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Original Research Paper

INFLUENCE OF GRADUAL CHANGE IN FEED, USE OF ACIDIFIER AND PREBIOTIC ON RABBITS IN THE PERIOD OF WEANING

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Summary: To establish the possibility of improvement of rabbit production results, the use of feed acidifier, supplements to feed and gradual change from feed for does to feed for weanlings was investigated. Ten days before parturition 3 groups of 15 pregnant does each were formed. They were fed feed containing coccidiostatic drug Robenidin (1 mg/kg). To the first two groups acidifier Acid Pac 4 Way (2 g/l) was administered in drinking watter. Between day 22 and 30 of weanlings age gradual change from feed for does to feed for weanling rabbits, that contained prebiotic Bio Mos (2 g/kg), was carried out in the first group. The second group got the same feed but there was no gradual change of feed. In the third group gradual change of feed was performed, but for weaned rabbits only basic feed without supplements was used.

The results of parturitions, feed consumption, number and weight of weaned rabbits to the 40th day of age and losses of does and their youngs were registered. Statistically significant difference ($\bar{x}$ ±SE) in the number of equalized and weaned rabbits were stated between 2nd (7.3±0.3, 6.7±1.91) and 3rd (8.7±0.21, 9.5±1.24) group (P<0.05). At weaning the greatest average weight of youngs was found in the 1st group (640.7±19.29 g) and at the age of 40 days in the 2nd group (934.1±10.41 g). The results showed that feed supplements can contribute to better results in intensive rabbit production.

Key words: animals, feeding; feed, additives; oligosaharides; animals, suckling; rabbits

Introduction

In the last decades, the performance of intensive rabbit production improved a lot, due to the development of specialised strains (hybrids), increasing use of artificial insemination, adapted diets and management rationalisation. However, mortality of youngs before and after weaning is still very high and mounts in total to nearly 25%. The major part of these losses is due to diarrhoea, whose etiology is multifactorial (1). The nutrition requirements of a rabbit derive from physiological processes of digestion. Being herbivorous a rabbit needs crude fibres, which assure normal physiological activity of digestion and reduce the appearance of metabolic disorders. Selective separation of particles inside ileo-cecal region and the ability of repeated utilization of soft faeces by cecotrophy represent two particularities of rabbit digestion with specific influence on digestive processes (1, 2).

For economical reasons in the intensive breeding of rabbits pelleted feeds are used (3). Due to small number of rabbit farms in Slovenia and correspondingly small demand for rabbit feeds, their production still represents a lateral program of feed industry. Customary three types of feed are used (for does, for weanling rabbits and for animals in fattening), despite the known fact that different categories of rabbits cannot be fed the same feed by regulating its amount in correspondence to the category (4).

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Actually the nutrition requirements of young rabbits after weaning and their mothers are antagonistic. Does have great demands for energy while the use of feed with low starch and high fibres content before weaning benefits the health status of weaned youngs. By classical technology of feeding young rabbits are fed together with their mothers from the same vessel and get special feed for weanling animals only after weaning. Frequently transition from milk to solid pelleted feed represents greater stress than weaning itself (1,5). Main problem of growing rabbits nutrition is thus securing of physiological balance between adequate provision of nutritional substances and avoiding of metabolic disturbances related to disharmonies of this provision. Symptoms of such digressions are in principle diarrhoea and higher mortality, especially in the period of weaning, causing great economic losses (6).

Besides the improvement of technological procedure of young rabbits transition from suckling period to the period after weaning, in intensive rabbit production different supplements (enzymes, nutritive antibiotics, flavours, probiotics, acidifiers etc.), helping in diminishing the stress, are used in feed or water. Because of illness complexity and lack of special products for rabbits the influence on microbial population of guts is in principle less successful. Anyhow some researches show positive effect of probiotics and acidifiers supplementation on rabbit production, feed conversion and on reduction of enteritis frequency (5,7). It is also considered that young rabbits with higher body weight by weaning show lower sensibility to weaning stress (1).

The presented research was performed to study the possibilities for diminishing of digestion disturbances in young rabbits by corresponding mode of feeding with the aim of lowering their mortality and achieving higher body weight at weaning.

Material and methods

Animals

The experiment was carried out in facilities for parent stock and for fattening rabbits of a bigger rabbit farm. All the technological procedures except feeding, where daily consumption of feed was controlled, were standard for the farm. The experiment included 45 pregnant, clinically healthy females of New Zealand - Californian crossbreed, from 38 do 90 weeks old, weighing between 3700 g and 5230 g. The experiment started ten days before parturition when the does were divided into three groups of 15 animals each. At the day 13 after delivery the does were inseminated and 18 days later the fertility control was carried out.

After delivery the offsprings were left in the groups of their mothers and were controlled until the day 10 after weaning – to the average age of 40 days. Two days after the last delivery in the group, the litters inside the group were equalized by size and number of kits, considering the principle that the litter must be composed from young rabbits with the same outliving ability and that weak litters belong to the does with higher milk production. In the case of doe's loss, the kits were divided among other litters of the same group.

Weanling rabbits were transferred to fattening stall at the average age of 30 days. For the first time they were weighed on the day of equalization and later at average age of 10, 17, 24, 31, and 40 days.

Health status and mortality of animals were controlled during the whole experiment.

Feed and feeding

The pelleted feed was prepared in the farm owned feed factory following the standard prescription used in the farm. The consumption was not limited and the composition of basic feed was as follows:

- feed for does contained: 37% alfalfa, 20% wheat bran, 15% oats, 11% sunflower meal, 8% dried beet slices, 4.25% barley, 1.5% vegetable oil, 1% pinotan (lignin sulphate as pellet binder), 0.7% dicalcium phosphate, 0.25% salt, 0.2% lisin, 0.1% alimet (liquid metionin - 88%), 1% premix for does and 1.4g/kg of natural tannin extract (extract from chestnut wood),
- feed for weanling rabbits: 37% alfalfa, 25% wheat bran, 23.7% oats, 6% dried beet slices, 5% soybean meal, 1% vegetable oil, 1% pinotan, 0.2% salt, 0.1% alimet, 1% premix for weanling rabbits and 2.0g/kg of natural tannin extract (extract from chestnut wood).

Regarding the program of the trial, the basic feeds were supplemented with Robenidin (coccidiastatic) or Bio Mos (Alltech Inc.) - beer leaven from yeast *Sacharomyces cerevisae* containing mannooligosaccharides, structural parts of yeast cell wall.

The samples of feeds were analysed at The Institute for Hygiene and Pathology of Animal Nutrition

of Veterinary Faculty in Ljubljana. Chemical composition was determinated by Weende analyses (8), whereas macro- and microelements: calcium, magnesium, sodium, potassium (9), manganese, zinc, copper and iron (10) were determined by atomic absorption spectrometry and phosphorus spectrophotometricaly (11). The microbiological quality of feeds was established in accordance with the procedure by Schmidt et al. (12). The number of grown colonies of mesofilic aerobic bacteria, moulds and yeasts was ascertained and expressed in colony forming units per gram feed.

For the gradual change from feed for does to feed for weanling rabbits, carried out between 22nd and 30th day of young rabbits· age, mixtures of both feeds were prepared and fed in appointed proportions. At the day 22nd and 23rd of the young rabbits age mothers and their offsprings were fed 80% of feed for does and 20% of feed for weanling rabbits. Next 3 days both feeds were mixed in proportion 50:50. Afterwards, up to the 29th day the mixture contained 20% of feed for does and 80% of feed for weanling rabbits. At the day of weaning (30th day of age) they got only feed for weanling rabbits.

The does returned to their own feed after three days. At the first day they got 80% of feed for weanling rabbits and 20% of feed for does, at the second day 50% of feed for weanling rabbits and 50% of feed for does and at the third day only 20% of feed for weanling rabbits and 80% of feed for does. At the fourth day they were fed only feed for does.

During gradual change of feed does got feed for weanling rabbits with no coccidiostatic drug. Therefore their faeces were coprologically controlled 3 times: at delivery, 3 weeks after delivery and 3 days after weaning. Collective faeces sample of each group was taken from ten places of the floor under cages.

Acidifier in the drinking water

In the 1st and the 2nd group of animals acidifier Acid Pac 4 Way (Alltech Inc.), in concentration of 2 g/l, was supplemented in fresh drinking water, which was permanently available to does and their kits until weaning. Afterwards, weaned rabbits got water with no acidifier.

