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Iodine bioavailability from cow's milk: a randomized, crossover balance study in healthy iodine-replete adults

OL van der Reijden[1], V Galetti[1], S Bürki[1], C Zeder[1], A Krzystek[1], M Haldimann[2], J Berard[3], MB Zimmermann[1], and I Herter-Aeberli[1]

[1]ETH Zurich, Institute of Food, Nutrition and Health, Laboratory of Human Nutrition, Zurich, Switzerland. [2]Federal Food Safety and Veterinary Office, Division of Risk Assessment, Bern, Switzerland. [3]ETH Zurich, AgroVet-Strickhof, Lindau, Switzerland.

Background and Objective

Milk and dairy products are considered important dietary sources of iodine in many countries [a]. However, to our knowledge, iodine bioavailability from milk has not been directly measured in humans.

We compared iodine bioavailability in iodine-replete adults from: 1) cow's milk containing a high concentration of native iodine; 2) milk containing a low concentration of native iodine, with addition of potassium iodide (KI) to assess a potential matrix effect; 3) an aqueous solution of KI as a comparator; with all three containing equal amounts of total iodine (263µg/250mL). We also determined iodine species in milk.

Results

Iodine intake from the standardized diet was 195±6µg/d for males and 107±6 µg/d for females; the test drinks provided an additional 263 µg. Eleven subjects completed the protocol.

Table 1: Nutrient composition of the standardized diet (energy, fat, protein, carbohydrates, and iodine) for men and women listed by meals and snacks

	Men					Women				
Meal	Energy [kcal]	Fat [g]	Protein [g]	Carbo-hydrates [g]	Iodine (mean±SD) [µg]	Energy [kcal]	Fat [g]	Protein [g]	Carbo-hydrates [g]	Iodine (mean±SD) [µg]
Breakfast	549	21.4	9.4	74.6	4.06±0.17	483	19.2	8.3	64.4	15.4±1.1
Snack 1	235	13.5	9.5	16.0	0.3±0.1	235	13.5	9.5	16.0	0.3±0.1
Lunch	635	25.7	19.4	76.4	74.9±3.1	635	25.7	19.4	76.4	74.9±3.1
Snack 2	311	0.4	2.1	70.0	1.1±0.0	248	0.3	1.6	56.0	0.9±0.0
Dinner	860	50.4	25.2	73.8	109.3±2.7	447	25.6	14.7	36.0	9.2±1.6
Snack 3	130	8.4	1.6	11.8	6.0±4.5	130	8.4	1.6	11.8	6.0±4.5
Total	**2719**	**119.8**	**67.2**	**322.6**	**195.3±6.1**	**2178**	**92.7**	**55.2**	**260.6**	**106.6±5.8**
Recommendation (11, 16, 30)	2700 – 2800[1]	61 – 112[2]	48 – 72[3]	304 – 386[4]	150	2100 – 2200[1]	47 – 88[2]	40 – 56[3]	236 – 303[4]	150

[1] Lower and higher energy requirement for men and women aged 19 – 25 years and 25 – 51 years, respectively. Physical activity level of 1.6, corresponding to mainly sedentary work like the attendance at lectures and studying, thus representing a student lifestyle
[2] 20 – 35% of daily energy requirement
[3] 0.8g/kg body weight/d; range calculated based on 60–90 kg and 50–70 kg for men and women, respectively
[4] 45 – 55% of daily energy uptake

There was a linear relationship between iodine intake and UIE (β=0.89, SE=0.04, p<0.001). There were no significant differences in UIE among the three conditions (p=0.24). Median fractional iodine absorption across the three conditions was 91, 72 and 98% on days 1, 2 and 3, respectively (p<0.001). In milk, 80-93% of the total iodine was inorganic iodide.

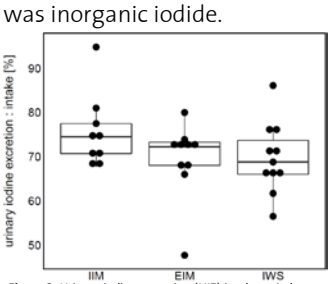

Figure 2: Urinary iodine excretion (UIE):intake ratio by test drink on day 2 (day of test drink administration), pooled for all n=11 participants. Statistical analysis was done using mixed effect models with study day as fixed factor and participant ID as random factor. Bonferroni correction was applied for multiple comparisons. Log(UIE:intake) did not reveal a difference between iodine species (IIM versus EIM: b=0.06, SE=0.03, p=0.21) or between matrix (IIM versus AIS: b=0.05, SE=0.03, p=0.26).

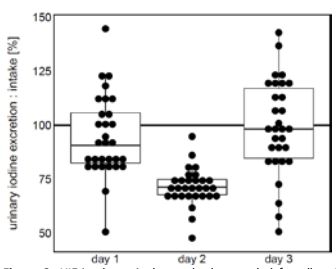

Figure 3: UIE:intake ratio by study day, pooled for all n=11 participants and n=3 balance periods. 100% equals the zero balance and is indicated with a line. Statistical analysis was done using mixed effect models including participant ID as a random factor. Bonferroni correction was applied for multiple comparisons. Log(UIE:intake) did not differ between days 1 and 3 (b=0.04, SE=0.05, p=1.00) but was significantly different between days 1 and 2 (b=0.26, SE=0.05, p<0.001) and between days 2 and 3 (b=0.30, SE=0.05, p<0.001).

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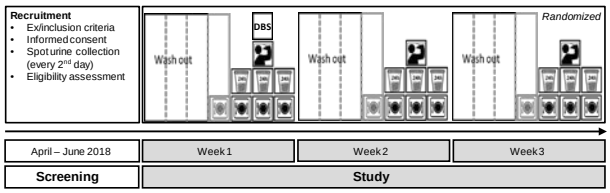
Study design

We conducted a 3-week, randomized, crossover balance study in adults (n=12) consuming directly-analyzed, standardized diets. During the three test conditions - high-intrinsic iodine milk (IIM); extrinsically-added iodine in milk (EIM) and aqueous iodine solution (AIS) - subjects collected 24-hr urines over 3 days and consumed the test drink on the second day, with 3 or 4-day wash-out periods prior to each treatment. Iodine absorption was calculated as the ratio of urinary iodine excretion (UIE) to total iodine intake. Milk iodine speciation was done with ion chromatography-mass spectrometry. The trial was registered at clinicaltrials.gov as NCT03590431.



Conclusions

Nearly all of the iodine in cow's milk is iodide and although fractional iodine absorption from milk decreases with increasing dose, its bioavailability is high, independent of the matrix. Thus, consumption of milk by infants older than 12 months and preschool children should be encouraged, because their iodine requirements are high and iodized salt consumption may be low at these ages. Also, pregnant/lactating women, along with using iodized salt, should be encouraged to consume milk and dairy products to help them cover their sharply higher iodine requirements, to ensure optimal fetal and newborn development [b].

Publication

van der Reijden, OL, et al. (2019) Iodine bioavailability from cow's milk: a randomized, crossover balance study in healthy iodine-replete adults. Am J Clin Nutr 110, 102-110.

References

a) van der Reijden, et al Iodine in dairy milk: Sources, concentrations and importance to human health. Best Pract Res Clin Endocrinol Metab, 2017. 31: p. 385-395.

b) Pearce EN, et al. Consequences of iodine deficiency and excess in pregnant women: an overview of current knowns and unknowns. Am J Clin Nutr 2016;104 Suppl 3:918s-23s.

For further information please contact:
isabelle.herter@hest.ethz.ch

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich