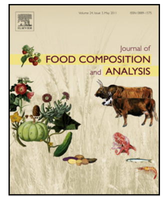
Journal of Food Composition and Analysis 41 (2015) 151–156

Contents lists available at ScienceDirect

Journal of Food Composition and Analysis

journal homepage: www.elsevier.com/locate/jfca



Original Research Article

A comparison of the *trans* fatty acid content of uncooked and cooked lean meat, edible offal and adipose tissue from New Zealand beef and lamb

Roger W. Purchas [a,*], Brian H.P. Wilkinson [a], Fiona Carruthers [b], Felicity Jackson [a]

[a] Institute of Food, Nutrition and Human Health, Massey University, Palmerston North 4442, New Zealand
[b] Beef + Lamb New Zealand Ltd., PO Box 121, Wellington 6140, New Zealand

ARTICLE INFO

Article history:
Received 12 November 2014
Received in revised form 20 January 2015
Accepted 23 January 2015
Available online 23 February 2015

Keywords:
Food analysis
Food composition
Fatty acids
Trans fatty acids
Edible offal
Adipose tissue
Cooking effects
Food processing

ABSTRACT

The concentrations of a group of *trans* fatty acids (FA) (not all isomers) in the lean tissue from 17 beef cuts and 18 lamb cuts were determined on raw and cooked within-cut composite samples (each containing lean tissue from at least 7 animals) as well as on composite samples (each from at least 9 animals) of raw and cooked edible offal items (5 items each from cattle and lamb), and single composite samples of subcutaneous and intermuscular adipose tissue for beef and lamb. For analysis, different cuts or offal items were the experimental unit as individual animal data were not available. *Trans* FAs were an average of 4.6% of total FA, with *trans* MUFA making up about 76% of the total. This value was higher for offal items than lean meat (78.9% vs. 73.4%; $P = 0.026$), and higher for beef than lamb (79.4% vs. 72.9%; $P = 0.007$). Of the *trans* MUFA, *trans* vaccenic acid (TVA, C18:1 *t*11) made up about 75% of the total, and this percentage was higher for lean meat than in offal (77.9% vs. 71.7%, $P = 0.001$), and higher for lamb than beef (84.0% vs. 65.6%; $P < 0.0001$). Of the non-MUFA fatty acids, the CLA C18:2 *c*9 *t*11 (rumenic acid (RA)) made up about 99% of the total, and was a higher percentage of total FAs in lamb than in beef (1.64% vs. 0.61%; $P < 0.0001$). *Trans* FA levels following cooking were unaffected as a percentage of total FA, but were higher per unit weight of the product because the fat percentage was higher. It is concluded that the *trans* FA of beef and lamb are dominated by the seemingly beneficial FA (TVA and RA) for both the MUFA and non-MUFA groups.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

The undesirable effects of dietary *trans* fatty acids (FA) on human health have been widely reported (e.g. Aro, 2001; Chowdhury et al., 2014), but a distinction has often been made between *trans* FA from industrial sources, which are undesirable, and those that occur naturally in food derived from animals such as milk and meat, which are considered acceptable or beneficial to some extent (Mozaffarian et al., 2006; Chardigny et al., 2008; Trumbo and Shimakawa, 2011; Jacome-Sosa et al., 2014). The primary industrial *trans* FA of concern is elaidic acid (C18:1 *t*9) with higher intakes being associated with higher levels of circulating cholesterol (Shen et al., 2007), while the primary *trans* FA in animal products is usually *trans* vaccenic acid (C18:1 *t*11; (TVA)), a precursor of the conjugated linoleic acid (C18:2 *c*9 *t*11) (Turpeinen et al., 2002; Shen et al., 2007), for which there is evidence of desirable health effects (Dilzer and Park, 2012).

