A STUDY OF AVAILABILITY OF IODINE FROM CALCIUM IODATE EMPLOYING ^{131}I-LABELED SALT

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A comparative study of the availability of iodine from calcium iodate and potassium iodate employing ^{131}I-labeled salts was carried out in 24 humans. Absorption (based on studies using a whole-body counter and urinary excretion) and thyroidal uptake of iodine from calcium iodate were as good as from potassium iodate. Because of the simplicity of the procedure and the low cost, calcium iodate can hopefully replace potassium iodate for fortifying common salt with iodine.

Iodization of common salt is a well-accepted public health measure to combat endemic goiter. Potassium iodide used to form the source of iodine in iodized salt. In recent years, however, potassium iodate which is more stable than potassium iodide is used for this purpose. The present system for the manufacture of iodized common salt consists of either dry mixing or wet spraying of potassium iodate in the ratio of 1:40,000 parts (corresponding value of 15 ppm iodine) in common salt.

In a new process, a submersion or cocrystallization process developed by the Central Salt and Marine Research Institute, Bhavnagar, India, calcium iodate is proposed to be used for iodization of salt instead of potassium iodate because of its higher stability and relatively low cost (*1*). Before calcium iodate is recommended for iodization of salt, the nutritional availability of iodine from it to human beings has to be known. Although the availability of iodine from calcium iodate has been studied in cattle (*2*), it appears not to have been studied in man. The present investigation was therefore carried out to determine the availability of iodine to man from calcium iodate and potassium iodate.

MATERIALS AND METHODS

A total of 24 apparently normal male adults were the subjects for this experiment.

Radioactive calcium iodate and potassium iodate were prepared from ^{131}I-sodium using the procedure described by Bahl, et al (*3*) with the following modification:

To 13 mg KI, 100 μCi of ^{131}I in the form of ^{131}I-sodium was added and dissolved in water. The solution was taken up in a separatory funnel and sufficient amount of ethyl ether was added (about 50 ml). Iodine was then liberated by the addition of 5 ml of 30% sulphuric acid and 5 ml of hydrogen peroxide (20 vol). All the liberated iodine was trapped in ether by shaking the separatory funnel vigorously. After removal of the aqueous layer, the ether layer was washed either with a solution of potassium hydroxide or a saturated solution of calcium hydroxide until all the iodine reacted with the alkali.

The aqueous layer was collected in a centrifuge tube and heated in a water bath at 70°C. A slow current of chlorine was passed until all the iodide was converted to iodate, indicated by the initial brown solution becoming colorless. (A slow current

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of chlorine and the temperature of 70°C prevented the iodine vapors from escaping into the atmosphere.) The iodates formed were precipitated quantitatively by the addition of acetone to the aqueous iodate solutions. The precipitate was then spun, dried, and weighed. It was then dissolved in water and made up to 100 ml in a volumetric flask. The amount of iodate present was estimated iodometrically (yields: calcium iodate, 73.2%; potassium iodate, 88.9%).

The amount of iodine and radioactivity present in the dose administered to each subject was 360 μg and 5 μCi, respectively. This amount of iodine ingested by each subject was that which would be obtained from iodized common salt in the diet if daily intake of salt is about 15 gm. These iodates were given along with food to simulate the situation that occurs when iodated common salt is consumed.

Absorption of calcium and potassium iodates was determined as described by Oddie (*4*) by counting the body radioactivity in the subject immediately and 72 hr following ingestion of radioactive iodate. Body radioactivity was determined employing a shadow shield whole-body counter with the scanning geometry of the design described by Dudley (*5*). The subjects were scanned for 10 min, and counts were registered in the energy range 0.1–1.32 MeV. Urine was collected for 72 hr and the activity measured in a well scintillation counter along with appropriately diluted standard. Activity retained in the body plus activity excreted in urine at the end of 72 hr was taken to represent absorbed activity.

