# Effect of Cold, Adrenocorticotropic and Thyroid Hormones on Urinary Excretion of Pentose in the Rat.* (17836)

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Green, Stoner and Bielschowsky(1) found that various forms of trauma are followed by an increase in the plasma concentration of total pentose and its phosphorylated fraction in the rabbit and the rat. These changes were of the same order as those produced by the intramuscular injection of fatal doses of adenosine triphosphate. McShan *et al.*(2) observed an increase in the pentose, inorganic phosphate, amino acid N, glucose, lactic and pyruvic acids of the blood of rats in shock induced by the Noble-Collip(3) and the tourniquet(4) methods. In studies of pentose metabolism in this laboratory the effects of various exogenous factors on urinary pentose excretion have been investigated. In this paper we are reporting the effect of cold, and of the administration of the adrenocorticotropic hormone (ACTH) and thyroid on urinary pentose excretion in the rat.

Rats of the Osborne-Mendel strain were placed on an adequate synthetic diet and water was allowed *ad libitum*. The urinary pentose in 24 hour samples of urine was determined by a modification of the method of Roe and Rice(5) for the determination of free pentose in animal tissues. To one part of urine was added 1 part of water, 4 parts of 5% Zn $SO_4 \cdot 7H_2O$ and 4 parts of 0.3 N $Ba(OH)_2$. The relatively large amounts of the Somogyi reagents used were necessary to obtain a satisfactory filtrate. The urine filtrate was treated in the same way as the filtrate of animal tissues in the Roe and Rice method.

*Effect of cold.* Twelve rats were placed in a constant temperature room at 31°C and control values were obtained on the urinary excretion of pentose over a period of 6 days. The animals were then placed in a constant temperature cold room at −1°C and the urinary pentose excretion was determined daily for a period of 6 days. A significant increase in the excretion of free pentose was observed ($P<0.01$). At the end of the 6 day period in the cold the animals were returned to the warm room at 31°C and the daily pentose excretion was determined for 6 days. In this follow-up period the urinary pentose excretion was essentially the same as observed during the original warm room period. These results are shown in Table I.

*Influence of adrenocorticotropic hormone (ACTH) upon exposure to cold.* Twelve rats were placed in a warm room at 31°C and control urinary pentose values were obtained for a 6 day period. The same animals were then transferred to a cold room at −1°C and 1 mg of ACTH† was given subcutaneously daily to each rat for 6 days. The daily urinary pentose excretion was determined during the latter period. As shown in Table I, the mean urinary excretion of pentose was slightly greater but this change is not statistically significant ($P$ = approximately 0.18). These data show that ACTH has an opposing influence upon the effect of cold on pentose excretion. The ACTH used produced glycosuria and increased uric acid ex-

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† Kindly supplied to us by the Armour Co.

TABLE I.
Effect of Cold and Administration of ACTH, Thyroid, and Thyroid Plus Thiouracil upon Urinary Pentose Excretion.
Data show average daily excretion of pentose as arabinose for periods of 6 days.

| Experiment | No. of rats | Control 31°C Mean, mg | Control 31°C Range, mg | Experimental —1°C Mean, mg | Experimental —1°C Range, mg | Follow-up 31°C Mean, mg | Follow-up 31°C Range, mg |
|---|---|---|---|---|---|---|---|
| Effect of cold | 12 | 2.47 ± .15 | 1.49-3.06 | 4.97 ± .19 | 4.01-6.15 | 2.54 ± .13 | 1.68-3.20 |
| Effect of cold + ACTH | 12 | 2.58 ± .12 | 1.91-3.57 | 2.93 ± .20 | 2.01-3.78 | — | — |
| | | | | Thyroid-fed 31°C | | Thyroid + Thiouracil-fed 31°C | |
| Effect of thyroid | 12 | 3.08 ± .25 | 1.25-4.42 | 6.20 ± .30 | 5.17-7.94 | 3.07 ± .16 | 2.01-3.99 |

The ± values are the standard error of the mean.

cretion in the rats and was thus shown to have biological potency.

*Effect of thyroid.* Twelve rats were placed in a warm room at 31°C and fed the basic diet, to which 2% of thyroid powder was added, for 6 days. As shown in Table I, the rats receiving thyroid powder showed a significant increase in the excretion of urinary pentose ($P<0.01$). The same animals were then fed the basic diet to which 2 g of thyroid powder and 2 g of thiouracil per 100 g of diet were added. The animals fed this diet showed a urinary pentose excretion practically the same as that observed during the control period.

*Discussion.* The method of Roe and Rice (5) does not determine appreciable amounts of combined pentose, as in this procedure the acetic acid reaction mixture is warmed at 70°C for only 10 minutes. The data reported are, therefore, for free pentose. It is possible that a part of the control values may be due to interfering substances. However, the increased values observed as a result of cold, or thyroid administration, very probably represent increases in true pentose. Evidence for this was obtained by the preparation of an absorption curve of the color produced with filtrate from a urine showing a high pentose value. The latter curve corresponded closely to the absorption curve of the color obtained with a pure arabinose solution.

The increased urinary pentose excretion resulting from cold appears to be due to increased metabolism mediated through the thyroid. Our results with thyroid feeding support this assumption. Under thyroid stimulation increased metabolism apparently brings about an increased cellular breakdown with an accelerated degradation of nucleotides. It has been shown that exposure to cold produces a rise in the metabolic rate and thyroid hyperplasia in the rat(6).

We observed a high concentration of free pentose in the blood of rats kept at −1°C. Blood studies will be reported later.

*Summary.* Low temperatures and thyroid administration increased significantly the urinary excretion of pentose in rats. ACTH administration had a preventive effect upon the increased pentosuria due to cold.

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