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Traditional cattle feeding stuffs: fatty acid profile

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Keywords: fatty acids, hay, meadow, forage, feeding stuffs

Introduction Dietary polyunsaturated fatty acids (PUFA) are perceived to be healthier than saturated fatty acids. Therefore, in order to be able to manipulate the fatty acid profile of meat and/or milk, to respond to the consumer demands, knowledge of the fatty acid profile of feeding stuffs for cattle is of major importance (LeDoux *et al.*, 2002; Petit, 2002). In this work a preliminary study was made of the fatty acid profile of the cow's diet in a traditional farm production system.

Materials and methods A farm that produces beef from the "Barrosã" breed, located near Montalegre (north of Portugal) was monitored for a year (autumn 2002 – 2003). Two samples, of each feeding stuff given to the cattle, were collected and analysed for the fatty acid profile: wheat straw (ws), high-quality hay meadow (hlm), forage rye (fr), forage wheat (fw), regional white corn (rwc), concentrate (c), low-quality hay meadow (lhm), highland grassland (hg), regional yellow corn (ryc), meadow (m) and low-quality meadow (lm). The extraction was performed by soxhlet with hexane followed by an acid derivatisation using sulphuric acid:methanol reagent. The methylated fatty acids were then extracted by diethyl ether followed by water and chlorophyll removal. The extracts were then analysed in duplicate by GC with FID detector and a SUPELCO column (SP-2560). The fatty acid quantification was carried out using internal standard calibration with undecanoic acid (C11:0) as internal standard. For GC calibration, a SUPELCO 37 commercial FAME mix solution was used.

Results Fatty acids were only considered if the amount found in at least one of the samples analysed was higher than 5% of the total fatty acids (TFA) content: C12:0; C14:0; C16:0; C18:0; C20:0; C21:0; C22:0; C24:0; C18:1n9c; C18:2n6c; C18:3n3. The uncertainty of the results obtained in this study was evaluated taking into account the repeatability and reproducibility. The relative average deviation for the TFA was less than 7% and 15%, respectively. The data were analysed using principal components analysis by SPSS v11.0 program (Figure 1). The fatty acid profiles show three different groups: forage (rwc, ryc, c, fr, fw), meadow (hg, m, lm) and hay (hlm, lhm, ws). Analysis of the TFA data (Table 1) explains these three groups: the forage group with TFA>10000 µg/g; the meadow group with a 2000<TFA<7500 µg/g and the hay group with a TFA=1000 µg/g. Moreover, this last group had a MUFA (monounsaturated fatty acids) content higher than the PUFA content, in contrast to the other two groups.

Conclusions From a nutritional point of view, the results obtained are in accordance with expectations. The TFA and PUFA contents were highest in the most nutritive feeding stuffs.

References

- LeDoux, M., A. Rouzeau., P. Bas & D. Sauvant (2002). Occurrence of *trans*-C_{18:1} fatty acid isomers in goat milk: effect of two dietary regimens. *Journal of Dairy Science*, 85, 190-197.
- Petit, H.V. (2002). Digestion, milk production, milk composition and blood composition of dairy cows fed whole flaxseed. *Journal of Dairy Science*, 85, 1482-1490.

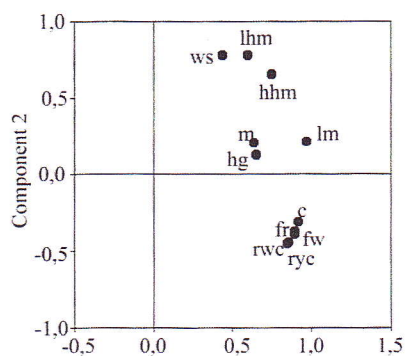


Figure 1 Component plot

Table 1 Total fatty acid content and MUFA percentage for the feed stuffs

Feed stuff	Total (µg/g)	MUFA (%)
Regional white corn	43208	16.6
Regional yellow corn	31681	16.7
Concentrate	30611	34.0
Forage rye	10566	17.9
Forage wheat	15057	18.6
Highland grassland	7429	24.1
Meadow	5552	27.8
Low-quality meadow	2190	48.0
High-quality hay meadow	1348	62.5
Low-quality hay meadow	1084	71.8
Wheat straw	1070	85.6

Traditional bovine cattle feeding stuffs: fatty acids profile



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Introduction

Dietary polyunsaturated fatty acids (PUFA) are perceived to be healthier than saturated fatty acids. Therefore, in order to be able to manipulate the fatty acid profile of meat and/or milk, in response to the consumer demands, the knowledge of the fatty acids profile of the feeding stuffs of the bovine cattle is of major importance (LeDoux *et al.*, 2002; Pettit, 2002). In this work a preliminary study was carried out to obtain fatty acids profile of the cow's diet in a traditional animal farm production.

Objectives

To improve the knowledge of the feeding stuffs lipid composition of the bovine cattle in order to be able to formulate new formula that take in account the animal's health and growth needs.

