RABBIT MEAT FATTY ACIDS AS AFFECTED BY DIET FAT

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SUMMARY.

The effects of four diets prepared with different fats on the chemical and fatty acid composition of rabbit meat have been studied. A conventional diet (CD) used as control, containing alfalfa hay (30%), barley (22%), cereal straw (20%), soya bean meal (11%), cereal bran (8%), sunflower meal (7%), salt, vitamins and minerals, was compared with three experimental diets. The composition of these diets was that of the control diet added with either 3% tallow (TD), 3% soya olein (OD), or 3% soya bean oil (SD).

The incorporation of soya olein and soya bean oil to the diet produced a decrease in the concentration of meat palmitic acid and a large increase in linoleic acid. The addition of tallow produced a small decrease in the concentration of palmitic acid and a small increase in oleic acid.

INTRODUCTION.

It is well known that rabbits could be a significant source of meat because they have high fecundity, a rapid rate of growth, a high feed efficiency, an early marketing age, and a desirable meat-to-bone ratio (Cheeke, 1980, Whiting and Jenkins, 1981). This suggests that the rabbit has a practical good potential as a livestock species in large scale production. Moreover, rabbit meat has very good nutritional value, being comparatively high in protein, low in fat, low in calories, and low in sodium (Sunki *et al.*, 1978, 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 lipid (Cambero *et al.*, 1991b) and a relatively high content of polyunsatured fatty acids (Ouhayoun, 1985). Thus, rabbit meat could be a very interesting food in human dietetics. For these reasons, more information is needed to evaluate the quality of this meat.

Previous research on rabbit meat include the effect of age, sex and different cuts on the chemical composition (El-Gammal *et al.*, 1984) and the seasonal effect on the patterns of deposition of water, fat and protein (Deltoro *et al.*, 1988), and meat digestibility (Gilka, 1975). Fat and water are the most variable components of meat, the quantity and quality of fat being influenced by sex, breed, feed and ambiental factors (Fraga *et al.*, 1983; El-Gammal *et al.*, 1984; Cambero *et al.*, 1991a,b,c). Chang-Han & Yeon-Hee (1982) studied the chemical composition of various meats (beef, pork, poultry, lamb and rabbit) showing that rabbit meat was the richest in palmitic acid and, together with chicken meat, the poorest in stearic acid content. Tsimbacova *et al* (1979) reported that the levels of 18:0 and 18:1 in rabbit fat varied from 1.5- to 5-fold lower than those of other meats. However, Lee and Ahn (1977) have observed that rabbit fat has a higher concentration of linoleic acid than that found in beef, poultry and pork.

In several animal species including the rabbit, it has been shown that body composition may be manipulated by dietary means (Fraga *et al.*, 1983). Raimondi *et al.* (1975) report that in rabbit, the greater part of diet fatty acids are unmodified during the digestion and they are incorporated to the fat depots almost unmodified.

The present work was envisaged to determine the effect of diets with different fats (tallow; soya olein, which is a by-product from the soya oil refining industry; and soya bean oil) on the chemical and fatty acid composition of rabbit meat in order to check the posibility of produce rabbit meat with more unsaturated fat .

MATERIAL AND METHODS.

Samples and compositional analysis. Four batches, with six rabbits (hybrid HYLA) in each, were performed. 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 humanely slaughtered at live weights of 2000 g. Chemical composition of diets was determinated as described below for meat samples meat. The ingredients and the chemical and fatty acid composition of the diets are shown in Table 1.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 discarded. 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.

Lipid analysis. Lipids were extracted and purified from the former homogenate according to the method described by Hanson & Olley (1963). Total lipids were gravimetrically determined.

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Fatty acid analysis. The fatty acid methyl esters of total fat were obtained by the method of Firestone & Horwitz (1979) and analysed with a Konik KNK 3000-HRGC chromatograph equipped with a dual flame-ionization detector. The capillar column (25 m internal diameter 0.22 mm) was packed with BP5 (0,25μm) on fused silica. Analysis was 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).

Statistical methods. Statistical analysis was performed using the analysis of variance and the differences between means were analyzed using the Scheffe F-test in a Statview SE program run in a Macintosh LC computer.

RESULTS AND DISCUSSION.

The chemical composition of the meat from rabbits fed on the different diets is shown in Table 2. Fat was the most variable component ranging from 7.4 % in the rabbits fed with TD to 10.0 % in those fed with SD diet. The rabbits fed on diets added with oleines or soy bean oil showed the highest fat concentration. Significant differences ($p<0.05$) were found for the chemical composition of the rabbit meat for dry matter in batch CD *versus* SD, TD *versus* OD, and TD *versus* SD; and for fat content in TD *versus* SD. The levels of fat from meat of rabbit fed on experimental diets are in general agreement with those obtained by Whiting and Jenkins (1981) and Cobos *et al.* (1991) but are different from those reported by Zegarska *et al.* (1979) whose 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, season of the year, etc. (Fraga *et al.*, 1983; El-Gammal *et al.*, 1984; Cambero *et al.* 1991a,b,c).