The name rumenic acid (RA) has been proposed and is widely used for C18:2 *c*9 *t*11 (Kramer et al., 1998). There is limited information on the relative contributions of *trans* monounsaturated FA (MUFA) and *trans* polyunsaturated FA (PUFA) to the total concentration of *trans* FA in raw and cooked New Zealand beef and lamb, or on the contribution of individual *trans* FA to the totals. This information is of particular interest because the samples analysed were from animals raised and finished on pasture, and there is good evidence that the pattern of *trans* FA in intramuscular fat is affected by the nature of the finishing diet, with pasture-based diets being associated with a more favourable pattern (Dannenberger et al., 2004; Purchas et al., 2005; Noci et al., 2005; Leheska et al., 2008; Aldai et al., 2011).

The objective of the current analysis was to use FA concentrations in lean meat, offal items and adipose tissue to evaluate the effects of cooking, species (beef vs. lamb), and tissue (lean muscle tissue vs. lean tissue of edible offal) on concentrations of *trans* FA, and on the contribution of specific *trans* FA to the total.

* Corresponding author. Tel.: +64 6 3504336.
E-mail address: R.Purchas@massey.ac.nz (R.W. Purchas).

http://dx.doi.org/10.1016/j.jfca.2015.01.016
0889-1575/© 2015 Elsevier Inc. All rights reserved.

2. Materials and methods

2.1. Samples

The 17 beef cuts and 18 lamb cuts evaluated were described in Purchas et al. (2014) and in Purchas and Wilkinson (2013), and the 5 edible offal items for beef and lamb are listed in Table 1, along with their number from "The New Zealand Meat Specification Guide" (www.beeflambnz.com/Global/Microsite/index.html). Table 1 also shows the method of cooking, cooking losses, and the number of lots per item. All samples were from animals raised and finished on pasture. A "lot" comprised sufficient weight of a cut or offal item to provide about 3 kg of uncooked lean and 3 kg of cooked lean, which meant that for large items a "lot" included a representative part of the whole from a single carcass, while for small items a "lot" included items from several animals. Samples of cuts or offal items came to the Massey University pilot plant as frozen vacuum packs from several different meat plants throughout New Zealand with all samples of a particular item coming from the same plant. Further details of dissection of raw and cooked items into "lean" tissue, fat tissue, and bone plus waste are given in Purchas et al. (2014). Samples of beef subcutaneous and intermuscular adipose tissue came from at least 10 cuts of beef striploin (1640) and at least 10 cuts of beef chuck-eye roll (2430), respectively, while corresponding samples for lamb came from at least 10 cuts of lamb loin saddle (3321), and at least 10 cuts of lamb boneless, rolled, netted shoulder (3620), respectively.

Following dissection of raw and cooked samples all the lean portions were combined, minced, mixed and freeze-dried prior to analysis so that for each cut one raw and one cooked composite value was obtained for each measurement.

2.2. Laboratory procedures

Fat content was measured on freeze-dried samples by an initial acid digestion (8.33 M HCl) followed by Mojonnier extraction (di-ethyl ether + petroleum ether (BP 40–60 °C)) (AOAC 954.02 in AOAC, 2005).

Fatty acids were quantified by gas–liquid chromatography (Shimadzu GC-17A chromatograph, Supelco SP™ column: 2560 fused silica capillary column; 100 m × 0.25 mm × 0.2 μm film thickness; injection volume of 1 μL) according to the method of Sukhija and Palmquist (1988), with the one-step methylation using a solvent mixture of methanol/toluene/acetyl chloride (27:25:3), except for the analysis of CLAs, when cold lipid extraction was with chloroform–methanol (2.5:1), and methylation was with sodium methoxide (Aldai et al., 2007). The internal standard was C15:0 pentadecanoic acid, and fatty acids were identified using methylated fatty acid standards from several sources (CLAs from Matreya LLC, Pleasant point, PA, USA; C22:5 (DPA) from Alltech/Grace, Deerfield, IL, USA; all other FA from Sigma–Aldrich, St. Louis, MO, USA).

