

EFFECT OF SOME PROBIOTICS ON PRODUCTION PARAMETERS IN GROWING RABBITS

UČINAK NEKIH PROBIOTIKA NA PROIZVODNA SVOJSTVA KUNIČA U RASTU

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ABSTRACT

The effects of three different probiotics (Toyocerin 10¹⁰ (spores of *Bacillus toyoi*), Paciflor (spores of *Bacillus* CIP 5832) and Yea-sacc (yeast *Sacharomyces cerevisiae*)) on production parameters of weaned New Zealand rabbits were studied. At the end of trial the rabbits (aging 71 ± 1 day) weighed between 2598 and 2664 g. In 4 weeks of the trial the average daily weight gain (from 44th to 71st ± 1 day of age) varied from 49 to 52 g/day, feed intake from 149 to 154 g of feed/day and feed efficiency from 2.9 to 3.1 kg of feed per each kg of weight gain. The addition of probiotics had no effect on feed intake, feed efficiency and live weight rabbits. Differences between groups appeared only in the second week of the trial when the group with added Paciflor had a significantly ($p \leq 0.05$) lower daily gain. The average daily weight gain in the entire experimental period did not differ between groups. Sex of the animals affected production parameters only in the first week of the experiment, when females gained weight faster than males. An interaction between probiotics and sex was noticed: in the first week of the trial a significant ($p \leq 0.05$) increase of feed intake was noticed in females in the groups fed with addition of Toyocerin and Paciflor.

Key words: animal nutrition / rabbits / probiotics / production parameters

1. INTRODUCTION

The use of different biotechnically produced feed additives in animal nutrition is becoming more and more important, especially due to today's demand for naturally produced and health feed. These additives, not having any negative influence on human feed of animal origin (no harmful residues in milk, meat or eggs), can successfully replace growth promotors, that are used all over the world. The role of such probiotic additives is to

sustain digestion processes, to enable better feed conversion and to improve health of the animal. The addition of probiotics to feed for rabbits has a particularly favorable effect on microbial balance in caecum. Stable microbial metabolism in caecum is extremely important to prevent digestion disturbances as well as to obtain favorable

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production parameters and a low mortality rate in the intensive breeding of rabbits.

Such additives seem to be the most efficient when fed to young animals, being the most sensitive to many different digestion disturbances (Harker, 1989). Additives have only a minor effect when animals are not under stress conditions or have balanced intestinal microflora (Lyons, 1987).

Cheeke et al., 1989 reported decreased intake of caecotrophes when microbial probiotics and acids were added. The urge for caecotrophes intake is closely correlated with protein content in feed therefore researchers assume that the probiotics improve protein efficiency and in such a decrease the need for the consumption of caecotrophes. Similarly, the results reported by El-Hindawy et al., 1993 indicate the improvement of digestibility of all nutrients when probiotic Lacto-Sacc. was added. Kamra et al., 1966 established improved digestibility of crude proteins after the addition of the same probiotic. On the contrary, Holister et al., 1989 and Chaudhary et al., 1995 found no influence of probiotics, acids or yeast cultures on digestibility of tested nutrients.

Probiotics can be bacterial probiotics, yeast cultures, moulds or other substances with a probiotic action. Yeast additives are used more often in ruminant nutrition, although their relative favorable effect in rabbits was found as well (Maertens, 1992; Maertens and De Groote, 1992; Nieves-Delgado et al., 1992) Holister et al., 1990 found a lower efficiency of additives based on yeast (Yea-sacc) than that of combined ones.

Most commonly used bacterial probiotics are lacto-acid bacteria, streptococcus and bifidobacteria (Fuller, 1989). With the help of microcapsulation, the vegetative forms of probiotic bacteria penetrate the acid stomach content with no damage, thus enabling effective colonization in guts. In some products for monogastrics the sporegenic bacteria were added (e.g. *Bacillus toyoi*) which pass to their vegetative phase in favorable conditions in intestine.

Some authors reported a slightly improved daily gain and feed conversion in rabbits fed with the addition of bacterial probiotics (Szabo-Lacza et al., 1988, 1990; De Blas et al., 1991; Maertens et al., 1994). Probiotics decrease mortality, especially when caused by digestion disturbances (Szabo-

Lacza et al., 1988, 1990; Guillot and Mercier, 1992; Dupperay and Robertson, 1990).

