EFFECT OF THE YEAST CULTURE FEED ADDITIVE ON PRODUCTIVITY AND EGG QUALITY OF LAYING QUAILS

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Summary. It is known that mananooligosaccharides contained in the cell walls of yeast have certain prebiotic characteristics, therefore, yeast cultures have been used as prebiotic feed additives.

Objective of performed study were to investigate the effect of the novel feed additive Diamond V XPls Yeast Culture on productivity and egg quality of laying quails.

Investigations with laying quails *Coturnix coturnix japonica* were carried out at the Research Laboratory of Biological Diversity and Technologies of Vilnius Pedagogical University, Lithuania, and under field conditions on the quail farm of JSC „Vilniaus Paukštynas"

For the trial the quails were divided into 3 groups with 2 replicates in each group. The quails of the trial groups 2 and 3 received the feed additive from the age of 6 weeks throughout the entire production period till 28 weeks of age. In the trial group 2 the dose of Diamond V XPls was 0.2%, and in the trial group 3 it was 0.4% from the weight of feed.

Addition of Diamond V XPls Yeast Culture to the feed of layer quails had positive influence on various parameters of productivity of laying quails and quality parameters of quail eggs. Most important parameter influencing economical results of layer quail farming is average egg production per quail and intensity of lay during the production cycle. The feed additive Diamond V XPls Yeast Culture had influenced sustainability of egg production keeping the production at high level during the period of 20–28 weeks of age, while in the control group egg production started decreasing already at 20 weeks of age. This resulted in significantly higher total number of eggs received in the trial groups. Intensity of lay in group 3 was higher by 15.35 % and average egg production per quail was higher by 4.62 eggs in comparison with the control group. There was some positive influence on various parameters of eggs quality.

Keywords: prebiotics, yeast culture, laying performance, egg quality, quails.

MIELIŲ KULTŪROS PRIEDO POVEIKIS PUTPELIŲ DEDEKLIŲ PRODUKTYVUMUI IR PRODUKCIJOS KOKYBEI

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Santrauka. Žinoma, kad mielių ląstelių sienelėse esantys mananooligosacharidai pasižymi tam tikromis prebiotinėmis sąvybėmis, todėl mielių kultūros vis plačiau naudojamos kaip prebiotiniai pašaro priedai.

Darbo tikslas – ištirti mielių kultūros „Diamond V XPls“ poveikį japoninių putpelių (*Coturnix coturnix japonica*) produktyvumui ir produkcijos kokybei.

Tyrimai atlikti Vilniaus pedagoginio universiteto Biologinės įvairovės ir technologijų laboratorijoje, o gamybinėmis sąlygomis – AB Vilniaus paukštynas.

Bandymui sudarytos trys grupės, su kiekviena grupe bandymas pakartotas du kartus. Pirma grupė buvo kontrolinė, kitos dvi – bandomosios. Bandomųjų grupių putpelės buvo lesinamos tokios pat sudėties ir maistingumo lesalais, kaip ir kontrolinės, tik šie lesalai buvo papildyti mielių kultūros „Diamond V XPls“ priedu: antrai grupei dozė buvo 0,2 proc., o trečiai – 0,4 proc. lesalų masės. Mielių kultūros priedą bandomųjų grupių putpelės gavo nuo 6 iki 28 amžiaus savaitės.

Putpelių dedeklių lesalų mielių kultūros priedas „Diamond V XPls“ teigiamai veikė bandomųjų grupių putpelių produktyvumą ir kiaušinių kokybės rodiklius. Vieni svarbiausių produktyvumo rodiklių, turinčių įtakos ekonominiams gamybos rezultatams, yra vidutinis putpelės dėslumas ir dėslumo intensyvumas viso gamybos ciklo metu. Mūsų tirtas mielių kultūros priedas „Diamond V XPls“ turėjo įtakos putpelių dėslumui. Ypač ženkliai bandomųjų grupių putpelių dėslumas padidėjo vėlesniais dėslumo laikotarpiais – 20–28 amžiaus savaitę, o kontrolinės grupės putpelių dėslumas ėmė ryškiai mažėti nuo 20 savaitės. Dėl mielių kultūros priedo „Diamond V XPls“ poveikio bandomosiose grupėse buvo surinkta daug daugiau kiaušinių palyginti su kontroline grupe, trečios grupės putpelės kiaušinius dėjo 15,35 proc. intensyviau, o vidutinis kiekvienos putpelės dėslumas buvo 4,62 kiaušiniais didesnis. Nustatytas ir teigiamas poveikis kai kuriems kiaušinių kokybės rodikliams.

