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A field test for detecting iodine-enriched salt

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Abstract

One of the most effective and well-established methods for the prevention of endemic goitre is the enrichment of table salt with appropriate amounts of iodine. A simple field test has been developed by which anyone, without special chemical training, can verify whether a sample of table salt has been enriched with iodine as required by local health regulations. Since all the equipment needed can conveniently be assembled as a small portable kit, the proposed method, which is highly sensitive, is appropriate for health workers in areas prone to endemic goitre.

The iodization of salt at some appropriate level is now the most widely used prophylactic public health measure against endemic goitre. While industrialized countries stipulate potassium (or sodium) iodide, developing countries usually prefer potassium iodate, which is more expensive but keeps better in storage, particularly in humid or warm conditions or when exposed to light.

If the locally recommended iodization agent is not known, two samples should be examined, one by the iodide test and the other by the iodate test. For routine controls the simplest approach is to compare the unknown salt with a standard sample of salt iodized according to local regulations, using the relevant test only.

IODIDE

The test described below will detect the presence of the iodide ion over the range of officially recommended levels of iodization (5–100 mg of potassium iodide per kilogram of salt).

Materials

The following three solutions should be prepared:[a]

Solution A. 50 ml of a 0.5% starch solution, made by boiling 50 ml of water with 0.25 g of rice starch for 1 min[b] and letting it cool. The resulting liquid is whitish, contrary to the normal colourless laboratory iodometric starch solutions; however, this is irrelevant to the proposed test.[c]

Solution B. 25 ml of 1% sodium nitrite (0.25 g in 25 ml of distilled water). 0.25-g capsules of dry crystalline nitrite can be provided if this is found useful.

Solution C. 25 ml of a 20% solution of 95% sulfuric acid (specific gravity 1.83).

All three solutions should be stored in glass-stoppered dropper bottles.

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[a] If no standard balance is available, weighings may be carried out on a good letter balance. Volumes of liquids may be measured with graduated cylinders and " drops " are those delivered by standard medicine droppers (about 0.05 ml each). Such equipment, if carefully used, is sufficiently accurate for these tests.

[b] If it is impractical to boil the starch, a suitable alternative is " Unguentum Glycerini ", which is a standard preparation in several pharmacopoeias. It is prepared from, in parts by weight: wheat starch, 10; water, 15; and glycerol, 90. The wheat starch and water are mixed to a homogeneous suspension, the glycerol is then added, and the mixture is warmed over a water bath (90° C) until it becomes uniformly translucent in thin layers. Under tropical conditions, this unguent may become mouldy over a period of days or weeks; however, if the surface layer of mould is removed, the remaining mixture may still be used. If mould growth becomes a serious problem, 6 parts per thousand of thiomersal, incorporated after the glycerol, will act as an effective preservative. An alternative preservative consists of 0.1 g of methyl-*p*-hydroxybenzoate plus 0.03 g of propyl-*p*-hydroxybenzoate per 100 g of unguent; although this preservative has not been tested under tropical conditions, it is effective in temperate climates and does not interfere with the proposed spot tests. Half a teaspoonful of the unguent plus 45 ml (3 tablespoonsful) of water, well mixed to a homogeneous whitish suspension, provides a good alternative to solution A.

[c] In tropical climates the solution will tend to become mouldy. It will keep longer if 5 g of thiomersal powder are added to each 25 g of starch, which gives a final concentration of 0.1% thiomersal in the solution. There is little doubt that other preservatives may be used instead, their choice being a matter of local availability, effectiveness, and lack of interference with the spot tests themselves.

The iodide reagent is obtained by mixing 50 ml of A, 10 drops (0.5 ml) of B, and 10 drops (0.5 ml) of C. It is stable for 2–3 days under temperate laboratory conditions.[d]

Method

The test is carried out as follows:

On a saucer, place a small amount of the salt to be tested and, separately on the same saucer, a similar amount of salt iodized at the locally legal level. Moisten both portions of salt with two drops of the reagent. The wet iodized salt should turn blue immediately and the colour will remain visible for several minutes before turning grey and eventually white (after about 30 min). If the salt being tested also turns the same blue, it is properly iodized.

Note: This test cannot be used to measure the relative degree of iodization in different samples because it produces a uniformly light blue colour over much of the official range of concentrations. Also, it cannot be used to detect the iodate ion because the reagent does not react with iodates in a visible way. It works best on the usual finely crystalline salts; it is less sensitive with very finely ground salts which are not wetted by the reagent as readily as the crystalline forms.

IODATE

This test will detect the presence of the iodate ion over the range of officially recommended levels of iodization (6–130 mg of potassium iodate per kilogram of salt).

Materials

The following three solutions should be prepared:

Solution I. Solution I is identical to solution A above.

Solution II. 50 ml of 12% potassium iodide (6 g of KI in 50 ml of distilled water).

Solution III. 25 ml of 10% hydrochloric acid (specific gravity 1.05). If necessary, it may be prepared by mixing 10 ml of concentrated HCl (specific gravity 1.13) with 15 ml of distilled water.

All three solutions should be stored in glass-stoppered dropper bottles.

The iodate reagent is obtained by mixing 25 ml of II, 12 drops of III and 25 ml of I. It is stable for 2–3 days under temperate laboratory conditions.[e]

Method

The test is carried out as follows:

On a saucer, place a small amount of the salt to be tested and, separately on the same saucer, a similar amount of salt iodized at the locally legal level. Moisten both portions of salt with two drops of the reagent. The wet iodized salt should turn greyish-blue immediately and the colour will remain visible for several minutes before turning brown. If the salt being tested turns the same greyish-blue, it is properly iodized.

Note: This test can be used to estimate roughly the relative degree of iodization in different samples because it produces some range of greyish-blue colour over much of the official range of concentrations. It cannot be used to detect the iodide ion because solution II is itself iodide: the test needs iodide to free iodine from iodate in a visible manner.

TRAVELLING KIT

A travelling kit can conveniently be assembled. For the iodide alternative it would consist of one 60-ml dropper bottle, two 30-ml dropper bottles, and two 50-ml powder flasks to contain, respectively, solution A (and the completed reagent), solutions B and C, powdered starch (or unguent), and iodized salt. For the iodate alternative the same kit would suffice if solutions II and III were substituted for solutions B and C, respectively. A kit allowing the detection of both iodide and iodate would require four 30-ml dropper bottles to contain B, C, II, and III. It is recommended that stoppers be secured with string tied in a pharmacist knot. Measuring spoons, one 50-ml graduated cylinder, one white-glazed ceramic tile, and two glass-rod stirrers may be convenient additions.

[d] Under tropical conditions the least stable component is solution A, and it is this solution that will need to be prepared anew if the positive test fails. Solution B should be the second component to be suspected, while solution C is adequate as long as it remains colourless.

[e] Under tropical conditions the least stable component is solution I, and it is this solution that will need to be prepared anew if the positive test fails. Solution II should be the second component to be suspected. Solutions II and III are adequate as long as they remain colourless.