EFFECT OF DIETARY SUPPLEMENTATION WITH CHESTNUT AND GRAPE POMACE EXTRACTS ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND MEAT QUALITY OF RABBITS

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ABSTRACT

The present study aimed at evaluating the effect of the dietary supplementation with two high-tannin extracts (chestnut vs. grape pomace) at two inclusion levels (0.2% vs. 0.4%) on growth performance, nutrient digestibility, and meat quality in growing rabbits. A total of 270 crossbreed rabbits were randomly divided into 5 experimental groups and fed from weaning to slaughter (30 to 66 d of age) with: control diet (B); diets supplemented with 0.2% or 0.4% of chestnut extract (C2 and C4, respectively), diets supplemented with 0.2% or 0.4% of grape pomace extract (G2 and G4, respectively). The mortality rate was very low (0.4% on average) without differences among groups. Growth performance was not affected by the dietary treatments. In the post-weaning period, the digestibility of crude protein was higher in G2 and G4 groups compared to the C4 group (+2.9%; $P<0.001$). The digestibility of ether extract was lower in rabbits fed diet C4 compared to the others ($P<0.001$). In the fattening period, the digestibility of dry matter (+3.1%), fibre fractions and gross energy was higher in rabbits fed diet G4 with respect to the control group ($0.05<P<0.001$), whereas the digestibility of crude protein was the lowest with diet C4 ($P<0.001$). Slaughter weight, cold carcass, and dressing percentage averaged 2664 g, 1618 g and 60.8%, respectively, without significant differences among groups. Meat pH, colour indexes, and oxidative status were not modified by the dietary treatments. In conclusion, both chestnut and grape pomace extracts rich in tannins can be used as feed additives in diets for growing rabbits at inclusion levels ranging from 0.2% to 0.4% without negative effects on growth performance, slaughter results, and meat quality traits. However, the chestnut extract reduced nutrient digestibility at the highest supplementation rate during the post-weaning period, whereas grape pomace extract increased nutrient digestibility at both rates in the post-weaning and fattening periods.

Key words: tannins, digestibility, carcass quality, growing rabbit.

INTRODUCTION

Tannins are phenolic compounds that can be classified according to their chemical structure into three main groups: hydrolysable tannins, condensed tannins, and phlorotannins (Huang et al., 2018). These molecules can play an important role in animal production thanks to their antimicrobial, anti-parasitic, antioxidant, anti-inflammatory, and anti-viral properties (Mueller-Harvey, 2006; Huang et al., 2018). Indeed, the dietary supplementation with 0.5% chestnut extracts rich in hydrolysable tannins can reduce mortality due to enteropathy (Maertens and Štruklec, 2006), without impairing growth performance and meat quality in growing rabbits (Dalle Zotte et al., 2012). On the other hand, grape pomace extracts rich in condensed tannins included up to 10% in poultry broiler diets enhanced the oxidative stability of meat lipid (Chamorro et al., 2015) and increased beneficial bacteria at gut (Viveros et al., 2011). Nevertheless, few data are available concerning the effect of grape pomace

extracts in meat rabbit production. Therefore, the present study aimed at evaluating the effect of the dietary supplementation different inclusion levels of tannin-rich extracts from chestnut and grape pomace on growth performance, digestive efficiency, and meat quality in growing rabbits.

