A CLASSIFICATION FUZZY MODEL FOR MINHOTA AND HOLSTEIN FRIESIAN COWS MILK BASED ON FUNCTIONAL FATTY ACIDS

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ABSTRACT

Recent studies have focused on the healthy components of milk fats, including polyunsaturated fatty acids (PUFA) of the omega-3 group, and conjugated linoleic acid (CLA). Several cows from Holstein Friesian and Minhota (autochthonous from the north of Portugal) were evaluated for their milk fatty acid composition, with the latter presenting significantly higher CLA amounts ($P<0.05$), lower saturated fatty acids and a smaller n6:n3 ratio. Considering these potentially functional differences, a classification system for an effective and fast discrimination of milks from different cow breeds would be an interesting tool for the dairy industry. In this work a Fuzzy model system was developed to classify milk samples as belonging to one of each evaluated breeds. For the total of 173 samples analyzed, the model identified correctly all the Friesian's milk but failed to classify 7 samples of the Minhota's milk, corresponding to a classification error of 7.5% within the class and a 4% error considering the total number of samples. These results are supported by the chemical data, with a higher variability observed in Minhota's milk composition.

INTRODUCTION

Dietary milk fats, on account of their higher content of saturated fatty acids and cholesterol, have long been associated with a variety of human diseases. However, recent studies have focused on the healthy components of milk fats, including polyunsaturated fatty acids (PUFA) of the n-3 (omega-3) fatty acid group, and conjugated linoleic acid (CLA) [1].
The main n-3 fatty acids (FA) in milk is α-linolenic acid (C18:3), frequently associated with neurological function improvement, protection against coronary heart disease, and prevention of some forms of cancer. Recent nutritional recommendations highlight the importance of increasing n-3 FA intake, advising a ratio of 3:1 between n-6 and n-3 FA in the human diet [2].
Ruminant milk fat is the main source of CLA in the human diet, including under this terminology the positional and geometric isomers of linoleic acid with conjugated double bonds. The primary isomer of CLA is *cis*-9-*trans*-11 octadecadienoic acid, accounting for more than 82% of the total CLA isomers in dairy products. Recent reports suggest that each conjugated FA isomer has different physiological functions, including anticarcinogenic activity, inhibition of atherosclerosis, a potential role as growth promoter, and the ability to reduce the catabolic effects of immune stimulation. Current estimates of the average daily intake of CLA range from 0.35 to 1g, while a daily intake around 3g is predicted to provide protection against cancer [3].
The potentially positive health benefit of PUFA and CLA offers the dairy industry an exciting opportunity to increase the consumption of dairy products, particularly those richer in these compounds. The FA profile of bovine milk will depend both on the feed fat composition and the biohydrogenation process occurring in the rumen. Thus, many factors can influence the milk composition including breed, feeding systems, seasonal changes, milking frequency and milking systems [1].
In Portugal, as in Europe, most milk is obtained from the Holstein Friesian breed. However, several autochthones breeds might offer increased functional potential for consumer's health, being of utmost importance to study and characterize them. Because of the ever-growing need to supply high quality food products within a short time, a classification system that allows for an effective and quick discrimination of milks from different cow breeds would be an interesting tool for the dairy industry. The objective of this work was to compare the functional potential of Minhota milk, a Portuguese autochthon breed, with the commonly used Holstein Friesian cow milk. Based on the compositional differences a Fuzzy model system was developed to classify milk samples as belonging to one of each evaluated breeds.

MATERIALS AND METHODS

Samples

Holstein Friesian (n=15) and Minhota (n=15) cows were used in this study. A total of 173 milk samples were collected from several dairy farms between October 2008 and September 2009, in order to included seasonal variations. Moreover, some cows sampling was repeated over several months, in order to include different lactation periods, also known to influence milk characteristics.

Fatty acid and cholesterol evaluation

FA were determined by gas-liquid chromatography with flame ionization detection (GLC-FID) based on ISO standards. Separation was achieved on a 50m x 0.25 mm i.d. fused silica capillary column coated with 0.19 µm film of CP-Sil 88 (Chrompack). The results are expressed in relative percentage of each fatty acid, calculated by internal normalization the chromatographic peak areas. Total cholesterol was evaluated by normal phase HPLC-UV after alkaline hydrolysis.