Combined microbial probiotics (milk-acid bacteria, yeast, fermentation extracts, enzymes etc.) are used as well. Such additives (for example Lacto-Sacc) have a similar effect as other probiotics; they can improve daily gains, feed conversion and decrease mortality (Cheeke et al., 1989; Holister et al., 1989, 1990; Nieves-Delgado et al., 1992; Yamani et al., 1992; Gippert et al., 1992; El-Hindawy et al., 1993; Zhang et al., 1992). A combined additive Acid-Pak 4-Way was tested under our conditions and the results showed a favorable influence on the growth of rabbits during the first two weeks after weaning (Kermauner and Štruklec, 1993, 1994).

The aim of study to establish the influence of different probiotics on production of growing rabbits under experimental conditions. Because of various results reported in the available literature three different probiotics were used: Toyocerin 10^{10} (spores of *Bacillus toyoi*), Paciflor (spores of *Bacillus CIP 5832*) and Yea-sacc (yeast *Sacharomyces cervisiae*). Their influence on production traits in growing rabbits was observed, in comparison with the control group.

2. MATERIAL AND METHODS

2.1. Animals and measured parameters

A total of 96 New Zealand White rabbits, both female and male were allotted to 4 trial groups (24 rabbits per group). Rabbits were housed in wire cages, during the first part of the experiment, two animals were housed together in one cage. During the second part of the trial, animals were housed individually. Temperature was between 17 and 18° C, humidity between 50 and 60%, the light period was 16 hours long. Rabbits were given both, feed and water ad libitum.

Rabbits were weaned at the age of 31 days, individually marked (ear tattooing) at the age of 37 days (1175 ± 115.8 g). After an adjustment period of 1 week, the experiment was started at the 44th days of life (1363 ± 107.9 g) and lasted 4 weeks (up to the 71st day of life). Before the trial began, rabbits were fed standard feed.

The following parameters were measured weekly: live weight of rabbits (g), mean daily feed intake (g feed/day), mean daily weight gain (g gain/day) and feed conversion ratio-FCR (g feed/g gain).

2.2. Feed

Control feed was prepared according to recommendations for growing rabbits (Maertens, 1995) with increased crude protein (CP) content.

Trial feeds based on control feed with the addition of the following probiotics:

0,01% of Toyocerin 10^{10} (spores of *Bacillus toyoi*)

0,01% of Paciflor (spores of *Bacillus CIP 5832*)

0.1% of Yea-sacc (yeast culture *Sacharomyces cervisiae*)

Actual trial feed composition is shown in table 1 and 2.

Table 1. Chemical composition of trial feeds (g/kg DM)

Tablica 1. Kemijski sastav ispitivane hrane (g/kg ST)

Component (g/kg DM)-Sastojci (g/kg ST)	Control - Kontrola	Toyocerin	Paciflor	Yea-sacc
Crude protein - Sirove bjelančevine	199.26	208.66	205.87	206.40
Crude fat - Sirove masti	25.23	21.61	20.82	20.71
Crude fibre - Sirova vlaknina	153.14	175.50	176.60	174.36
NDF	331.87	339.76	346.97	350.04
ADF	184.51	217.51	219.66	220.41
ADL	33.15	41.39	40.57	38.96
Crude ash – Pepeo	79.84	74.26	73.91	73.87
N-free extract – NET	542.53	519.97	522.80	524.65
Phosphorus – Fosfor	7.26	5.79	5.72	5.76
Calcium – Kalcij	13.81	11.01	10.68	10.84
Potassium – Kalij	11.47	14.54	14.17	14.43
Sodium – Natrij	2.61	2.30	2.24	2.30
Zinc (mg/kg) – Cink	183.92	264.76	251.28	273.33
Manganese (mg/kg) – Mangan	237.05	315.73	295.64	309.81
Starch - Škrob	207.86	171.78	173.36	136.29
Total sugars - Ukupni šećeri	60.09	66.92	64.48	56.15
Dry matter (DM) - Suha tvar (ST)	862.83	909.61	893.44	897.18
Gross energy (MJ/kg) - Ukupna energija	17.88	17.86	17.88	17.78
Digestible energy (MJ/kg)* - Probavljiva energija	10.0	10.0	10.0	10.0