Raktažodžiai: prebiotikai, mielių kultūra, putpelės, dėslumas, kiaušiniai.

Introduction. Society‘s concern about food safety has forced a ban on the use of antibiotics in feed. Consequently, the interest in alternative feed additives of natural origin, fostering productivity of animals and their resistance to diseases without causing any danger to human health as well as the safety of food products, has been increasing (Ewing and Cole, 1994; Verstegen, 2005; Mordenti, 2005)

The following possible alternatives have been selected: probiotics, prebiotics (non-digestible oligosaccharides), organic acids, enzymes, and vegetable substances influencing the activeness of microorganisms (Verstegen, 2005; Sirvydis *et al*., 2006)

Inclusion of probiotics – live benign bacterial cultures into the animal feed was the first tested alternative to antibiotic growth promoters (AGP) (Breves *et al*., 1997). Probiotics are widely used in fermented food products for humans. Bacterial species like some Bifidobacteria (*B. breve, B. infantis, B. longum, B. bifidum* and *B. adolescensis*), *Lactobacillus* (*L. acidophilus* ir *L. paracasei*), *Enterococcus* (*E. faecium* ir *E. faecalis*) as well as *Saccharomyces boulardi* are actually used for these purposes (Guarner and Schaafsma,1998). Research of the influence of probiotics on human health had proven that they are easening recovery from some intestinal diseases, limiting enzymatic activity of pathogenic bacteria and have beneficial effect on the immune system (Verstegen, 2005).

Other alternative taken into consideration by researchers were prebiotics – polysaccharides which are not hydrolized and not resorbed in the small intestines and therefore reach the colon where they are fermented by a specific group of indigenous bacteria. Prebiotics were defined as "non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited group of bacteria in the colon, leading to an improvement in host health" (Gibson and Roberfroid, 1995). So, prebiotics are used in order to provide a substrate for beneficial bacteria of gastrointestinal tract *(Bifidobacterium* spp., *Lactobacillus* spp., etc.). Most of the substances investigated so far were forms of carbohydrates (Mordenti, 2005; Verstegen, 2005; Gibson and Roberfoid, 1995). It is known that main substates of fermentation for intestinal microflora are non digestible oligosaccharides and non starch polysaccharides (Bauer *et al*., 2006).

Sources of natural prebiotics are the seeds of leguminosae (soya, peas, broad beans, lupins), yeasts in whose cell walls there is a high contens of mannano-oligosacharides (MOS) well known for their prebiotic activity. Synthetic prebiotics are obtained from polymerization of the dysaccharides or from complex carbohydrates (fructo-oligosaccharides, galacto-oligosaccharides: FOS and GOS) via enzymatic hidrolysis (Mordenti, 2005).

Prebiotics in human diets have been shown to bring out "bifidogenic" effects and a shift in microbial metabolism from "proteolytic" to the more favourable "saccharolytic" (Gibson and Roberfroid, 1995).

This stimulation of saccharolytic activities leads to a reduced formation of toxic substances, such as ammonia, hydrogen sulfide, indoles and secondary bile acids. Another aspect of the potential usefulness of oligosaccharides as prebiotics is their immunomodulating effect. Indeed, mannose oligosaccharides have been shown to agglutinate pathogens and to function as an alternative to at least part of the AGP effect (Spring and Privulescu, 1998).

Another option was to use combined products synbiotics, defined (Salminen *et al*., 1998) as "one mixture of probiotics and prebiotics influencing favourably the host, improving the survival and the colonization of the probiotics in the gastrointestinal tract through one selective stimulation of the growth and/or activating the metabolism of one or of a limited number of bacteria promoting the wellbeing and health of the host". In fact, at least for this synbiotic approach, the prebiotics should stimulate the survival and the metabolic activity of the probiotic flora, they should derive an exaltation of the probiotic effect of the bifidobacteria, of the lactic bacteria and also of yeasts.

The experiments on animals often give interesting results but it is not easy to distinguish if the effectiveness is related to one or to the other of the principles studied or their association.

