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Seasonal variation in the fatty acid composition of milk available at retail in the United Kingdom and implications for dietary intake

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ABSTRACT

Milk and dairy products are major sources of fat in the human diet, but there are few detailed reports on the fatty acid composition of retail milk, *trans* fatty acids in particular, and how these change throughout the year. Semi-skimmed milk was collected monthly for one year from five supermarkets and analysed for fatty acid composition. Relative to winter, milk sold in the summer contained lower total saturated fatty acid (SFA; 67 vs 72 g/100 g fatty acids) and higher *cis*-monounsaturated fatty acid (MUFA; 23 vs 21 g/100 g fatty acids) and total *trans* fatty acid (6.5 vs 4.5 g/100 g fatty acids) concentrations. Concentrations of most *trans*-18:1 and -18:2 isomers also exhibited seasonal variation. Results were applied to national dietary intakes, and indicated that monthly variation in the fatty acid composition of milk available at retail has limited influence on total dietary fatty acid consumption by UK adults.

1. Introduction

Milk and dairy products are a major source of fat and fatty acids in the human diet, contributing to between 18% and 24% total fat, 30% and 40% total saturated fatty acid (SFA) and 20% and 25% total *trans* fatty acid intake (Henderson, Gregory, Irving, & Swan, 2003; Hulshof et al., 1999). The consumption of fat-reduced milk has been increasing in the UK since market introduction in the early 1980s, with consumption in 2010 of around 60.2 kg/person/year compared with whole milk consumption of 18.3 kg/person/year (DairyCo, based on DEFRA, 2010). This has led to an overall increase in the proportion of dietary fat and SFA provided by fat-reduced milk. Cheese consumption has increased over the last 10 years to around 6.1 kg/person/year (DEFRA 2010), and makes the largest contribution to SFA intake of all dairy products (Bates, Lennox, & Swan, 2010).

Diet is the major environmental factor influencing milk fatty acid composition (Chilliard et al., 2007; Dewhurst, Shingfield, Lee, & Scollan, 2006). It is well established that increasing the proportion of energy from fresh forages enhances the concentration of certain unsaturated fatty acids and typically lowers SFA content compared with conserved forages or cereal concentrates (Chilliard et al., 2007; Dewhurst, Shingfield, Lee, & Scollan, 2006). Total SFA concentrations in milk fat are generally lower in the summer than in winter under UK conditions (Ellis et al., 2006; Lock & Garnsworthy, 2003). Seasonal differences are, at least in part, due to the influence of forage composition on the intake of polyunsaturated fatty acids (PUFA). In addition to decreasing SFA concentrations, grazing generally increases milk fat 18:3 n-3 and conjugated linoleic acid (CLA) concentrations, but also results in higher *trans* fatty acid content due to incomplete biohydrogenation of dietary unsaturated fatty acids in the rumen (Chilliard et al., 2007; Dewhurst et al., 2006).

Recent advances in dairy cow nutrition have allowed for the formulation of diets to decrease milk fat SFA concentrations in response to governmental calls for lowering human SFA intake (e.g., Food Standards Agency, 2008). Such strategies include supplementing the ruminant diet with lipid such as oilseeds, but these approaches also result in a concomitant increase in milk *trans* fatty acid content (Shingfield, Chilliard, Toivonen, Kairenius, & Givens, 2008). Despite inconsistent evidence as to whether ruminant-derived *trans* fatty acids (so called "natural *trans*") have similar adverse effects on cardiovascular disease risk factors as reported for industrial-derived *trans* fatty acids (e.g., Bendsen, Christensen, Bartels, & Astrup, 2011; Brouwer, Wanders, & Katan, 2010), there is now regulation in place within the European Union which states that the proportion of SFA and *trans* fatty acids should be summed when making claims about lowered SFA foods (European Commission, 2006). Correct identification and reporting of *trans* fatty acids in milk fat is therefore crucial to an accurate declaration of milk total *trans* fatty acid content.

There is evidence from controlled experiments and under commercial conditions that milk fat composition differs between the

