ОРИГИНАЛЬНАЯ СТАТЬЯ

STUDY AND ASSAYS OF IODINE IN TABLETS «BIOIOD»

ОПРЕДЕЛЕНИЕ СОДЕРЖАНИЯ ЙОДА В ТАБЛЕТКАХ «БИОЙОД»

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ABSTRACT. Bioiod (Innbiotech, Russia) product is an animal- or vegetal-produced protein to which positive iodine was added. Content of iodine in the product was estimated by an independent laboratory. The Sandell–Kolthoff reaction and mid-infrared spectroscopy were used to identify iodine and organic components. It was verified that Bioiod contains 42.5 ± 5.85 μg of iodine per tablet.

РЕЗЮМЕ: «Биойод» представляет собой БАД на основе животного или растительного белка, к которому присоединен йод в положительной степени окисления. Независимой лабораторией была проведена оценка содержания йода в продукте с использованием реакции Кольтгоффа–Сэнделла и определение органических компонентов методом средневолновой ИК-спектроскопии. Установлено, что одна таблетка «Бойода» содержит 42,5 ± 5,85 мкг йода.

INTRODUCTION

Iodine is an essential trace element involved in the production of thyroid hormones, which play a key role in brain growth and development. When iodine intake is insufficient, various thyroid function abnormalities may occur. Severe deficiency may cause goitre development, endemic cretinism and mental retardation, fertility rate decrease, and spontaneous abortion and perinatal mortality rates increase (Duron, 2001). Iodine supplementation of salt has been considered in many countries in order to reduce deficiency risks (Venkatesh Mannar, Dunn, 1995).

However, total iodination of table salt has disadvantages. People salt foods adjusting not for the added amount of iodine but for the taste of prepared meal, thus consumers risk the regular intake of several daily allowances of iodine instead of one. Iodinated salt is a very unstable compound requiring special storage conditions; furthermore, it decomposes during boiling and thus may be added to ready-to-serve meals only. Salt load is dangerous to young children, elderly people, especially those with risk of hypertension, people with kidney or cardiovascular disease.

Other iodine supplementation modalities are also available. For example, biologically active additives based on iodinated milk or whey proteins. Such products have high iodine bioavailability and do not depend on peculiarities in consumption of other foods. According to some investigations, organic-bounded iodine have some preferences in health effects in comparison with inorganic salts (Zhukova et al., 2004). Starting from this point, Russian company Innbiotech proposes additional supplementation methods, especially «Bioiod» tablets. Bioiod (Innbiotech, Russia) product is an animal- or vegetal-produced protein to which positive iodine was added. Today, the only known protein form of iodine is that integrated to thyroid hormones during iodine organification in the thyroid gland. In this system, iodine is incorporated as an iodide, i.e. as an anion instead of a cation. In order to estimate real supply of iodine in Bioiod, several tests were conducted.

MATERIAL AND METHODS

Two boxes of the tablets have been received from the manufacturer (labelled #1 and #2), for which the level of iodine must be 50 μg per tablet.

For assaying iodine, we have used the Sandell and Kolthoff reaction (Sandell, Kolthoff, 1937), based on the catalytic effect of iodine as iodide anion in the reduction process of Ce^{4+} in the presence of As^{3+}, and at 52°C. This chemical reaction is considered as the reference method for the assay of total iodine, whatever

is its chemical form (mineral or organic compounds) in the crude material of the sample. The chemical reaction is written by:

$$2Ce^{4+} + H_2AsO_3^- + H_2O \rightarrow 2Ce^{3+} + \\ + H_2AsO_4^- + 2H^+$$

Optical properties of this reaction are as follows: in the redox couple Ce^{4+}/Ce^{3+}, Ce^{4+} alone is the ion which is able to absorb ultraviolet light at 420 nm. For this reason, is measured the decrease of absorbance («signal»). These signals are directly proportional to concentrations of the studied solutions (samples).

When measuring the absorbance, we used standard solutions made in the range 160–1600 nmol/L from potassium iodate (KIO_3^-). Tested samples were studied in solution in ultrapure water, using precise dilutions able to product signals in the range 160–1600 nmol/L. For this study, 28 diluted solutions were realized, and some of them were diluted again to obtain usable signals. In practice, these dilutions really are suspensions of insoluble material. Using mid-infrared spectroscopy, we demonstrated that this solid material was an association of starches (Fig. 4, 5). For assays of iodine, we have used these «solutions», containing suspended substances, after vigorous shaking just before their introduction in the reactive medium of mineralization. The table summarizes the different sample portions that we have weighed. Samples were weighed with precision of 0.1 mg.