In any case one aspect is sure and important: neither the prebiotics nor the probiotics and their association are no source of worry for man and animals: they are safe (Mordenti, 2005)

From studies in experimental animals, it has been shown that non-digestible oligosaccharides (NDO) and other fermentable carbohydrates can improve mineral absorption (e.g., calcium and magnesium) probably by increasing their solubility in the intestine resulting from microbial fermentation.

Trials performed in the USA and other countries have shown that MOS can improve growth and feed conversion ratio (FCR) in chickens. In order to exert their action on immunology, it should be noted that this NDO needs to act before fermentation and/or has to escape fermentation. It is stated that MOS is not fermented and can prevent bacterial infection via a mechanism which is quite different from that of antibiotics (Spring and Privulescu, 1998)

Prebiotic feed additives separately or in combination with probiotics are often included into the poultry feeding schemes. It was scientifically proven that they can increase productivity, weight gain and improve feed conversion in broilers (Gibson and Roberfroid, 1995; Lan *et al*., 2007; Yalcinkaya *et al*., 2008). Previous research of our group had also proven that prebiotic feed additives can accelerate growth of chicken, improve quality of broiler meat and have positive influence on some biochemical parameters of blood in broiler chicken (Sirvydis *et al*., 2006). It was also shown that oligosaccharide feed additives can have an influence on quality parameters of quail meat (Gardzielewska *et al*., 2004).

Little or no report about applications of prebiotics on layer performance was available. In the study of Chen P.

and Chen.T supplementing prebiotic had increased (P<0.05) egg production by 6.49% in 27 week-old layers, and by 13.35% in 57 week-old layers. Increase of 6.10% in the weekly cumulative egg weight per bird was observed after three weeks of feeding. In older layers (57 weeks of age), even higher increase of 12.50% was recorded. After a 4-week feeding trial, layers fed with prebiotic supplementation produced more eggs than the controls (by 2.63% at 27 weeks and by 13.35% at 57 weeks). An improvement (P<0.05) of feed conversion ratio was also observed in the older layers fed with prebiotic supplementation. No differences (P>0.05) in average egg weight and albumen quality upon storage among trial and control groups were observed in this experiment. It was also recorded that egg shells from older layers fed the prebiotic supplementation were stronger (P<0.05) than those from the controls. The results also demonstrated lower serum cholesterol levels in trial group layers and lower (P<0.05) yolk cholesterol levels (Chen and Chen, 2005).

It is known that mananooligosaccharides contained in the cell walls of yeast have certain prebiotic characteristics. Therefore, the preparations of yeast and various yeast cultures have been used as prebiotic feed additives. One of such preparations is Diamond V XPls Yeast Culture which is a feed additive derived from a fermentation process of cereal grains, fermentation by-products and yeast (*S. cerevisiae*). In addition to the yeast cell wall mananooligosaccharides it is containing some valuable products of metabolism due to an additional fermentation in the production process.

Diamond V Yeast Culture is a popular feed additive improving performance and production parameters in cattle, swine and poultry.

Objective of performed study were to investigate the effect of the novel feed additive Diamond V XPls Yeast Culture on productivity and egg quality of laying quails.

Materials and methods. Investigations with laying quails *Coturnix coturnix japonica* were carried out at the Research Laboratory of Biological Diversity and Technologies of Vilnius Pedagogical University, Lithuania, and under field conditions on the quail farm of JSC „Vilniaus Paukštynas"

For the trial the quails were divided into 3 groups with 2 replicates A and B in every group. Each replicate contained 30 quails (Table 1). The first group was the control group, and the others were the trial ones. Quails of both trial and control group were fed standard feed P–4–2 produced by Kauno Grūdai feedmill. The quails of the trial groups received the feed of the same composition and nutritional value as the quails of the control group but supplemented with the yeast preparation Diamond V XPls. The quails of the trial groups received this preparation additive from the age of 6 weeks throughout the entire production period till 28 weeks of age. In the trial group 2 the dose of Diamond V XPls was 0.2%, and in the trial group 3 it was 0.4% from the weight of feed.

Table 1.**The scheme of the trial with laying quails**

Group	Replicates	Type of group	Feeding characteristics	Number of laying quails in a group
1	A	Control	F – (feed without Yeast Culture)	30
	B	Control		30
2	A	Trial	F+ Diamond V XPls Yeast Culture, inclusion rate 0,2% (from the weight of feed)	30
	B	Trial		30
3	A	Trial	F+ Diamond V XPls Yeast Culture, inclusion rate 0,4% (from the weight of feed)	30
	B	Trial		30

Note: F- standard combined feed; A – replicate; B – replicate.

