EFFECT OF DIETARY ENERGY LEVEL ON FREE FATTY ACID COMPOSITION IN BOVINE LONGISSIMUS DORSI MUSCLE.

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SUMMARY

The aim of this paper was to determine if bovine diet energy level induces a change on free fatty acid (FFA) composition beef longissimus dorsi (LD) muscle. Twenty-four Aberdeen Angus steers were divided into two groups. One of them received a diet of mixed grass pasture, and the other, sorghum grain and corn silage. Both groups were slaugthered at the same abattoir after 178 days of treatment. Samples of LD muscles and subcutaneous fat were extracted using Folch et al. (1957) procedure, 24 h after slaughtering. FFA levels were analyzed by Margaría and García (1990a) technique and FFA composition using Margaría and García (1990b) method. Although the difference was not significant ($P<0.05$), the absolute value of FFA of subcutaneous fat and LD muscle samples from Gn-FA were higher than the ones from Gs-FA.

The multivariate analysis of FFA composition resulted statistically different ($P<0.007$) between groups, while univariate comparisons revealed differences statistically significant for 16:1, 17:0, 18:1, and 18:2. These components had higher proportions in Gn-FA than in Gs-FA, except component 18:1 that was higher in Gs-FA. A discriminant analysis of the data allows separation into two groups with an efficiency of 100% and 92% for grain and Gs-FA respectively. Although both groups had the same quantities of FFAs, Gn-FA had higher quantities of linoleic acid. This makes meat from Gn-FA more susceptible to oxidative deterioration than meat from Gs-FA, specially if its lipids are involved in auto-oxidation mechanisms.

INTRODUCTION

Argentine is a traditional beef exporting country, in which meat production is generally based in extensive grass-feeding systems (low energy level), which is not commonly used in other countries, where feed-lot systems (high energy level diet) are widely employed.

As the diet is important in meat animal production (Hood y Allen, 1972; Alder y Wertheimer, 1968), and free fatty acids (FFAs) are considered to be involved in deterioration processes (rancidity), the purpose of this research was to study the influence of the diet on FFAs production. For all animal species, the dietary lipids are important since they have influence on adipose tissue composition (Allen y Foegeding, 1981). Although in ruminants adipose tissue composition is also affected by rumen hydrogenation capacity (Sumida et al. 1980).

The knowledge of meat FFA composition of different production systems may contribute to build a criteria to decide if a kind of production is more convenient to be commercialized (fresh, frozen or cooked) than the other, regarding on the stability of the final product.

MATERIALS AND METHODS

Twenty-four Aberdeen Angus steers were divided into two groups. In the same ranch, located in Buenos Aires province, one of them received a diet of mixed grass pasture (Gs-FA), and the other, sorghum grain and corn silage (Gn-FA). Both groups were slaugthered after days of treatment. Gs-FA had an initial weight of 360K and a final weight of 465K; ga 0.589K/day, produced a subcutaneous fat thickness of 9.23±1.76mm, 21.8% of them were gra (according to National Meat Joint República Argentina) and 68.2% grade 2. Gn-FA had an i tial weight of 320K and a final weight of 436K; gained 0.651K/day, produced a subcutane fat thickness of 7.64±1.87mm, 31.3% of them were grade 1 (according to National Meat Bo Standard Regulations, República Argentina) and 68.7% grade 2.

Chloroform extracts were obtained from 10.0g samples of 24 longissimus dorsi muscles and from 5.0g samples of 19 subcutaneous fat that covers the muscle (Folch et 1957), 24h after slaughtering. FFA composition was analyzed by Margaría y García (19 method and FFA levels by Margaría y García (1990b) procedure.

Multivariate analysis of variance and discriminant analysis were carried out using S TAT statistical computer package (Wilkinson, 1987).

RESULTS and DISCUSSION

FFA levels in subcutaneous fat were 194±34µmol% for Gn-FA and 160±52µmol% for Gs (non statistically different, P<0.05). For LD muscle FFA levels were 202±23µmol% 186±22µmol% for Gn-FA and Gs-FA respectively (non statistically different, P<0.05). The mu tivariate analysis of variance for FFA composition between groups resulted statistica different (P<0.007), while univariate comparisons revealed that the differences among 16 17:0, 18:1 and 18:2 were significant (**TABLE I**). These fatty acids were in higher proporti in Gn-FA than in Gs-FA, except 18:1, which proportion was higher in Gs-FA. A discrimi analysis of the data allows separation into two groups with an efficiency of 100% and for grain and Gs-FA respectively (**FIGURE 1**). These results contrast with the findings Brown et al. (1979) for neutral lipid fraction of frozen ground meat. These authors det mined that in Gs-FA, FFA composition for the components 16:1, 18:0 and 18:3 were higher in Gn-FA, while in Gn-FA the composition in 16:0, 18:1 and 18:2 were higher than in the FA.

