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PII: S0263-2241(16)30620-0
DOI: http://dx.doi.org/10.1016/j.measurement.2016.10.059
Reference: MEASUR 4421

To appear in: *Measurement*

Received Date: 3 June 2015
Revised Date: 19 September 2016
Accepted Date: 31 October 2016

Please cite this article as: M. Werteker, S. Huber, S. Kuchling, B. Rossmann, M. Schreiner, Differentiation of milk by fatty acid spectra and principal component analysis, *Measurement* (2016), doi: http://dx.doi.org/10.1016/j.measurement.2016.10.059

Differentiation of milk by fatty acid spectra and principal component analysis

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Keywords:
milk
feeding systems
fatty acids
principal component analysis
partial least square regression

Abstract:
Aim of the presented study was the development of a procedure for the analytical differentiation of cow milk according to the applied feeding system origin. 30 samples of milk from Tyrol – declared as hay milk - and 31 samples from Lower Austria – declared as conventional (silage) milk - were collected. Fatty acid methyl esters (FAME) were analyzed by gaschromatography (GC). The results were evaluated by principal component analysis (PCA) and partial least squares-discriminant analysis (PLS-DA). 109 FAMEs could be separated,. By PCA and PLS-DA a clear distinction between the two groups of milk samples was possible. By evaluation of correlation loadings an estimation of the contribution of distinct FAMEs to the characterization of samples was possible. Among others most odd chained, saturated and unsaturated C18 FAMEs – especially C18:2c9t11 conjugated linoleic acid were significantly different in the two groups of samples.

1. Introduction

In the last years there was an increasing interest of consumers in food products of defined origin. Foods processed according to special, traditional procedures, from defined raw materials and of distinct geographical origin are in demand. Especially in Austria milk and some milk products are offered as “hay milk” or “made from hay milk”. This kind of milk is defined as produced without feeding of silage. Food surveillance authorities are challenged now to verify the truth of these offers to protect consumers against cheating and producers against fraudulent competitors.

About 75% of the fatty acids (FAs) in milk fat are saturated FAs like myristic, palmitic and stearic. Around 21% are monounsaturated FAs, mainly oleic acid. Only about 4% are polyunsaturated FAs [1]. These figures may give some guidance for the composition of milk fat, but a lot of work has been spent to the investigations concerning influences on the FA composition by species and bred of animals, geographical origin and others. Most attention is paid to the influence of feeding systems and related factors as altitude and geographical origin, while species and bred of animals are discussed comparatively marginal in literature or as a side aspect in some papers. E.g. there are studies on some species specific characteristics of goat milk, which is characterized mainly by higher levels of C8:0 and C10:0 FAs compared to cow milk [2]. Also the influence of bred on C16:0 and stearic acid could be established [3].

There are complex interactions between feeding and FA profiles of milk. Main products of the hydration of unsaturated FA like linoleic and linolenic acid are C18:1t11 vaccenic acid and C18:2c9t11 conjugated linoleic acid. The concentration of these FAs is correlated with the activity of rumen bacteria. On the other side herbs and grass, which are feedstuffs enhancing the rumen fermentation are rich in unsaturated FAs, so that also the concentrations of α-linolenic and linoleic in the milk fat may be enhanced by increased uptake of these FAs, as far as they are not hydrated by the rumen bacteria [4]. Further on branched and odd chained FAs are an indicator for high activity of the rumen flora. The FA-spectrum of milk is also influenced by tissue desaturase activity. Due to the diversity of influencing factors the theoretical prediction of FA-composition is difficult and the impact of feeding systems may be characterized best by descriptions based on analysis as will be shown in the following paragraphs.

Concentrates. Vegetable Oil supplementation. Milk from cows fed a diet rich in concentrates is characterized by short and medium chain FAs (C4:0 - C14:0) originated from *de novo* synthesis. Concentrates