Acta agriculturae Slovenica, suplement 2 (september 2008), 117–122.

http://aas.bf.uni-lj.si

Agris category codes: L02 COBISS Code 1.08

THE EFFECT OF TANNINS PARTLY BOUNDED ON PROTEINS ON PRODUCTION AND SLAUGHTER PARAMETERS IN GROWING RABBITS

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ABSTRACT

Production traits of 144 rabbits (104 male and 40 female) of Slovene sire SIKA line were recorded from weaning (31 days of age) to slaughter (73 days). Rabbits were allotted to 5 groups in two trials: control, F-0.3 (added 0.3% of Famatan®), TA-0.19 (added 0.19% of TA), TA-0.25 (added 0.25% of TA) and TA-0.5 (added 0.5% of TA). TA preparation is experimentally produced by Tanin Sevnica d.o.o. in extraction procedure of their commercial product Farmatan® (water extract from sweet chestnut (*Castanea sativa* Mill.) wood), where only a part of tannins was bounded by whey proteins. Statistical analysis was performed by SAS statistical package (SAS, 1999) with GLM procedure. The addition of 0.5% TA (TA-0.5) increased feed intake and weight gain during the most critical period (3 weeks after weaning) in comparison with Control group. The addition of 0.25% of TA (group TA-0.25) increased weight gain and live weight of rabbits during the entire trial in comparison with Control group. There were no differences between groups in feed intake and FCR during the entire trial. Rabbits from all groups with added TA (TA-0.19, TA-0.25 and TA-0.5) had significantly higher proportion of liver than Control rabbits. This can indicate higher burdening of liver where TA was added, but this influence has to be examined on greater number of experimental animals. The influence of added tannins (Farmatan® or TA) on other slaughter parameters was not explicit.

Key words: rabbits / animal nutrition / tannins / production parameters / carcass traits

VPLIV TANINOV, DELNO VEZANIH NA BELJAKOVINE, NA PITOVNE IN KLAVNE LASTNOSTI RASTOČIH KUNCEV

IZVLEČEK

Merili smo pitovne lastnosti 144 kuncev (104 samcev in 40 samic) slovenske očetovske linije SIKA od odstavitve (31. dan starosti) do zakola (73. dan). Kunce smo razdelili v 5 skupin v dveh poskusih: kontrolno, F-0,3 (dodatek 0,3 % Famatana®), TA-0,19 (dodatek 0,19 % TA), TA-0,25 (dodatek 0,25 % TA) in TA-0,5 (dodatek 0,5 % TA). Pripravek TA poskusno proizvaja Tanin Sevnica d.o.o., kjer se je v postopku ekstrakcije njihovega komercialnega produkta Farmatan® (vodni ekstrakt lesa navadnega kostanja (*Castanea sativa* Mill.)) del prisotnih taninov vezal na sirotkine beljakovine. Podatke smo obdelali s proceduro GLM v statističnem paketu SAS (SAS, 1999). Dodatek 0,5 % TA (TA-0,5) je povečal zauživanje krme in dnevni prirast v najbolj kritičnem obdobju prvih 3 tednov po odstavitvi v primerjavi s kontrolno skupino. Dodatek 0,25 % TA (skupina TA-0,25) je povečal priraste in telesno maso v celotnem poskusu v primerjavi s kontrolno skupino. V celotnem poskusu ni bilo razlik med skupinami v zauživanju in izkoriščanju krme. Kunci iz vseh skupin z dodanim TA (TA-0,19, TA-0,25 in TA-0,5) so imeli povečan delež jeter v primerjavi s kontrolno skupino, kar lahko kaže na povečano obremenitev jeter, vendar bi to morali preveriti na večjem številu živali. Vpliv dodanih taninov (Farmatan® ali TA) na druge klavne kazalnike ni bil jasno izražen.

Ključne besede: kunci / prehrana živali / tanini / pitovne lastnosti / klavne lastnosti

INTRODUCTION

In intensive rabbit breeding the mortality rate is often very high and leads to high economic losses (Cheeke, 1987). The predominant reasons of mortality in growing rabbits are digestion disturbances, which are the consequence of unbalanced microbial population (dysbiosis) in caecum, caused by inadequate nutrition. To stabilise the caecal microbial fermentation various feed additives could be used. Among these, (poly)phenolics, especially tannins, have great potential. Published results showed that tannins influences microbial activity in caecum (Štruklec *et al.*, 1993), improve production results (Štruklec and Kermauner, 1994) and reduce mortality in rabbits (Štruklec *et al.*, 1993; Atta and Mouneir, 2005; Maertens and Štruklec, 2006).