* calculated from tables - kalkulirano prema tablicama (Schlout, 1982; Maertens et al., 1990)

Table 2. Composition of trial feed**Tablica 2. Sastav pokusne hrane**

Component - Sastojak	%
Alfalfa meal - Lucerna	23.6
Barley - Ječam	11.0
Oats - Zob	5.0
Wheat fodder meal Pšenično stočno brašno	6.0
Sugar beet pulp - Rezanci šećerne repe	18.0
Soybean meal - Sojina sačma	11.0
Sunflower meal - Suncokretova sačma	10.0
Brewer's yeast - Pivski kvasac	2.0
Sawdust - Piljevina	3.0
Molasses - Melasa	3.0
Binder - Vezivo	2.0
Mineral-vitamin mix Mješavina minerala-vitamina	8.4

Basic feed mixture (recipe in table 2) was divided into 4 parts. Three above mentioned probiotics were added to 3 parts of feed, each to one part. All mixture were prepared and pelleted in Experimental blend unit (Biotechnical Faculty, Zootechnical Dep.) in Homec.

Control feed partly differs from the other three feed mixture, mainly in crude fibre and starch content as well as in content of some macro-and microminerals the possible reason for this is a sampling error.

2.3. Statistics

Data were subjected to statistical analysis using GLM procedure in the SAS statistical program (SAS/STAT, 1990). Covariance analysis (regression on live weight at the beginning of the trial-initial weight) was included in the model. The model used was as follows:

$$Y_{ijk} = \mu + P_i + S_j + P.S_{ij} + b_1(x-x) + e_{ijk}$$

Y_{ijk} - measured value

μ - population mean

P_i - effect of the probiotic ($i = 1,2,3,4$)

S_j - effect of the sex ($j = 1,2$)

$P.S_{ij}$ - effect of the interaction between probiotic and sex

b_1 - linear regression coefficient

e_{ijk} - error

Differences between groups in mortality were processed by CATMODE procedure (SAS/STAT, 1990). Differences between groups were tested at $p \pm 0.05$.

3. RESULTS

Production parameters of growing rabbits were tested between groups:

- mean live weight of rabbits (g) in separate trial weeks
- mean daily weight gain (g gain/day) in separate weeks and during the entire trial period
- mean daily feed intake (g feed/day) in separate weeks and during the entire trial period
- feed conversion ratio (g feed/g gain) in separate weeks and during the entire trial period

Significance (p) of all effects is shown in an Anova table (table 3).

Live weight of rabbits in all trial weeks significantly depended on their live weight at the beginning of the trial, therefore the regression was to eliminate this influence. Regression was linear and positive, indicating that heavier rabbits maintained their advantage during the entire trial period. This is in accordance with the independence of daily weight gain from initial live weight. Live weight at the beginning of the trial had no influence on feed conversion ratio.

The initial live weight of rabbits had no effect on feed intake in separate weeks, but showed an important influence on feed intake during the entire trial period. Regression was linear and positive: rabbits with higher initial live weight consumed more feed per day during the entire trial.

Table 3. Analysis of variance: significance (p) of all effects for parameters tested in rabbits**Tablica 3. Analiza varijance: značajnost (p) sviju učinaka za parametre ispitivane u kunića**

		Main effects Glavni učinak		Interaction P.S. Međusobno djelovanje	Regression-Regresija		
		Probiotic	Sex Spol		Covariable	Linear	p
Live weight- Živa vaga	1. week – tjedan		***		Initial live weight Početna živa vaga	1.161	***
	2. week – tjedan					1.370	***
	3. week – tjedan					1.448	***
	4. week – tjedan					1.484	***
Daily weight gain Dnevni prirast težine	1. week – tjedan	**	***		-		
	2. week – tjedan		**		-		
	3. week – tjedan				-		
	4. week – tjedan				-		
	Average-Prosječno				-		
Feed intake Utrošak (uzimanje) hrane	1. week – tjedan		*	*	-		
	2. week – tjedan				-		
	3. week – tjedan				-		
	4. week – tjedan				-		
	Average-Prosječno				Initial live weight Početna živa vaga	0.055	**
FCR Iskorištenje hrane	1. week – tjedan		*		-		
	2. week – tjedan				-		
	3. week – tjedan				-		
	4. week – tjedan				-		
	Average-Prosječno				-		

