EFFECT OF ADDED Zn-METHIONINE ON PRODUCTION PARAMETERS AND LIVER AND KIDNEY WEIGHTS IN RABBITS

DJELOVANJE DODATKA Zn-METIONINA NA PROIZVODNA SVOJSTVA I TEŽINU JETRE I BUBREGA U KUNIĆA

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SUMMARY

Sixty female animals were fed from the day 10 of lactation on the mixture (1:1) of "standard" feed (Kun/stand) and enriched "lactation" feed (Kun/lakt). "Lactation" feed for experimental animals (n = 34) was supplemented with 500 mg of Zn-methionine. Combining these two feeds (standard and lactation 1:1) the Zn supply in the control group was 257.1 and in the Zn group 522.9 mg of Zn per kg of feed dry matter (DM). The youngs were fed from weaning to 71 day of age on Kun/stand: in the control group the Zn supply was 292.2 and i the Zn group 938.8 mg of Zn/kg of DM. The slaughter weight, carcass, skin, liver and kidney weights and dressing percentage were measured at slaughter (71st day of life). The data were subjected to SAS GLM procedure.

Increased Zn supply during lactation (about 250 mg) and during growth (about 650 mg) significantly increased slaughter weight (from 2167.8 g to 2288.8 g, $P \leq 0.05$), carcass weight (from 1166.3 g to 1226.2 g, $P \leq 0.05$) and dressing percentage (from 51.49 % to 54.16 %, $P \leq 0.05$) but decreased liver weight (from 89.9 to 75.4 g, $P \leq 0.05$). However, addition of Zn did not affect skin and kidney weight.

Female animals of the control group had significantly lower slaughter weight, carcass weight and dressing percentage than males (2078.3 vs. 2257.2 g, $P \leq 0.05$; 1143.6 v.s. 1188.9, $P \leq 0.05$ and 50.33 vs. 52.65 %, $P \leq 0.05$). The effect of sex in the experimental group was not significant.

INTRODUCTION

The use of microelement zinc (Zn) in animal nutrition is becoming more and more important. Zn is due to its configuration of electrons a very reactive microelement and it is able to form different chemical compositions (Bentley and Grubb, 1991b). This way interactions between Zn and different minerals can occur. Zn can act antagonistically with Ca at D-galactose transport (Rodriges-Yoldi et al., 1995b), influences the absorption of amino acids in small intestine (Bentley and Grubb, 1991a,

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Rodriges-Yoldi et al., 1995a), and together with Cu affects cholesterol concentration in blood (Robberts and Samman, 1990) etc. Biological activity of Zn can be explained by its functional and structural linkage with enzymes (Roth and Kirchgessner, 1996). Therefore Zn can strongly affect the activity of cell wall enzymes and consequently provoke changes in nutrient absorption (Bentley and Grubb, 1991a).

The animal organism responds with special mechanisms (homeostasis) to excessive Zn supply and by this means it maintains normal Zn concentration within tissues in physiological limits (Bentley and Grubb, 1991a). Zn surplus is loaded in blood serum and bones. When Zn supply is above requirements the Zn concentrations strongly increase in liver, kidney and pancreas; the increase in skin and fur is less distinctive. An important decrease of Zn concentration (- 35%) in skin and fur appeared when Zn supply was insufficient (Menke and Huss, 1987).

The predisposition of microminerals to react with different substances like amino acids, fatty acids etc. influences the absorption of microminerals (Bentley and Grubb, 1991b). Their absorption is alleviated when ionogenic microminerals are bound to organic component (Roth and Kirchgessner, 1996). These complexes are formed in digestion and decomposed in metabolism.

The aim of our study was to establish the influence of very high supply of Zn-methionine during the lactation period and after weaning till slaughter. The influence of Zn on slaughter weight on 71st day, on carcass weight, dressing percentage and on the weight of liver, kidney and skin (with fur) was observed and compared to the control group.

MATERIAL AND METHODS

A total of 116 New Zealand White rabbits, both female and male were allotted to two trial groups the control group (C) with 40 rabbits and the trial group (Zn) with 76 rabbits. Zn was added to feed in the form of Zn-methionine.

The experiment lasted from the 10th to the 71st day of life. Till weaning (at the age of 31 days) the young were fed the same feed as their mothers. They received the mixture of Kun/stand (standard feed) and Kun/lakt (enriched feed for lactating does) in ratio 1:1 ad libitum. After the adjustment period of 1 week after weaning the rabbits were fed on standard feed Kun/stand. After weaning rabbits were caged in groups (4-5 per cage) and individually marked on 42nd day of life.

The trial design, feed used during separate trial period and concentrations of Zn in the trial feed are shown in Table 1. Chemical analysis of consumed feed is shown in Table 2.

