EFFECT OF A HIGH FIBROUS DIET IN THE FINISHING PERIOD ON CARCASS YIELD AND MEAT QUALITY OF RABBITS

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ABSTRACT

Effect of dietary insoluble fibre level during the last week of fattening period on carcass and meat quality traits was investigated in rabbits slaughtered at 9 weeks of age. Eighty eight rabbits, identified at weaning (28 d) with a glass-encapsulated transponder, were randomly selected at 56 d of age from two groups of rabbits fed a moderate (33% NDF) or a high (41% NDF) insoluble fibre diet. Within treatment, half rabbits were fed an experimental diet containing a very high concentration of NDF (49%) from defatted grape seed meal and the remaining animals continued receiving the same diet than before up to 63 d of age. Without fasting, rabbits were carried to a slaughterhouse and processed following standard techniques. Rabbits fed a high fibrous diet in the last week of the fattening period (56-63 d) maintained their growth rate when NDF dietary level increased from high commercial levels (41%) up to near 50%. However, when this diet was fed to rabbits following a moderate NDF (33%) diet in the growing period, feed intake increased greatly, but not enough to maintain growth rate. Dietary treatments did not significantly influence live weight before and after transport. Full gastrointestinal weight decreased by feeding the highest fibrous diet (49% NDF) in the last week of the fattening period if a high fibre diet (41% NDF) was also fed in the growing period, but the opposite effect was observed when the growing diet had a moderate fibre content (33% NDF). Expressed as live weight percentage, full gastrointestinal weight of rabbits fed moderate fibre levels (33% NDF) for the whole fattening period was significantly lower than in rabbits fed higher fibre levels (41% NDF), and dressing percentage of the former was higher. These slaughtering traits were not influenced by increasing fibre level during the finishing period from 41 to 49% NDF. The meat ultimate pH was not significantly affected by treatments. Carcass colour of rabbits with the lowest growth rate in the fattening period considered was darker, and that of animals fed the 33% NDF diet over the whole fattening period were more red coloured, compared with rabbits fed the 41% NDF diet. In conclusion, the gastrointestinal content weight, cold carcass weight and dressing percentage of rabbits may be modified by feeding a high fibrous diet in the last week of the fattening period (56-63 d). Effects depend on the fibre and energy dietary levels in the growing diet (28-56 d). No significant relationship is observed between dietary factors and carcass quality traits of rabbits slaughtered at the same age.

Key words: Rabbit, Dietary fibre, Slaughtering traits, Carcass quality, Meat quality.

INTRODUCTION

Rabbit gastrointestinal contents represents a main concern at industrial slaughterhouses because of their impact on dressing percentage, potential microbial contamination of meat and cost of offal withdrawal. Source and level of fibre affects retention time of digesta in the gut at different extents. Feeding high lignified fibre sources, as grape by-products, has demonstrated to effectively reduce digesta transit time (Fraga *et al*., 1991) and weight of cecal contents (García *et al*., 1999; 2002). However, their effect on rabbit slaughter performance and meat quality traits has not been studied. Moreover, some work indicates that increasing dietary fibre levels reduced the glycogen content of rabbit muscles and resulted in higher ultimate pH, which may affect to shelf-life quality of the meat (Gierus and Teixeira, 1997).

The aim of this experiment was to determine the effect of dietary insoluble fibre level during the last week of fattening period on weight of digestive contents, carcass and meat quality traits of rabbits slaughtered at the same age.