⁰ : p ≤ 0.10; * : p ≤ 0.05; ** : p ≤ 0.01; *** : p ≤ 0.001

3.1. INFLUENCE OF PROBIOTICS

The mortality during the trial was: in control group 1 rabbit (4,2%), in Toyocerin and Paciflor groups 2 rabbits in each (8,3%) and in Yea-sacc group 3 rabbits (12.5%). Differences between groups were not significant.

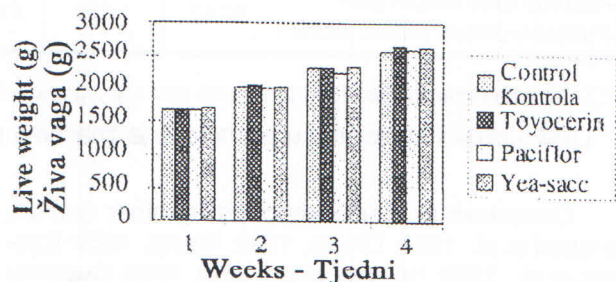
Analysis of variance (table 3) showed that probiotics had no significant influence on live weight, feed intake and feed conversion ratio. (graph 1, 2 and 3).

Significant differences were noticed only in daily weight gains (table 4).

The final live weight of rabbits (71 ± 1 day) was almost equal in all groups. Animals weighed between 2598 g and 2664 g, representing a great

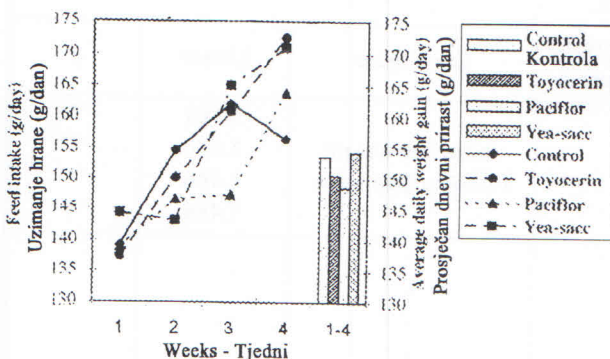
performance for this age. Control and Paciflor rabbits had the same final live weight, rabbits from Yea-Sacc group were heavier for 2% and Toyocerin for 3%.

Graph 1. Average live weight of rabbits in trial weeks
Grafikon 1. Prosječna živa vaga kunića u pokusnim tjednima



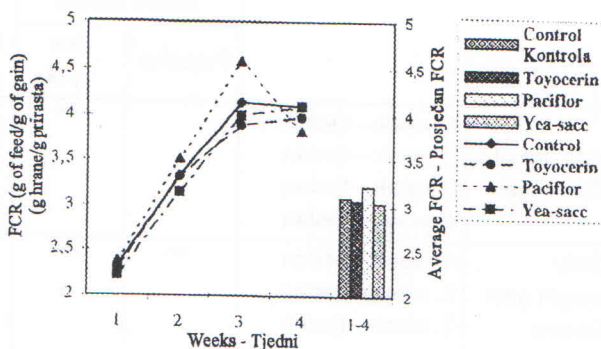
Graph 2. Average daily feed intake in separate weeks and during the trial

Grafikon 2. Prosječno dnevno uzimanje (utrošak) hrane pojedinih tjedana i tijekom pokusa



Graph 3. Average FCR in separate weeks and during the trial

Grafikon 3. Prosječno iskorištenje hrane pojedinih tjedana i tijekom pokusa



Daily feed intake varied between 149 and 154 g of feed/day. In Control and in Yea-Sacc group the feed intake was same, rabbits consumed 2% less feed with Toyocerin and 3% less feed with Paciflor. The most desirable course of feed intake was obtained in Toyocerin group.