The higher proportions of unsaturated FFA (16:1 y 18:2) in animals fed with high ene diet (grain) the higher and quicker the development of rancidity in meat (Gray and Pears 1987). This may cause a loss of meat quality in Gn-FA compared with the meat quality f low energy diet fed animals. The difference in component 18:1 is somewhat less importa due to high concentrations of this acid in both kinds of samples and that it is less susc tible to oxidation than 18:2.

Even though the number of animals tested is not enough, these results are important b cause the same conditions were used for both groups (breed, climatic stress, transportati production, etc.), and the differences observed can be mostly attributed to the differe diet.

FFAs are more susceptible to oxidation than when esterified (Holman, 1947). Althou both groups had the same quantities of FFA, higher quantities of linoleic acid in Gn makes those meat more susceptible to oxidative deterioration than in Gs-FA, specially if i volved in auto-oxidation mechanisms as demonstrated by Holman, 1947; Miyashita and Takag 1987, 1988; Kaneniwa, 1988. Even though the proportion of oleic acid is higher in Gs-FA th in grain-fed ones, this difference is less important because here the number of double bon involved is almost the same, and linoleic acid is more susceptible to an oxidative attack.

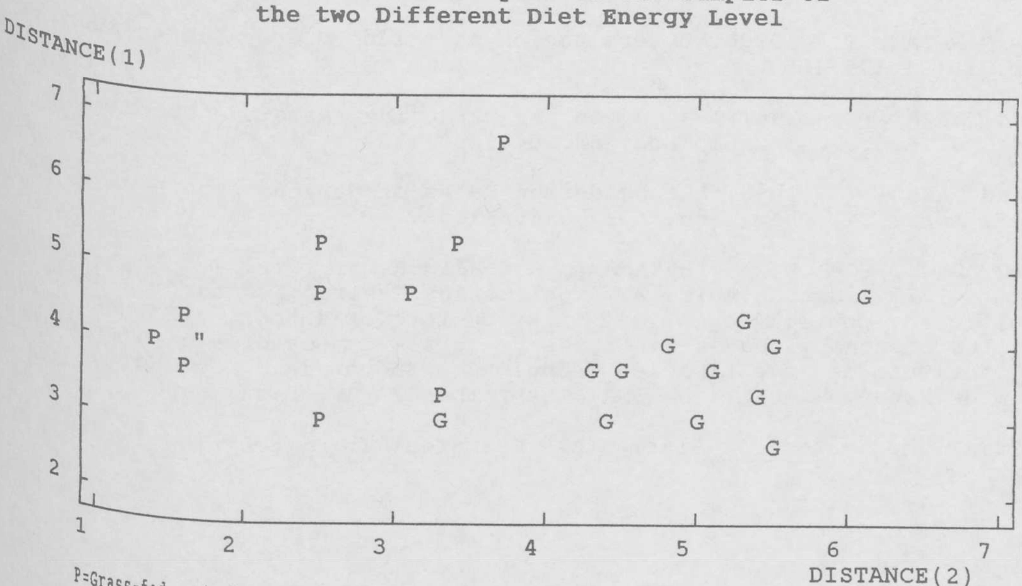
TABLE I

FFA Composition of the Samples of Each Group and Significance Level for the Differences

FFA	GRAIN	GRASS	DIFFERENCE	P
140	2.2±1.58	1.2±1.01	1.0	0.087
150	0.1±0.19	0.0±0.06	0.1	0.174
160	25.5±3.53	27.9±3.48	-2.4	0.111
161	2.3±2.33	0.7±1.09	1.6	0.000
170	0.6±0.42	0.1±0.06	0.5	0.000
171	0.3±0.34	0.1±0.11	0.2	0.057
180	29.0±2.23	32.8±6.69	-3.8	0.089
181	31.8±2.95	35.7±3.54	-3.9	0.011
182	7.6±3.72	1.5±2.12	6.1	0.000
183	0.5±1.55	0.0±0.00	-0.5	0.328

FIGURE 1

Discriminant Analysis of the Samples of the two Different Diet Energy Level



P=Grass-fed animals. G=Grain-fed animals."=Coincident data. DISTANCE(1-2)= Mahalanobis space distances. Each point represents the average of two determinations. N=24.

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