DETERMINATION OF IODINE CONTENT OF MILK FROM DIFFERENT ANIMALS AND IN CERTAIN DAIRY PRODUCTS

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ABSTRACT

Dietary iodine is essential for thyroid hormone production. Ensuring that the population receives adequate amount of iodine demands careful monitoring of the iodine content in food, milk and dairy products are good sources of dietary iodine. There are no recent data available about iodine content in Egyptian milk and dairy products. So the present study was conducted to measure the iodine content in whole raw buffalo milk from different locations in Egypt during the summer and winter seasons as well as measuring iodine content in cow goat and camel milk, beside processed milk and some dairy products collected from the supermarket during the winter season. The iodine concentration of all samples were measured by ammo. persulfate with catalytic spectrophotometric method. The results showed that the average iodine content of whole raw buffalo milk in the summer season was significantly lower than that during the winter season. There were no significant differences in the milk samples with regard to geographical sampling location. The average content of iodine in buffalo was 42.46 ± 1.38 µg/100 ml which is close to camel milk, however it was not significantly higher, comparing with cow milk. The average iodine value in goat milk 16.22 ± 3.2 µg/100 ml was highly significant lower than the average amount of iodine in buffalo, cow and camel milk. While the average of iodine levels in the processed milk were in range 28.40 – 39. 86 µg/100 ml and depends on the additives. With regard to rayeb milk the average level of iodine was 28.29 ± 2.08 µg/100 ml. The median iodine concentration in UF white soft cheese was significantly higher (69.43±1.73 µg/100 ml) than that in karie sh cheese (57.43 ±2.13µg/100 ml). It was found that recovery of iodine in whey of kareish cheese and permeate of UF white soft cheese were 59 % and 55%, respectively. of original milk. Moreover, the results revealed that the average iodine content in skim milk, cream, butter and butter milk were 35.56 ± 1.56, 24.61 ± 1.60, 24.77 ± 2.10, 13.04±1.98 µg/ 100 ml, respectively.

Keywords: Iodine, buffalo, cow, goat, camel, milk, some dairy products, catalytic spectrophotometric determination, season variation.

INTRODUCTION

Iodine is an essential element for human health. Adequate iodine levels are essential for the production of thyroid hormones and proper immune system function (Stone, 1988; Hetzel & Clugston, 1999).The main source of iodine is generally food items such as milk and dairy products (Pearce et al., 2004). Deficiency of iodine can lead to hypothyroidism, enlargement of the thyroid gland and mental retardation in children (Philip and Lawrence (2001). The role of iodide in breast cancer is an area of active research (Stoddard et al., 2008). Researchers have found correlation between iodine deficiency, iodine-deficient goitre and gastric cancer.
Abo El Enien, Karima and Magda Abd El Aziz

(Behrouzian, R& Aghdami, N., 2004; Abnet et al., 2006 and Josefssson & Ekblad, E., 2009). In addition over consumption of iodine can be toxic and just as damaging as a deficiency. The recommended daily allowances of iodine 150 µg /day for adult men and women. For pregnant women the amount rises to 220 µg /day. Breastfeeding women need at least 290 µg /day and an upper limit of the daily iodine intake at 1.1 mg, for adults (Food and Nutrition Board Institute of Medicine 2001). Therefore, the public should be aware of the need for adequate dietary iodine intake. Ensuring that a population receives adequate amount of iodine demands careful monitoring of the iodine content in food. Among major dietary items, milk is an important source of dietary of iodine and other dairy products such as cheese, yogurt and ice cream (Food Sources of Dietary Iodine, 2010), therefore there exists an increasing interest in the determination of total iodine in various species of milk and dairy products.

There are variations of iodine in milk which are related to whether and feeding. According to Castro et al., (2010) iodine concentration of cow milk in Canada was 304 ± 8.4 µg/kg, with concentrations ranging from 54 to 1,902 µg /kg influenced by feeding and milking practices. Also the study of Schöne et al., (2009) showed that the iodine content of milk and serum reflected the iodine dosages in feed significantly and the total amount of iodine in milk per day was 30-40% of ingested supplemental iodine. Also, a pervious study reported by Hemken, (1980) showed that iodine level in milk may vary over time, between 1965 and 1980, the iodine content of milk increased by 300 to 500 percent due largely to changes in cattle feeds. On the other hand, the amount of iodine may vary according to seasonal variations and the way in which the manufacturer prepares the milk. (Brzóaska et al 2009)

Recent studies showed that organic milk was lower (42·1 %) iodine content than non-organic milk (Rasmussen et al., 2000, Bath et al., 2011).

