EFFECT OF THE FEEDING SUPPLEMENTATION WITH CHESTNUT HYDROLYSABLE TANNIN ON THE COLOUR AND OXIDATIVE STABILITY OF RABBIT MEAT

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***Abstract*—The aim of the study was to evaluate the effect of feeding growing rabbits with pelleted diets medicated-free, or medicated with coccidiostat, or with 3 different chestnut hydrolysable tannin levels, on the oxidative stability of the rabbit meat. From the age of 18 days the rabbits were fed pellets supplemented with coccidiostat (Cc), or with tannin (400g/100 kg: T400). At weaning (35 d of age) within both groups 5 sub-groups were formed: medicated-free (Co), and supplemented pellet containing coccidiost (Cc), or different levels of chestnut tannin (T200, T400 and T600). Rabbits were slaughtered at 11 weeks of age and *Biceps femoris* muscle was analysed for meat colour, hindleg meat for haem iron concentration, whereas *Longissimus dorsi* (LD) muscle was dissected and used for fatty acid (FA) profile, TBARS value and conjugated dienes determination. The tannin-supplemented diet T400 fed before weaning seemed to be more effective than the 3 tannin levels administered during fattening period on FA profile change in the LD muscle. T400 diet fed before weaning increased SFA and MUFA (P<0.01) and decreased PUFA (P<0.05), decreasing the n-6/n-3 ratio (P<0.01), however. During fattening, only T600 diet showed significant difference (P<0.05) compared to Cc diet on FA profile, leading to higher SFA and MUFA contents. Meat colour, TBARS value and conjugated dienes were not affected by the tannin supplementation and it can be concluded that dietary chestnut hydrolysable tannins didn't improve the colour and oxidative stability of the rabhit meat.**

***Index Terms*— chestnut hydrolysable tannin, feed, meat, rabbit.**

I. INTRODUCTION

Tannins are a heterogeneous group of phenolic polymers with a strong astringent activity. According to their chemical structure they can be divided into hydrolysable tannins and condensed tannins. Altogether, tannins are reported to have various physiological effects like antiphlogistic, antimicrobial and antiparasitic effects.

A recent study has demonstrated the antioxidant and antiradical activity of condensed tannin extract (Marín-Martinez, Veloz-García, Veloz-Rodríguez, Guzmán-Maldonado, Loarca-Pina, Cardador-Martinez, Guevara-Olvera, Miranda-López, Torres-Pacheco, Pérez Pérez, Herrera-Hernández, Villaseñor-Ortega, González-Chavira and Guevara-Gonzalez, 2009). Very few studies were conducted to evaluate the effect of the dietary tannin extract supplementation on the carcass and meat traits in the rabbit species. In the rabbit meat, condensed tannins of red quebracho tree have been demonstrated to increase (P<0.05) the b* value (Dalle Zotte and Cossu, 2009) whereas hydrolysable tannins from chestnut tree reduced the TBARS values at 0.5% supplementation level (P<0.05), but only at 30 min of induced oxidation, compared to 60, 120 and 180 min (Gai, Gasco, Liu, Lussiana, Brugiapaglia, Masoero and Zoccarato, 2009). In lamb meat, the red quebracho tannin supplementation increased the haem pigment concentration, improved the colour stability, but had no effect on lipid oxidation (Luciano, Monahan, Vasta, Biondi, Lanza and Priolo, 2009).

The aim of our study was to determine if supplementing a commercial diet for fattening rabbits with chestnut hydrolysable tannin the meat colour and oxidative stability could be improved.

II. MATERIALS AND METHODS

Large body line rabbits (n=80) were used. From the age of 18 days the rabbit kits were fed pellets supplemented with coccidiostat (0.5% Robenidin: Cc), or with chestnut hydrolysable tannin (400g/100 kg: T400). At weaning (35 d of age) within both groups 5 sub-groups were formed according to the feed supplementation: control diet (without coccidiostat and tannin: Co), Cc diet, and three levels of chestnut hydrolysable tannin (T200, T400 and T600). Experimental diets were isoenergy and isoprotein (16±0.4% protein, DE 9.83±0.08 MJ/kg).Rabbits were slaughtered at 79 days of age and *Biceps femoris* (BF) muscle was analysed for meat colour (L*a*b* values), hindleg meat for haem iron concentration (expressed as mg/kg of fresh tissue) whereas *Longissimus dorsi* (LD) muscle for fatty acid (FA) profile, TBARS value (expressed as MDA, mg/kg meat) according to Botsoglou *et al*. (1994), and conjugated dienes (expressed as absorbance unit/g of lipid), according to Corongiu and Banni (1994) and Banni, Carta, Contini, Angioni, Deiana, Dessi, Melis and

Corongiu (1996) determined on lipid extracted according to Folch (Folch, Lees and Stanley, 1957). For TBARS and conjugated dienes determination, the LD was minced, then half of the sample was used raw while the other half was cooked (5 min at 70 °C core temperature).

ANOVA tested the diet administered before weaning (Cc, T400), after weaning (Co, Cc, T200, T400, T600) and their interactions as fixed effects (SAS, 2004).

