

NUTRITIONAL IODINE IN PROCESSED FOODS

CANBOX

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□ SOME IODINE DEFICIENCIES persist in the United States despite the extremely small requirement of 410 $\mu\text{g}/\text{day}$ established by the National Research Council (1968) for an adult male and despite the fact that adequate iodine has been available through the use of iodized table salt for almost 50 years.

The White House Conference on Food, Nutrition, and Health (1969) recommended a study of the alleged iodine deficiency problem in order to determine how much supplementation might be required in food. No conclusions have been reached to date.

The trend in U.S. food patterns has been toward increasing use of industrially processed and prepared foods, which are pre-salted with un-iodized salt. These foods are replacing food previously salted at home, often with iodized salt. Thus one apparent solution to possible iodine deficiency problems would be a selective iodization of processed foods.

PROCESSORS RELUCTANT

Food processors, however, have been somewhat reluctant to deal with iodine fortification of foods for various reasons. Besides the normal problems of quality control involved in adding controlled amounts of an iodine-containing substance, there are also undoubtedly fears of adverse effects upon food processing, appearance, flavor, and odor.

Although Joslyn and Timmons (1967) commented that iodized salt should not be used in food processing, we have been unable to document their claim of adverse effects on color and flavor of food products. Kojima and Brown (1955) found no undesirable effects from the use of iodized salt in canned tomato juice, bulk or canned sauerkraut, canned green beans, canned whole kernel yellow corn, or bottled pickled olives.

According to a private communication from F.C. Lamb of the National Canners Association, the canning industry had opposed the use of iodized salt because of an observed interaction with tinplate. However, El Wakeil (1958) established that this reaction was due to the presence of sodium thiosulfate, which is no longer used to stabilize potassium iodide in iodized salt.

This article presents an evaluation of the effects of iodine from various sources upon food processing, including the determination of iodine stability during food preparation and storage.

SALT SAMPLES PREPARED

Batches of iodized salt were prepared with potassium iodide, potassium iodate, and calcium iodate as sources of iodine. Dendritic salt (NaCl) was selected for several reasons, mainly its non-caking characteristics and its ability to adhere to potato chips.

Both potassium iodide and potassium iodate were added to the salt as a water solution. Since potassium iodide in salt is subject to oxidation, it was stabilized as is normal for iodized salt, i.e., by mixing with 4 g of dextrose and 0.55 g of sodium bicarbonate per gram of potassium iodide. Because of the limited water solubility of calcium iodate, it was incorporated into the salt as a solid, with 0.1% propylene glycol added to prevent segregation.

The elemental iodine level in each iodized salt, as shown in Table 1, was 0.0077%, equivalent to the normal 0.01% potassium iodide level in iodized table

Table 1—ANALYSIS of iodized salt samples

Source of iodine	Additive level in salt (%)	Iodine level in salt (%)
Potassium iodide*	0.0100	0.0077
Potassium iodate	0.0128	0.0077
Calcium iodate	0.0118	0.0077

* Stabilized with dextrose and sodium bicarbonate

salt. After preparation, each salt sample was analyzed to verify the iodine content; each was reanalyzed at the time of usage in a food.

Iodine analyses were performed on finished food products by Shuman Chemical Laboratory, Battle Ground, Ind. The analytical procedure involves combustion of the food in an oxygen stream, with absorption of the products in a sulfuric acid-chromic oxide mixture. Addition of water to the acid mixture, followed by boiling, oxidizes all iodine to iodate. Phosphorous acid, arsenious acid, and hydrogen peroxide reduce the iodate, and the iodine and the hydroiodic acid are distilled into an alkaline solution. Iodine content of the distillate is measured by its catalytic effect upon reduction of ceric sulfate by arsenious acid.

FOOD PRODUCTS TESTED

Bread, potato chips, and frankfurters were prepared with the various iodine compounds, and analyzed before and after storage.