MATERIALS AND METHODS

Animals, housing and diets

Eighty eight crossbred New Zealand White x Californian rabbits were randomly selected at 56 d of age from a group of fattening rabbits fed from weaning (28 d) till 56 d of age either a high (41% NDF, diet C1) or a moderate (33% NDF, diet C2) insoluble fibre containing commercial diet (44/treatment). Half of the rabbits from each diet were assigned to an experimental diet containing a very high concentration of insoluble fibre (49% NDF, diet T) and lignin (16% ADL) from defatted grape seed meal. The other half continued receiving the same feed than before. The ingredients and chemical composition of the experimental diets are shown in Table 1. The experiment finished when the animals were 63 days old. Rabbits were caged in pairs and offered *ad libitum* access to the feed. Feed intake per cage and individual weight gain of the animals were recorded at the experimental period. Rabbits were electronically identified at weaning (28 d of age) with a glass-encapsulated transponder (12 x 1.2 mm), implanted subcutaneously on the dorsal midline between scapulas. Injections were performed using a multi-shot injector, equipped with a multiple-use 25 x 2.5 mm needle. Transponders were in cartridges of 10 and the needle was immersed in iodine solution before each injection. Readings of transponders were made with a FX-Pet reader (Ref EI2010, FELIXCAN, Albacete, Spain) and they were recovered from the carcasses after finishing the experimental measurements at the slaughterhouse.

Table 1: Ingredients and chemical composition of diets

	Diet C1	Diet C2	Diet T
Ingredients (%):			
Barley	6.00	31.0	.
Wheat bran	15.0	.	16.4
Sunflower meal, 30% CP	19.7	19.7	2.80
Alfalfa hay, 16% CP	28.1	28.3	56.9
Defatted grape seed meal	.	.	19.8
Wheat straw	10.0	.	2.8
Sugar beet pulp	15.0	15.0	.
Soybean oil	2.10	2.10	.
Calcium carbonate	1.40	1.15	0.33
Monocalcium phosphate	0.57	0.50	.
Sodium chloride	0.40	0.50	0.30
L-lysine	0.12	0.15	0.06
Methionine[1]	.	.	0.05
L-threonine	.	0.09	0.07
Mineral and vitamin premix[2]	0.50	0.50	0.49
Sepiolite	0.85	1.00	.
Calculated composition (%)[3]:			
DM	90.7	90.8	90.9
CP	15.2	15.4	14.3
NDF	40.6	32.6	49.2
ADF	26.2	21.2	36.4
ADL	5.89	4.88	16.0
Starch	7.71	17.0	5.31
Digestible energy (MJ/kg)	8.59	10.08	6.83

[1]Supplied by Alimet (88% Met) and provided by Novus Spain S.A. (Barcelona, Spain)
[2]Provided by Trouw Nutrition España S.A. per kg of complete diet: Mg, 290 mg; Fe, 76 mg; Cu, 10 mg; Mn, 20 mg; Co, 0.7 mg; I, 1.25 mg; Zn, 59 mg; vitamin A, 8,375 IU; vitamin D_3, 750 IU; vitamin E, 20 IU; vitamin K_3, 1 mg; vitamin B_6, 1 mg; niacine, 20 mg; choline, 250 mg; riboflavin, 2 mg; 0.01 mg cianocobalamin; 0,9 g robenidine (66 g/kg of active ingredient)
[3]Calculated from ingredient composition according to FEDNA (2003)

Slaughter and carcass quality trait measurements

Rabbits were individually weighed just before transport (live weight before transport, LWBT) to an industrial slaughterhouse. The animals were not fasted before slaughter. At arrival to the slaughterhouse, reachable in a 1.5-h journey, all the rabbits were individually weighed again (slaughter live weight, SLW). Animals were immediately slaughtered by severance of the jugular veins, after electrical stunning, and then processed following standard industrial techniques. The weight of the full gastrointestinal tract and of the cold (0ºC for 1.5 h) carcass (inclusive of the head, kidneys, liver, heart, scapular and perirenal fat) were recorded. During the first 24 h post-mortem the carcasses were stored in a ventilated cold room at 4ºC, after which the ultimate pH (pHu) and carcass colour were measured. The pH was measured *in situ* on the *Longissimus dorsi* (LD) muscle of the right side at the level of the 6th lumbar vertebra, using a penetrating electrode adapted to a portable pH meter (Crison micropH 2001). Additionally, carcass colour was determined on the same surface of the LD using a MINOLTA portable chromameter (model CR-300) and the Commission Internationale de L'Eclairage system. The colour was expressed as colour coordinates L* (lightness), a* (redness), and b* (yellowness).

