CLXV. THE IODINE CONTENT OF POTATOES.

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POTATOES were chosen by Remington as a staple food which is widely grown and might show an index of the iodine content of local foods of any locality, and we have therefore worked for some years on the technique of iodine determination in potatoes. This work is to some extent disappointing since we have found the iodine content of potatoes very low and very difficult to determine. The potato tops would be a better choice for iodine analysis since the iodine content is increased by the evaporation of water from the leaves and translocation from the roots, but they contain solanine which is toxic, and are therefore not used as food and are more difficult to obtain in distant localities. Towards the end of the season the tops are in various degrees of disintegration and are often entirely destroyed by potato beetles.

The potatoes were washed free of soil, sliced, dried in a current of air, ground in a coffee mill and dried again in an electric oven at 100° . Weighed samples of 50–200 g. of dry material were taken, and two methods were used for ashing. One was ashing in an electric furnace at 400° for about 36 hours. During the first part of this process whenever the sample showed any redness it was taken out and allowed to smoulder and then put back in the furnace when it had ceased smouldering.

Fig. 1. Apparatus for burning dried tissue for iodine analysis. A detail of the opening of the screw-feed is shown below. The central circle is the space containing the dried tissue packed in a Visking sausage casing and around it is an annular opening from which oxygen issues to burn the tissue (the small circle below is an opening for a gas pilot flame).

The other method of ashing was in a combustion tube similar to the one used for seaweed [McClendon and Imai, 1933] except that the sample, instead of being pushed in gradually, was slowly introduced with a screw-feed (Fig. 1). The first part of the combustion tube is made of a one litre pyrex balloon flask with a hole in the bottom to receive an 8 mm. silica tube (containing an electrically heated

platinum wire) and the whole turned on its side until the silica tube is horizontal. The sample is dried, powdered, packed in a Visking sausage casing and placed in the screw-feed, the open end of which is surrounded by an annular opening through which oxygen is emitted to burn the sample. A very small pilot flame starts the combustion as soon as the screw is sufficiently advanced. The products of combustion pass over the heated platinum wire in the silica tube and are cooled in a pyrex U-tube and the iodine is absorbed by bubbling through two wash-bottles in series, only one of which is shown in the figure. Each wash-bottle contains an alundum capsule (RA 98) in NaHSO_3 solution, but sintered glass discs may be substituted for alundum to break up the bubbles and screen out the white smoke. This solution is evaporated with the washings of the apparatus and added to the ash.

The ash from either method of ashing is ground in a 200 ml. ball-mill with three portions (50 ml. each) of 85 % alcohol, which is evaporated, transferred to a boat, and heated in a simple combustion tube to which is connected a small wash-bottle containing NaHSO_3 solution and this solution together with the washings of the tube is added to the ash, which is rubbed up with a glass rod. To this extract is added a milligram of sodium azide, it is acidified with phosphoric acid and boiled down to 10 ml., transferred to a separating funnel and extracted twice with 1 ml. CCl_4 . These extracts are set at 1 cm. in the micro-colorimeter (Bausch and Lomb) and compared with a standard containing 0.1 mg. I_2 per ml. CCl_4 . Total iodine equals $\frac{x_1^2}{(x_1 - x_2)}$, where x_1 is the sum of 10 readings in cm. on standard balancing the first extract, and x_2 is the sum of 10 readings from the second extract. The result is the milligrams of iodine in the sample.

Fig. 2. The iodine in potatoes ($\gamma/\text{kg. dry matter}$) is shown in plain figures. The dotted line divides the eastern part of Minnesota lower in iodine and higher in goitre from the western part higher in iodine and lower in goitre. The figures in circles are the goitres too large to accommodate a military collar per 1000 men drafted during the World War. The numbers in squares are the percentage goitre in the schools.

It was found that there was a loss of iodine on burning in the electric furnace. Even after practising this technique for years there seemed no way to prevent this loss. An example is as follows: A composite sample of potatoes from western Minnesota was thoroughly mixed in the dried, ground condition by shaking in a large can and 50 g. were analysed in the combustion tube, showing an iodine content of 460 γ /kg. whereas in the electric furnace only 240 γ /kg. were recovered. Similar data for eastern Minnesota are 400 γ /kg. for closed and 310 γ /kg. for open ashing. The average of 55 samples of Minnesota potatoes burned in the electric furnace was 174 γ /kg. (see Fig. 2). The average of 28 samples from North Dakota burned in the electric furnace by another analyst was 170 γ /kg. (One sample from North Dakota burned in the tube gave only 140 γ /kg.) The main conclusion is that potatoes are very low in iodine content. If the wet weight is taken this is at once apparent. Owing to the fact that the water content of potatoes changes during shipment and storage we have made all determinations on the dry basis.

Although there are losses in the open ashing method at 400° we conclude from several years' experience that an analyst may develop a technique whereby his losses are comparable and by averaging a large number of determinations he may be able to tell whether the iodine content of potatoes of one region is higher or lower than that of another. This does not mean that these data may be compared with those of another analyst. The 55 samples of Minnesota potatoes analysed by the same analyst may be divided into those from the eastern and those from the western section of the State. The average value for the eastern section is 85 γ /kg. and the average for the western section 226 γ /kg. These figures may be compared with the simple goitre per thousand drafted men during the World War, which was 19 for this eastern section and 7.5 for this western section, indicating an inverse relation between the iodine in potatoes and the goitre in drafted men (Fig. 2).

REFERENCE.

McClendon and Imai (1933). *J. Biol. Chem.* **102**, 91.