Availability of iodine from these salts was also assessed by the 24-hr thyroidal uptake of labeled iodine by counting the radioactivity in the thyroid of the subjects with a NaI scintillation probe of a medical spectrometer (Bhaba Atomic Research Centre, Trombay). Counts were taken at a distance of 10 cm from the thyroid for 10 min. Background was determined by interposing a 2.5-cm-thick lead block between the thyroid and probe.

TABLE 1. RADIOACTIVITY IN THE BODY AND URINE 72 HR AFTER INGESTING LABELED IODATES*

	Body		Urine		Absorbed	
	$Ca(IO_3)_2$	KIO_3	$Ca(IO_3)_2$	KIO_3	$Ca(IO_3)_2$	KIO_3
No. of subjects	8	8	8	8	8	8
Mean	34.4	28.3	42.0	41.1	76.4	69.4
±s.e.	5.29	4.60	6.79	4.93	6.51	4.54
Significance	NS		NS		NS	

* In percent of ingested dose.

TABLE 2. UPTAKE OF ^{131}I BY THYROID*

	Calcium iodate	Potassium iodate
No. of subjects	12	12
Mean	30.2	22.2
±s.e.	2.26	1.58
Significance	$p < 0.01$	

* In percent of ingested dose.

RESULTS AND DISCUSSION

Results of iodine absorption expressed as percent of ingested radioactivity from calcium and potassium iodates, conducted in 16 subjects, are depicted in Table 1. Table 2 gives the results of thyroidal uptake of radioactive iodine studied in 24 subjects.

The mean figure of absorption for calcium iodate (76.4%) was higher than that for potassium iodate (69.4%). This difference was not statistically significant since there was a wide variation in the absorption of both these iodine salts [$Ca(IO_3)_2$:52.1–94.9%; KIO_3:53.7–95.3%]. Similarly the mean figures for the urinary excretion of radioactivity during 72 hr were higher in the case of calcium iodate although the difference between these figures for calcium and potassium salts was not statistically significant. The explanation of higher absorption of calcium iodate is not clear. It is known that iodate has to be converted to iodide before it is absorbed. The efficiency of such conversion may be higher with calcium iodate than with potassium iodate.

The uptake of radioactive iodine by the thyroid, with a mean value of 30.2% of the ingested dose for calcium iodate, was significantly higher ($p < 0.01$) than that obtained for potassium iodate, which was 22.2%. Here again there was a wide variation within the groups receiving both calcium and potassium iodates. The apparent higher thyroid uptake of ^{131}I from calcium iodate appears to be due to higher absorption of iodine from calcium iodate. When thyroid uptake was expressed as percent of absorbed dose there was no difference between calcium iodate and potassium iodate. Thus ^{131}I uptake as percent of absorbed dose was 34.4 (range 28–48.3) in the case of calcium iodate and 34.7 (18.0–46.3) in the case of potassium iodate.

It has been reported by Miller, et al (*2*) that availability of iodine from calcium iodate and sodium iodide is similar in cattle. The present data indicate that from the point of nutritional availability of iodine to humans calcium iodate is as good as KIO_3 if not better. Since the proposed method for the fortification of common salt with calcium iodate is claimed to be superior to the conventional procedures and since it is cheaper than the potassium salt, it can hopefully replace potassium iodate for fortifying the common salt with iodine.

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REFERENCES

1. Jain VK: Personal communication

2. Miller JK, Moss BR, Swanson EW, et al: Calcium iodate and pentacalcium orthoperiodate as sources of supplemental iodine for cattle. *J Dairy Sci* 51: 1831–1835, 1968

3. Bahl RK, Singh S: The action of chlorine on the hydroxides of alkaline earths in the presence of iodine. II. *J Indian Chem Soc* 17: 397–399, 1940

4. Oddie TH: Clinical applications of whole body radioiodine counting. In *Clinical Uses of Whole Body Counting,* Vienna, IAEA, 1966, pp 232–240

5. Dudley RA: The design and performance of a simple clinical whole body counter. In *Radioaktive Isotope in Klinik und Forschung,* Vol. 9, Munich, Urban and Schwarzenberg, 1970, pp 135–145