The mineralization of samples and standards corresponds to the decomposition associated to the chemical reduction of the organic or mineral compounds in iodide ions (I^-). This reaction was realized by the mixture of perchloric acid ($HClO_4$ 70–72%, d = 1.66, 100 mL; HNO_3 70%, «ultrapure concentrated», 25 mL) in H_2SO_4 («ultrapure concentrated», d = 1.84) medium.

Table. ***Results of the investigation of iodine amounts in tested Bioiod tablets***

Box	Sample No.	Sample weight, mg	Dilution (final volume), mL	Further dilution coefficient	Signal measured	Iodine concentration in the solution, nmol/L	Iodine concentration in the sample, nmol	Iodine amount in the tablet, μg
#1	1	122.2	100	1	205	1400	332.2	42
#1	1	122.2	100	1	198	1360	322.7	41
#1	2	166.8	100	1	275	1985	345.1	44
#1	2	166.8	100	2	145	960	333.8	42
#1	3	143.3	100	1	249	1755	355.2	45
#1	3	143.3	100	1	220	1530	309.6	39
#1	3	143.3	100	2	105	730	295.5	38
#1	4	146.0	100	1	237	1650	327.7	42
#1	4	146.0	100	2	116	800	317.8	40
#1	5	137.0	100	1	282	2050	433.9	55
#1	5	137.0	100	3	63	525	333.4	42
#1	6	151.7	200	1	145	970	370.9	47
#1	6	151.7	200	1	104	685	261.9	33
#2	7	158.3	200	1	136	915	335.2	43
#2	7	158.3	200	1	105	700	256.5	33
#2	8	129.0	200	1	113	770	346.2	44
#2	8	129.0	200	1	95	640	287.8	37
#2	9	169.2	200	1	186	1250	428.5	54
#2	9	169.2	200	1	169	1140	390.8	50
#2	10	124.0	200	1	110	760	355.5	45
#2	10	124.0	200	1	92	630	294.7	37