III. RESULTS AND DISCUSSION

FA profile of Co diet was slightly higher in SFA and lower in PUFA contents, compared to the other four experimental diets (Table 1). However, the n-6/n-3 ratio was similar among the diets (average=13; CV=2.72).

Table 1. Fatty acid (FA) profile of the experimental diets (% total FA)

	Experimental diets					CV[a]
	Co	Cc	T200	T400	T600	
Total SFA	17.1	15.5	15.8	15.2	15.3	4.90
Total MUFA	22.9	22.4	22.3	22.4	21.9	1.59
Total PUFA	53.9	58.1	58.1	58.6	59.4	3.73
C18:2n-6ct	49.4	53.9	53.7	54.2	54.9	4.10
C18:2c9t11	0.00	0.01	0.02	0.03	0.01	81.4
C18:3n-6	0.22	0.04	0.09	0.08	0.07	69.6
C18:3n-3	2.83	3.25	3.41	3.29	3.62	8.84
C20:2n-6	0.30	0.12	0.05	0.07	0.08	82.0
C20:3n-6	0.15	0.03	0.03	0.03	0.03	99.4
C20:3n-3	0.07	0.01	0.03	0.10	0.02	82.2
C20:4n-6	0.00	0.01	0.00	0.00	0.01	137
C20:5n-3	0.94	0.69	0.75	0.71	0.64	15.5
C22:6n-3	0.05	0.04	0.02	0.09	0.07	50.0
n-6	50.1	54.1	53.9	54.4	55.1	3.82
n-3	3.89	3.99	4.21	4.19	4.35	4.46
n-6/n-3	12.9	13.6	12.8	13.0	12.7	2.72

[a]Coefficient of variation

The FA profile of the *Longissimus dorsi* (LD) muscle of the rabbits receiving the 5 diets didn't reflect that of their diets (Table 2). The tannin-supplemented diet T400 fed before weaning seemed to be much more effective than the 3 tannin levels administered during fattening period on FA profile change in the LD muscle. Comparing the effect of the 2 diets fed before weaning on FA profile, T400 diet increased SFA and MUFA ($P<0.01$) and decreased PUFA ($P<0.05$), decreasing the n-6/n-3 ratio ($P<0.01$), however. During fattening, only T600 diet showed significant difference ($P<0.05$) compared to Cc diet on FA profile, leading to higher SFA and MUFA contents. Comparing the FA profile of LD muscle of rabbits fed for the whole period (from 18 to 79 days of age) with the extreme diets "Cc-Cc+Co" *vs* "T400-T600", the dietary hydrolysable tannin supplementation seemed to be very effective in increasing the SFA (40.6 *vs* 46.7% total FA) and MUFA (24.4 *vs* 27.2 % total FA) content, to the detriment of PUFA content (33.1 vs 29.5 % total FA), and in decreasing the n-6/n-3 ratio, favourably. Thus, our results confirm that hydrolysable tannins may play a role on lipid metabolism, like so indicated for condensed tannins (Luciano et al., 2009).

The decrease in the degree of unsaturation of the meat didn't increase its oxidative stability (Table 3), however. Indeed, TBARS value was not affected by the dietary hydrolysable tannin supplementation, as well as the meat haem iron concentration and colour.

The absorbance values obtained from the second-derivative spectrum for conjugated dienes of polyunsaturated fatty acids (D2235) and secondary oxidation products (mainly ketones and aldehydes) with conjugated double bonds (D2269) did not show any significant difference among dietary treatments confirming that already observed for TBARS.

In the samples submitted to cooking test has been observed a trend of reduction in the values of the secondary oxidation products (D2269) in subjects with diet enriched in tannin compared to those of the control diet. At the same time the supplementation with hydrolysable tannin caused the rise in conjugated dienes in sample before weaning measured after the thermal treatment ($P<0.05$).

Table 2. Fatty acid (FA) profile of the *Longissimus dorsi* muscle (% total FA)

