



# Further studies on the iodine concentration of conventional, organic and UHT semi-skimmed milk at retail in the UK



Melissa C. Stevenson<sup>a</sup>, Chris Drake<sup>a,b</sup>, D. Ian Givens<sup>a,\*</sup>

<sup>a</sup> Institute for Food, Nutrition and Health, University of Reading, Earley Gate, Reading RG6 6AR, UK

<sup>b</sup> Hypha Discovery Ltd, Russell Building, Brunel Science Park, Uxbridge, Middlesex UB8 3PQ, UK

## ARTICLE INFO

### Article history:

Received 12 February 2017

Received in revised form 17 June 2017

Accepted 23 June 2017

Available online 30 June 2017

### Chemical compounds studied in this article:

Tetramethylammonium hydroxide

(PubChem CID: 60966)

Ammonium iodide (PubChem CID: 25487)

Rhodium chloride (PubChem CID: 24872)

### Keywords:

Iodine

Milk

Organic

UHT

## ABSTRACT

Milk is the largest source of iodine in UK diets and earlier studies showed organic summer and winter milk to be significantly lower in iodine than conventional milk. One study also showed UHT milk to have lower iodine concentration. The study on winter and UHT milk was small and accordingly a new study is reported here involving conventional, organic and UHT semi-skimmed milk from four supermarkets over a six-month period in summer and winter in two regions of the UK. The results showed organic milk to be 44% lower in iodine than conventional milk (427 vs. 241 µg/L,  $P < 0.001$ ) and UHT milk was 27% lower in iodine than conventional milk (427 vs. 314 µg/L,  $P < 0.001$ ) although the differences tended to be less in the summer. The results indicate that replacement of conventional milk by organic or UHT milk will increase the risk of sub-optimal iodine status especially for pregnant/lactating women.

© 2017 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Iodine is an essential micronutrient in the human diet, required for thyroid hormone synthesis which controls key aspects of metabolism, brain and bone development (Grau et al., 2015). The recommended daily intake of iodine varies; the World Health Organisation (WHO, 2007) advises 150 µg/d for adults and 250 µg/d for pregnant and lactating women, whilst the UK Reference Nutrient Intake (RNI) for iodine is 130 µg/d for children aged 11–14 and 140 µg/d for adults, with no increase during pregnancy or lactation (Department of Health, 1991). The availability of iodised salt has helped to lower the number of countries with iodine deficient populations, however globally, 30% of school children are still believed to consume sub-optimal amounts of the nutrient (Andersson, Karumbunathan, & Zimmermann, 2012). Iodised salt has never been compulsory in the UK (Phillips, 1997) and recent public health advice to reduce salt intake suggests this situation will not change.

A review of data from the recent UK National Diet and Nutrition Survey showed that many sections of the population are still not consuming adequate amounts of iodine (Miller, Spiro, & Stanner, 2016). In particular, 22% of girls aged 11–18 years old and 10% of women aged 19–64 have iodine intakes below the lower reference nutrient intake (70 µg iodine/d) (Bates et al., 2014; Miller et al., 2016). Cohort studies in the UK have shown 51% of schoolgirls to be mildly iodine deficient based on urinary iodine concentrations (Vanderpump et al., 2011) and a large cohort of pregnant women were classified as being mild-to-moderately iodine deficient (Bath, Walter, Taylor, Wright, & Rayman, 2014). In addition, the UK Avon Longitudinal Study of Parents and Children (ALSPAC) showed an association between mild-moderately iodine deficient pregnant women and lower verbal IQ, reading accuracy and comprehension in their children compared to those born from mothers of adequate iodine status (Bath, Rayman, Steer, Golding, & Emmett, 2013). A similar outcome was seen in an Australian study where children from mothers with urinary iodine concentrations during pregnancy  $<150$  µg/L, had significantly lower ability in spelling, grammar and English-literacy at 9 years old than children whose mothers' urinary iodine concentrations were  $>150$  µg/L (Hynes, Otahal, Hay, & Burgess, 2013).

\* Corresponding author.

E-mail addresses: [millyclarestevenson@hotmail.com](mailto:millyclarestevenson@hotmail.com) (M.C. Stevenson), [chrdrake@googlemail.com](mailto:chrdrake@googlemail.com) (C. Drake), [d.i.givens@reading.ac.uk](mailto:d.i.givens@reading.ac.uk) (D.I. Givens).

In the UK, semi-skimmed milk is by far the primary source of dietary iodine for children and adults alike with other dairy products also making important contributions (Bates et al., 2014). Whilst milk is a good source of iodine, the type of milk, time of year, dairy cow diet and the human diet can all affect the amount available for thyroid hormone synthesis. Organic milk has significantly less iodine than conventional milk (Bath, Button, & Rayman, 2012; Payling, Juniper, Drake, Rymer, & Givens, 2015) whilst milk produced in summer months has consistently lower iodine concentrations than winter milk (Food Standards Agency, 2008; Crnkić, Haldimann, Hodžić, & Tahirović, 2015). Furthermore, the presence of thiocyanate in the diet, found in plants belonging to the *Brassica* genus and in tobacco, can prevent the uptake of iodine into the thyroid gland due to competitive inhibition of the sodium-iodine symporter (NIS) (Bivolarska, Gatseva, Nikolova, Argirova, & Atanasova, 2015; Trøan et al., 2015).

The study by Payling et al. (2015) on iodine concentration in organic and conventional winter milk at retail was subject to scrutiny. There was concern that by the time of publication, the results were out of date as it was reported that recently permitted iodine additions to the diet of many organic dairy herds was now leading to organic milk with comparable iodine levels to conventional milk (OMSCO, 2015, 2016). The current study therefore aimed to further the research of Payling et al. (2015) by incorporating into one study the effect on iodine content of conventional, organic and UHT milk of month purchased, supermarket of purchase and geographical area.