Table 1. The experimental design

Tablica 1. Plan pokusa

Period - Razdoblje	Control group - Kontrolna skupina	Zn group - Zn skupina
Before weaning - Prije odbića	Kun/stand+Kun/lakt	Kun/stand+Kun/lakt-Zn
10th – 32nd day	257.1 mg Zn/kg DM - ST	522.9 mg Zn/kg DM - ST
After weaning - Poslije odbića	Kun/stand	Kun/stand-Zn
32nd – 71st day	292.2 mg Zn/kg DM - ST	938.8 mg Zn/kg DM - ST

Feed mixtures were prepared according to the recommendations (Maertens, 1995). All mixtures were prepared and peleted in Experimental Blend Unit (Biotechnical Faculty, Zootechnical Dep.) in Homec. Feed in after weaning trial period was enriched with 500 mg of Zn; established differences in analytical values are probably the result of sampling and analytical error.

The following parameters were measured at slaughter on the 71st day: slaughter weight of rabbits, carcass weight (warm carcass excluding head and lower parts of legs), dressing percentage, weight of liver, kidneys and skin (with fur, excluding head and lower parts of legs).

Table 2. Chemical analysis of consumed feed in two trial periods

Tablica 2. Kemijska analiza utrošene hrane u dva pokusna razdoblja

		Before weaning - Prije odbića 10^{th} – 32^{nd} day		After weaning - Poslije odbića 32^{nd} – 71^{st} day	
		Control Kontrola	Zn-group Zn skupina	Control Kontrola	Zn-group Zn skupina
Dry matter - Suha tvar	(g/kg)	881.5	880.8	871.3	894.3
Crude protein - Sirove bjelančevine	g/kg DM - ST)	198.7	214.3	172.4	195.5
Crude fat - Sirova mast	(g/kg DM - ST)	29.9	37.2	20.0	20.4
Crude fibre - Sirova vlaknina	(g/kg DM - ST)	165.4	154.8	164.8	177.9
NDF	(g/kg DM - ST)	321.6	308.8	345.0	321.2
ADF	(g/kg DM - ST)	198.1	186.6	208.9	209.0
ADL	(g/kg DM - ST)	39.6	38.6	49.8	54.4
Crude ash - Sirovi pepeo	(g/kg DM - ST)	87.3	87.9	97.1	74.1
N-free extract - NET	(g/kg DM - ST)	518.6	505.8	545.8	532.2
P	(g/kg DM - ST)	6.8	7.0	7.9	5.9
Ca	(g/kg DM - ST)	15.7	15.5	17.2	10.6
K	(g/kg DM - ST)	12.5	12.3	12.2	12.9
Na	(g/kg DM - ST)	2.8	2.9	3.4	2.5
Zn	(mg/kg DM - ST)	257.1	522.9	292.2	938.8
Mn	(mg/kg DM - ST)	297.4	289.8	319.0	295.4
Gross energy - Bruto energija	(MJ/kg)	17.57	17.79	17. 16	17.74

Data were subjected to statistical analysis using GLM procedure in the SAS statistical program (SAS/STAT, 1990). Covariate analysis (regression on slaughter weight) was included in the model. By this means the influence of different slaughter weight on measured parameters was avoided.

RESULTS

The significance of all the effects is shown in an Anova table (Table 3). Added Zn (the effect of feed) significantly influenced slaughter weight, and despite the same slaughter weight (by regression) it also influenced carcass weight, dressing percentage and liver weight of rabbits (Tables 3 and 4).

Table 3. Analysis of variance and significance (p) of all effects for parameters tested

Tablica 3. Analiza varijance i značajnost (p) svih učinaka testiranih parametara

Tested parameter Testirani parametri	Main effects Glavni učinci		Interaction Interakcija	Regression - Regresija		
	Feed Hrana	Sex Spol	Feed*Sex Hrana*Spol	Covariable - Kovarijabla	lin.	p
Slaughter weight - Klaonička težina (g)	*		*	-		
Carcass weight - Težina polovica (g)	***		*	Slaughter weight - Klaonička težina	0.5985	***
Dressing percentage - Randman (%)	***		*	Slaughter weight - Klaonička težina	0.0032	**
Weight of skin - Težina kože (g)				Slaughter weight - Klaonička težina	0.0938	**
Weight of liver - Težina jetre (g)	***			Slaughter weight - Klaonička težina	0.0488	***
Weight of kindeys - Težina bubrega (g)				Slaughter weight - Klaonička težina	0.0067	***

