<u>Effects of several diets on the chemical and fatty acid composition of rabbit meat</u>

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SUMMARY

The effects of four diets prepared with several levels of barley (B), complemented with beet pulp (BP), cereals straw (CS) or alfalfa hay (AH), [<u>Diet 1</u> (%): 50 (B); O (BP); 14.3 (soy meal); 5.3 (CS) and 29.7 (AH). <u>Diet 2:</u> 0; 50; 14.3; 5.3 and 29.7. <u>Diet 3</u>: 30; 0; 11.1; 0 and 58.3. <u>Diet 4</u>: 15; 15; 11.1; 0 and 58.3], on the chemical and fatty acid (FA) composition of rabbit meat were studied.

Significant differences ($p<0.05$) were found for the chemical composition of the rabbit meat ($n=10$) for dry matter and fat in batch fed with Diet 2 *versus* Diet 3 and for fat in batch fed with Diet 1 *versus* Diet 2. Significant differences ($p<0.05$) were also found for C-16:1, C-16:0, C-18:1, C-18:0 and C-20:4 free fatty acids in batch fed with Diet 2 *versus* Diet 3; for C-16:1, C-16:0, and C-18:1 in batch fed with Diet *versus* Diet 4; for C-16:1 and C-18:0 in batch fed with Diet 2 *versus* Diet 1 and for C-16:1 and C-18:0 in batch fed with Diet 1 *versus* Diet 4.

INTRODUCTION

Rabbit production for meat is a very important livestock activity in the most of Mediterranean countries. Likewise, in other countries such as USA, New Zealand, Australia and some Asiatic countries, the rabbit meat industry is also very developed. The rabbits have a rapid rate of growth, a high feed efficiency, an early marketing age, and require a small land area (Cheeke, 1980). Moreover, in comparison with other species, rabbits are able to consume large quantities of high-fibre feeds (Méndez *et al.*, 1986). This suggest that the rabbit has a practical good potential as a livestock species in large scale production. However, information on carcass quality and composition of rabbit meat is limited in contrast to that of other meats. Several studies have indicated that rabbit meat has high content of protein, but low levels of sodium and fat (Rao *et al.*, 1978; El-Gammal *et al.*, 1984). It also posseses a relatively high content of phospholipids, ranging from 9% to 19% of total lipids (Cambero *et al.*, 1991) and a relatively high content of poliunsatured fatty acids (Ouhayoun, 1985). Thus, rabbit meat could be a very interesting food in human dietetics.

A primary objective in rabbit production is to minimize nutrient requirements because their feed intake represents about 35% of total feed consumption in commercial farms. Moreover, an impairment in the composition of the diet has a great effect on meat composition.

As an attempt to cheap the feed, several diets were prepared with four levels of barley, which were complemented with beet pulp, cereals straw or alfalfa hay. The effects of these diets on the chemical and fatty acid composition of meat were studied.

MATERIAL AND METHODS

<u>Samples and compositional analyses.</u> Four batches, with ten rabbits (hybrid HYLA) in each, were analyzed. During the first 20 days of life, the rabbits were fed exclusively with the milk from their mothers. From the 21st day to the end of the experiment, all rabbits were fed *ad libitum* with the appropiate diet. Animals were humanitary slaughtered at live weights ranging from 2000 to 2500g.

The formulation and the chemical composition of the diets are shown in Tables 1 and 2, respectively. Chemical composition of diets was determinated according to AOAC (1980) methods.

For analysis, the animals were slaughtered and bled in a local abattoir. The head, viscera and skin were immediately removed, and the flesh was obtained removing the bones. The perirenal and subcutaneous fat was descarted. The meat obtained from each animal was finely minced in a blender (Sorvall, Omni-Mixer 17106). The final sample was composed of a homogenate of the meat from each animal. Samples were kept at -20°C until analysis.

AOAC (1980) methods were used for the moisture (24.002), protein (24.057) and ash (24.009) determination.

TABLE 1. Formulation of experimental diets (%, w/w)

Ingredients	Diet 1	2	3	4
Barley	50.0	0	30.0	15.0
Beet pulp	0	50.0	0	15.0
Soy bean meal	14.3	14.3	11.0	11.0
Cereals straw	5.3	5.3	0	0
Alfalfa hay	29.7	29.7	58.3	58.3
Salt	0.5	0.5	0.5	0.5
Vit. and minerals	0.2	0.2	0.2	0.2

Lipid analyses. Lipids were extracted and purified from the former homogenate according to the method described by Hanson & Olley (1963). Total lipids were determined gravimetrically. The fatty acids methyl esters were obtained by the method of Firestone & Horwitz (1979).

Fatty acid analyses. Fatty acid methyl esters were analysed with a Konik KNK 3000-HRGC chromatograph equipped with a dual flame-ionization detector. The capilar column (25 m, internal diameter 0.22 mm) were packed with BP5 (0,25μm) on fused silica and the analysis were performed using a temperature gradient from 50 to 140°C programmed at 10°C/min, then an isotherm period (140°C, 10 min.) was established; and thereafter the temperature was increased to 220°C at an increasing rate of 4°C/min. The final temperature was 230°C by using a ramp rate of 1°C/min. For quantitative analyses, a Hewlett-Packard HP 300A integrator was used. The identification of different fatty acid methyl esters was made by comparison with authentic standards (Sigma).