MATERIALS AND METHODS

Animals and experimental design

At 30 d of age, 270 crossbreed rabbits of both genders, born and weaned at the experimental facilities of the University of Padova, were housed in individual cages and randomly assigned to 5 experimental groups fed with: control diet (group B); diets supplemented with 0.2% (group C2) and 0.4% (group C4) of a commercial chestnut extract; diets supplemented with 0.2% (group G2) and 0.4% (group G4) of a commercial grape pomace extract. Tannins extracts were mixed to the pelleted control diet with a mechanical mixer at the time of feed distribution. All rabbits had *ad libitum* access to feed and water. From 30 to 54 d, they were fed with a post-weaning diet (14.7% CP, 37.2% aNDF, 21.2% ADF, 10.9% starch, 9.54 MJ DE/kg) supplemented with coccidiostat (Diclazuril, 1 mg a.p./kg). From 54 to 66 d, a fattening diet (14.2% CP, 33.3% aNDF, 18.2% ADF, 15.0% starch, 10.46 MJ DE/kg) without coccidiostat was provided. Mortality and morbidity were recorded daily, whereas individual feed intake and live weight were recorded three times a week and once a week, respectively. The nutrient and energy apparent digestibility of post-weaning diets (from 49 to 53 d) and fattening diet (from 60 to 64 d) diets were evaluated in two *in vivo* digestibility trials on 12 rabbits per diet (Perez et al., 1995). At 66 d, all rabbits reaching a minimal live weight of 2.2 kg were slaughtered to measure slaughter results and carcass traits (Blasco and Ouhayoun, 1996). The carcasses were chilled for 24 h at 2°C. Then, CIE L*a*b* colour indexes were measured in duplicate in the *Longissimus lumborum*. The pH of the *Longissimus lumborum* and hind leg muscles were measured in duplicate (Birolo et al., 2019). Right hind leg was then dissected to determine muscle to bone ratio (Blasco and Ouhayoun, 1996).

Diets and faeces were analysed according to harmonised procedures (E.G.R.A.N., 2001). A sample of raw meat from the hind legs was stored at 2°C for 12 d and then analysed for TBARS. The TBARS values were expressed as mg of malondialdehyde (MDA)/kg of sample according to Botsoglou et al. (1994).

Statistical Analysis

All data were analysed by a one–way ANOVA using the PROC GLM of SAS 9.4 software (SAS, 2013) with the experimental group as a fixed effect. The Bonferroni t-test was used to compare means.

RESULTS AND DISCUSSION

All rabbits showed a good health during the trial. The mortality rate was very low (0.4% on average) and only seven animals were discarded at the end of the trial because of low live weight (<2.2 kg) without differences among the experimental groups. Neither the type nor the inclusion level of extracts affected rabbit growth performance, slaughter results and carcass traits (Table 1), as already reported by Dalle Zotte et al. (2012) using a 0.4% dietary inclusion of chestnut tannins.

The diet digestibility changed significantly with the supplementation level of chestnut and grape pomace extracts (Table 2). In details, in the post-weaning diet, the inclusion of chestnut at 0.4% reduced digestibility of crude protein with respect to the grape pomace extract at both 0.2% and 0.4% (-3.3%; $P<0.001$). The C4 group also showed a lower digestibility of ether extract compared to the other ones. In the fattening diet, the highest inclusion of grape pomace extract increased the digestibility of dry matter, fibre fractions and gross energy with respect to the control group ($0.05<P<0.001$), whereas the digestibility of crude protein was lower in the C4 group with respect to G

groups (P<0.001). The digestibility of ether extract was higher in G4 group than B and C2 groups and in G2 group with respect to C2 group (P<0.001). Differently, Mancini et al. (2019) did not found differences in diet digestibility when rabbits were fed diet supplemented with a mix of quebracho and chestnut extracts (inclusion levels from 0.3% to 0.6%). Differences in diet composition, type of additives, and supplementation methods could explain the different results among studies.