Feed conversion ratio was the most advantageous in the first week of the trial (2.3 kg of feed for 1 kg of weights gain), afterward it gradually to about 4.0 kg of feed for 1 kg of weight gain. In the first part of the trial (1st, 2nd week) the feed conversion

ratio was the best in Yea-Sacc group and in the second part of the trial (3rd, 4th week) in Toyocerin group.

The average daily weight gain in the entire trial was very high (49 to 52 g/day) and did not differ between the trial groups. The highest weight gain was achieved in the 1st week (61 to 67 g/day), afterwards it decreased. Only in the 2nd week Paciflor group showed significantly less favorable weight gains than other groups.

Table 4. Influence of probiotics on daily weight gain of rabbits

Tablica 4. Utjecaj probiotika na dnevni prirast težine kunića

Daily weight gain- Dnevni prirast težine	Control-Kontrola		Toyocerin		Paciflor		Yea-sacc	
	LSM	±SE	LSM	±SE	LSM	±SE	LSM	±SE
1. week - tjedan	61.19	2.577	64.23	2.577	64.83	2.593	66.55	2.577
2. week - tjedan	50.19 ^a	1.919	47.31 ^a	1.882	41.62 ^b	1.866	48.00 ^b	2.054
3. week - tjedan	40.02	2.636	42.04	2.559	35.33	2.847	42.03	2.869
4. week - tjedan	41.27	2.216	43.89	2.135	43.81	2.350	43.73	2.477
Average daily weight gain Prosječni dnevni prirast težine	50.47	1.632	51.86	1.639	48.91	1.691	50.92	1.706

^{a,b} LSM with different letters in the same row are significantly different ($p \leq 0.05$)

^{a,b} LSM s različitim slovima u istom redu je značajna razlika ($p \leq 0.05$)

Compared to results reported by other authors (Hattori et al., 1984; Cheke, 1988; Kranjc, 1989; Erjavec et al., 1989; Hollister et al., 1989, 1990; Duperray

and Robertson, 1990; Marionnet and Lebas, 1990; De Blas et al., 1991; Kavar, 1993; Kermauner and Štruklec, 1993, 1994, 1996; Maertens et al., 1994)

rabbits in our trial reached higher live weight and daily weight gains. Feed intake was higher as well.

There are only a few available data considering the addition of Toyocerin into rabbit nutrition. Hattori et al., 1984 found a higher daily weight gain in rabbits fed with addition of Toyocerin which was indicated in our trial as well. Guillot and Merciel, 1992 established the influence of Toyocerin on productivity of rabbit does: the addition reduced mortality and number of culled does, but number of live-born and still-born rabbits was not affected. In broilers, the addition of Toyocerin increases a daily weight gain (Nguyen et al., 1988).

Some authors (Dupperay and Robertson, 1990; Maertens et al., 1994) found increased weight gains and live weights of rabbits when Paciflor was added, which is not in accordance with our results. De Blas et al., 1991 established, beside higher daily weight gains and increased feed intake, a more

important effect of Paciflor in stress conditions. Our results are in accordance with experiment of Vörös et al., 1992, where Paciflor group did not differ from control rabbits. In broilers, Paciflor increased daily weight gains, decreased feed intake and improved feed conversion ratio (Nguyen et al., 1988).

The addition of yeast cultures into rabbit's feed improved daily weight gains (Maertens, 1992; Maertens and De Groote, 1992). However, our results are in accordance with Chaudhary et al., 1995, who found no influence of yeast cultures on growth or digestibility of feed in rabbits.

3.2. Influence of sex

Analysis of variance (table 3) showed that sex of trial animals influenced production parameters only at the beginning of the trial, afterwards differences between sexes disappeared. Influence of sex is showed in a table 5.