Statistical analysis

Data were analyzed as a completely randomized design by using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC) with feeding treatments at growing and finishing period as the main source of variation. Carcass quality traits were analyzed including SLW as a linear covariate. All mean comparisons were made using pre-planned orthogonal contrasts and differences were considered significant at P<0.05.

RESULTS AND DISCUSSION

The effect of feeding treatments on growth traits is shown in Table 2. There was no mortality over the experimental period. Initial body weight at 56 days did not differ (P>0.10) among treatments. In the period considered (56-63 d), average daily feed intake (ADFI) was about 36% higher (P<0.001) for rabbits that continued receiving the C1 instead of the C2 diet, but no differences in average daily weight gain (ADG) were found (41.5 g/d on average). As a consequence, feed conversion rate (FCR) was a 47% higher (P<0.001) in rabbits fed the C1 diet. These results are in accordance with previous work (De Blas *et al*., 1986, Xiccato, 1999; Gidenne *et al*., 2000) showing the ability of the growing rabbits to adjust their voluntary intake, among certain dietary NDF levels (33-41%, in this study) and DE levels of feeds (from 8.59 to 10.08 MJ/kg, in this study), to maintain DE intake and weight gain.

Table 2: Effect of dietary NDF level on rabbit growth performance in the finishing period

	Treatments								
Grower diet (28-56 d)	C1	C1	C2	C2		Contrast, P-value[1]			
Finisher diet (56-63 d)	C1	T	C2	T	SEM[2]	1	2	3	4
Initial live weight 56 d (g)	1732	1709	1831	1817	50.8	0.18	0.75	0.86	0.13
Average daily gain (g)	40.0	39.1	42.9	34.2	1.40	0.15	0.67	0.001	0.013
Average daily feed intake (g)	174	186	128	167	7.91	0.001	0.27	0.001	0.08
Feed conversion rate (g/g)	4.51	4.76	3.07	4.89	0.25	0.001	0.49	0.001	0.73

[1]Contrasts: 1= C1C1 vs. C2C2; 2= C1C1 vs. C1T; 3 =C2C2 vs. C2T; 4= C1T vs. C2T
[2]n=22 for initial live weight and ADG; n=11 for ADFI and FCR

Performance of rabbits fed diet T in the finishing period (56-63 d) depended on the diet fed in the previous growing period (28-56 d). Feed intake increased (by 30%, P<0.001) whereas ADG and FCR were impaired (by 20 and 59%, P<0.001) in rabbits fed previously the C2 diet (C2T) with respect to rabbits that continued receiving the diet C2 (C2C2), but differences were no significant when rabbits were fed previously diet C1 (C1C1 vs. C1T). Otherwise, rabbits fed diet T had a higher ADG (by 14%, P=0.01) but a similar FCR (4.46 vs. 4.89) when they were fed previously diet C1 instead of diet C2. These results indicate that rabbits are able to maintain their growth rate when NDF dietary level increases at the finishing period, well above the present fibre dietary recommendations, from high commercial levels (41%) up to near 50%. However, after feeding a moderate NDF (33%) commercial diet, growth rate is impaired probably because of the short adaptation period to a sudden 50% increase in the NDF dietary level.