There are no recent data available about iodine content in Egyptian milk and dairy products. It's difficult to determine just how much iodine you're getting from these foods. Therefore the present study aimed to measure the iodine content in Egyptian milk from buffalo, cow, goat and camel, processed milk and some of dairy products. Also, iodine content in buffalo milk from different of locally regions during winter and summer seasons will be measured.

MATERIALS AND METHODS

A systematic study was carried out for detecting the iodine content in Egyptian raw milk samples of different animals (buffalo, cow, goat and camel) and in some dairy products.

For studying the effect of seasons variation and geographic origin, raw buffalo milk samples were collected from different Egyptian governorates (Monofia, Dakahlia, Al-Shrkia, Kafr El-Sheikh, Giza) during winter and summer seasons. Cow and goat milk samples were obtained
from the herd of ministry of agriculture (Sakha – Kafr EL-Shikh). Camel milk samples were obtained from Marsa Matroh station. Pasteurized milk samples (buffalo and cow) milk were heated at 75 °C for 15 sec. and then cooled to 4 °C. UHT cow milk (chocolate milk, banana milk) 1.5 % fat and Rayeb milk made from cow pasteurized milk were collected from super market Karish cheese being made from buffalo skim milk samples were obtained from Dairy Processing Unit belongs to Animal Production Research Institute. Cream, butter and butter milk samples made from cow whole pasteurized milk were obtained from Dairy Processing Unit belongs to Animal Production Research Institute. Potassium iodate to be used as standard and ceric ammonium sulfate were purchased from Sigma Chemical Co. Ammonium per sulfate, arsenic trioxide, concentrated sulfuric acid (98%) were obtained from Prolabo. Deionized water was used for preparing reagents and dilution procedure. Total iodine concentration in milk samples was measured by ammonium per sulfate with catalytic spectrophotometric method according to Pino et al. (1996) method modified to determine iodine in milk and some dairy products by Abd El Aziz, magda and Abo El Enien, Karima (2012). All samples were extracted with ammonium per sulfate at 95 °C for 30 min. After extraction, the reaction of As³⁺–Ce⁴⁺ was performed at 32 °C, and the transmission was measured spectrophotometrically at 420 nm.

Statistical analyses were performed according to Bailey (1995). The data are represented as means ± SD where the number of samples analysis were 20 for buffalo milk during seasons variation and 5 – 10 for other samples (Cow, goat, Camel milk and different products) during winter season.

RESULTS AND DISCUSSION

The average iodine contents of whole raw buffalo milk from different regions in Egypt through winter and summer were represented in Fig.(1). Average values of milk iodine concentration in summer season were 30.51-33.15 µg/100 ml for all milk samples from different regions, while the content during the winter season (average values 41.73 – 44.75 µg/100 ml ). Milk iodine concentration in the summer season was lower than winter about 26 %, with a standard deviation of 0.5 %.The average iodine content in milk was significantly higher (p < 0.05) in winter than summer. These results were agreed with those obtained by Dahl et al., (2003) who determined the iodine concentration in Norwegian-produced milk and found that low-fat milk from the summer season had significantly lower median iodine concentration, compared with low-fat milk from the winter season. Also, Pearce et al., (2004) found mean iodine content of cows’ milk was significantly higher in the winter (116 ± 23.1 µg/250 ml) than in the summer (91.3 ± 16.6 µg/250 ml, P = 0.0004). Moreover, Brzóska et al., (2009) reported that milk iodine concentration in the summer season was lower by an average of 25.2% than the winter season.
On the other hand, the data revealed no significant differences in the milk samples with regard to geographical sampling location. As reported in previous study of Larsen et al., (1999) the a temporal difference showed a general increase in iodine concentration in milk from all regions during the winter months over the summer months.

Fig (1): Iodine level in raw buffalo milk from different Egyptian governorates during summer and winter

Iodine levels of raw milk from buffalo, cow, camel and goat were shown in Table (1) The average content of iodine in buffalo was 42.46 ± 1.38, ranging from 40.58- 44.27 µg /100ml which was closed to camel milk (mean 41.51 ± 0.71 range 38.12 – 42.33), and no significant difference, compared with iodine in cow milk. While the results showed that the average value for iodine in goat milk was 16.22 ±3.2 µg /100 ml ranged from 11.54 – 21.10 µg /100 ml, which was highly significant ( p < 0.001 ) lower than the average amount of iodine in buffalo, cow and camel milk. On the other hand, previous study by Underwood, ( 1977) reported that iodine content in goat milk and cow milk were significantly higher human milk, that may be important for human nutrition since iodine is necessary for thyroid hormone which is closely related to the metabolic rate of physiological body functions.
Table (1): Iodine content in milk from different species of animals