- Bread. Loaves of white bread containing 2% of

Table 2—IODINE STABILITY in white bread*

Iodine additive	Iodine concentration ^b (ppb)		Iodine retention ^c (%)	
	2 days after preparation	After 10 days in freezer	2 days after preparation	After 10 days in freezer
Potassium iodide	1,140	1,090	76	73
Potassium iodate	1,240	1,070	80	70
Calcium iodate	1,100	1,110	73	74

* All values adjusted to 2.00% salt content for easier comparison

^b Corrected for iodine content of control (380 ppb)

^c Based only on iodine added with salt

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each of the provided salt samples were baked by the American Institute of Baking, Chicago, Ill. They were prepared in the normal manner and observed for possible abnormalities in fermentation, appearance, aroma, and taste.

No difference was observed in fermentation time, proof time, internal appearance, taste, or aroma among control and iodized bread samples. Iodine stability was checked 2 days after preparation of the bread and then after 10 days in freezer storage.

As shown in Table 2, iodine retention is surprisingly good—at least 70% retention throughout baking, freezer storage, and air-drying (in preparation for iodine analysis).

• **Potato Chips.** Potato chips were produced by the Frito-Lay Research Department, Irving, Tex., using the salt samples added at the normal 2% level. The prepared chips were stored in an unheated room in multiple plastic bags protected from light.

The samples of potato chips were analyzed for iodine content after 7 weeks and 13 weeks of storage. The results are shown in Table 3. Since salt content varied somewhat, all iodine values in the table have

Table 3—IODINE STABILITY in potato chips^a

Iodine additive	Iodine concentration ^b (ppb)		Iodine retention ^c (%)	
	7 wk	13 wk	7 wk	13 wk
Potassium iodide	1,140	940	82	67
Potassium iodate	1,220	710	81	48
Calcium iodate	1,190	1,120	77	73

^a All values adjusted to 2.00% salt content for easier comparison
^b Corrected for iodine content of the control (280 ppb)
^c Based only on iodine added with salt

been adjusted to 2% salt for easier comparison of results. The low value for potassium iodate at 13 weeks probably represents analytical difficulties.

Taste panel tests 4 weeks after preparation of the chips showed no significant flavor differences between iodized and un-iodized chips.

• **Frankfurters.** Four lots of frankfurters, both iodized and un-iodized, were made by the Swift Research & Development Center, Oak Brook, Ill., in a manner typical for the industry. During preparation of the emulsion, the meat batter was watched carefully for atypical changes; none were noted. The frankfurters were stuffed into cellulose casings, smoked using natural smoke, chilled overnight, then peeled.

Samples from each lot were inspected and found to be typical in texture and cure color development. The same was true after heating in simmering water for 5 min. As for flavor, the frankfurters containing calcium iodate were described by one or two tasters as typical, slightly bitter or astringent. Even this batch, however, received a good flavor rating. It may be that

relatively insoluble iodine sources, such as calcium iodate, are undesirable because they are not sufficiently distributed throughout certain food products.

The remaining frankfurters were packed in polyethylene bags and frozen, then kept in freezer storage for 20 weeks. Iodine content was checked after the prolonged freezer storage, then after refrigerator storage for 10 days, and again after preparation in hot water. The results are shown in Table 4. Again, one iodine value, that for potassium iodide in prepared frankfurters, is clearly out-of-line and undoubtedly results from analytical difficulties.

IODIZATION FEASIBLE

No flavor or processing abnormalities were found in this study, and iodine stability was generally accept-

Table 4—IODINE STABILITY in frankfurters

Iodine additive	Iodine retention ^a (%)		
	Frozen ^b	Refrigerated ^c	Prepared ^d
Potassium iodide	46	61	93
Potassium iodate	54	53	65
Calcium iodate	41	60	52

^a Based only on iodine added with salt
^b Frozen for 18 wk
^c Frozen for 20 wk, then placed in sandwich bags and refrigerated at 42°F for 10 days
^d Frozen for 22 wk, then thawed at room temperature and prepared by simmering in hot water for 5 min

able for all iodine compounds, with at least 50–80% retention of iodine throughout processing and storage. Of the compounds tested, only potassium iodide, which is used for iodizing table salt, has Food and Drug Administration approval as a source of dietary iodine.

This study therefore indicates that:

- Iodization of processed foods is feasible.
- Salt is an acceptable carrier for the iodizing additive.
- Potassium iodide is a practical and reasonably stable iodine source.

The desirability of iodine fortification of commercial foods is a separate and complex nutritional problem, but this study indicates that it can be done.

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