The quails were kept in cages. Keeping and care conditions in all the groups of quails were equal and met zootechnical requirements which are valid in Lithuania.

The quails' intensity of lay was determined each day during the trial period from 8 to 28 weeks of age, separately in groups and replicates by collecting, counting eggs and weighing the total weight of collected eggs on the farm site. Intensity of lay of an average quail in the replicates of all the groups was calculated.

Quality of the quail eggs was determined by the method of morphological and physical chemical analysis, following standard methodologies. The researches on the eggs were carried out when the quails were at the age of 8, 12 and 19 weeks. In the replicates of the groups, the individual weight of the quail eggs was determined, by weighing with presision scales. The Haugh units were calculated following the formula: $HU = 100 \log (H + 7{,}57 – 1{,}7W^{0{,}37})$, (H – the height of the egg white; W - the egg weight). The amount of dry substances, fats and proteins in the egg yolk and white was determined following the methodologies LST ISO 1443:2000 and LST ISO 1523:1998. Data were analysed by ANOVA with the statistic software JMP (Version 5,1, SAS Insitute). Diferences between means were tested for significance by t-test.

Quails had ad libitum access to water from automatic equipment. The quails were kept in cages. Husbandry conditions for quails were complying with good commercial practices and with the Law of the Republic of Lithuania on the Care, Keeping and Use of Animals as well as secondary legislation – Order of the State Food and Veterinary Service of the Republic of Lithuania „On Veterinary Regulations on Breeding, Handling and Transportation of Laboratory Animals" and „On the Use of Laboratory Animals in Scientific Experiments (LAW ON THE CARE, WELFARE AND USE OF ANIMALS 2002).

Results and discussion. Egg quality and productivity are the most important parameters for both producers and researchers (Yuan *et al.,* 1994). Egg quantity and quality are dependent on assimilation of nutrients in the organism of layers, because major amount of energy from feed is used for production of eggs (Robinson *et al*., 1998). Results of our trial show that addition of Diamond V XPls Yeast Culture to the quail feed had increased egg production in quails. During all the trial periods both average egg production per quail and intensity of lay were higher in trial groups in comparison with the control group.

Egg production increase in the trial groups became more pronounced in later periods of the trial (20–28 weeks). During the period of 20–23 weeks of age in the trial group 2 average egg poduction per quail was higher by 3.42 eggs and in trial group 3 – higher even by 4.62 eggs in comparison with the control group. Positive tendency was also observed in the trial groups 2 and 3 during the period of 24–28 weeks of age – average egg production per quail was higher accordingly by 3.58 eggs and by 2.29 eggs in comparison with the control group (Table 2).

Table 2. **Average egg production of quails and intensity of lay**

Age of quails in weeks	Lay parameters	Feeding characteristics		
		F – (feed without yeast culture)	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)
18–11	Average egg production per quail, pcs	19.72	22.07	22.80
	Intensity of lay, %	73.03	81.75	84.45
12–15	Average egg production per quail, pcs	25.09	25.72	26.50
	Intensity of lay, %	89.41	91.86	94.64
16–19	Average egg production per quail, pcs	27.28	28.42	29.31
	Intensity of lay, %	88.02	91.69	94.58
20–23	Average egg production per quail, pcs	23.34	26.76	27.96
	Intensity of lay, %	77.80	89.16	93.15
24–28	Average egg production per quail, pcs	21.88	25.46	24.17
	Intensity of lay, %	70.58	82.14	77.95