Basic feeds, supplements and feeding technology used in the experiment are presented in table 1.

Table 1: Scheme of feeds, supplements and feeding technology used in the experiment

group	feed supplements		Acid Pac 4 Way in water (only for does)	gradual change from feed for does to feed for weanling rabbits
	feed for does	feed for weanling rabbits		
1	feed A	feed 1	YES	YES
2	feed A	feed 1	YES	NO
3	feed A	feed 2	NO	YES

Legend: feed A: Basic feed for does + coccidiostatic Robenidin (1mg/kg)
feed 1 : Basic feed for weanling rabbits + prebiotic Bio Mos (2 g/kg)
feed 2 : Basic feed for weanling rabbits

Statistical methods

The results were statistically evaluated by one way ANOVA, followed by posthoc Scheffe test. All data were analysed using SPSS (Statistical Package for Social Sciences - Version 12, November 2003) software package.

Results

Feed analyses

The results of chemical analyses of feeds (table 2) were estimated regarding producer's declaration. Considering maximum permitted deviations and measurement uncertainty of used methods no digression from declared values was found.

Consumption of feed

In the first fifteen days after delivery feed was available only to does and afterwards also to their offsprings. No statistical significant difference between groups was observed regarding average consumption of feed (does + litter) from delivery to weaning. The lowest average consumption was observed in the second group (440.6 ± 185.1 g feed per day) and the highest in the first group (486.9 ± 199.3 g feed per day). The highest average day consumption of feed from weaning to the 40th day of age, calculated on single weaned rabbit, was found in the 1st group (table 3).

Table 2: Analyzed composition and microbial content of diets for does and weanling rabbits

analysis	feed for does	feed for weanling rabbits	
		Bio Mos	no supplement
dry matter (g/kg)	892.1	904.3	895.2
humidity (g/kg)	107.9	95.7	104.8
crude proteins (g/kg)	159.2	150.6	151.1
crude fibres (g/kg)	163.5	150.7	149.6
crude fat (g/kg)	30.0	28.0	30.0
ash (g/kg)	72.8	71.0	70.7
nitrogen free extract NFE (g/kg)	466.6	504.0	493.8
starch (g/kg)	173.9	195.6	163.0
calcium (g/kg)	8.0	7.0	6.8
phosphorus (g/kg)	6.1	4.7	4.6
pothassium (g/kg)	11.3	11.0	10.6
sodium (g/kg)	1.7	2.0	1.8
magnesium (g/kg)	3.0	2.9	2.8
zinc (mg/kg)	157.0	129.7	106.3
copper (mg/kg)	28.7	33.0	22.2
manganesse (mg/kg)	177.4	144.0	125.8
iron (mg/kg)	519.0	570.8	556.6
chlorides (g/kg)	4.4	5.2	5.3
yeasts (v 1000/g)	0	0	0
total number of moulds (v 1000/g)	0	0	1.0
Aspergillus spp. (v 1000/g)	0	0	1.0

Table 3: Average day consumption of feed from weaning to the 40th day of age

	group 1		group 2		group 3		P		
	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	1 vs.2	1 vs.3	2 vs.3
consumption of feed (g/weanling)	108	105.4 ± 9.76	98	95.9 ± 11.66	97	84.7 ± 6.58	0.732	0.869	0.782

Legend: n = nr. of 40 days old rabbits; $\bar{x}$ = average day consumption of feed; SE = standard error

The highest feed conversion in the first 10 days after weaning was also stated in the 1st group (3.7 kg of feed per 1 kg of weight gain) while the lowest in the 3rd group (2.8). Feed conversion of the 2nd group was 3.1 kg of feed per 1 kg of weight gain.

Deliveries

The deliveries took place from 30th to 34th day of gestation. Out of 45, 44 does delivered, so the 1st group was formed only from 14 litters, one less than the other two groups. The greatest number of live born, equalized and weaned rabbits was in the 3rd group (table 4).