In Slovenia and some other European countries the sweet chestnuts (*Castanea sativa* Mill.) wood extract (CWE), containing mostly hydrolysable tannins, is frequently used in intensive rabbit breeding to control digestive disturbances. Tannins form complexes with proteins (Mangan, 1988; McLeod, 1974), thus forming a thin layer of nonsolvent proteins on the surface of intestinal mucous membrane, which protects brush border from microbial colonisation, appeases peristaltics in the case of inflammation and prevents the dehydration (Farmatan, 1998). Tannins form also complexes with amino acids, polysaccharides, metal ions, vitamins, bacterial cell membranes and enzymes involved in protein and carbohydrate digestion; these complexes are more or less stable (Makkar, 2003). Formation of such complexes can provoke negative effects in upper part of gastro-intestinal tract (GIT): reduces digestibility of nutrients and harms mucous membrane of small intestine, especially when higher concentrations of tannins are used. On the contrary, in lower part of GIT tannins can have favourable effects, because they could directly affect the activity of microbes by binding on their cell membranes (Butter *et al.*, 1999; McSweeney *et al.*, 2001). To take advantage of positive effects and to reduce or eliminate the negative effects, tannins should be in such form, that they would not interfere with digestion in the upper GIT, but react specifically only in the large intestine. To investigate this possibility we used preparation with working name TA, originating from experimental production process, where tannins from CWE were partly bounded to whey proteins. The aim of the study was to investigate if this complex between CWE and proteins (preparation TA) can have the same effect on production and some slaughter traits of rabbits as tannins in usually used form (CWE as commercial product Farmatan®).

MATERIAL AND METHODS

Feeds and animals

Feed mixtures were prepared according to the recommendations for weaned rabbits (Maertens, 1995; (De Blas C. and Mateos G.G. 1998); Gidenne, 2003; Kermauner, 2005). All mixtures were prepared and peleted in Jata Emona, Novo mesto, Slovenia, chemical analyses were performed on Dept. of Animal Science, Biotechnical Faculty, University of Ljubljana. TA preparation is experimentally produced by Tanin Sevnica d.o.o. in extraction procedure of their commercial product Farmatan®, where only a part of tannins was bounded by whey proteins. Farmatan® is a natural product, produced by water extraction from sweet chestnut (*Castanea sativa Mill.*) wood. It is based on tannins, 85% of which are from a group of hydrolysable tannins and 15% from condensed tannins. Farmatan® contains about 75% of tannins, the rest are natural sugars. Chemical analysis of experimental feeds is shown in Table 1.

After 3 days of restrictive feeding weaned rabbits were fed *ad libitum*. Drinking water was also *ad libitum*. Temperature in the trial room was between 17–24 °C, humidity between 56 and

85%. Animals were weighted and examined every trial week, when their health status was recorded as well.

Table 1. Chemical composition of experimental feeds

Component, g/kg DM	Control	F-0.3	TA-0.19	TA-0.25	TA-0.5
Dry matter (DM), g/kg	906.0	916.1	914.9	917.4	917.0
Crude proteins	189.2	191.4	190.4	188.5	190.2
Crude fat	41.0	46.6	45.9	47.3	46.8
Crude fibre	198.0	211.2	208.8	213.2	211.0
Crude ash	99.2	93.6	85.0	82.4	85.1
N-free extractive	472.7	457.3	470.0	468.6	467.0
NDF	363.6	383.1	379.5	372.9	371.6
ADF	231.8	243.6	234.4	232.4	232.0
ADL	46.6	48.4	48.5	50.4	50.5
Calcium	12.1	11.1	9.8	9.7	9.6
Phosphorus	6.5	6.0	6.4	6.6	6.6
Magnesium	3.7	3.6	3.6	3.6	3.6
Potassium	14.6	15.1	15.0	15.2	15.1
Sodium	2.2	2.2	2.5	2.3	2.2
Digestible energy, MJ/kg *	10.2	10.2	10.2	10.2	10.2

* calculated from tables (Schlolaut, 1982; Villamide *et al.*, 1998)

144 rabbits (104 male and 40 female) of Slovene sire SIKA line for meat production were weaned on 31st day of age and allotted to 5 groups in two trials:

- Control: without added tannins (n = 36),
- F-0.3: with addition of 0.3% of Farmatan® (powder) (n = 12),
- TA-0.19: with addition of 0.19% of TA preparation (n = 36),
- TA-0.25: with addition of 0.25% of TA preparation (n = 36),
- TA-0.5: with addition of 0.5% of TA preparation (n = 24).