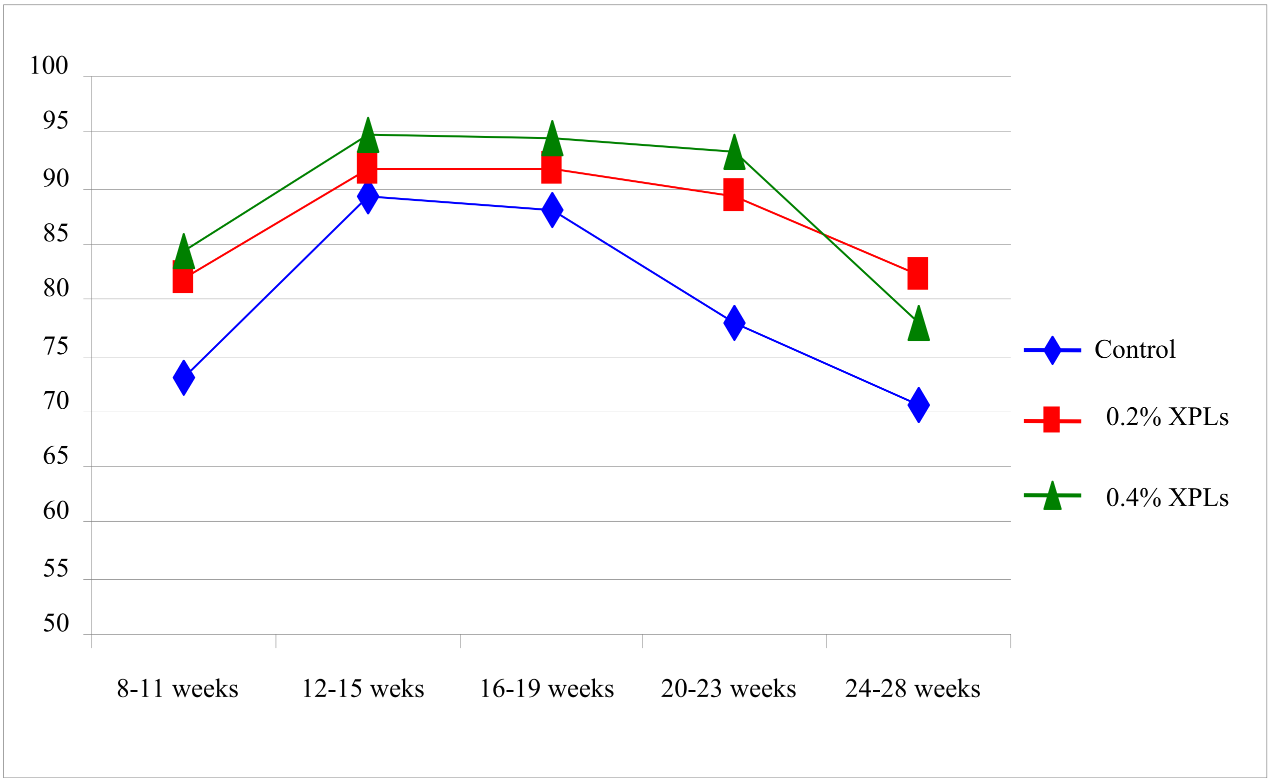
Percentage of intensity of lay in the trial groups was already quite high in the initial period of 8–11 weeks of age. In trial group 3 it was higher by 11.42% in comparison with the control group. Especially big increase in the intensity of lay was observed in the 2 last periods of the trial. During the period of 20–23 weeks of age in trial group 2 this parameter was higher by 11.36% and in trial group 3 – by even 15.35% and accordingly during the period of 24–28 it was higher by 11.56% and 7.37% in comparison with the control group (Table 2). The results obtained in the trial show that quails of all groups were coming into the peak of lay at the age of 16-19 weeks of age. At later periods intensity of lay in the trial groups was remaining at quite high level and started decreasing only after 23 weeks of age. However in the control group quails intensity of lay started going down significantly already at 20 weeks of age (Picture 1).

These results suggest that addition of Diamond V XPls Yeast Culture to the quail feed of the trial groups had resulted in keeping intensive lay performance for much longer period after reaching the peak in comparison with the control group. In fact quails of the trial groups were keeping intensive lay parameters for approximately 4 weeks longer than the control group quails (Picture 1). Accordingly this higher lay performance data in trial groups had resulted in higher total egg weight during the trial period in comparison with the control group. During the total period of the trial (8–28 weeks) the total egg weight in group 2 was higher by 2036 g and in group 3 by 2944 g in comparison with the control group where total egg weight during the trial was 35402 g

Individual weight of eggs which was measured in the laboratory conditions in both trial groups was very similar or even slightly lower in comparison with the weight of control group eggs. It was found that at the periods of 8 and 12 weeks in group 3 it was higher by 0.53–1.04% ($P<0.05$), but in group 2 – lower in comparison with control group ($P<0.001$) (Table 3).

These results show that total egg weight was higher due to higher lay performance resulting in bigger number of eggs, not due to the increase of individual weight of eggs.

