

# IODINE CONTENT OF TRADITIONAL GREENLANDIC FOOD ITEMS AND TAP WATER IN EAST AND WEST GREENLAND

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## ABSTRACT

**Objectives.** The iodine intake level is important for the occurrence of thyroid disorders in a population. The iodine intake in Greenland has been proposed to be more than ten times the recommended level. However, no measurements have been performed to determine the iodine content of Greenlandic food items, drinking water, and beverages available in East and West Greenland.

**Study desing.** Food samples were collected at the local market, kalaalimeerniarfik, in Nuuk and Ammassalik, and tap water was obtained from all towns in Greenland. Beverages were purchased at Kalaallit Niuerfiat KNI Pisiniarfik.

**Results.** Iodine content of seal, whale, wild fowl, reindeer, and musk ox varied between 4 and 195 µg/kg with low values for terrestrial animals (< 10 µg/kg) and higher values for marine animals (10 - 195 µg/kg). The iodine content of fish varied from 9 µg/kg in freshwater fish to 1,380 µg/kg in a sample of cod. The iodine content of sea mammals was: blubber 130 µg/kg; viscera 70 µg/kg; meat 21 µg/kg. No difference was observed between animals from East Greenland and West Greenland ( $P > 0.1$ ). Iodine content of tap water was below 3.3 µg/l for all towns. Two sorts of beer had a high iodine content, up to 240 µg/l. The iodine content of all other beverages was 5 - 38 µg/l.

**Conclusions.** We found a relatively high iodine content in marine animals but low iodine content in tap water and beverages in Greenland. The food and drinking water evaluated in the present study indicate adequate iodine intake in this area and do not support the notion that Greenland is an area of excessive iodine intake.

**Key words.** Iodine, traditional food, tap water, beverages, Greenland, Inuit.

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Iodine is an essential micronutrient for all animal species, including humans, because it is necessary for thyroid hormone synthesis (7). Iodine deficiency can lead to a wide spectrum of diseases ranging from developmental brain damage to a high incidence of nodular thyroid disorders in the elderly, depending on the level of deficiency (21, 25). On the other hand, high levels of iodine intake are associated with a high risk of hypothyroidism in a population (24, 25).

Iodine is ingested with food and water. In general marine food items have a higher iodine content than terrestrial foods (6, 35, 38). Traditional Greenlandic food is mainly of marine origin (3, 30). It has been suggested to contain an excess of iodine that causes the iodine intake level in Greenland to be more than ten times the recommended level (14). However, this estimate was based on assumptions only, as no measurements of iodine content of Greenlandic food items were performed (16).

Traditional Greenlandic food items continue to be highly valued (4) and widely consumed among Inuit in Greenland as described in detail in a recent Ph.D. thesis (30). The positive effect of marine fat on cardiovascular disease due to poly-unsaturated fatty acids has been established (8, 29). Also, the intake of lead, cadmium, mercury, organochlorines, zinc, selenium, and copper (13, 18, 36) as well as vitamins and minerals (9, 17, 27, 28, 31, 37) has been investigated and the impact on health in circumpolar populations estimated (19, 36). However, no data on iodine content of traditional Inuit food items are available and data on iodine intake are sparse (2).

In Denmark we found tap water iodine content to be highly variable and of considerable importance for regional differences in iodine intake (32). In Greenland fluoride, another halogen, was found in the cryolite quarry in Ivittut and in tap water in Narsaq (22). However, the iodine content of tap water in Greenland remains unsettled. A number of beverages are made exclusively for KNI, a chain of shops covering all of Greenland with a uniform selection. The iodine content of these beverages is unknown.

The aim of the present study was to obtain information on the iodine content of some traditional Greenlandic food items, of tap water, and of beverages sold in East and West Greenland in order to estimate the iodine intake from a traditional Greenlandic diet.

## METHODS

### Sample collection and preparation

*Greenlandic food items.* Greenlandic hunters bring part of their catch to an open slaughterhouse and market, kalaalimineerniarfik, to be sold to town inhabitants (30). Traditional Greenlandic food items were purchased from kalaalimineerniarfik in the Capital Nuuk in West Greenland (including the suburb Nussuaq) and in Tasiilaq, Ammassalik district in East Greenland, for determination of iodine content. In Ammassalik some food items were obtained directly from hunters in settlements. Samples were purchased in July and November 1998. One sample was obtained from each animal available. All samples were kept at  $-20^{\circ}\text{C}$  until analysis. Each sample was grated, thawed, and minced for one minute at 25,000 rpm using a Heildolph Diax 900 homogenizer (Heildolph-Elektro, Kelheim, Germany) before alkaline incineration and determination of iodine content.