	Diet before weaning		Diet after weaning					SE	*P*	
	Cc	T400	Co	Cc	T200	T400	T600		before weaning	after weaning
n	40	39	16	16	16	15	16			
C6:0	0.54	0.67	0.79	0.39	0.46	0.68	0.73	0.05	0.110	0.065
C10:0	0.18	0.22	0.21	0.17	0.19	0.21	0.21	0.006	0.001	0.084
C12:0	0.10	0.13	0.13	0.10	0.10	0.13	0.11	0.007	0.072	0.500
C14:0	1.66	2.05	1.98	1.55	1.78	1.97	2.02	0.06	0.000	0.055
C15:0	1.24	1.54	1.32	1.24	1.29	1.36	1.71	0.07	0.035	0.207
C16:0	28.0	29.6	29.0	27.5	28.1	29.3	30.1	0.32	0.006	0.057
C17:0	0.56	0.66	0.74^{b}	0.45^{a}	0.46^{a}	0.71^{b}	0.70^{b}	0.03	0.044	0.000
C18:0	8.61	8.66	8.57	8.56	8.36	8.68	9.01	0.10	0.817	0.346
C20:0	0.14	0.14	0.14	0.14	0.13	0.14	0.15	0.001	0.137	0.053
C21:0	0.12	0.17	0.15	0.10	0.15	0.17	0.18	0.01	0.006	0.071
Total SFA	41.1	43.8	43.0^{ab}	40.2^{a}	41.0^{ab}	43.3^{ab}	44.8^{b}	0.51	0.004	0.017
C14:1	0.037	0.037	0.038	0.034	0.035	0.039	0.039	0.001	0.779	0.364
C16:1	1.77	2.06	1.90	1.64	1.97	2.00	2.06	0.07	0.054	0.404
C17:1	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.002	0.009	0.203
C18:1n-9	20.3	21.5	21.5^{ab}	19.6^{a}	20.3^{ab}	21.4^{ab}	21.8^{b}	0.24	0.006	0.009
C18_1n-7	1.84	1.94	1.95^{ab}	1.82^{ab}	1.80^{a}	1.91^{ab}	1.98^{b}	0.02	0.007	0.009
C20:1n-9	0.20	0.18	0.19	0.20	0.17	0.19	0.21	0.005	0.206	0.202
Total MUFA	24.4	26.0	25.8^{ab}	23.6^{a}	24.5^{ab}	25.8a^{b}	26.3^{b}	0.31	0.006	0.016
C18:2n-6	26.6	24.4	24.6	26.7	26.7	24.5	24.8	0.47	0.017	0.301
C18:3n-6	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.002	0.448	0.111
C18:3n-3	1.66	1.88	1.87	1.66	1.75	1.79	1.79	0.05	0.027	0.758
C18:4n-3	0.16	0.26	0.23^{ab}	0.13^{a}	0.19^{ab}	0.23^{ab}	0.25^{b}	0.01	0.000	0.029
C20:2n-6	0.37	0.39	0.38	0.37	0.37	0.37	0.39	0.006	0.194	0.820
C20:3n-6	0.41	0.41	0.40	0.41	0.43	0.36	0.42	0.01	0.886	0.306
C20:3n-3	0.16	0.16	0.16	0.15	0.16	0.16	0.17	0.005	0.679	0.762
C20:4n-6	3.88	3.55	3.52	4.04	3.91	3.51	3.59	0.10	0.086	0.266
EPA	0.07	0.09	0.08	0.07	0.08	0.09	0.10	0.004	0.002	0.100
C22:5n-3	0.41	0.27	0.35^{ab}	0.45^{b}	0.36^{ab}	0.32^{ab}	0.24^{a}	0.02	0.000	0.015
DHA	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.0008	0.195	0.816
Total PUFA	33.9	31.6	31.8	34.2	34.1	31.7	31.9	0.54	0.025	0.290
n-6	31.0	28.8	29.0	31.6	31.5	28.1	29.3	0.55	0.042	0.141
n-3	2.59	2.79	2.81	2.59	2.66	2.71	2.67	0.05	0.037	0.695
n-6/n-3	12.1	10.8	11.0	12.4	12.1	10.6	11.1	0.24	0.004	0.063

Table 3. a*, b* colour values, haem iron content, TBARS (MDA content) and Dienes number of rabbit meat

	diet before weaning		diet after weaning					SE	*P*	
	Cc	T400	Co	Cc	T200	T400	T600		before weaning	after weaning
Sample number	40	40	16	16	16	16	16			
Biceps femoris muscle:										
a*value	-2,56	-2,64	-2,71	-2,57	-2,72	-2,63	-2,37	0,06	0,536	0,404
b* value	-4,32	-4,02	-4,49	-4,09	-4,16	-4,15	-3,97	0,16	0,339	0,884
Hind leg meat:										
haem iron, mg/kg	2.79	2.91	2.83	2.86	2.67	2.76	3.11	0.06	0.286	0.150
Longissimus dorsi muscle[(1)]:										
MDA, mg/kg raw	0.0127	0.0127	0.0195	0.0171	0.0093	0.0052	0.0124	0.0024	0.990	0.292
MDA, mg/kg cooked	0.0261	0.0228	0.0284	0.0293	0.0213	0.0194	0.0238	0.0029	0.612	0.820
$D_2$235 raw,AU/g [(2)]	0.0046	0.0109	0.0100	0.0148	0.0019	0.0079	0.0042	0.0019	0.084	0.193
$D_2$269 raw, AU/g [(2	0.0129	0.0183	0.0171	0.0184	0.0116	0.0199	0.0110	0.0021	0.175	0.494
$D_2$235 cooked, AU/g [(2	0.0044	0.0131	0.0091	0.0067	0.0026	0.0144	0.0109	0.0021	0.035	0.417
$D_2$269 cooked, AU/g [(2	0.0123	0.0099	0.0218	0.0052	0.0077	0.0085	0.0123	0.0022	0.579	0.171

[(1)] analysis performed on 8 samples per dietary treatment.

[(2)] Conjugated Dienes, absorbance unit/g lipids

IV. CONCLUSION

On the basis of the results, it can be concluded that dietary chestnut hydrolysable tannins were shown to be ineffective in improving the colour and the oxidative stability of the rabbit meat. However, they may play a role on lipid metabolism.

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