 2008

Accepted 10 April 2008