The feeding treatments did not significantly influence LWBT or SLW, but they affected other slaughter traits (Table 3). Weight losses during transport were higher (P=0.024) in animals receiving the diet T when they were fed previously diet C1 instead of diet C2, and were inversely related to the full gastrointestinal weight, as they are mainly due to fecal and urine losses (Jolley, 1990). Additionally, full gastrointestinal weight decreased (by 13%, P=0.006) when diet T replaced diet C1 in the finishing period. These results are in agreement with the short cecal (7.61 h, García *et al.,* 2002) and total (9.30 h, Fraga *et al*., 1991) mean retention time of grape byproduct fibre. When diet T substituted diet C2 this effect was not observed, which might be related to the great increase of feed intake noticed in the growth trial. The full gastrointestinal weight constituted a lower (P<0.001) percentage of LWBT in rabbits fed diet C2 for the whole fattening period. This result is probably due to the reduction of ADFI in the low fibre diet, and differs from the general effect of dietary fibre content on slaughter yield as reviewed by Ouhayoun (1998).

Table 3: Effect of dietary NDF level on slaughter data and carcass quality traits in rabbits

	Treatments								
Grower diet (28-56 d)	C1	C1	C2	C2		Contrast, P-value[1]			
Finisher diet (56-63 d)	C1	T	C2	T	SEM	1	2	3	4
Live weight and slaughtering data									
Live weight before transport, LWBT (g)	2012	1983	2131	2057	49.4	0.098	0.68	0.30	0.29
Weight losses (g)	65.5	69.6	55.3	54.0	4.88	0.15	0.55	0.85	0.024
Slaughter live weight, SLW (g)	1946	1913	2075	2003	49.7	0.075	0.64	0.31	0.20
Full gastrointestinal weight (g)	437	383	422	453	12.2	0.39	0.006	0.067	0.001
Full gastrointestinal weight (%LWBT)	22.2	19.9	19.5	21.6	0.41	0.001	0.001	0.001	0.006
Cold carcass weight (g)	1083	1052	1197	1122	31.8	0.015	0.50	0.11	0.12
Dressing percentage (%LWBT)	53.8	53.0	56.1	54.3	0.45	0.001	0.22	0.006	0.040
Dressing percentage (%SLW)	55.6	55.0	57.6	55.8	0.40	0.001	0.26	0.003	0.12
Carcass quality traits									
pHu	5.91	6.10	5.93	5.94	0.07	0.81	0.060	0.98	0.11
L* (lightness)	54.2	54.2	54.2	52.9	0.42	0.98	0.99	0.041	0.036
a* (redness)	4.75	4.52	5.52	5.01	0.26	0.044	0.54	0.19	0.18
b* (yellowness)	-0.91	-1.73	-0.05	-0.94	0.38	0.12	0.13	0.11	0.14

[1]See footnote of Table 2

As a consequence of the previous effects, cold carcass weight of rabbits fed C2 diet during the whole fattening period increased (P=0.015) with respect to animals fed C1 diet, whereas dressing percentage, expressed both on LWBT or SLW, was higher (P<0.001) than that obtained from animals fed C1C1 and C2T treatments. Moreover, the substitution of C1 diet with T diet during the finishing period did not affect those slaughtering traits. The higher (P=0.040) dressing percentage, calculated on LWBT, of rabbits fed C2T with respect to C1T treatment was a consequence of lower weight losses during transport, as no significant differences between these treatments were detected when dressing percentages were calculated on SLW.

No significant effects of carcass weight as a covariate were found for any of of the quality traits studied. The ultimate (24 h) pH of meat was no significantly affected by feeding treatments and values were below 6.0, except for the C1T treatment, which value could compromise the hygienic quality and the shelf-life of the meat (Dalle Zotte, 2002). Carcass colour of animals fed the C2T treatment was darker (lower L* value; P=0.036), and that of animals fed C2 diet over the whole fattening period were more red (higher a* value; P=0.044), compared with rabbits fed the C1C1 treatment.

CONCLUSIONS

Results indicate that it is feasible to modify the gastrointestinal content weight, cold carcass weight and dressing percentage of rabbits by feeding a high fibrous diet in the last week of the fattening period (56-63 d). Effects also depend on the fibre and energy dietary levels in the growing diet (28-56 d). No significant relationship was established between dietary factors and ultimate pH of rabbit meat.

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