Experiment lasted from 31st to 73rd day of age, when rabbits were slaughtered and slaughter parameters were recorded.

Measurements and statistics

During the experiment, feed intake and weight of rabbits were recorded weekly. Average feed intake, daily weight gain (DWG) and feed conversion ratio (FCR) was calculated each week and during the entire trial. Slaughter weight, warm carcass weight (without head and distal parts of legs, including liver and kidneys), weight of liver, kidneys and separate digestive organs (with their contents) were measured at slaughter and the proportions with respect to the slaughter weight were calculated. pH values in separate parts of digestive tract (stomach, duodenum, ileum, caecum) were also measured. Mortality and morbidity were observed daily.

Statistical analysis was performed by SAS statistical package (SAS, 1999) with GLM procedure. Effects of experiment, feed and sex as fixed effects and weaning weight as independent variable (only in the case of live weight) were included in the model. Differences between groups were tested with t-test. Statistical analysis of mortality and morbidity was performed with CATMOD procedure (SAS, 1999).

RESULTS AND DISCUSSION

The effect of added tannins

Morbidity and mortality were low in both experiments, only 2 rabbits died during the second experiment. Both animals were from group TA-0.5 (8.33%), but differences between groups were not statistically proved.

Significant differences in production parameters appeared mostly in the first part of the experiment (from 31st to 52nd day of age, Table 2). During this period rabbits with the highest addition of TA (TA-0.5) consumed more feed and had better daily weight gain (DWG), while during the entire trial (31–73 day) better DWG and higher live weight (Table 2 and 3) were observed in rabbits from group TA-0.25. There were no significant differences between groups in feed conversion efficiency (FCR) (Table 2).

Table 2. Production parameters of rabbits during experiment

Parameter	Control n = 36	F-0.3 n = 12	TA-0.19 n = 36	TA-0.25 n = 36	TA-0.5 n = 22
Feed intake 31–52 days	118.59 ^{ab}	117.98 ^{ab}	114.0 ^{a}	119.32 ^{ab}	124.15 ^{b}
Feed intake 31–73 days	137.44	137.38	134.19	138.57	137.04
DWG 31–52 days	48.50 ^{a}	48.21 ^{ab}	47.75 ^{a}	48.80 ^{ab}	51.10 ^{b}
DWG 31–73 days	41.43 ^{a}	42.94 ^{ab}	42.61 ^{ab}	43.67 ^{b}	43.72 ^{ab}
FCR 31–52 days	2.45	2.44	2.40	2.44	2.42
FCR 31–73 days	3.20	3.13	3.09	3.14	3.12

$^{a, b}$ values with different superscripts differ significantly ($p \leq 0.05$)

Table 3. Average live weight of rabbits during trial weeks

Age, days	Control n = 36	F-0.3 n = 12	TA-0.19 n = 36	TA-0.25 n = 36	TA-0.5 n = 22
31	720	722	720	724	720
38	1 057	1 064	1 052	1 060	1 070
45	1 416 ^{ab}	1 410 ^{ab}	1 404 ^{a}	1 410 ^{ab}	1 447 ^{b}
52	1 738 ^{a}	1 734 ^{ab}	1 723 ^{a}	1 749 ^{ab}	1 794 ^{b}
59	1 948 ^{ab}	1 951 ^{ab}	1 939 ^{a}	1 973 ^{ab}	2 002 ^{b}
66	2 255	2 282	2 259	2 301	2 311
73	2 489 ^{a}	2 540 ^{ab}	2 516 ^{ab}	2 565 ^{b}	2 556 ^{ab}

$^{a, b}$ values with different superscripts differ significantly ($p \leq 0.05$)

Differences between groups were expressed only in some slaughter traits (Table 4). Carcass weight of rabbits from TA-0.25 group was higher than in Control group. Group with added Farmatan® had lower percent of fat on GIT, but only the difference between F-0.3 and TA-0.25 was significant. The proportion of fat on GIT is very well correlated with the proportion of kidney fat, so we can assume that the rabbits from Farmatan® group were not so fatty. Rabbits from all groups with added TA preparation (TA-0.19, Ta-0.25 and TA-0.5) had significantly higher proportion of liver than Control rabbits. This can indicate higher burdening of liver where TA was added, but this influence has to be examined on greater number of experimental animals.