TABLE 2. Chemical composition (% dry matter) and crude energy (kcal/kg DM) of diets

Item	Diet 1	2	3	4
Dry matter (%)	89.4	91.3	91.4	91.5
Ash	6.6	8.1	8.7	9.2
Crude fibre	12.2	20.9	18.6	20.8
Crude protein	17.9	18.9	19.1	18.9
Crude fat	4.8	3.8	4.1	3.8
Gross energy	4294	4228	4240	4228

RESULTS AND DISCUSSION

The chemical composition of the rabbit meat fed with experimental diets are shown in table 3. Fat was the most variable component ranging from 7.2 % in the rabbits fed with diet 2 to 10.2 % in those fed with diet 3. A decrease in the fat content with increasing beet pulp percentage of diet was observed. Significant differences ($p< 0.05$) were found for the chemical composition of meat from rabbit ($n=10$) fed with Diet 2 *versus* 3 for dry matter and fat and only for fat in those fed with Diet 1 *versus* 2. The levels of fat from rabbit meat fed experimental diets are in general agreement with those obtained by Whiting and Jenkins (1981) but are different from those reported by Zegarska *et al.* (1979) who found a lower percentage of fat (about 2%). These differences may be attributed to the different factors affecting the chemical composition of the rabbit meat, such as age, sex, diet, breed, etc. (Fraga *et al.*, 1983; El-Gammal *et al.*, 1984).

Many researchs have been made about the effects of the diet on rabbit meat composition. E.g., Fraga *et al.* (1983) observed that fibre content of diet per se has not significant effect on meat composition but a high relation dietary energy/protein (E/P) increases the proportion of meat fat and reduces the proportion of protein. Battaglini and Costantini, (1971) studied the effects of beet-pulp molasses in rabbit diets (4-7%) and they observed no clear changes on the chemical composition of meat.

Table 3. Effect of experimental diets on chemical composition of rabbit meat (n=10).

	Chemical composition(g/100g) Diet				Student´s t-test analysis					
	1	2	3	4	1-2	1-3	1-4	2-3	2-4	3-4
Dry matter	28.53	27.15	29.12	28.15	-	-	-	+	-	-
Fat	9.34	7.19	10.17	8.61	+	-	-	+	-	-
Ash	0.99	1.03	1.03	0.99	-	-	-	-	-	-
Protein	18.07	18.96	17.90	18.53	-	-	-	-	+	-

(++): $p<0.005$; (+): $p<0.05$; (-): $p\geq0.05$, not significant.

Gas-liquid chromatography (GLC) analysis of fatty acid methyl esters from fat of rabbit meat fed with the four experimental diets reveled the presence of more than twenty fatty acids. The more abundant ones are shown in Table 4. Although oleic acid is the most abundant fatty acid in most meats (beef, pork, mutton and chicken), the fat of rabbit is characterized by a high palmitic acid content, this always being the major fatty acid (Table 4). This fact has been also observed by other authors (Chang-han and Yeon-Hee., 1982; Cambero *et al.*, 1991). However, in wild rabbits, the percentage of C-16:0 is lower and the concentration of C-18:1 and C-18:2 higher, than those found in meat from farmed rabbit (Cambero *et al.*, 1991b).

C-18:1 and C-16:1 were the monoenoic fatty acids most abundant (from 27 to 30% and from 5 to 7 %, respectively). The percentage of C-18:2 was about15%, the C-18:3 concentration was, in general, lower than 1,5% and the C-20:4 was only found in a 0,5-0,9%. Similar percentages have been reported by Matter (1981) and Cambero *et al.* (1991a). Tsimbakova *et al.*, (1979) observed that the levels of C-18:0 and C-18:1 in rabbit fat varied from 1.5- to 5-fold lower than those of other meats.

Table 4. Effect of experimental diets on fatty acids composition (weight %) of rabbit meat (n=10).

	Diet				Student´s t-test analysis					
Fatty acid	1	2	3	4	1-2	1-3	1-4	2-3	2-4	3-4
C 14:0	4.18	3.87	3.83	3.65	-	-	+	-	-	-
C 16:1	6.69	5.27	7.06	6.77	+	-	-	+	+	-
C 16:0	35.84	36.41	34.66	34.59	-	-	-	+	+	-
C 18:2	15.08	15.85	14.56	14.96	-	-	-	-	-	-
C 18:1	28.27	26.90	29.64	29.17	-	-	-	++	++	-
C 18:3	1.56	1.45	1.49	1.26	-	-	-	-	-	-
C 18:0	7.69	9.36	8.18	8.88	+++	-	-	-	-	-
C 20:4	0.68	0.90	0.57	0.70	-	-	-	+	-	-

(+++): $p<0,0005$; (++): $p<0,005$; (+): $p<0,05$; (-): $p\geq0,05$, not significant

The effects of diet on fatty acid composition of rabbit meat have been studied by several authors, Ouhayoun *et al.* (1981) observed that the incorporation of rapessed hulls to the rabbit diet produced a decrease in the concentration of saturated fatty acids (especially palmitic acid), a large increase in monounsaturated (especially oleic acid) and a small increase in polyunsaturated fatty acids of the rabbit perirenal fat with increasing incorporation of rapessed hull in the diet. Our results showed a slight increase of the C-18:0 content with increasing of crude fibre of diet. Significant differences ($p<0.05$) were found between rabbits fed with experimental diets for many fatty acids (mainly C-16:1; C-16:0; C-18:0; C-18:1), especially between rabbit fed with Diet 2 (complemented with 50% of beet pulp) and those fed with diets (1,3 and 4) with lower beet pulp percentage.

The effects of the diets used in this work on the physiology of rabbit are being simultaneously studied by other investigation team. Results indicated that the digestibility coeficient was higher as the beet pulp content increased in the diet. No significant differences were found when barley was substituted for 15% beet pulp. At 50% beet pulp level, the growth rate of rabbit was delayed, and the carcass yield was lower (García, personal communication).

In conclusion, it seems to be that barley may be substituted by beet pulp in the diets at levels up 15% without causing important adverse effects in rabbit physiology and chemical and fatty acids composition of rabbit meat.

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