Gas-liquid chromatography (GLC) analysis of fatty acid methyl esters from meat of rabbits fed on the four diets revealed the presence of more than twenty fatty acids. The more abundant ones are shown in Table 2. It may be seen that the meat fatty acid composition of the four batches of rabbits was very different as it was proved by the statistical analysis. As expected according to reports of other authors (El-Gammal *et al*, 1984; Cambero *et al*, 1991a,c; Cobos *et al*, 1991), the C-16:0, C-18:1 and C-18:2 were the dominant fatty acids. The results of the application of the Scheffe-F-test for the means comparison are also included in Table 2. The fatty acid 16:0 presented significantly higher ($p<0.05$) mean value in batch CD than those in batches TD, OD or SD. The fatty acid 18:1 showed significantly higher mean value in batch TD than those in the other three batches. In batches OD and SD, the fatty acid 18:2 reached significantly higher mean value than those found in CD and TD batches. When fatty acid composition of diets (Table 1) and that of rabbit meat (Table 2) is compared, a directly influence was observed. Diet OD and SD contained a higher C-18:2 level than CD and TD diets. The same fact was found in the meat fatty acid composition. Diet TD was the richest in the fatty acid C-18:1 and, consequently, rabbits fed on this diet showed that the oleic acid was the dominant with a significantly higher mean value than the other diets.

The meat from rabbit fed on diet SD (the poorest on C-16:0) showed a significantly lower mean value in palmitic acid than CD although no differences with OD were found. The animals fed on diet TD (the richest on C-16:0) presented a significantly higher mean concentration on palmitic acid than OD and SD batches. However, the meat from batch CD showed a significantly higher mean value on C-16:0 than TD, meanwhile the diet CD was poorer in this fatty acid than TD. This fact reflects the richness in C-18:1 in the diet TD and probably, this fatty acid has a greater influence on the meat fatty acid concentration than C-16:0.

Other authors (Raimondi *et al*, 1975) reported that the meat and the kidney fat of rabbits fed on the higher percentages of fat had higher content of unsaturated fatty acids and a lower both saturated and saturated fatty acid / unsaturated fatty acid ratio. 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 significant differences ($p<0.05$) between rabbits fed with control and tallow diets and those fed with soya olein and soya bean oil diets for mainly, the fatty acids C-14:0; C-16:0; C-18:2. The incorporation of soya olein and soya bean oil to the rabbit diet produced a decrease in the concentration of the meat saturated fatty acids (especially palmitic acid), a large increase in polyunsaturated (especially linoleic acid). The incorporation of tallow to the rabbit diet produced a small decrease in the concentration of palmitic acid, and a small increase in oleic acid, although they were statistically differents.

In conclusion, it seems to be that the incorporation of soya olein and soya bean oil to the rabbit diet has not important effects on the chemical composition of rabbit meat while it provokes significant effects on the fatty acid composition of rabbit meat. The addition of soya olein or soya bean oil permits the production of rabbit meat with a higher unsaturation degree than those obtained using conventional

TABLE 1. Principal ingredients, chemical (dry matter %) and fatty acids (weight %) composition, and crude energy (kcal/kg dry matter) of control and experimental diets.

	Diet			
	CD*	TD**	OD**	SD**
Ingredients				
Alfalfa hay	30.0	30.0	30.0	30.0
Barley	22.0	16.0	16.0	16.0
Cereals straw	20.0	20.0	20.0	20.0
Soya bean meal	11.0	11.0	14.0	14.0
Cereal bran	8.0	6.0	6.0	6.0
Sunflower meal	7.0	7.0	7.0	7.0
Tallow	0.0	3.0	0.0	0.0
Soya olein	0.0	0.0	3.0	0.0
Soya bean oil	0.0	0.0	0.0	3.0
Chemical composition				
Moisture	6.3	6.3	6.2	6.1
Ash	9.1	9.1	8.9	9.0
Crude fibre	18.2	19.0	19.2	19.5
Crude protein	18.1	18.8	18.9	18.6
Crude fat	1.9	4.8	5.3	5.4
Fatty acids				
14:0	-	4.7	-	-
16:0	15.6	20.7	15.7	11.5
16:1	-	4.8	-	-
18:0	4.0	10.0	3.6	3.4
18:1	14.4	26.7	15.6	17.1
18:2	52.9	27.2	58.3	59.5
18:3	13.1	5.8	6.8	8.5
Crude energy	4349	4462	4524	4437

*CD: Control Diet; **TD, OD or SD: Experimental diets prepared with the control diet added with 3% tallow, soya olein or soya bean oil, respectively.

TABLE 2. Chemical and fatty acid (weight %) composition of meat from rabbits fed on diets added with tallow, soya olein or soya bean oil (n=6).

	Batch			
	CD*	TD**	OD**	SD**
Dry matter	27.64^{a,b}	27.04^{a}	29.96^{b,c}	30.23^{c}
Fat	7.78^{a,b}	7.40^{a}	9.64^{a,b}	10.02^{b}
Ash	0.93^{a}	1.00^{a}	0.94^{a}	0.98^{a}
Protein	18.79^{a}	18.49^{a}	19.21^{a}	19.14^{a}
Fatty acids				
14:0	3.94^{a}	3.71^{a}	2.79^{b}	2.70^{b}
16:0	32.69^{a}	29.83^{b}	26.30^{c}	25.29^{c}
16:1	4.24^{a}	3.81^{a}	2.54^{a}	2.47^{a}
18:0	7.46^{a}	7.97^{a}	8.28^{a}	7.43^{a}
18:1	28.16^{a}	32.52^{b}	26.34^{a}	26.17^{a}
18:2	20.97^{a}	19.90^{a}	31.60^{b}	32.77^{b}
18:3	1.80^{a}	1.53^{a}	1.34^{a}	2.40^{b}
20:4	0.74^{a}	0.72^{a}	0.80^{a}	0.76^{a}

a,b,c Means within a row without a common superscript differ significatively ($p<0.05$)
*CD: Rabbits fed on control diet
**TD,OD or SD: Rabbits fed on control diet added with 3% tallow, 3% soya olein or 3% soya bean oil, respectively.

diets. From an economical point of view, the enrichment of the diet with soya olein is more appropiate than with soya bean oil because former is a by-product from the oil refining industry and, therefore, a cheaper ingredient.

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