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$

Table 4. Influence of added Zn on the tested parameters

Tablica 4. Utjecaj dodanog Zn-a na testirane parametre

Parameter - Parametri	Control - Kontrola		Zn-group - Zn skupina	
	n=40	± SE	n = 76	±SE
Slaughter weight - Klaonička težina (g)	2167.8[a]	45.7	2288.8[b]	31.8
Carcass weight - Težina polovica (g)	1166.3[a]	10.8	1226.2[b]	7.4
Dressing percentage - Randman (%)	51.49[a]	0.50	54.16[b]	0.34
Weight of skin - Težina kože (g)	223.8	16.1	220.8	11.0
Weight of liver - Težina jetre (g)	89.9[a]	2.4	75.4[b]	1.6
Weight of kindeys - Težina bubrega (g)	15.54	0.34	15.16	0.23

a, b - different letters in the same row indicate statistically significant difference ($p \leq 0.05$)

a, b - Različita slova u istom redu označuju statistički značajnu razliku ($P \leq 0.05$)

Table 5. Effect of interaction between added Zn and sex on the tested parameters

Tablica 5. Djelovanje interakcije između dodanog Zn-a i spola na testirane parametre

Parameter - Parametri	Control - Kontrola		Zn-group - Zn skupina	
	Females - Ženke	Males - Mužjaci	Females - Ženke	Males - Mužjaci
Slaughter weight - Klaonička težina (g)	2078.3[a]	2257.2[b]	2311.2	2266.3
Carcass weight - Težina polovica (g)	1143.6[a]	1188.9[b]	1231.6	1220.8
Dressing percentage - Randman (%)	50.33[a]	52.65[b]	54.38	53.94

a, b - different letters in the same row indicate statistically significant difference ($p \leq 0.05$)

a, b - Različita slova u istom redu označuju statistički značajnu razliku ($P \leq 0.05$)

The interaction between sex and added Zn was observed at slaughter and in carcass weight and dressing percentage (Table 3 and 5). Increased Zn supply favourably affected growth, especially in females, so in the Zn group differences between sexes did not appear (Table 5). Rabbits in the Zn group had higher carcass weight and dressing percentage (Table 4) and differences between sexes in the Zn group were not established (Table 5). The possible explanation may be the connection between Zn and insulin-like growth factor (Roth and Kirchgessner, 1996); but for what reason females were strongly affected is still not explained. It can be presumed that the hormonal status of animals was modified under the influence of increased Zn supply. Higher homogeneity in tested parameters was observed in the trial (Zn) group than in the control group (lower variability, SE - Table 4).

Increased supply of Zn (in organic form) had no influence on weight of skin and kidneys; but significantly lower liver weight was observed in the Zn group (Table 4). This can be explained by better biological function of Zn in organic form or by the lower burden on the liver. In the available literature no similar results were found.

The interpretation will be easier when the experiment is concluded, offering measurements of Zn concentrations in separate organs and tissues of rabbits.

CONCLUSIONS

Zinc in organic form had favourable influence on growth, slaughter weight and dressing percentage of rabbits; this influence was especially expressed in females.

In the control group the males had significantly better results than females; in the Zn group the differences between sexes were not found.

Only liver weight was affected by increased Zn supply: in the Zn group lower weight of liver was observed.

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SAŽETAK

Šezdeset je ženki hranjeno od 10. dana laktacije krmnom smjesom (1:1) "standardne" hrane (kun/stand) obogaćene "laktacijskom" hranom (Kun/Lakt)."Laktacijskoj" hrani za pokusne životinje (n=34) dodano je 500 mg Zn-metionina. Kombiniranjem ove dvije vrste hrane (standardne i laktacijske 1:1) opskrba Zn-om u kontrolnoj skupini bila je 257.1, a u Zn skupini 522.9 mg Zn-a na kg suhe tvari u hrani (DM). Mladunčad je hranjena od odbića do 71. dana starosti s Kun/stand: u kontrolnoj skupini opskrba Zn-om bila je 292.2 a u Zn skupini 938.8 mg Zn/kg suhe tvari. Klaonička težina, težina polovica, kože, jetara i bubrega te randman mjereni su kod klanja (71. dana života). Podaci su podvrgnuti SAS GLM postupku.

Povećana opskrba Zn-om za vrijeme laktacije (oko 250 mg) i za vrijeme rasta (oko 650 mg) značajno je povećala klaoničku težinu (od 2157.8 g na 2288.8 g, $P \leq 0.05$), težinu polovica (od 1166.3 g na 1226.2 g, $P \leq 0.05$) i randman (od 51.49% na 54.16% $P \leq 0.05$), ali se smanjila težina jetara (od 89.9 na 75.4 g, $P \leq 0.05$). Međutim, dodatak Zn-a nije djelovao na težinu kože i bubrega.

Ženke životinja u kontrolnoj skupini imale su značajno nižu klaoničku težinu, težinu polovica i randman od mužjaka (2078.3 prema 2257.2 g, $P \leq 0.05$, 1143.6 prema 1188.9, $P \leq 0.05$ odnosno 50.33 prema 52.65%, $P \leq 0.05$). Djelovanje spola u pokusnoj skupini nije bilo značajno.