Same tendency was observed analysing the weight of egg yolk and egg white. Yolk weight of eggs of the trial group quails was lower in comparison to the control group ($P<0.001$). Weight of yolk of individual eggs was not correlating clearly with the addition of XPls.



Picture 1. **Intensity of lay in quails ,** %

Table 3. **Weight of individual eggs,** g

Group No.	Feeding characteristics	Age of quails in weeks		
		8	12	19
1	F – (feed without yeast culture)	10.83±0.082	11.97 ±0.085	12.17 ±0.062
2	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	10.69 ±0.015	11.53 ±0.081***	12.08±0.065*
3	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)	10.89 ±0.152*	12.09 ±0.139*	11.92 ±0.081*

Note: The difference between the control and respective trial group was statistically significant: *P<0.05, *** P<0.001.

However weight of egg white was 3.10% (P<0.05) higher in the trial group 3 at 12 and 19 weeks of age and in the trial group 2 it was higher by 2.82% (P<0.05) at 19 weeks in comparison with the control group (Table 4).

Egg shell quality is an important parameter for producers as it is easier to handle and transport eggs with thicker shell. For having thick egg shell it is important to ensure good absorption of calcium and some other minerals from the feed in the GIT of quails. H.S.Zeweil had reported that addition of yeast culture to the feed of layer hens had positive influence on thickness and weight of egg shells (Zwell, 2007). Shell weight was measured in the trial and was significantly higher by 2,24–6,27% (p<0.01) in the trial groups 2 and 3 at the age of 8 and 12 weeks in comparison with the control group (Table 5).

Egg Shape Index is also one of the important parameters. Eggs with higher Index have more round shape, better yolk and white ratio, more dry substance and therefore have higher nutritional value. Haugh units were also measured during the trial. Haugh units are describing egg freshness, based on the thickness of the albumen. Aksoy et al. is describing that this parameter was decreasing with age of quails (Aksoy *et al.*, 2007). Results of our trial show that the Egg Shape Index in the trial groups was slightly higher at the beginning of lay – at 8 weeks of age. In the trial group 2 this index was higher by 0.95% and in group 3 – by 0.34% in comparison with the control group. At later periods of the trial this parameter was close to that of the control group quail eggs (Table 6).

Haugh units in the trial group eggs was higher at all age periods during the trial in comparison with the controls. Biggest difference of 2.49 % was observed at 12 weeks of age in group 3 (Table 6).

Table 4. **Weight of yolk and white of individual eggs,** g

Group No.	Feeding characteristics	Age of quails in weeks					
		8		12		19	
		Yolk	White	Yolk	White	Yolk	White
1	F – (feed without yeast culture	3.28 ±0.054	6.44 ±0.062	3.87±0.065	6.99 ± 0.061	4.01 ±0.031	6.76 ±0.120
2	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	3.16 ±0.059	6.24 ±0.117	3.52 ±0.060***	6.87 ±0.063	3.92 ±0.054*	6.95 ±0.066*
3	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)	3.29 ±0.085	6.34±0.098*	3.69 ±0.050**	7.21 ±0.112*	3.76 ±0.058**	6.97 ±0.065*

Note: The difference between the control and the respective trial group was statistically significant:
* P<0.05, **P< 0.01, ***P< 0.001

Table 5. **Thickness and weight of egg shells**

Group No.	Feeding characteristics	Age of quails in weeks					
		8		12		19	
		µm	g	µm	g	µm	g
1	F – (feed without yeast culture)	181.60±18.00	1.13±0.015	189.10±7.200	1.13±0.010	198.80±7.800	1.21±0.019
2	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	178.95±18.950	1.19±0.021*	191.00±4.00*	1.15±0.013*	192.50±1.20	1.19±0.019
3	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)	176.50±19.400	1.21±0.017**	186.85±0.450	1.19±0.016**	219.35±9.350*	1.18±0.010

Note: The difference between the control and the respective trial group was statistically significant:
* P<0.05, **P< 0.01.