Table 5. Influence of sex on production parameters in rabbits
Tablica 5. Utjecaj spolova na proizvodna svojstva kunića

Parameter Svojstvo		Females - Ženke		Males - Mužjaci	
		LSM	±SE	LSM	±SE
Live weight Živa vaga	1. week - tjedan	1707.56 ^a	11.487	1648.65 ^b	10.634
	2. week - tjedan	2053.41	23.505	2027.76	21.919
	3. week - tjedan	2319.96	30.757	2317.89	25.645
	4. week - tjedan	2614.46	44.399	2646.07	38.038
Daily weight gain Dnevni prirast težine	1. week - tjedan	68.58 ^a	1.879	59.82 ^b	1.769
	2. week - tjedan	44.86 ^a	1.405	48.69 ^b	1.325
	3. week - tjedan	38.34	2.097	41.37	1.750
	4. week - tjedan	42.05	1.752	44.30	1.488
Average daily weight gain Prosječni dnevni prirast težine		50.31	1.200	50.77	1.167
Feed intake Uzimanje hrane	1. week - tjedan	144.92 ^a	2.765	134.95 ^b	2.479
	2. week - tjedan	150.89	5.239	146.41	4.684
	3. week - tjedan	158.41	4.805	159.25	4.010
	4. week - tjedan	164.10	5.834	167.93	5.009
Average feed intake Prosječno uzimanje hrane		153.71	2.762	149.75	2.652
FCR – Iskorištenje hrane (kg/kg)	1. week - tjedan	2.15 ^a	0.113	2.46 ^b	0.101
	2. week - tjedan	3.37	0.124	3.28	0.115
	3. week - tjedan	4.32	0.200	3.99	0.167
	4. week - tjedan	4.07	0.143	3.94	0.121
Average FCR - Prosječno iskorištenje hrane (kg/kg)		3.03	0.054	2.99	0.052

^{a,b} LSM with different letters in the same row are significantly ($p \leq 0.05$)

^{a,b} LSM s različitim slovima u istom redu je značajna razlika ($p \leq 0.05$)

In the first week on the experiment, female rabbits grew faster than males, eat more feed and had better FCR. In the 2nd week of the trial, females showed a significantly lower daily weight gain than males. In the following trial weeks and during the entire trial, differences between sexes were not prominent.

Evidently, microbial imbalance in caecum occurred in females due to increased feed intake at the beginning of the trial. It was expressed as lower weight gains of females in 2nd week. Morisse, 1985 states that proper growth curve is essential for normal colonization and proliferation of microflora in rabbit's caecum. The author recommends equable growth without major oscillations.

Differences between sexes were found only by some authors. Kermauner and Štruklec, 1993, 1994 established a decreased daily weight gain in females in the last trial week. Štruklec et al., 1994 found differences between sexes in stomach and caecum weight (with its content) and in the percent age of acetic acid in caecum content. Kermauner and Štruklec, 1996 reported higher weight and

proportion of caecum and lower proportion of small intestine in females than in males. Kermauner et al., 1996 found the interaction between sex and age of trial rabbits. In 67 days females mol % of acetic acid in caecum content was lower and mol % of propionic acid was higher than in males. Lopez et al., 1988 found faster growth of digestive organs (especially caecum) in females than in males.

3.3. Interaction between probiotic and sex

Analyses of variance (table 3) showed an interaction between probiotic addition and sex of trial animals in feed intake in the 1st trial week. Differences between males and females appeared in Toyocerin and Paciflor group: in both groups females are more feed in the first week than males (table 6). In the literature available similar data were not found. Due to faster growth in the 1st week females needed more nutrients and they consumed more feed. Obviously, the stimulative effect of probiotics was expressed stronger in females than in males.

Table 6. Interaction between probiotic and sex on feed in trial rabbits

Tablica 6. Međusobno djelovanje između probiotika i spola na uzimanje hrane u pokusnih kunića

		Control		Toyocerin		Paciflor		Yea-saac	
		Females Ženke	Males Mužjaci	Females Ženke	Males Mužjaci	Females Ženke	Males Mužjaci	Females Ženke	Males Mužjaci
1. week-tjedan	LSM ±SE	139.3 5.53	139.1 5.12	150.6 ^a 5.53	124.3 ^b 4.78	147.0 ^a 5.53	130.7 ^b 4.79	142.8 5.53	145.8 5.12
2. week-tjedan	LSM ±SE	155.5 10.23	153.8 9.47	155.6 10.23	144.5 8.86	148.2 11.20	145.2 8.86	144.3 10.23	142.2 10.23
3. week-tjedan	LSM ±SE	167.1 8.87	157.1 8.21	158.5 8.87	163.1 7.68	147.1 10.86	147.6 7.24	161.0 9.71	169.3 8.87
4. week-tjedan	LSM ±SE	162.1 10.76	151.0 9.97	167.6 10.76	177.6 9.97	167.1 13.18	160.7 9.92	159.6 11.79	182.5 10.76

