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Effect of Ingestion of Acid and Alkali upon Amount of Vitamin C Found in Urine.*

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In a 3-weeks' study of the vitamin C content of the urine of normal individuals when comparable amounts of vitamin C were added to a diet free of vitamin C in the form of orange juice, cevitamic acid by mouth and cevitamic acid intravenously (Hawley, Stephens & Anderson,[1]) unexplainable variations were found in the C output of several individuals. If this method, which appears to be the most satisfactory method of determining vitamin C undernutrition, is to be of value, the variation in response must not be greater than normal biological deviation. A chance observation on a hospital patient suggested that changes in the pH of the urine might be one factor affecting the results. Marked changes in the vitamin C content of the urine in spite of constancy of intake were observed and were found to be correlated inversely with the pH. Accordingly, the experiment now in progress, and to date of 13 weeks' duration, was designed. The subjects, 3 at first and then 2, have maintained throughout a constant diet. The effect of changes in pH brought about by the ingestion of $NaHCO_3$ or of NH_4Cl on vitamin C content of the urine has been observed when the vitamin was administered as orange juice and cevitamic acid (Merck's "Cebione" supplied by them for this purpose) both by mouth and by intravenous injection.

The effect was striking and consistent. A marked decrease in output has resulted in all instances when the urinary pH was in the alkaline range of 7.5-8.1. This effect was found not to be due to a reversible oxidation. The question arises whether this decrease is due to destruction or to better utilization (increased storage) of the vitamin. One might assume the latter from the fact that foods rich in vitamin C are initially acid but basic as a result of metabolic processes. Preliminary studies on the C content of guinea pig liver (Hawley & Daggs—unpublished work) suggest that there is greater storage under the influence of the $NaHCO_3$. A

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[1] Hawley, Stephens and Anderson, *J. Nutrition*, 1936, **11**, 135.

comprehensive study has been started to determine, if possible, the reason for this variation.

Summary: Alterations in urinary pH have a definite effect on the vitamin C content of the urine. The amount found is less when the reaction is in the alkaline range.

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Enhancement of Muscle Contraction after Tetanus.

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(Introduced by H. S. Liddell.)

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The contractions of sciatic-gastrocnemius preparations of *Rana pipiens* were recorded isotonically by means of a free-weighted lever loaded with 20 or 30 gm. The preparations were repeatedly stimulated with maximal break shocks at intervals of one second. At one-half minute intervals a tetanising current (10 per second) was applied for 5 seconds. The following changes in amplitude of contraction after tetanus, as compared with the amplitude before tetanus, appeared:

1. *Normal Muscle.* A. *Indirect Stimulation.* In a fatiguing muscle an increase in amplitude occurred and the percent increase became greater (up to 800%) as fatigue progressed. No change was observed in unfatigued muscle, and tetanus during this time diminished the increase to be expected in fatigue. The enhancement of contractions in a fatigued muscle was greater after tetanus (for 5 seconds) than after a rest period of similar duration, and the enhancement persisted for a greater number of stimulations.

B. *Direct Stimulation.* Fine copper wires, inserted into the belly of the gastrocnemius, were employed. No increases appeared in most of the experiments. It is concluded that in those fatigued preparations in which enhancement occurred after each tetanus some muscle fibers were being stimulated indirectly. This has been proved by the studies on curarised preparations.

2. *Curarised Muscle.* There was no enhancement after tetanus during direct stimulation of the gastrocnemius. It is therefore