Table 6. **Egg shape indexes and Haugh units ,** %

Group No.	Feeding characteristics	Age of quails in weeks					
		8		12		19	
		Egg shape index	Haugh unit	Egg shape index	Haugh unit	Egg shape index	Haugh unit
1	F – (feed without yeast culture)	78.55	90.54	79.39	94.26	79.11	95.94
2	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	79.50	91.81	77.93	95.73	78.06	96.63
3	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)	78.89	92.61	79.15	96.75	78.26	96.22

Results of our research show that in eggs of quails of the trial groups fed with addition of Diamond V XPls Yeast Culture feed additive the contents of dry substance, proteins and crude fat had slightly increased. At the age of 8 weeks in yolk of eggs of the trial group 2 the dry substance contents had increased by 0.84%, proteins – by 0.51% and crude fat by 2.22% in comparison with the trial group parameters. Similar results were obtained in the trial group 3. In the egg white of the trial group 3 dry substance was higher by 0.15%, proteins – by 0.06% and the crude fat was equal to that in the control group eggs. Similar tendencies were observed in the trial groups at 19 weeks of age (Table 7).

Table 7. **Chemical composition of quail eggs,** %

Age of quails in weeks	Parameters of egg composition	Feeding characteristics		
		F – (feed without yeast culture)	F+Diamond V XPls, inclusion rate 0, 2% (from the weight of feed)	F+Diamond V XPls, inclusion rate 0, 4% (from the weight of feed)
In egg yolk				
8 weeks	Dry substance	51.29	52.13	51.60
	Proteins	17.33	17.84	17.49
	Crude fat	15.29	17.51	18.16
12 weeks	Dry substance	52.46	52.83	52.08
	Proteins	16.23	16.21	16.02
	Crude fat	16.16	17.71	17.06
19 weeks	Dry substance	52.97	53.12	53.10
	Proteins	15.93	16.06	15.85
	Crude fat	15.67	15.24	14.85
In egg white				
8 weeks	Dry substance	13.18	12.97	13.33
	Proteins	10.32	10.23	10.38
	Crude fat	0.03	0.03	0.03
12 weeks	Dry substance	13.30	13.25	13.00
	Proteins	10.99	10.79	10.48
	Crude fat	0.02	0.02	0.02
19 weeks	Dry substance	13.09	13.12	13.75
	Proteins	10.68	10.90	11.64
	Crude fat	0.02	0.03	0.03

Addition of Diamond V XPls Yeast Culture to the feed of layer quails had a positive influence on various parameters of productivity of the laying quails and quality parameters of quail eggs. Most important parameter influencing economical results of layer quail farming is an egg production per quail and intensity of lay during the production cycle. Feed additive Diamond V XPls Yeast Culture had influenced sustainability of egg production keeping the production at high level during the period of 20–28 weeks of age, while in the control group egg production started decreasing already at 20 weeks of age. This resulted in significantly higher number of eggs received in the trial groups.

Conclusions:

1. Feed additive Diamond V XPls Yeast Culture had a positive influence on the parameters of lay during the entire production period. Especially big increase of the intensity of lay was observed at the period of 20–23 weeks of age, where it was higher by 15.35 % and average egg production per quail was higher by 4.62 eggs in comparison with the control group.

2. Feed additive Diamond V XPls Yeast Culture had some positive influence on various parameters of eggs comparing to the control group:

- Individual weight of eggs was slightly increased 0.53–1.04% ($P<0.05$);
- Egg yolk weight was close to the control group or even lower ($P<0.001$);
- Egg white weight was increased by 2.82 –3.10 % ($P<0.05$);
- Weight of the egg shell was 2.24–6.27% ($p<0.01$) higher;
- Egg shape index at 12–19 was slightly lower and Haugh units at all periods was higher by up to 2.49 % ;

3. Feed additive Diamond V XPls Yeast Culture did not have a significant influence on the chemical composition of quail eggs: dry substance, protein and crude fat content was close to these parameters of the eggs in the control group.

References

1. Aksoy T., Narinc D., Karabag K., Ilaslan D. A Research on egg quality of Japanese quail (*Coturnix coturnix japonica*). Proceedings of XVIII European Symposium the Quality of poultry Meat and XII European Symposium the Quality of eggs products. Prague, 2007. P. 196–197.

2. Bauer E., Williams B.A., Verstegen M.W.A.,Mosenthin R. Fermentable carbohydrates: potencial dietary modulators of intestinal physiology, microbiology and immunity in pigs. Biology of Nutrition in Growing Animals. 2006. Vol.4. P.33–64.

3. Breves G., Winckler C., Leister R. Untersuchungen im Gastrointestinalen Wirksamkeit

von Probiotika beim Schwein. In: Aktuelle Themen der Tierernährung. 1997. P. 83–86.