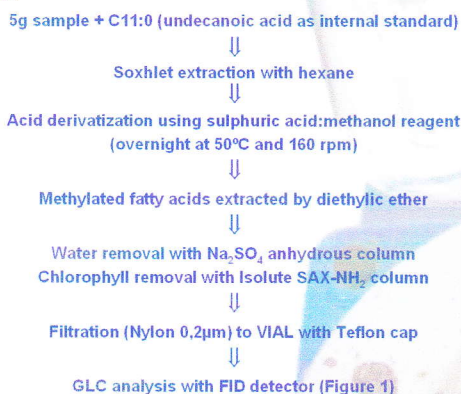
Keywords: fatty acids, hay, meadow, forage, feeding stuffs

Samples

A farm, that produces cattle beef, from the "Barrosã" breed, located near Montalegre (North of Portugal) was monitored for a year (autumn 2002 – 2003). Two samples, for each feeding stuffs given to the cattle, were collected and analysed in order to obtain the fatty acids profile:

- wheat straw (ws)
- high quality hay meadow (hhm)
- forage rye (fr)
- forage wheat (fw)
- regional white corn (rwc)
- concentrate (c)
- low quality hay meadow (lhm)
- highland grassland (hg)
- regional yellow corn (ryc)
- meadow (m)
- low quality meadow (lm)

Method



GLC CONDITIONS

- Column: SP-2560, 100m x 0,25mm x 0,2µm (Supelco)
- Oven: 140°C (5min) to 240°C at 4°C/minute; 240°C (16min) ;
- Carrier gas: constant flow of H₂, 1mL/min
- Injection: 1µL, split 1:77, 250°C
- Detector: FID, 260°C
- Standard commercial solution: FAME (Supelco)
- Internal standard calibration

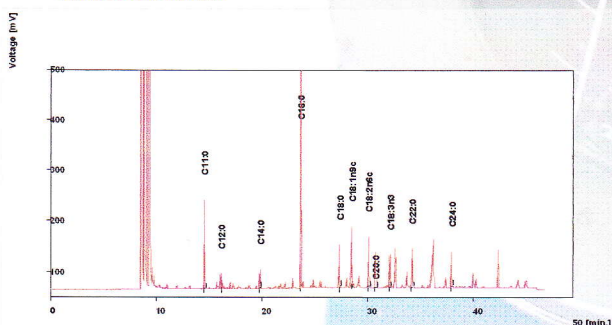


Figure 1 – Low quality hay meadow sample chromatogram

Results

Fatty acids were only considered if the amount found in at least one of the samples analyzed was higher than 5% of the total fatty acids (TFA) content:

- Lauric acid (C12:0)
- Myristic acid (C14:0)
- Palmitic acid (C16:0)
- Stearic acid (C18:0)
- Arachidic acid (C20:0)
- Heptacosanoic acid (C21:0)
- Behenic acid (C22:0)
- Lignoceric acid (C24:0)
- Oleic acid (C18:1n9c)
- Linoleic acid (C18:2n6c)
- Linolenic acid (C18:3n3)

Table 1 - Total fatty acids content and MUFA percentage for the feeding stuffs

Feeding stuffs	Total (mg/g)	MUFA (%)
Regional white corn	43208	16.6
Regional yellow corn	31681	16.7
Concentrate	30611	34.0
Forage ray	10566	17.9
Forage wheat	15057	18.6
Highland grassland	7429	24.1
Meadow	5552	27.8
Low quality meadow	2190	48.0
High quality hay meadow	1348	62.5
Low quality hay meadow	1084	71.8
Wheat straw	1070	85.6

The uncertainty of the results obtained in this preliminary study was evaluated taking into account the repeatability and reproducibility. The relative average deviation for the TFA was less than 7% and 15%, respectively.

The data were statistically analysed using principal components analysis by SPSS v11.0 program (Figure 2).

The results show the formation of three different groups: **forage** (rwc, ryc, c, fr, fw), **meadow** (hg, m, lm) and **hay** (hhm, lhm, ws) by fatty acids profile comparison. The analysis of the TFA data (Table 1) found in the studied samples explain the three above-mentioned groups: forage group with TFA > 10000 mg/g; meadow group with a 2000 < TFA < 7500 mg/g and the hay group with a TFA ≈ 1000 mg/g. Moreover, it is also interesting to note that this last group shows a MUFA (monounsaturated fatty acids) content higher than PUFA content, which is an inversion regarding the other two groups.

Globally, the differences between the mentioned groups are mostly due to the contribution of 4 fatty acids:

- C16:0
- C18:3n3
- C18:1n9c
- C18:2n6c

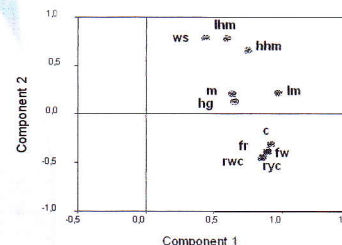


Figure 2 - Component Plot

Conclusions

From a nutritional point of view the results obtained are in accordance with the expected ones.

The results show that globally the most nutritive feeding stuffs are those that present an higher TFA and PUFA contents.

In fact, the hay group presents the lower fatty acid content and, in order to improve feeding stuff quality, it should be mixed with, at least, one of the other two feeding groups.

References

- LeDoux, M., A. Rouzeau, P. Bas & D. Sauvant (2002). Occurrence of *trans*-C_{18:1} fatty acid isomers in goat milk: effect of two dietary regimens. *Journal of Dairy Science*, 85, 190-197.
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