<table>
<thead>
<tr>
<th>Type of milk</th>
<th>Concentration of iodine (µg/100 ml)</th>
<th>Range</th>
<th>Average</th>
<th>± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo</td>
<td>4.58 – 44.27</td>
<td>42.46</td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td>Cow</td>
<td>35.33 – 39.38</td>
<td>37.43</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>Camel</td>
<td>0.71 – 38.12</td>
<td>41.51</td>
<td>38.12 – 42.33</td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td>11.54 – 21.10</td>
<td>16.22</td>
<td>3.2</td>
<td></td>
</tr>
</tbody>
</table>

Table (2) showed the average value of iodine in processed milk (pasteurized milk, UHT milk, chocolate and banana milk) and rayeb milk. For the pasteurization process, buffalo and cow milk in the iodine level was 37.31 ± 1.1 and 34.66 ± 1.21 µg/100 ml, respectively. Whereas the mean iodine content found in the buffalo and cow milk prior to heating processing were 42.46 ± 38 ml and 37.43 ± 1.41 µg / 100 ml respectively as shown in Table (1). This indicated that the effect of heating in pasteurization process on iodine concentration was significant (p < 0.05). These results in line with Norouzian, (2011), who reported that the reduction of iodine concentration by high-temperature short-time pasteurization process was not negligible. Moreover, the data showed that effect of UHT process on iodine concentration was highly significant (p < 0.01).

However, it was found that the average concentration of iodine in UHT milk was 28.40 ± 1.22 increased to 37.57 ± 1.24 and 39.86 ± 1.64 in UHT chocolate milk and banana milk, respectively. The results showed the addition of chocolate and banana to milk elevated the iodine level 32.29 % and 40.35 %, respectively. Whereas for the rayeb milk the level of iodine was 28.29 ± 2.08 coincide with UHT milk.

Table (2): Iodine content in some processed milk and rayeb milk

<table>
<thead>
<tr>
<th>Samples</th>
<th>Concentration of iodine (µg/100ml)</th>
<th>Range</th>
<th>Average</th>
<th>± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurized buffalo milk</td>
<td>35.86 – 39.22</td>
<td>37.31</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Pasteurized cow milk</td>
<td>33.25 – 36.80</td>
<td>34.66</td>
<td>1.21</td>
<td></td>
</tr>
<tr>
<td>UHT cow milk</td>
<td>26.56 – 30.22</td>
<td>28.40</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>UHT cow chocolate milk</td>
<td>35.57 – 39.20</td>
<td>37.57</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>UHT cow banana milk</td>
<td>37.70 – 42.60</td>
<td>39.86</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td>Rayeb milk</td>
<td>25.12 – 31.10</td>
<td>28.29</td>
<td>2.08</td>
<td></td>
</tr>
</tbody>
</table>

The data in Table (3) showed the iodine levels in cheese and its whey. The results indicated that iodine content in cheese and its whey was affected by the method of processing. The average content of iodine in UF soft cheese and permeate were 69.98 ± 1.73 and 27.29 ± 1.34 (µg/100 g), respectively. These results were higher than kariesh cheese and its whey. This might be due to higher dry matter of UF soft cheese than kariesh cheese. It was found that recovery of iodine in whey and permeate were 59 % and 55% of original milk, respectively, while 36 and 47 % of iodine were retention in kariesh cheese and UF white soft cheese, respectively, as shown in Fig. (2). This indicated that iodine is considered as solid soluble in whey and permeate. These results are in line with the study of Sanchez and Szpunar (1999), which reported that the whey obtained after centrifugation of fresh milk or reconstituted milk powders contained more than 95% of the
iodine initially present in milk, with the exception of the infant formulas in which only 15–50% of the total iodine was found in the milk whey.

**Table (3): Iodine content in cheese and its whey**

<table>
<thead>
<tr>
<th>Samples</th>
<th>Content of iodine (µg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>UF soft cheese</td>
<td>67.20 – 72.15</td>
</tr>
<tr>
<td>Permeate</td>
<td>25.45 – 30.01</td>
</tr>
<tr>
<td>Kariesh cheese</td>
<td>54.63 – 60.52</td>
</tr>
<tr>
<td>Kariesh cheese whey</td>
<td>19.85 – 24.72</td>
</tr>
</tbody>
</table>

