

Investigations during recent years have revealed no parallel between the content of trace elements in the body and their qualitative importance for the living organism. Even in trace amounts, these elements perform an important biological function, participating in biochemical reactions by their nonspecific catalytic action on enzymes, vitamins, and hormones, or as specific structural components of their molecules.

The biological role of gallium and its presence in plants, lower and higher animals, in the parenchymatous organs of dogs and the human endocrine glands, and the connection between the trace element and certain enzyme systems have been noted by several authors [2-4, 6]. Experimental and clinical investigations have demonstrated the remarkable property of exogenous gallium of undergoing concentration in a tissue with high proliferative properties: in the tissues of osteoblastomas, at the points of bone growth, and in the neighborhood of healing fractures [7].

No reference could be found in the literature to quantitative estimations of the trace element gallium in healthy human organs, and the present investigation was accordingly carried out for that purpose.

#### EXPERIMENTAL METHOD

Gallium was determined in the organs of healthy human subjects of both sexes killed in traffic accidents. The organ for investigation was dried in a drying cupboard for 30 days, after which the gallium content in 3 g of the dried organ was estimated and the result subsequently expressed per 100 g.

An extraction-colorimetric method was used, based on the color reaction with the element and rhodamine C. The dried test organ was incinerated in porcelain crucibles in a muffle furnace at 450-500°. The color reaction was performed on the ash by V. A. Oshman's method [5].

The trace element was determined not only in the organs, but also in the blood, urine, and stools of healthy persons.

#### EXPERIMENTAL RESULTS

The blood of 40 donors was tested. The results showed that the gallium concentration in their blood was  $27.9 \pm 0.6 \mu\text{g}\%$ . In 15 healthy persons the concentration of gallium in the plasma and the cells of the blood was determined separately. None of the element was found in the plasma and leukocytes.

##### Concentration of Gallium in Organs and Tissues of Healthy Persons

Organ and tissue	Content of gallium (in mg/100 g weight)
Spleen. . . . .	$2.93 \pm 0.5$
Liver . . . . .	$1.57 \pm 0.3$
Kidneys. . . . .	$1.55 \pm 0.1$
Brain. . . . .	$1.28 \pm 0.1$
Adrenals . . . . .	$1.20 \pm 0.06$
Thyroid. . . . .	$1.00 \pm 0.03$
Heart . . . . .	$0.81 \pm 0.2$
Bone. . . . .	$0.17 \pm 0.01$

The trace element was found to be conjugated with the erythrocytes. Since the erythrocytes consist of a membrane (stroma) and internal contents, 90-96% of which is hemoglobin, an attempt was made to discover the part of the erythrocyte with which the gallium was conjugated. For this purpose freshly collected, defibrinated blood was washed three times with a 1% solution of sodium chloride. In this way erythrocytes completely freed from plasma and leukocytes were obtained. To the packed erythrocytes thus obtained 5 ml of distilled water was added, causing hemolysis to take place. Next, by ultracentrifugation, the contents of the erythrocytes could be obtained in the supernatant fluid, and the membranes in the residue. After this, the gallium in both fractions was estimated. The investigation was carried out colorimetrically and spectroscopically. The gallium was found to be concentrated in the membranes of the erythrocytes.

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The excretion of gallium in the 24-hour urine and stools was studied in 16 healthy subjects. The results showed that during the 24-hour period  $41.9 \pm 5.9 \mu\text{g}$  of gallium is excreted in the urine and  $68.2 \pm 3.8 \mu\text{g}$  with the stools.

The quantitative estimation of gallium in the diet showed that the trace element enters the body mainly with products of animal origin, and to a lesser extent from vegetable products; a little enters with the water.

The content of gallium in the organs was studied quantitatively in the cadavers of 8 persons (5 males and 3 females), dying at the ages of 9 months (1), 18 years (1), 25 years (2), 30 years (1), 54 years (1), and 70 years (2). This showed that most of the trace element is contained in the spleen, liver, and kidneys, followed in order by the brain, adrenals, thyroid, pancreas, heart, and lungs. Least gallium of all is present in the bone tissue (see table).

In this connection it is interesting to note that the author's investigation of the blood gallium level of patients with various types of jaundice [7] demonstrated maximal concentration of this element in hemolytic jaundice; in epidemic hepatitis the maximal increase in the gallium concentration in the blood took place in the phase when the disease was subsiding.

Hence, gallium is an element constantly present in the human body, mainly in the blood, parenchymatous organs, brain, and certain endocrine glands. The element is excreted in the urine and stools.

According to reports in the literature, if the exogenous radioactive isotope of gallium is administered it is concentrated in the parenchymatous organs.

#### SUMMARY

The extraction-colorimetric method was used to study the level of the trace element gallium in the blood of forty donors, the diurnal excretion of gallium with urine and feces in sixteen healthy persons and in the organs of eight corpses of victims of a trauma. It has been found that the blood contains  $27.9 \pm 0.6 \mu\text{g} \%$  of gallium, and that this trace element is connected with the membranes of the erythrocytes. During 24 hours  $41.9 \pm 5.9 \mu\text{g}$  of gallium is excreted with urine and  $68.2 \pm 3.8 \mu\text{g}$  with feces.

Gallium enters the body with food, mainly of animal origin. Gallium concentration in the organs decreases in the following sequence: the spleen, liver, kidneys, brain, adrenal glands, thyroid gland, pancreas, heart, lungs, and bone tissue.

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