Table 4: Number of live born, equalized and weaned rabbits in different groups

	group 1		group 2		group 3		P		
	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	1 vs.2	1 vs.3	2 vs.3
live-born	14	8.6 ± 0.99	15	8.3 ± 0.89	15	9.3 ± 1.01	1.00	0.999	0.991
still-born	14	1.8 ± 0.96	15	0.7 ± 0.66	15	0.5 ± 0.53	0.912	0.865	1.000
equalized	14	8.1 ± 0.34	15	7.3 ± 0.30	15	8.7 ± 0.21	0.444	0.884	0.034
nr. of weanling	13	7.3 ± 3.35	15	6.7 ± 1.91	12	9.5 ± 1.24	0.971	0.093	0.008

Legend: n = number of animals in the group; $\bar{x}$ = average body weight; SE = standard error

Statistical comparisation between 2nd and 3rd group showed significantly higher number of equalized rabbits (P = 0.034) and weaned rabbits / doe in the 3rd group (P = 0.008).

Body weight of young rabbits

Average weight of young rabbits by equalization and at the 10th day of age was similar in all three groups. At the 17th day of age retardation of weight gain was observed in rabbits of the 2nd and especially of the 3rd group (table 5). With exception of rabbits from the 3rd group, the average body weight of rabbits at weaning exceeded 600 g. At the end of experiment (at the age of 40 days) the highest average body weight of rabbits was in the 2nd and the lowest in the 3rd group.

Table 5: Average body weight and the number of young rabbits in groups from equalization to weaning

body weight of young rabbits (g)	group 1		group 2		group 3		P		
	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	n	$\bar{x}$ ± SE	1 vs.2	1 vs.3	2 vs.3
at equalization	114	93.3 ± 5.46	109	91.9 ± 4.60	130	90.5 ± 5.22	1.000	0.999	1.000
10th day of age	111	192.2 ± 8.91	104	187.0 ± 6.49	127	171.1 ± 9.26	1.000	0.640	0.813
17th day of age	111	291.1 ± 12.08	102	264.0 ± 10.84	126	254.7 ± 11.89	0.729	0.461	0.997
24th day of age	111	404.3 ± 21.68	100	395.1 ± 11.64	120	351.1 ± 13.77	0.999	0.382	0.583
at weaning	110	640.7 ± 19.29	100	627.0 ± 21.01	114	578.8 ± 28.00	0.999	0.909	0.999
40th day of age	108	922.7 ± 16.36	98	934.1 ± 10.41	97	881.9 ± 27.28	1.000	0.884	0.772

Health status control

Mortality observed during the experiment in all groups and categories of animals could be considered as the consequence of technological reasons. Five casualties among does were due to pneumonia and endometritis and the reason for mortality at young rabbits was mainly diarrhoea.

Loss of kits from equalization to weaning was the greatest in the 3rd and the smallest in the 1st group (figure 1). After weaning the mortality in the 3rd group was still increasing while in the 1st and the 2nd group it diminished to the practically equal amount (1.8% and 2%).

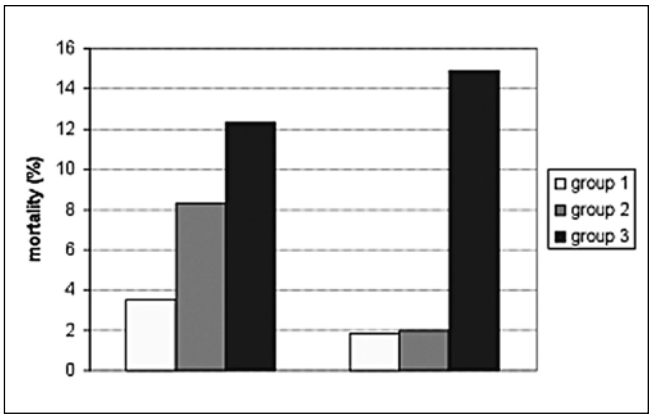

Figure 1: Percentage of mortality from equalization to weaning and from weaning to the age of 40 days

Coprological examinations of faeces

The contamination of does with coccidia ooccysts and eggs of other parasites is presented in table 6.

Table 6: Results of coprological examinations of does faeces

group	results of coprological examinations		
	on the day of delivery	21st day of litter age	three days after weaning
1	0	Passalurus ambigus +	Passalurus ambigus +
2	Passalurus ambigus +	Passalurus ambigus +	Passalurus ambigus +
3	single oocysts	Passalurus ambigus +	Passalurus ambigus +

In the facilities for parents stock no clinical case of coccidiosis was stated. The presence of coccidia was confirmed only in the 3rd group, but the low number of stated coccidia prevented their determination. In the groups with gradual change of feed (group 1 and 3) the number of coccidia oocysts was not increased.