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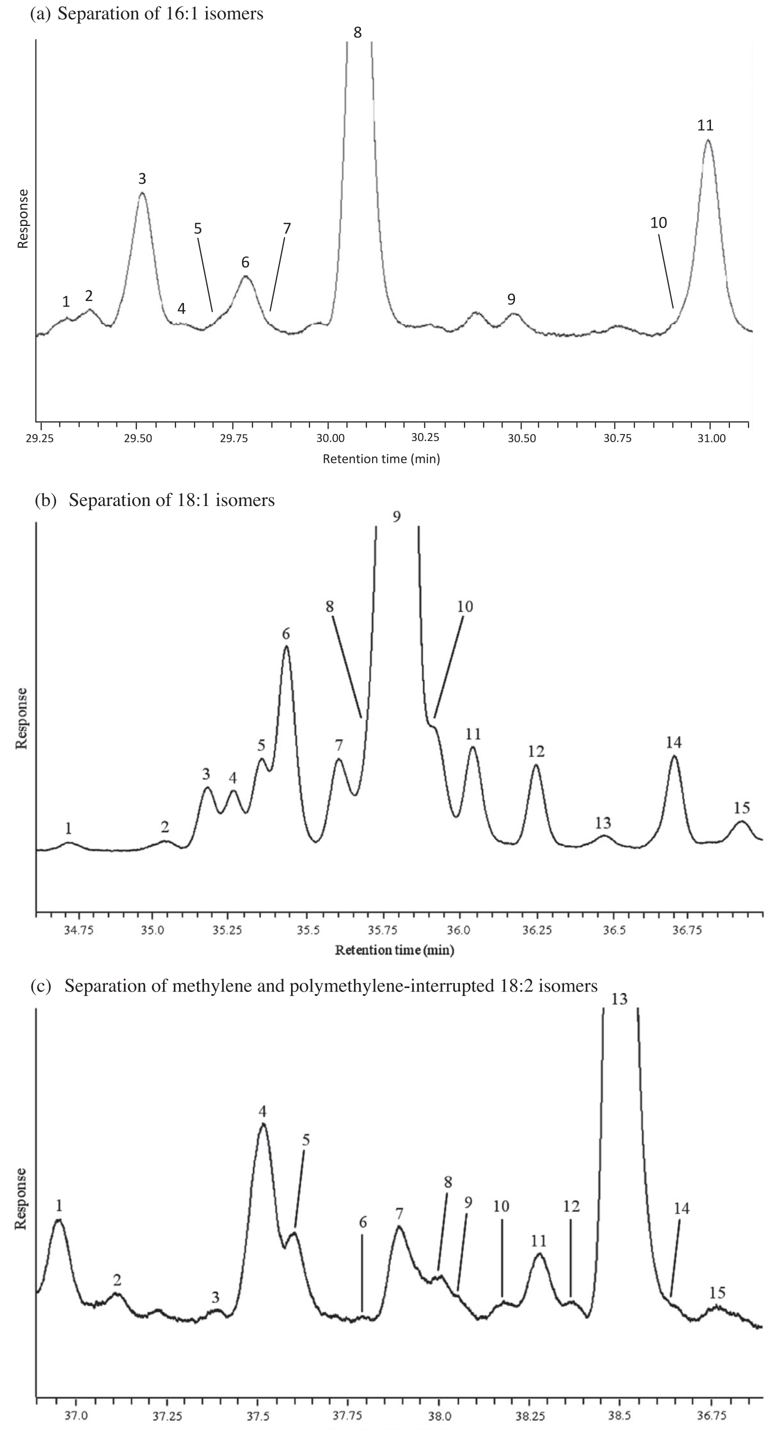

Fig. 1. Partial gas chromatograms indicating the separation of (a) 16:1, (b) 18:1, and (c) methylene and polymethylene-interrupted 18:2 isomers obtained using a temperature gradient for fatty acid methyl esters (FAME) prepared from milk fat. Identification based on retention time comparisons with authentic standards and verified based on electron impact ionization spectra recorded during GC–MS analysis of FAME and corresponding 4,4-dimethyloxaline derivatives. (a) Separation of 16:1 isomers. Peak identification: 1 = unresolved 16:1 *trans*-6 and *trans*-7, 2 = 16:1 *trans*-8, 3 = unresolved 16:1 *trans*-9 and 17:0 iso, 4 = 16:1 *trans*-10, 5 = 16:1 *trans*-11, 6 = 16:1 *trans*-12, 7 = 16:1 *trans*-13, 8 = unresolved 16:1 *cis*-9 and 17:0 anteiso), 9 = 3S,7R,11R,15 tetramethyl 16:0, 10 = unresolved 16:1 *cis*-11 and 3R,7R,11R,15 tetramethyl 16:0, 11 = 16:1 *cis*-13, 12 = 17:0. (b) Separation of 18:1 isomers. Peak identification: 1 = 18:1 *trans*-4 2 = 18:1 *trans*-5, 3 = unresolved 18:1 *trans*-6, -7 and -8, 4 = 18:1 *trans*-9, 5 = 18:1 *trans*-10, 6 = 18:1 *trans*-11, 7 = 18:1 *trans*-12, 8 = unresolved 18:1 *trans*-13 and -14, 9 = unresolved 18:1 *cis*-9 and -10, 10 = 18:1 *trans*-15, 11 = 18:1 *cis*-11, 12 = 18:1 *cis*-12, 13 = 18:1 *cis*-13, 14 = unresolved 18:1 *trans*-16 and 18:1 *cis*-14), 15 = unresolved 18:1 *cis*-15 and 19:0. (c) Separation of methylene and polymethylene-interrupted 18:2 isomers. Peak identification: 1 = unresolved 19:0 and 18:1 *cis*-15, 2 = 18:2 *trans*-11, *trans*-15, 3 = 18:2 *trans*-9, *trans*-12, 4 = 18:2 *cis*-9, *trans*-13, 5 = 18:2 *cis*-10, *trans*-14, 6 = 11-cyclohexyl-11:0, 7 = 18:2 *cis*-9, *trans*-14, 8 = 18:2 *cis*-9, *trans*-12, 9 = 18:1 *cis*-16, 10 = 18:2 *trans*-9, *cis*-12, 11 = 18:2 *trans*-11, *cis*-15, 12 = 19:1 *cis*-7, 13 = 18:2 *cis*-9, *cis*-12, 14 = unresolved 18:2 *cis*-9, *cis*-15 and 19:1 *cis*-9, and 15 = 18:2 *trans*-12, *cis*-15.

summer and winter (Butler, Stergiadis, Seal, Eyre, & Leifert, 2011; Ferlay et al., 2008). However, the extent of these differences at a retail level, and the potential impact on fatty acid intakes in the UK population, is not known. The main objective of this study was to