Table 4. Slaughter parameters of 73 days old rabbits

Parameter	Control n = 36	F-0.3 n = 12	TA-0.19 n = 36	TA-0.25 n = 36	TA-0.5 n = 22
Slaughter weight (SW), g	2 494	2 547	2 521	2 575	2 569
Carcass weight, g	1 343 [a]	1 373 [ab]	1 361 [ab]	1 396 [b]	1 392 [ab]
Dressing percentage, %	53.87	53.91	53.99	54.21	54.18
Liver, % SW	3.09 [a]	3.15 [ab]	3.35 [b]	3.34 [b]	3.33 [b]
Kidney, % SW	0.59	0.61	0.60	0.61	0.62
Spleen, % SW	0.069	0.060	0.065	0.064	0.060
Stomach, % SW	5.09	5.25	5.21	5.15	4.98
Small intestine, % SW	3.40	3.44	3.45	3.45	3.35
Caecum, % SW	5.54	5.46	5.40	5.55	5.58
Large intestine, % SW	2.43	2.38	2.37	2.26	2.30
Gasto-intestinal tract (GIT), % SW	16.46	16.53	16.43	16.41	16.22
Fat on GIT, % SW	0.89 [ab]	0.78 [a]	0.92 [ab]	0.93 [b]	0.92 [ab]
pH in stomach	1.91	2.04	1.93	1.77	2.12
pH in duodenum	6.20	6.38	6.39	6.07	6.14
pH in ileum	7.33	7.44	7.40	7.36	7.36
pH in caecum	6.30	6.32	6.27	6.32	6.31

[a, b] values with different superscripts differ significantly ($p \leq 0.05$)

The effects of experiment and sex

When statistical analysis of joined data from both experiments was performed, the effects of experiment and sex were also included in the model. Production traits differed between experiments: in the second trial rabbits had higher daily weight gain (1st exp.: 41.93, 2nd exp. 43.81 g/day, P = 0.0401) and reached higher live weight at the end of experiment (73 days of age: 1st exp.: 2 495, 2nd exp. 2 572 g, P = 0.0392), while in feed intake and FCR during entire trial differences were not significant (feed intake: 1st exp.: 134.97, 2nd exp. 138.87 g/day, *NS*; FCR: 1st exp.: 3.16, 2nd exp. 3.11, *NS*). Slaughter parameters did not differ between experiments as well.

The growth of rabbits was probably affected by environmental conditions, especially by temperature, which was rather high at the end of the first trial (last two weeks between 21 and 25 ^{o}C). These high temperatures depress feed intake and the growth of rabbits as well.

The effect of sex was mainly expressed when slaughter traits were considered: male rabbits had lower proportion of small intestine (males 3.30, females 3.53%, P = 0.0162), large intestine (males 2.26, females 2.43%, P = 0.0710) and whole GIT (males 16.05, females 16.77%, P = 0.0110) and consequently better dressing percentage than female rabbits (males 54.28, females 53.79%, P = 0.0730). We know that caecum of female rabbits reaches higher weight at the same age than the caecum of male rabbits from literature (Lopez *et al*., 1988; Kermauner and Štruklec, 1996), but this was not found in our experiment. Kermauner and Žgur (2002) found similar differences between sexes for proportion of large intestine.

In production traits the only difference was found in daily weight gain during the entire trial: male DWG was higher than that of females (males 43.75, females 42.00 g/day, P = 0.064).

CONCLUSIONS

The addition of tannins, partly bounded on proteins (TA preparation) had favourable effect on production parameters of growing rabbits:

- The addition of 0.5% TA (TA-0.5) increased feed intake and weight gain during the most critical period 3 weeks after weaning in comparison with Control group.
- The addition of 0.25% of TA (group TA-0.25) increased weight gain and live weight of experimental rabbits during the entire trial in comparison with Control group. There were no differences between groups in feed intake and FCR during the entire trial.
- Rabbits from all groups with added TA (TA-0.19, TA-0.25 and TA-0.5) had significantly higher proportion of liver than Control rabbits. This can indicate higher burdening of liver where TA was added, but this influence has to be examined on greater number of animals.
- The effect of added tannins (Farmatan® or TA) on other slaughter parameters was not explicit.

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