

EFFECT OF IODINE COMPOUNDS ON ACTIVITY OF CERTAIN CHICKEN LIVER ENZYMES

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Activity of glucose-6-phosphate and glutamate dehydrogenases and of alanine and aspartate aminotransferases in the chicken liver was significantly lowered after thyroidectomy. A single injection of thyroxine or ICl into thyroidectomized animals increased glucose-6-phosphate dehydrogenase activity; activity of the NAD- and NADP-dependent isocitrate dehydrogenases showed no appreciable change. Under the influence of thyroxine the concentration of soluble proteins in the liver also was increased. It is postulated that thyroid hormones participate in the regulation of activity of the enzymes investigated, while iodine ions induce a thyroxine-like effect in this regulation.

Of all the many hormones formed in the human and animal body thyroid hormones have the broadest spectrum of action. They control the activity of many enzymes concerned in the reactions of protein, carbohydrate, and lipid metabolism. The suggestion has been made that at the subcellular level thyroid hormones are deiodized with the formation of free iodine radicals (I^+ and I^-) [3], which are responsible for certain effects of the hormone at the molecular level [1, 5-7].

This paper describes the results of a study of the effect of thyroxine, ICl, and 1-methyl-2-mercaptoimidazole on the activity of alanine and aspartate aminotransferases, of glutamate, isocitrate, and glucose-6-phosphate dehydrogenases (GDH, ICDH, and G6DPH, respectively), and on the concentration of soluble proteins in the chicken liver.

EXPERIMENTAL METHOD

Chickens of the White Plymouth Rock breed were subjected to thyroidectomy or a mock operation at the age of 5 days and used in the experiments at the age of 15 days. The chickens were divided into five groups: 1) birds undergoing the mock operation (control); 2) birds undergoing the mock operation and receiving methiothylin (1-methyl-2-mercaptoimidazole) in a dose of 1.5 mg/100 g body weight; 3) chickens after thyroidectomy; 4) thyroidectomized chickens receiving an intramuscular injection of thyroxine 24 h before sacrifice in a dose of 25 μ g iodine/100 g body weight; 5) thyroidectomized chickens receiving an intramuscular injection of ICl 24 h before sacrifice in a dose of 25 μ g iodine/100 g body weight. After the animals had been killed, the GDH [9] and NAD-specific ICDH [5] activities were determined in the liver. Soluble proteins were estimated by the biuret method. Optical tests (Boehringer) were used to investigate activity of the dehydrogenases and aminotransferases; the determinations were carried out at 340 nm. The activity of all enzymes was expressed in Racker units per 10 g tissue.

EXPERIMENTAL RESULTS

The changes in the content of soluble proteins and enzyme activities in the liver of the different groups of chickens are given in Table 1. The content of soluble proteins in the liver of chickens of groups 2 and 3

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TABLE 1. Content of Soluble Proteins and Activity of Some Enzymes in the Liver of Chickens

Group of animals	Content of soluble proteins (in mg/g tissue)	Activity of enzymes (in Racker units/10 g tissue)					
		G6PDH	GDH	ICDH		alanine amino-transferase	aspartate aminotransferase
				NAD	NADP		
1	97,1±2,6 (11)	1,2±0,1 (11)	27,9±1,9 (12)	1,8±0,2 (11)	14,1±0,8 (11)	3,0±0,3 (11)	44,0±3,3 (12)
2	77,6±3,4 (6)	0,6±0,2 (5)	29,1±2,7 (6)	1,6±0,3 (5)	18,9±1,8 (6)	1,9±0,7 (6)	40,6±1,0 (6)
3	87,4±6,8 (11)	0,6±0,1 (9)	17,4±2,3 (11)	1,3±0,2 (10)	12,9±1,0 (11)	1,6±0,2 (12)	28,8±7,3 (12)
4	109,0±7,1 (11)	1,0±0,1 (10)	20,9±2,4 (9)	1,1±0,1 (9)	12,3±0,9 (10)	1,3±0,2 (9)	23,2±2,8 (9)
5	91,2±4,1 (7)	1,2±0,2 (8)	20,0±3,1 (9)	1,1±0,2 (9)	13,2±1,1 (8)	1,2±0,2 (8)	28,8±2,8 (8)

Note. Number of experiments given in parentheses.

was significantly reduced compared with the control. In the animals of group 4 the content of soluble proteins in the liver was increased by comparison with the chickens of groups 1 and 3. The content of soluble proteins in the liver of the animals of group 5 was close to the control value.

The G6PDH activity in the liver of the chickens of group 2 and 3 was significantly lowered. Meanwhile, in the birds of groups 4 and 5 the activity of this enzyme was increased up to the control level. GDH activity in the liver of the chickens of group 3 was appreciably lowered; in the animals of group 2 injection of methothylin had no effect on the activity of the enzyme. Thyroxine and ICl affected the GDH activity of the thyroidectomized birds in the same way. The activity of the NAD- and NADP-dependent ICDH showed only a tendency toward a decrease in the birds of group 3, 4, and 5. In the chickens of group 2, the activity of NADP-dependent ICDH was significantly increased.

Thyroidectomy led to a marked decrease in the activity of alanine and aspartate aminotransferases, while a single injection of thyroxine or ICl was insufficient to raise it. Methothylin decreased the activity of alanine aminotransferase in the liver of the chickens undergoing the mock operation but had no such action on aspartate aminotransferase.

Similar results were obtained by determination of the specific activity of the enzymes investigated.

The results of these experiments show that the activity of certain enzymes of carbohydrate and protein metabolism is under the control of thyroid hormones. The most sensitive enzyme is the glucose-6-phosphate dehydrogenase of the liver. The activity of this enzyme, unlike all that of other enzymes studied, was reduced both after thyroidectomy and after the blocking of thyroid function, and it returned to normal after administration of thyroxine or ICl to the thyroidectomized animals. An increase in the G6PDH activity under the influence of thyroid hormones has also been reported by other workers [2, 4, 8], but there is no information on the effect of ICl on the activity of this enzyme in the literature.

GDH activity in the chicken liver fell below the control level after thyroidectomy; administration of a single dose of thyroxine or ICl to these animals caused a tendency for the activity of this enzyme to rise, and it approached the values found in the animals undergoing the mock operation. Consequently, the effect of ICl was greater than that of thyroxine on the activities of both GDH and G6PDH. Thyroxine is known to lower GDH activity in vitro [10, 11].

The doses of thyroxine and ICl used did not affect the activity of alanine and aspartate aminotransferases in the liver of the thyroidectomized animals. The effect of ICl was thus similar to the action of thyroxine on the activity of all enzymes investigated in the chicken liver.

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