## 2. Materials and methods

### 2.1. Milk samples

On approximately the same date every month from July to December 2015 milk samples were collected from four leading supermarkets in Reading (South East England) and Stratford-upon-Avon (Midlands, England). From each supermarket a conventionally produced pasteurised, organic produced pasteurised and conventionally produced ultra-high temperature (UHT) processed milk sample (all semi-skimmed) was bought, yielding 24 samples each month and a total of 144 samples collected for analysis. After every collection, a 40 ml aliquot of each milk sample was taken and stored at  $-20^{\circ}\text{C}$  in the same freezer until required.

### 2.2. Sample analysis

Milk samples were left to thaw overnight, before thorough mixing in a vortex machine prior to analysis. Iodine was measured in all samples by alkali extraction followed by inductively coupled plasma mass spectrometry (ICP-MS) based on the method of Fecher, Goldmann and Nagengast (1998). In brief, 100  $\mu\text{L}$  of each milk sample was diluted to 10 ml using a diluent of 0.22 M tetramethylammonium hydroxide (TMAOH) in ultra-pure water and containing 5  $\mu\text{g/L}$  Rh (as  $\text{RhCl}_3 \cdot 3\text{H}_2\text{O}$ ) as an internal standard. The samples were then filtered using Whatman 0.45  $\mu\text{m}$  PVDF w/pp filters to remove any fat which could block the nebuliser in the ICP-MS instrument. All samples were analysed in the same way, using the same ICP-MS instrument (iCAP Q, ThermoScientific Inc. Waltham, MA, USA). Certified ammonium iodide calibration standards were made up to 0, 2, 4, 6, 8, and 10  $\mu\text{g/L}$  iodine in the same standard 5  $\mu\text{g/L}$  Rh 0.22 M TMAOH diluent.

The accuracy of results obtained was verified using a certified reference material of skim milk powder (LGC Standards, Teddington, TW11 0LY, UK, 2015; certified iodine content 1.73 mg/kg [ $\pm 0.14$  mg/kg]). In triplicate 0.87 g of skim milk powder was dissolved in 10 g of distilled water to yield a normal homogenous

solution of cow's milk with an anticipated iodine concentration of 150  $\mu\text{g/L}$ . Dilutions with 5  $\mu\text{g/L}$  Rh in 0.22 M TMAOH were then made to give 10 sample solutions with anticipated iodine concentrations in the range 0–5  $\mu\text{g/L}$ . Iodine concentration was then measured in the same way as for the milk samples. Anticipated and observed values for iodine concentration of the certified reference material showed no significant differences ( $P = 0.857$ ), indicating a good level of accuracy.

### 2.3. Statistical analysis

The effect of milk product type (conventional production, organic production, UHT, supermarket of origin (1–4), area of the country (Midlands, South East) and month purchased (July–December) were determined by fixed effects analysis of variance using a general linear model (Mintab Version 17; Minitab Inc., State College, PA, USA). Tukey's pairwise multiple comparison test was then used to identify which treatments were significantly different from each other when the significance was  $P < 0.05$ .

## 3. Results

The iodine concentrations of the milk types by supermarket and overall are shown in Table 1. Within each supermarket, milk iodine concentration was significantly influenced by milk type ( $P < 0.001$ ) and in three supermarkets by month purchased but there was no effect of area of the country and few interactions. Overall, milk iodine concentration was significantly influenced by milk type, supermarket and month of purchase (all  $P < 0.001$ ) but not by area. The effect of milk type was pronounced, with the iodine concentration of organic and UHT milk being 43.5 and 26.6% lower than conventional milk respectively. There was a notable month  $\times$  milk type interaction ( $P = 0.028$ ) showing that for all milk types iodine concentration progressively increased from summer to winter but with an overriding impact of milk type (Fig. 1). A supermarket  $\times$  milk type interaction ( $P < 0.001$ ) was also seen, mainly resulting from a progressive rise in conventional and organic milk iodine concentrations in the order of supermarkets 3, 4, 1 and 2 which was not the case for UHT milk (Fig. 2).

## 4. Discussion

Previous studies (Bath et al., 2012; Payling et al., 2015; Rey-Crespo, Miranda, & López-Alonso, 2013) and meta-analysis (Średnicka-Tober et al., 2016) have reported that organic milk has a lower iodine concentration than conventionally produced milk. At the time of publication, the data of Payling et al. (2015) were the most up to date available for UK retail milk produced in the winter. It used milk purchased in January 2014, was a relatively small study and there was some concern that by the time of publication the results were out of date as a result of recently permitted iodine additions to the diet of many organic dairy herds (OMSCO, 2015). The results of the present study involving both summer and winter produced milk confirm the same outcome, with retail organic milk having a 43.5% lower iodine concentration than conventionally produced milk.

The overall mean iodine concentration in organic milk in the present study (241.4  $\mu\text{g/L}$ ) is markedly lower than in the study of Payling et al. (2015) (343  $\mu\text{g/L}$ ) although this is likely since the current study involves milk produced in winter and summer whereas that of Payling et al. (2015) was restricted to winter milk. It has been recognised for some time that summer milk contains less iodine than winter milk (Crnkić et al., 2015; Food Standards Agency, 2008) and this effect was seen in the present study with the progressive increase in iodine content from summer to winter

Download English Version:

<https://daneshyari.com/en/article/5132999>

Download Persian Version:

<https://daneshyari.com/article/5132999>

[Daneshyari.com](https://daneshyari.com)