**Fig. (2): Distribution of iodine percentage between cheese and its whey compared with whole milk**

With regard of iodine level in skim milk, cream, butter and butter milk and comparing with whole milk, the data in Table (4) revealed that the average contents of iodine were 35.56 ± 1.52, 24.61 ± 1.60, 24.77 ± 2.16, 13.04 ± 1.98 µg/100 ml for skim milk, cream, butter and butter milk, respectively. In addition the results showed that the distribution of iodine in skim milk and cream were approximately 93% and 8% respectively as shown in Fig.(3). While recovery of iodine in butter and butter milk were about 5% and 2% of whole milk, respectively. This indicated that 5% of iodine bond with fat and 95% found in soluble constituent of milk. These results also are in agreement with the result of Sanchez and Szpunar (1999). Moreover the fractionation analysis of iodine in bovine milk by preconcentration neutron activation analysis which was performed by Olive et al., (2008) showed that iodine concentrations in homogenized milk (3.25% milk fat) 0.48 ± 0.02 µg mL⁻¹ of total iodine, 0.020 ± 0.003 µg mL⁻¹ of lipid-bound iodine, 0.039 ± 0.002, 0.019 ± 0.002 and 0.021 ± 0.004 µg mL⁻¹ of protein-bound iodine depending on the protein separation method and 0.45 ± 0.02 µg mL⁻¹ of inorganic species.
Table (4): Iodine content in skim milk, cream, butter and butter milk

<table>
<thead>
<tr>
<th>Items</th>
<th>Range</th>
<th>Average ±  SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skim milk</td>
<td>33.44 – 37.10</td>
<td>35.56 ± 1.52</td>
</tr>
<tr>
<td>Cream</td>
<td>22.22 – 27.34</td>
<td>24.61 ± 1.60</td>
</tr>
<tr>
<td>Butter</td>
<td>22.01 – 28.00</td>
<td>24.77 ± 2.16</td>
</tr>
<tr>
<td>Butter milk</td>
<td>11.22– 15.16</td>
<td>13.04 ± 1.98</td>
</tr>
</tbody>
</table>

CONCLUSION

Milk and dairy products are important sources of iodine intake in Egypt. Rayeb milk and processed milk contain between 28 and 39 µg of iodine / 100 ml and thus contributes significantly to the daily requirement of the average human. With a recommended iodine intake of 150 µg/day for adults, a daily intake of 200 ml milk meet the requirement with 37 – 52 %, while 50gm of white soft cheese and kariesh cheese contributed by 23 % and 19 % respectively. These results decreased in summer by about 26%.

REFERENCES


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1- متوسط محتوى البوت في اللبن الجاموس، الكامل النسب في مسمى الصيف أقل بشكل معنوي من متوسط تركيز البوت في فصل الشتاء لم تكن هناك اختلافات كبيرة في عينات اللبن من مواقع جغرافية مختلفة.

2- أعلى متوسط لمحتوى البوت كان في اللبن الجاموس 45.41 ± 0.71 ميكروجرام / 100 مل (40 مل) و 32.04 ± 0.34 ميكروجرام / 100 مل من اللبن البقرى (33 مل) و 26.76 ± 1.15 ميكروجرام / 100 مل من اللبن الزبداء (28 مل) و 14.22 ± 1.04 ميكروجرام / 100 مل من اللبن الأبقار (24 مل) و 3.28 ± 0.51 ميكروجرام / 100 مل من اللبن الشمال (21 مل) .

3- متوسط محتوى البوت في الألبان المصنعة في نطاق 4.04 - 3.92 ميكروجرام / 100 مل تم تعميم على المواد المصنعة ووجد أن اضافة الشيكولاتة والموز رفع نسبة البوت حوالي 22.69 ± 2.32 على التوالي . في حين أن اللبن الرايد كان مستوى البوت في الألبان المصنعة في نطاق 4.04 - 3.6 ميكروجرام / 100 مل و 4.04 - 3.29 ميكروجرام / 100 مل

4- تركيز البوت في الجبن الفردي القصير والعسلة ويدعى مستوي الألبان المصنعة تحتوي على ما بين 14.44 ± 2.30 ميكروجرام / 100 مل و 14.84 ± 2.01 ميكروجرام / 100 مل، وذلك بنسبة 18.99% و 19.85% على التوالي من اللبن الأصلي.

5- تمت تحليل جبة البقرة (4 مل) و (3 مل) و (2 مل) و (1 مل) و (0 مل) على التوالي . وجد أن نسبة انتاج البوت في هذه المنتجات هي 4% و 2% و 1% من اللبن كمعدل النسب المستخدم في تصنيعها على التوالي.

الخلاصة:

اللبن ومنتجاته مصدر هام لتناول البوت في مصر حيث وجد أن اللبن الرايد والألبان المصنعة تحتوي على ما بين 28 - 34 ميكروجرام من البوت / 100 مل وهذ يساهم بشكل كبير في الاحتياجات اليومية الإلابس البالغين. وتشمل 0.00 مل للبن يوميًا يلبس المتطلبات بنسبة 27 - 31 من البوت الموصى به (50 ميكروجرام / يوم للبالغين) . في حين أن 50 جرام من الجبن الطري والجبنة الألبس الفيكة تساو 8% و 19% على التوالي . وتنخفض هذه القيم في فصل الصيف بنسبة 26% تقريبا.

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