Table 1: Effect of the dietary treatment on growth performance, and slaughter results

	Experimental groups					Prob.	RMSE
	B	C2	C4	G2	G4		
Rabbits, no.	51	54	53	53	52		
Live weight 31 d (g)	825	825	824	827	828	0.998	64
Live weight 54 d (g)	2166	2175	2163	2178	2154	0.881	131
Live weight 66 d (g)	2779	2794	2790	2815	2773	0.749	169
Wight gain (g/d)	57.5	57.9	57.8	58.5	57.2	0.590	4.1
Feed intake (g/d)	167	169	172	170	167	0.159	13
Feed conversion	2.91	2.92	2.98	2.92	2.92	0.097	0.10
Slaughter weight (SW) (g)	2649	2668	2662	2688	2652	0.739	158
Cold carcass weight (g)	1610	1623	1610	1630	1618	0.803	99
Cold dressing out percentage (% SW)	60.8	60.9	60.5	60.7	61.0	0.326	1.3

Table 2: Effect of the dietary treatment on diet digestibility

	Experimental groups					Prob.	RMSE
	B	C2	C4	G2	G4		
Rabbits, no.	12	12	12	12	12		
Post-weaning diet							
Dry matter (%)	55.0	55.5	54.9	56.2	56.4	0.333	1.39
Crude protein (%)	68.0^{ab}	68.0^{ab}	67.2^{a}	68.9^{b}	69.4^{b}	<0.001	1.20
Ether extract (%)	81.3^{b}	80.7^{b}	78.4^{a}	80.8^{b}	82.4^{b}	<0.001	1.96
aNDF (%)	25.7	28.9	26.8	27.5	27.8	0.06	2.66
ADF (%)	20.0	17.5	18.3	19.2	20.0	0.319	3.43
Gross energy %)	54.6	55.0	54.4	55.6	55.7	0.104	1.43
Fattening diet							
Dry matter (%)	60.5^{a}	62.1^{ab}	60.8^{ab}	61.9^{ab}	62.4^{b}	0.01	1.40
Crude protein (%)	68.3^{ab}	69.6^{b}	67.1^{a}	69.5^{b}	70.1^{b}	<0.001	1.43
Ether extract (%)	78.5^{ab}	77.0^{a}	79.2^{abc}	80.8^{bc}	81.6^{c}	<0.001	2.40
aNDF (%)	31.8^{a}	34.3^{ab}	35.5^{ab}	36.1^{b}	36.8^{b}	<0.01	3.11
ADF (%)	18.8^{a}	21.5^{ab}	22.6^{ab}	22.3^{ab}	24.2^{b}	<0.05	3.88
Gross energy (%)	59.9^{a}	61.3^{ab}	60.1^{ab}	61.2^{ab}	61.9^{b}	0.01	1.43

Means with different superscript letters are statistically different (Bonferroni test).

Table 3: Effect of the dietary treatment on meat quality traits and colour indices

	Experimental groups					Prob.	RMSE
	B	C2	C4	G2	G4		
Rabbits, no.	24	24	24	24	24		
Longissimus lumborum							
pH	5.64	5.63	5.67	5.62	5.63	0.582	0.11
L*	54.3	53.9	53.4	54.0	54.3	0.606	2.30
a*	–0.49	–0.47	–0.55	–0.83	–0.42	0.461	0.83
b*	4.43	4.36	3.74	3.57	4.48	0.331	1.88
Hind leg							
Muscle to bone ratio	5.92	5.84	5.82	6.08	6.07	0.439	0.61
pH	5.81	5.80	5.87	5.82	5.82	0.233	0.12
TBARS (mg MDA/kg)	0.082	0.083	0.074	0.067	0.065	0.577	0.047

No significant effect of the dietary inclusion with chestnut or grape pomace extracts at different levels was observed on meat quality traits and oxidative stability (Table 5), confirming previous results of Dalle Zotte et al. (2012) when rabbit diets were supplemented with 0.2-0.6% chestnut extracts.

CONCLUSIONS

In conclusion, chestnut and grape pomace extracts rich in tannins can be safely used in growing rabbits at levels ranging from 0.2% to 0.4%. The different contents and composition in tannins account for the different effects on nutrient digestibility, which were more favourable with the supplementation of grape pomace compared to that of chestnut extracts. However, their effects on health and productive performance do not seem relevant when animals are reared in good hygienic and environmental conditions and fed with balanced diets.

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