*Tap water.* In most Greenlandic towns the majority of houses have tap water. The remaining collect water from municipal water supplies at central locations (5). Tap water samples were collected in iodine-free polyethylene containers from clinics in all towns in Greenland and in Kangerlussuaq. Also, in Nuuk tap water samples were collected on five separate days. Cold tap water was allowed to run for 30 seconds before collection and was sent via mail to Nuuk. Also, water was collected from a meltwater brook in Nordlandet (Akia) in Nuuk fjord, West Greenland. Water samples were kept at  $-20^{\circ}\text{C}$  until analysis.

*Beverage.* Beverages were purchased at Kalaallit Niuerfiat (KNI) Pisiniarfik, which is a chain of shops covering all of Greenland with a uniform selection. The only exception was IceCap which was bought in Kangerlussuaq. Eight sorts of soft drinks were made by Mineralvandsfabrikken Cito Ltd., Randers, Jutland, Denmark exclusively for KNI, and the water used was local Randers tap water. Two soft drinks were made by Menken drinks B.V., Bodengraven, Holland. One soft drink and Faxe Premium beer were made by Faxe Brewery, Faxe, Zealand, Denmark. Both Tuborg and Carlsberg beer were brewed in Copenhagen, Zealand, Denmark. Thor Pilsner and X-MAS beer were brewed in Randers by Thor Brewery Ltd. using water from a local well. IceCap beer was brewed by Gießener Brewery, Denninghoff, Germany. The water used was melted ice from the Greenlandic icecap near Narsaq (11). Snaps was Aalborg Taffel

Akvavit, distilled by Danish Distillers, Aalborg, Denmark. Beverages were stored at -20 °C until analyses.

#### Iodine determination

Iodine was determined by the method of Wilson and van Zyl (39) as described previously (23). The principle is alkaline incineration of the sample followed by measurement of iodine by detection of the catalytic role of iodine in the reduction of ceric ammonium sulfate in the presence of arsenious acid. For determination of iodine content of water a 2 ml sample was used giving a limit of detection of 1.0 µg/l. When 21 water samples (iodine concentrations 1.4 - 50 µg/l) were measured in triplicate the intra assay coefficient of variation was 9.2 % (interval 1-4 µg/l, n=8); 8.7 % (interval 5-9 µg/l, n=4); 4.2 % (interval 10-15 µg/l, n=4); 1.5 % (interval 15-50 µg/l, n=5). Recovery of added iodine was > 95 % and not corrected for. For food items, the analytical coefficient of variation was 19.1 % (interval 15-50 µg/kg, n=7); 25.7 % (interval 50-100 µg/kg, n=5); 12.3 % (interval > 100 µg/kg, n=4). Comparisons were performed using Wilcoxon matched pairs signed rank test. A p value of less than 0.05 was considered significant. Data were processed and analysed using Corel Quattro Pro 8.

#### RESULTS

The iodine content of seventeen different Greenlandic food items purchased in Ammassalik and in Nuuk is shown in Table 1. No difference in iodine content was observed between the twelve samples available in both areas ( $p > 0.1$ ). Marked differences were present between different parts from sea mammals. Blubber had an average iodine content of 130 µg/kg, whereas it was around 70 µg/kg for viscera and 21 µg/kg for meat from both seal and whale. Other marine animals varied between 9 and 195 µg/kg and the iodine content of cod flesh was very variable. Terrestrial animals had the lowest iodine content of 10 µg/kg or below.

The iodine content of tap water in all towns in Greenland is also shown in Table 1. It was very low in samples from all locations. The highest concentration was 3.3 µg/l in tap water from Ilulissat. In Nuuk, five samples all had iodine content below 1.0 µg/l.

Table 1.  
The iodine content ( $\mu\text{g}/\text{kg}$  or  $\mu\text{g}/\text{l}$ ) of some traditional Greenlandic food items, beverages, and drinking water in Greenland.

The iodine content of soft drinks, beers, and snaps for sale in Greenland is included in Table 1. Soft drinks and snaps had a relatively low iodine content whereas this varied widely for beer. Four beers had a low iodine content of 25  $\mu\text{g}/\text{l}$  and two beers had a high

	Iodine content		Samples n
	Mean	Range	
<i>Food items:</i>			
Seal meat	27	20-38	4
Seal blubber	121	71-195	4
Seal kidney	51	32-76	3
Seal liver	96	47-180	4
Whale meat	14	8-20	3
Whale blubber	151	109-192	2
Whale skin (mattak)	50	41-58	2
Cod flesh	744	108-1380	2
Cod liver	320	na <sup>a</sup>	1
Trout	17	9-24	2
Catfish flesh	78	41-103	3
Capelin (dried)	92	25-100	3
Wild fowl <sup>b</sup>	45	41-49	2
Reindeer (Caribou)	4	na <sup>a</sup>	1
Musk ox meat	10	na <sup>a</sup>	1
<i>Beverages and water:</i>			
Soft drinks KNI	8	4-20	8
Soft drinks Other	10	8-11	3
Beer	24	16-38	4
(Faxe Premium; X-mas Gold)		(215; 240)	
Snaps Aalborg Akvavit	6	na <sup>a</sup>	1
Tap Water	1.1	1-3.3	16
Meltwater	< 1.0	< 1.0	2

<sup>a</sup> na: not applicable.