^{a,b} LSM with different letters in the same row are significantly different ($p \leq 0,05$)

^{a,b} LSM s različitim slovima u istom redu je značajna razlika ($p \leq 0,05$)

4. CONCLUSIONS

Production parameters of rabbits were very good in all groups.

The addition of selected probiotics Toyocerin 10¹⁰ (spores *Bacillus toyoi*), Paciflor (spores of

Bacillus CIP 5832) and Yea-sacc (*Yeast Saccharomyces cerevisiae*) had no significant influence on feed intake, feed conversion ratio (FCR) and live weight of rabbits. Differences between group appeared only in the 2nd trial week, when the daily weight gain of rabbits in Paciflor

group was significantly lower compared to other groups. The average daily weight gain during the entire trial period (4 week) did not differ between groups. Under the usual rearing conditions, weaned rabbits are feed restricted. This can avoid the risk of overfeeding and consequently impaired growth. In our trial, rabbits were fed ad libitum, so we can not forecast the growth curve under normal rearing conditions.

The sex of experimental rabbits affected production parameters only in the 1st trial week, when females grow faster than males. Too elevated weight gain in the first week caused an important decrease in growth of females in the 2nd trial week. In the following weeks and during the trial the differences between sexes were not expressed. Feeding of females has to be different than that of males. Immediately weaning, the female rabbits have to be feed restricted for a longer period than the male rabbits (at least 2 weeks after weaning). Otherwise at ad libitum feeding females are overfed (accelerated growth), which can result in microbial disbiosis in digestive tract and consequently in impaired production parameters in the following fattening period.

Interactions between probiotic addition and sex of trial animals appeared in the 1st trial week: in Toyocerin and Paciflor group feed intake in females was significantly higher than in males.

It can be concluded that in our trial probiotics had no particular effect on rabbit's production parameters. The reason for this may be in favourable rearing conditions and in good quality of trial feed. This research work will be continued by digestibility trial, by measurements of digestive organs size, of digest viscosity and of fermentation products in caecum.

5. LITERATURE

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SAŽETAK

Istraživali su se učinci triju različitih probiotika (Toyocerin 10¹⁰ (spore Bacilli toyoi), Paciflor (spore bacilli CIP 5832) i Yea-Sacc (kvasac Sacharomyces cervisiae) na proizvodna svojstva odbijenih novozelandskih kunića. Na kraju ispitivanja kunići su (u dobi od 71 ± 1 dan) težili između 2598 i 2664 gr. U 4 tjedna ispitivanja prosječan je dnevni prirast težine (od 44. do 71. ± 1 dana starosti) iznosio od 49 do 52 g/dnevno, utrošak hrane od 149 do 154 g hrane/dnevno, a iskorištenje hrane od 2.9 do 3.1 kg hrane za svaki kg prirasta težine. Dodatak probiotika nije utjecao na uzimanje hrane, iskorištenje hrane niti na živu vagu kunića. Do razlika između skupina došlo je samo drugog tjedna ispitivanja, kad je skupina kojoj se dodao Paciflor imala znatno niži dnevni prirast težine. Prosječan se dnevni prirast težine tijekom cijelog pokusnog razdoblja nije razlikovao među skupinama. Spol je životinja djelovao na proizvodna svojstva samo prvog tjedna pokusa, kada su ženke dobivale na težini brže od mužjaka. Opaženo je međusobno djelovanje probiotika i spola: prvog je tjedna ispitivanja opaženo značajno povećanje uzimanja hrane u ženka u skupinama kojima su u hranu dodavani Toyocerin i Paciflor.

Ključne riječi: hranidba životinja, (kunići/ probiotici), proizvodna svojstva



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