4. Chen P. and Chen T. Improved Layer Performance and Reduced Yolk Cholesterol as Obtained from Probiotic pr Prebiotic Layer Diet Supplementation. Feedinfo News Service, 2005. [Available Online]. [Accessed 2010 October 11]. Internet site: <http:// www.feedinfo.com >.

5. Ewing, W.N., Cole D.J.A. The living gut . Context. Dungammon, Ireland, 1994.

6. Gardzielewska J., Tarasewicz Z., Szczerbinska D., Jakubowska M, Karamucki T., Natalczyk – Szymkowska W. Putpelių mėsos kokybės modifikacija lesinant oligosacharidų pašaro papildais. Vetrerinarija ir zootechnika. 2004. T.26. P.29–33.

7. Gibson G. R., Roberfroid M.B. Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. J. of Nutr. 1995. Vol.125. P. 1401–1412.

8. Guarner F., Schaafsma G.J. Probiotics. Internal. J. of Food Microbiol. 1998. Vol. 39. P. 237–238.

9. Gudavičiūtė D., Čepulienė R., Bobinienė R., Kepalienė I. Funkcinio maisto ingredientų - prebiotikų įtaka paukščių organizmo fiziologinėms funkcijoms ir mėsos kokybei. Žemės ūkio mokslai. 2006, Nr. 4. P. 53–56.

10. Yalcinkaya U., Gungor T., Basalan M., Erdem E. Mannan Oligosaccharies (MOS) from *Saccharomycetes cerevisiae* in Broilers: Effects on Performance and Blood Biochemistry. Turk. J.Vet. Anim. Sci. 2008. Vol. 32. P. 43–48.

11. Yuan T., Lein R.J., Mcdaniel G.R. Effect of increased rearing period body weights and early photostimulation on broiler breeder egg production. World's Poultry Science. 1994. Vol.73. P.792–800.

12. Lan Y., Williams B.A., Verstegen M. W.A., Petterson R., Tamminga S. Soy oligosaccharides *in vitro* fermentation characteristics and its effect on caecal microorganisms of young broiler chickens. Anim Feed Sci Techn. 2007. Vol. 133. P.286–297.

13. LAW ON THE CARE, WELFARE AND USE OF ANIMALS. (Parliament of the Republic of Lithuania/ Law/VIII-500/2001 11 08/came into force 2002 01 01/Official Gazzette Valstybės žinios' 2002 Nr.99–3521).

14. Mordenti A. Probiotics for Animal Nutrition, Concept and Evidences. 1 st International Seminar on Probiotics in Animal Nutrition. Rome, Italy 6 September, 2005. [Available Online]. [Accessed 2010 June 28]. Internet site: <http:// www.feedinfo.com >.

15. Robinson F.E., Renema R.A., Bouvier L., Feddes J.J.R., Zuckerman A. I., wilson J.L., Newcombe M., McKay R.I. Effects of photostimulatorylighting and feed allocation in female broiler breeders. 2. Egg and chick production characteristics. Canadian Journal of Animal Science. 1998. Vol. 34. P. 222–236.

16. Salminen S., Bouley C., Boutron-Rault M.C., Cummings J.H., Frank A., Gibson G.R., Isolauri E., Moreau M.C., Roberfroid M., Rowland I. Functional food science and gastrointestinal physiology and function. Br. J. Nutr. Vol. 80 (suppl. 1). 1998. P.147–171.

17. Sirvydis V., Čepulienė R., Bobinienė R., Semaška V., Gudavičiūtė D., Vencius D. Influence of probiotic feed additive on quantitative changes of blood proteins in chicken Animal Husbandry Collection of Scientific Works. Kaunas, 2006. N. 47. P. 94–100.

18. Spring P., Privulescu M. Mannan-oligosaccharide; its logical role as a natural feed additive. In: Proc. of Alltech's 14th Annual Symposium, 1998. P. 553–561.

19. Verstegen M. W.A. Diet Composition and Non-antibiotic Feeding Programs in Europe. 66 th Minnesota Nutrition Conferenece. Minnesota, USA 20-21 September, 2005.

20. Zwell H.S. Effect of Yea-Sacc and garlic powder (Allium sativum) on the production, egg quality, cholesterol of plasma and yolk egg of laying Japanese quail hens. XVIII European Symposium the Quality of poultry Meat and XII European Symposium the Quality of eggs products. Prague, 2007. P.345–346.

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