<sup>b</sup> Black guillemot (Nuuk) and Black legged kittiwake (Ammassalik).

iodine content up to 240 µg/l. The other beverages had more uniform and low iodine concentrations (< 10 µg/l) despite different places of production.

## DISCUSSION

We measured the iodine content of traditional Greenlandic food items available at the local market, kalaalimineerniarfik, in the capital Nuuk in West Greenland and in Ammassalik district in East Greenland. The iodine content of traditional food items ranged from 4 to 195 µg/kg with higher values for one sample of cod. In general, terrestrial food items had a low iodine content while marine animals had a higher iodine content. No difference was observed between the animals from East Greenland and West Greenland in neither the overall iodine content nor in the difference between different parts of mammals. The iodine content of wild fowl, fish and other marine animals from Greenland was similar to that reported from other locations (6, 35, 38). The huge variation of iodine content in some samples of cod is in keeping with previous reports from other parts of the world (6, 38).

Tap water iodine is important for iodine intake in many countries (1, 10, 12, 33). In Denmark tap water is ground water and the iodine concentration varies between < 1.0 and 139 µg/l (33, 34) and is important for regional differences in iodine intake (33). In Greenland tap water is mainly surface water from glacial or snow meltwater reservoirs (5). In parts of Greenland wells and springs add to these reservoirs. In other mountainous areas of the world meltwater was found to be without iodine (12). However, the rocks of Greenland differ from rocks in other mountainous areas in being nearly as old as the Earth and fluoride, another halogen, was found in Greenland both in the cryolite quarry in Ivittut and in tap water in Narsaq (22), whereas no data have been obtained on iodine.

We measured the iodine content of tap water in all towns in Greenland. We found very low values in all samples. Furthermore, water from a meltwater brook did not contain measurable iodine. Hence, drinking water is not a source of iodine intake in Greenland whether from spring, well, or melted ice.

Beverages are widely consumed in Greenland (30). All beverages are imported, though some are produced exclusively for sale in Greenland. We found the iodine content of all soft drinks to be below 11 µg/l despite highly different places of production. Such a low iodine content scarcely contributes to the population iodine intake. More

variable results were obtained for beers. Two beers had a ten-fold higher iodine concentration than the remaining. No additives known to be rich in iodine were used. Also, the iodine was not from the water used as this was the same as that of Thor beer with an iodine content of 23  $\mu\text{g/l}$  and that of one soft drink with an iodine content of 11  $\mu\text{g/l}$ . The most likely origin of iodine was remnants from cleaning procedures. Tubes and pipes from the brewing process were cleaned in iodine baths, and iodine containing chemicals used by the food industry are known to lead to unexpected high iodine concentrations of food items (26). The iodine content of snaps was low and the importance of snaps consumption in this context is insignificant. In general, the iodine content of beverages in Greenland is on the same level as reported elsewhere (34, 35) and contributes little to the population iodine intake.

These are the first measurements of iodine content of Greenlandic food items. The number of food samples is limited. However, they are representative constituents of a traditional Greenlandic diet (3, 30) and a clear pattern is seen with a similar iodine content in comparable food items investigated in other areas (6, 34, 35, 38). However, dietary habits among Inuit differ from those of other populations (3, 15, 30) and the iodine intake level may differ accordingly.

A diet based on imported food items contributes to an iodine intake level of 40-50  $\mu\text{g}/24\text{ h}$  when the iodine content of drinking water is as low as in Greenland (20, 32, 33). On the other hand, the results of the present study suggest that a diet based on traditional Greenlandic food items (3, 15, 30) contributes an iodine intake in the order of 200  $\mu\text{g}/\text{day}$ , which is only marginally higher than the recommended intake of 150  $\mu\text{g}/\text{day}$  (7). This finding is in contrast to a recent suggestion of an excessive iodine intake level in Greenland of 1,700  $\mu\text{g}/\text{day}$  (14). In other populations such high intakes correlated to a high prevalence of thyroid disorders (25). The results of the present study are in keeping with the report of a relatively rare occurrence of thyroid disorders in Greenland (2).

The marked difference in iodine intake from imported versus traditional Greenlandic food items causes the iodine intake level of the inhabitants of Greenland to be highly influenced by the degree of traditional Greenlandic dietary habits. This may turn out to be a delicate balance, and the consequences of the continuing changes of di-

etary habits in Greenland (4, 15, 30) for the iodine intake and for the occurrence of thyroid disorders in Greenland call for attention.

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