EFFECT OF ACEPHATE (ORTHENE) ON TISSUE LEVELS OF THIAMINE, PYRUVIC ACID. LACTIC ACID, GLYCOGEN AND BLOOD SUGAR

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Summary : Effect of Acephate, an organophosphorus insecticide, on tissue levels of thiamine, pyruvic acid, lactic acid, glycogen and blood sugar, has been studied. The albino rats, injected subcutaneously with Acephate (25 *mg*/100 *gm* body wt./day) for 4 weeks and 8 weeks, showed appreciable depletion of thiamine in liver, heart, kidney, brain and blood. The depletion of thiamine was found to be more after 8 weeks of Acephate injection. There was concomitant increase in pyruvic acid and lactic acid in various tissues. There was enormous depletion of glycogen in liver and slight rise in blood sugar concentration The animals injected thiamine (120 μg/100 *gm* body wt./day) along with Acephate, showed more or less normal levels of thiamine, pyruvic acid, lactic acid, liver glycogen and blood sugar. The increase in pyruvic acid and lactic acid in tissues has been attributed to depletion of thiamine which is required for pyruvic acid oxidation. The increase in blood sugar has been attributed to the excess breakdown of glycogen.

Key words : Acephate (orthene) thiamine pyruvic acid
lactic acid glycogen blood sugar

INTRODUCTION

Thiamine pyrophosphate plays an important role as coenzyme in the oxidative decarboxylation of α-ketoacids like pyruvic acid and α-ketoglutaric acid. It also acts in the hexose monophosphate shunt for glucose utilization. The lack of thiamine leads to neurological symptoms of predominant peripheral neuritic character. In a few types of poisoning, it is possible to delineate particular interrelationship with thiamine deficiency. Polyneuritis is caused by acute chlorophos poisoning (6,14,17). Hermann (12) found that a grave polyneuritis is caused by DDT poisoning. It is also found that polyneuritis is caused by poisoning with insecticides of organophosphorus groups (26). Deficient intake of thiamine potentiates the cholinergic action of phospho-organic compound chlorophos (5,27). Several organic phosphorus pesticides have been found to deplete liver glycogen (18,19,22). Organophosphates and organochlorine pesticides have been found to increase blood sugar by disturbing carbohydrate metabolism (10,18,20,22,23,25). The hyperglycemia is accompanied by reduction in glucose tolerance and elevation in blood lactate and pyruvate (4,13).

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In the present investigation, the effect of Acephate, an organophosphorus water soluble insecticide, on tissue levels of thiamine, pyruvic acid, lactic acid, liver glycogen and blood sugar was studied in albino rats.

MATERIALS AND METHODS

Male albino rats, weighing 120 to 150 *gms* were employed in the present investigation. They were divided into three groups.

Group I : Control

Group II : Acephate injected subcutaneously (25 *mg*/100 *gm* body wt/day).

Group III : Thiamine (120 μg/100 *gm* body wt/day) along with Acephate (25 *mg*/100 *gm* body wt/day) injected subcutaneously.

Control and experimental rats were kept on stock laboratory diet for 4 weeks and 8 weeks. The composition of stock diet is as shown in Table I.

TABLE I : Percent composition of stock diet (in *gms*).

Constituents	*Stock diet*
Wheat flour	65
Casein	20
Ground nut oil	10
Hawk oser salt mixture	4
Vitamin mixture	1*

*1 *gm* of vitamin mixture contains : Thiamine 0.6 *mg*, Riboflavin 1.2 *mg*, Pyridoxine 0.4 *mg*, Niacin 5.0 *mg*, Calcium pantothenate 4.0 *mg*, Para-aminobenzoic acid 2.5 *mg*, Inositol 100 *mg*, Choline chloride 200 *mg*, Biotin 1 *mcg*, Folic acid 1 *mcg*, Cynocobalamine 1 *mcg*, Vitamin A 200 Units, Vitamin D 20 Units, α Tocopheral 12 *mg*, Menadione 12 *mg*.

Rats were kept on fasting for 24 hrs and decapitated 10 mins after an injection of Nembutal (3 *mg*/100 *gm* body wt.). Blood was collected, brain, liver, kidney and heart were rapidly removed, chilled, weighed and then homogenised in cold water, centrifuged for 20 min and thiamine was determined by thiochrome method (1,11,21). (Results are shown in Table II). Pyruvic acid was determined by Friedemann and Haugen method (8) and lactic acid by Braker-Summerson method (2). Results are shown in Table III. Liver glycogen was estimated by phenol-sulphuric acid method (7) and blood sugar was determined by Nelson-Somogyi method (15,24). (Results are shown in Table IV).

TABLE II : Thiamine content of various tissues in normal and acephate injected rats for 4 weeks and 8 weeks on 24 hrs fasting.

Sr. No.	Group	No. of animals	Experimental period of weeks	Thiamine content mg/100 gm. of tissue				
				Liver	Heart	Kidney	Brain	Blood µg/100 ml
	I	8	0	0.762±0.95	0.738±0.09	0.421±0.11	0.442±0.88	10.00±0.07
I	II	10	4	0.560±0.08*	0.608±0.02+	0.340±0.03*	0.301±0.03+	8.00±0.05+
	III	10	4	0.769±0.12	0.729±0.08	0.423±0.13	0.441±0.11	10.20±0.06
	I	8	0	0.781±0.89	0.742±0.10	0.420±0.09	0.440±0.12	10.01±0.06
II	II	10	8	0.505±0.02*	0.565±0.03+	0.301±0.03*	0.298±0.20+	7.50±0.01+
	III	10	8	0.788±0.06	0.762±0.05	0.402±0.12	0.442±0.10	10.00±0.02

*P<.02 +P<.05

TABLE III : Pyruvic acid and lactic acid content *mg/100 gm* of fresh tissue in normal and acephate injected rats for 8 weeks on 24 hrs fasting.

Sr. No.	Metabolite	Group	No. of animals	Experimental period of weeks	Liver	Heart	Kidney	Brain	Blood mg/100 ml
(i)	Pyruvic acid	I	8	0	2.88±0.25	1.62±0.50	2.42±0.14	1.77±0.18	0.90±0.05
		II	10	8	3.98±0.15*	3.24±0.68*	4.01±0.09*	2.90±0.10+	1.0 ±0.10+
		III	10	8	2.98±0.10	2.00±0.31	3.01±0.20	1.82±0.15	0.91±0.01
(ii)	Latic acid	I	8	0	14.52±1.32	8.50±1.21	10.40±0.98	15.56±1.30	5.20±0.13
		II	10	8	20.48±1.50*	13.75±2.10*	16.81±0.50*	23.12±3.21+	7.85±0.05+
		III	10	8	14.85±1.02	9.20±1.20	11.98±1.60	16.10±1.08	5.40±0.15

*P < 0.02 +P < 0.05

The animals which were injected daily with thiamine along with Acephate showed more or less normal levels of pyruvic acid and lactic acid in tissues, suggesting that Acephate may increase the requirement for thiamine. It has recently been shown by one of our research workers that there is an increase in the activities of liver Glucose-6- phosphatase and phosphorylase in albino rats treated with Acephate (16). It is likely that the slight increase in blood sugar of animals receiving Acephate may be due to excess breakdown of glycogen in the liver.

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