Discussion

Concerning the results of different management of rabbit feeding, there was no significant difference between the three experimental groups regarding body weight of weaned rabbits and average day consumption of feed from weaning to the 40th day of age, representing the essential data of the experiment. The average number of weaned rabbits was statistically significantly higher in 3rd group in comparison with 2nd, but the mortality in this group was during the experiment the highest and the average body weights of rabbits were the lowest. Gradual change from feed for does to feed for weanling rabbits did not improve production results, but the positive effect of prebiotic and acidifier supplementation was clearly obvious from higher body weight and lower mortality in the 1st and 2nd groups where they were used.

Feed for does and weanling rabbits that was normally used on the farm was applied in the experiment. Especially the feed for weanling rabbits was problematic due to provision of rough material with higher crude protein and crude fiber content. The content of starch was also too high, which was obvious from the analyses of feed for does and feed for weanling animals where similar values of starch and other nutritive substances were detected (table 2). The comparison of crude fibre with normative values reviewed by Kermauner (13) showed their lack in the feed for weanling rabbits (150.7 and 149.6 vs. ≥ 155 g/kg). Problems of crude fibres, crude proteins and starch content in rabbit feeds are known elsewhere in the world, but the conclusions of different authors involved in that problem are not the same (14, 15, 16, 17, 18).

The lowest mortality to weaning (3.5%) in our experiment took place in the 1st group. In comparison to the 2nd group the breeding results in this group over the first ten days were better despite the fact that no other difference was stated until the introduction of gradual change of feed (21st day of age). The rabbits from the 1st group had also the highest body weight at weaning but later, in the period to the 40th day of age, their breeding results were lower from those of the 2nd group. Such results are hard to evaluate. However, great variety of results is obvious also from other experiments on rabbits. Di Meo et al. (19) investigated the effect of two different solid feeds during suckling on productive performance and caeccal content characteristics of rabbits at weaning (28 days). From day 16th, the first group was administered a commercial weaning diet and to the others was given the same feed as to their mothers. After weaning, the rabbits from both groups received *ad libidum* diet for weanlings, and later a finisher diet. The differences between body weight of mentioned groups were statistically significant only in the 1st week after weaning. The consumption of feed and production rate in the first group was better, which

was explained by feeding feed for weaned animals in this group before weaning. Feed intake before weaning has no greater influence on hint gut fermentation but contributes to easier transition from milk to pelleted feed thus diminishing risks of nutritional disturbances. Their opinion was confirmed also by Gidenne and Fortun - Lamothe (20), who investigated different technological procedures of weaning. They emphasize the benefit of feeding young rabbits specifical feed if this feeding is performed between 28th and 35th day of age. In the opposite case suitable technological solutions enabling compromise between nutritional needs of mothers and their offsprings must be taken in consideration (20, 21). However the effect of gradual change of feed performed in our experiment was most probably not clearly obvious because of great composition similarity of feed for does and feed for weaned rabbits. The mortality of young rabbits was the greatest in the 3rd group. Following the results of research including 850 French rabbit farms, Gidenne and Fortun-Lamothe (20) stated that 30% of mortality from birth to slaughtering is not rare. In our experiment the greatest mortality to weaning (12.3%) and 14.9% from weaning to the 40th day of age was found in the 3rd group where only gradual change from feed for does to feed for weanling rabbits was used. In the same group the greatest appearance of digestive disturbances was observed, which resulted in average body weight at weaning lower than 600 g, which was surpassed in both other groups.

Comparison of the 3rd group to other two groups also showed that prebiotic (Bio Mos) supplementation can contribute to better results in intensive rabbit production. Probiotics, containing bacteria from *Bacillus* species or different yeasts, were found to be useful in the nutrition of rabbits also by other authors (22). Use of probiotic Paciflor contributed to significantly better growth rate during fattening and lower mortality in stress situations such as high temperature and low weaning weight (23). Similar results were obtained by Dupperay and Roberton (24) and Szabo-Lacza et al. (25, 26). On the contrary Maertens et al. (27), using the same probiotic, did not report statistically better growth results during fattening.