Trans MUFA measured included palmitelaidic acid (C16:1 *t*9), elaidic acid (C18:1 *t*9) and *trans* vaccenic acid (TVA; C18:1 *t*11), while *trans* non-MUFA included linoelaidic acid (C18:2 *t*9 *t*12), and two conjugated linoleic acids (CLAs; C18:2 *c*9 *t*11 (RA) and C18:2 *t*10 *c*12). It is acknowledged that other *trans* isomers exist that were not quantified in this study (see, for example, Aldai et al., 2009).

Table 1
The five beef and lamb offal items with cooking procedures and cooking loss means (±standard deviation and number of lots in brackets).

Cut name [number[a]]	Cooking procedures	Cooking loss% ± SD; (*N*)
Beef offal items		
Heart (cap-off) [0121]	Soak[b], then heat at 90–100 °C for 2.0 h[c]	43.7 ± 2.6; (10)
Kidney [0140]	Soak[b], then heat at 90–100 °C for 1.5 h[c]	53.4 ± 2.0; (10)
Liver [0130]	Soak[b], then fry to an internal temperature of 72 °C	15.0 ± 3.9; (9)
Sweetbread (thymus) [0117]	Soak[b], then heat at 90–100 °C for 30 min[c]	15.5 ± 4.3; (10)
Tongue[d] (Swiss-cut) [0112]	Soak[b], then heat at 90–100 °C for 2.0 h[c]	31.2 ± 4.7; (10)
Lamb offal items		
Heart [0220]	Soak[b], then heat at 90–100 °C for 1.5 h[c]	39.3 ± 2.5; (10)
Kidney [0240]	Slices of ~15 mm fried for 4 min/side.	28.8 ± 2.4; (10)
Liver [0230]	Soak[b], then ~15 mm slices fried for 4 min/side	25.9 ± 4.0; (10)
Sweetbread (thymus) [0217]	Soak[b], then heat at 90–100 °C for 20 min[c]	29.2 ± 1.8; (10)
Tongue[d] (Swiss cut) [0212]	Soak[b], then heat at 90–100 °C for 20 min[c]	25.9 ± 0.9; (10)

[a] Number from "The New Zealand Meat Specification Guide" published by Meat & Wool New Zealand.
[b] Soaked in 5 times their weight in cold water for 5 times at 5 min each time.
[c] Items were sealed in a boil-in-the-bag plastic bag with 800 mL/kg of water, before being cooked in a steam kettle.
[d] The skin of tongues was included with bones as waste.

2.3. Statistical analysis

Data were analysed using the GLM Procedure of SAS (SAS Institute, Inc., Cary, NC, USA) with a nested ANOVA model because cooked and raw samples came from the same cuts. Thus, within the ANOVA, the species effect (beef vs. lamb) and meat vs. offal effect plus their interaction were tested against the cut-within-species term, and the cooking effect, the cut effect, and other interactions were tested against the overall error. Differences between cuts are not reported here because they are based on only two composite samples (one raw and one cooked) although they were often significant ($P < 0.05$). Interaction effects were seldom significant and when significant ($P < 0.05$) are noted in the text only rather than in tables. Data for the subcutaneous and intermuscular fat depots were not assessed for statistical significance as the composite samples came from only one lamb cut and one beef cut for each depot. Correlation coefficients between selected raw and cooked values within beef and within lamb were calculated using PROC CORR within SAS.

3. Results and discussion

3.1. Sample characteristics

In this study the variation between species, between meat and offal items, and between raw and cooked samples was due to differences between items rather than between individual animals, as each cut value was for a composite sample made up of sub-samples from several animals (Table 1). As noted in Purchas et al. (2014), this variation excludes some between-animal variation, although different items came from different groups of animals, but it includes variation between cuts. The net effect on levels of variation relative to that between animals for the same cut is not known.

Differences between beef and lamb are reported in the tables of this paper, but are not discussed in detail and need to be interpreted with care because the samples were not obtained from animals that had been raised together in the same environment with respect to nutrition and other factors. Similarly, in considering the differences between lean meat and the lean tissue of offal items, it needs to be kept in mind that the lean meat is a single

Download English Version:

https://daneshyari.com/en/article/1218228

Download Persian Version:

https://daneshyari.com/article/1218228

Daneshyari.com