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Review

Modifying milk composition through forage

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Abstract

The fatty acid (FA) composition of cows milk has become less favorable to human health in the last four decades due to changed feeding and management practices, notably higher proportions of concentrates and silages in diets with less grazing. Essential FA and conjugated linoleic acid (CLA) concentrations have generally declined and, with more 'low-fat' dairy products, human intake of these FA has declined even further since ruminant food products are the main source of human CLA intake. Changing societal drivers and consumer demands require dairy production systems that provide food products through sustainable production systems. Milk FA were examined in milk produced in different regions of the world, in the different seasons of the year, and under different feeding systems. FA levels were examined in forages, concentrates and milk. Milk from cows fed fresh green forage, especially those grazing grass, had a much higher unsaturated:saturated FA proportion, with more polyunsaturated FA and more CLA (in particular C18:2 *cis*-9, *trans*-11), than milk from silage-fed cows. Farmers from some dairy cooperatives in The Netherlands that produce milk from grazed grass now receive a premium payment in addition to the base milk price, so that primary producers can benefit from the higher market value at the end of the production chain.

Keywords: Forage; Silage; Feeding system; Seasonal change; Milk fatty acids

Abbreviations: CLA, conjugated linoleic acid; DM, dry matter; FA, fatty acids; LDL, low density lipoprotein; MUFA, monounsaturated FA; PUFA, polyunsaturated FA; UFA, unsaturated FA

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Contents

1. Introduction

Changing societal drivers (*e.g.*, landscape values, animal welfare) and consumer demands (*e.g.*, tasty/healthy products) require systems that provide desired human foods produced through sustainable production processes.

High-fat humen diets, especially those rich in saturated fats, are often claimed to have detrimental effects on cardiovascular disease risk factors such as blood low density lipoprotein (LDL) cholesterol (Ascherio et al., 1996; Williams, 2000). Dairy products contribute 15–20% of human intake of total fat, 25–33% of saturated fat and about 15% of dietary cholesterol in the USA (Havel, 1997). At present, about 2% of total fatty acids (FA) in milk are polyunsaturated (PUFA) and about 70% are saturated, but less than 40% of saturated FA are in categories considered to be less healthy. These values can be modified by changing the animal diets (Tamminga, 2001; Kennelly, 2001; Chilliard et al., 2001), and it is thought that lauric acid (C12:0), but especially myristic (C14:0) and palmitic (C16:0) acid, raise total and LDL cholesterol, whereas stearic acid (C18:0) is neutral relative to the monounsaturated fatty acid (MUFA) oleic acid (C18:1) in animal fats (Grundy and Vega, 1998). Cardiovascular risk might be reduced by lowering intake of undesirable saturated FA and/or by making alterations in the FA profile of the fat consumed. Increasing the concentration of desired FA in ruminant products is receiving current attention.

The main $n-3$ FA in milk is α-linolenic acid (C18:3 *cis*-9, *cis*-12, *cis*-15), and another category of PUFA is conjugated linoleic acid (CLA), the main isomer in milk being rumenic acid (C18:2 *cis*-9, *trans*-11). The MUFA in milk consist mainly of C18:1 *cis*-9 (oleic acid) and also C18:1 *trans*-11 (vaccenic acid). Rumenic and vaccenic acids are both *trans*-11 FA produced by rumen microorganisms and are unique to ruminant fats. Rumenic acid has been associated with anticarcenogenic properties in rats (Corl et al., 2003; Ip et al., 1999) and possibly in humans (Aro et al., 2000; Belury, 2002). Other potential beneficial effects of CLA for human health were mentioned, but more work is needed to elucidate the safety and efficacy of isomers and their required doses (Belury, 2002). Ingested vaccenic acid can be converted into rumenic acid in mammals, including humans (Salminen et al., 1998; Santora et al., 2000). Turpeinen et al. (2002) estimated that, on average, humans endogenously convert 19% of dietary vaccenic acid into rumenic acid. Banni et al. (2001)