In some researches Bio Mos (Alltech Inc.) was stated to be a perfect supplement to feed for rabbits (28). Supplementation of 2 kg/1000kg of feed lowered mortality caused by enteritis (29). Regarding Tibor et al. (30) in rabbits supplemented with Bio Mos daily weight gain was 9.2% and the body weight at the end of experiment 5.5% higher. Kocher et al. (31) performed the analysis of 20 experiments in which feed for weanling rabbits was supplemented with antibiotics, Bio Mos or contained no supplements. By use of Bio Mos better growth results ($P = 0.001$) and feed conversion was observed in comparison with control without Bio Mos supplementation. In 19 experiments lower mortality was also stated.

Benefits of organic acidifier Acid Pac 4 Way (Alltech Inc.) supplementation in the feed for young rabbits before and after weaning were also described. Its application applenish the production of gastric acids in the critical period of weaning, when a young rabbit has no ability for maintaining of correspondingly low Ph, which represents an important barrier against invasion of pathogenic bacteria (32). Cheeke et al. (33) also stated the beneficial effects of Lacto-sacc and Acid Pac 4 Way supplementation on breeding results, microbial digestion in caecum, weight at weaning and diminishing of mortality. In our experiment the supplementation of acidifier in drinking water for does started 10 days before parturitions so the results of deliveries were, due to short period of its use, most probably not influenced. Anyhow the beneficial effect of acidifier supplementation occurred from the 16th day of their age, when they started to take their mothers' feed.

After weaning the best results of weight gain was found in the 2nd and the worst in the 1st group. Unfortunately in our experiment following the animal body weight till slaughtering was not possible owing to production technology of the farm.

Although no significant difference was observed between the groups, the results lead to conclusion that supplementation of Bio Mos (Alltech Inc.) in feed for weanling rabbits and use of acidifier Acid Pac 4 Way in drinking water effected better production results.

Gidenne and Fortun-Lamothe (20) stated that momentary change of feed during lactation reduces feed intake of does and has drastic consequences on milk production. Following their conclusions gradual change from feed for does to the feed for weanling rabbits should improve the technology of rabbit feeding, which was also the reason why it was introduced in our experiment. In our opinion such mode of feeding can be successfully introduced in production technologies where feeding of mothers and their kits cannot be separated.

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VPLIV POSTOPNEGA PREHODA KRMLJENJA, ZAKISOVALCA IN PREBIOTIKA PRI KUNCIH V OBDOBJU ODSTAVITVE

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Povzetek: V poskusu smo poskušali ugotoviti ali lahko s kombiniranjem zakisovalca, krmnih dodatkov in postopnega prehoda s krme za samice na krmo za odstavljence izboljšamo rejske rezultate pri kuncih. Deset dni pred kotitvami smo oblikovali 3 skupine po 15 brejih samic. Krmili smo jih s krmo, ki je vsebovala kokcidiostatik Robenidin (1 mg/kg). V vodi sta prva in druga skupina samic dobivali zakisovalec Acid Pac 4 Way (2 g/l). V skupini 1 smo od 22. do 30. dne starosti mladičev izvedli postopni prehod s krme za samice na krmo za odstavljence, ki je vsebovala prebiotik Bio Mos (2 g/kg). V skupini 2 postopnega prehoda ni bilo, krma za odstavljence pa je bila enaka kot v skupini 1. V skupini 3 je bil izveden postopen prehod, krma za odstavljence pa ni vsebovala nobenih dodatkov. Spremljali smo rezultate kotitev, porabo krme, število in težo odstavljenih mladičev do starosti 40 dni ter izgube med samicami in mladiči. Statistično značilna razlika ($\bar{x}$±SE) v številu izenačenih in odstavljenih kuncev je bila ugotovljena med drugo (7,3±0.3, 6,7±1,91) in tretjo (8,7±0,21, 9,5±1,24) skupino ($P<0,05$). Ob odstavitvi so bili najtežji kunci v 1. skupini (640,7 ± 19,29 g), pri starosti 40 dni pa kunci v 2. skupini (934,1 ± 10,41 g). Rezultati kažejo, da krmni dodatki v intenzivni reji kuncev lahko prispevajo k boljšim rejskim rezultatom.

Ključne besede: živali, prehrana; hrana, dodatki; oligosaharidi; živali, sesne; kunci