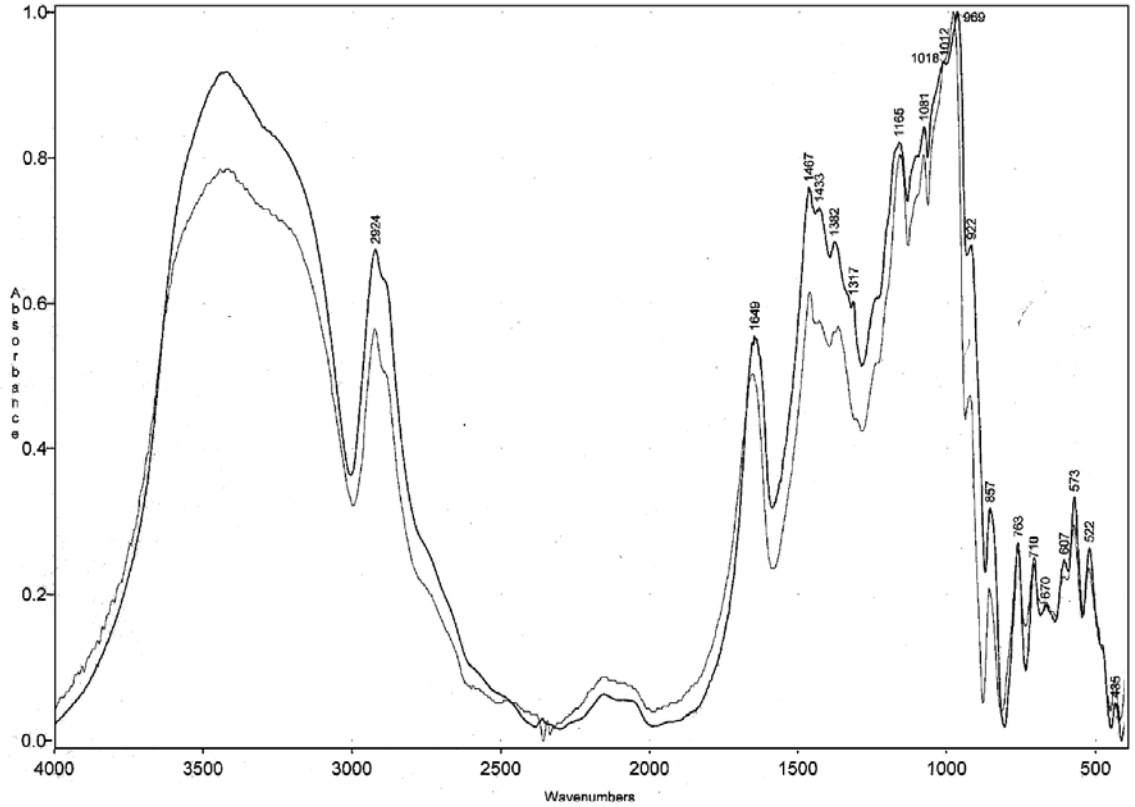

Fig. 1. *Mid-infrared spectrum of white powder in Bioiod tablets*

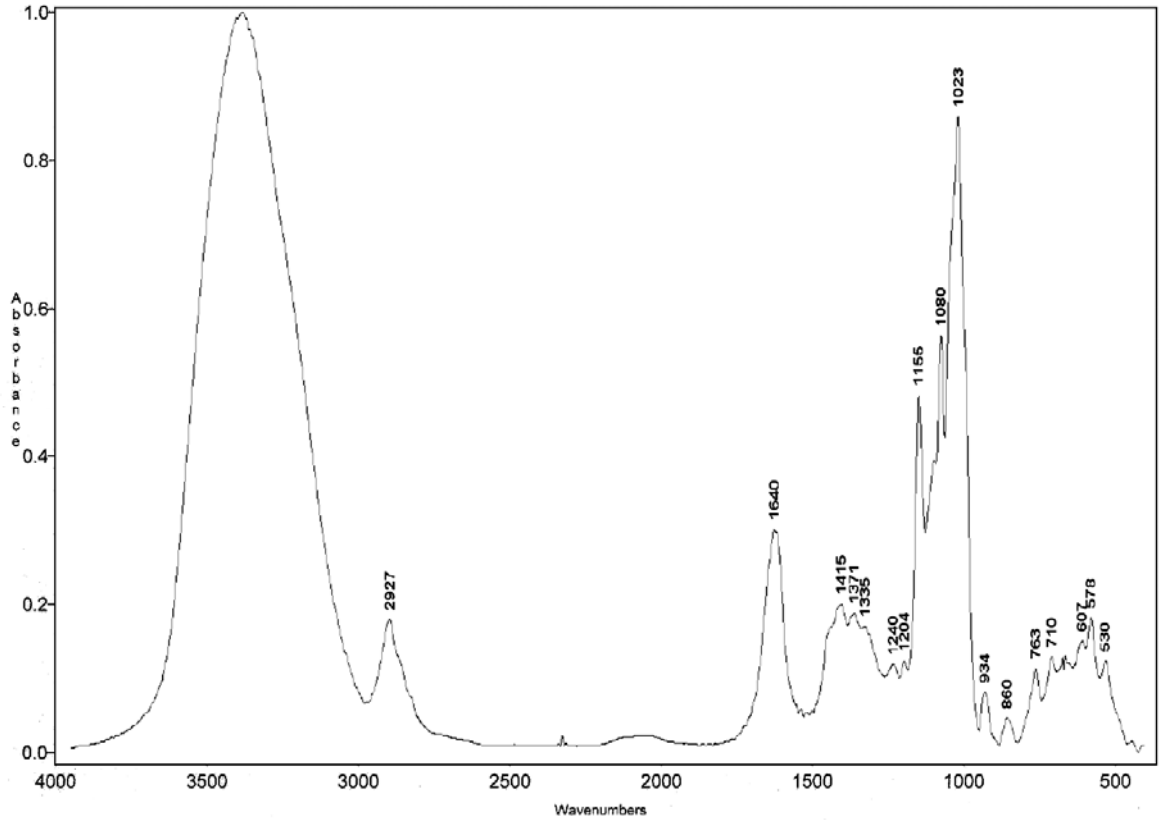

Fig. 2. *Mid-infrared spectrum of binding agent in Bioiod tablets*

RESULTS AND DISCUSSION

The table summarizes the calculated amounts of total iodine for each tablet. They were calculated according to average mass of each tablet measured as 290 mg and iodine atomic mass 127 g/mol.

Thus, the average amount of iodine in the tablets was obtained as 42.5 ± 5.85 μg, and the coefficient of variation was 13.8%.

For tablets in a defined box we have noted some dispersion of results. Then, we have imagined that this fact was in relation with the presence of particles (starch) in suspension, in the solution of sample. A possible adsorption was considered. But this phenomenon is not real, because the method of mineralization that we utilize possesses a very high power of mineralization (by use of both perchloric and nitric acids in sulphuric acid medium in high concentrations). In addition, it is the reference method. But it is possible that there exists an inhomogeneity of the mixture of powder (starches) and of «iodinated proteins», during their mechanical mixing. And this fact may be amplified by the high difference in quantities of these two products.

CONCLUSIONS

The average mass of «Bioiod» tablets was found equal to 290 mg. An investigation using mid-infrared spectrometry have identified starch(es) in the tablets. Average amount of iodine in the tablets was obtained as 42.5 μg with SD = 5.85 and c.v. = 13.8%. So, «Bioiod» (tablets of 50 μg iodine), which contain iodine in organic-bounded form, can be used as a thera peutic or preventive mean in elimination of iodine deficiency.

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