Effect of Thyroxine, Hydrocortisone and Growth Hormone on Food Intake in Rats.*† (29746)

J. GROSSIE AND C. W. TURNER
Department of Dairy Husbandry, University of Missouri, Columbia

During lactation, food consumption of rats gradually increased from a mean of 5.26 g/100 g bw/day in normal animals to 14.1 g/100 g bw/day on day 20 of lactation(1,2). In nutrition practice, the difference between total food consumption of lactating animals minus the maintenance requirement would indicate the requirement for lactation and the efficiency of the animal as a transformer of food nutrients into milk nutrients. This method does not take into account the possibility that the maintenance requirement of lactating animals is greater than that of non-lactating animals. It has been shown that the secretion rate of several hormones is increased during lactation, including thyroxine (3), adrenal glucocorticoids(4), lactogen(5) and possibly growth hormone(6). If one determined the influence of these hormones separately and together on food intake one might estimate the maintenance requirement of the lactating animal.

In this report are presented data on the feed consumption of normal female rats as influenced by the administration of several hormones which influence the lactation process in order to attempt to estimate the maintenance requirement of animals which are stimulated by levels of hormones secreted by lactating animals.

Materials and methods. Female Sprague-Dawley-Rolfsmeyer rats weighing from 200 to 270 g were maintained as described previously(1) and the mean daily consumption of Purina Lab Chow was determined for a period of 6 days.

Sodium L-thyroxine (T_4), hydrocortisone acetate (HCA), and growth hormone (GH) were administered separately and in combination as indicated in Table I. After 3 days of hormone administration, the mean daily feed consumption was again determined for the duration of experiment.

Sodium L-thyroxine prepared in a slightly alkaline saline solution was administered at a level of 3.0 μg/100 g bw/day. Hydrocortisone acetate suspended in normal saline with the aid of 5 mg of gum arabic per 100 mg was administered at the rate of 500 μg/day. Bovine growth hormone‡ prepared in a slightly alkaline saline solution was administered at the rate of 1 mg per day.

Results. A group of 16 female rats weighing a mean of 221 g showed a normal food intake of 13.6 g/day or 6.29 g/100 g bw. Thyroxine at a level of 3 μg/100 g bw was then injected daily for 3 days prior to determination of the food consumption. At this level of administration daily food consumption increased to a mean of 14.55 g or 6.38 g/100 g bw, a non-significant increase of 1.43% (Table I).

A similar group of 16 rats showed a mean normal food intake of 14.03 g/day or 6.65 g/100 g bw. Hydrocortisone acetate at a level of 500 μg/day was injected for 3 days, then the daily feed consumption was determined for a period of 6 days. The mean daily feed consumption increased to 15.04 g or 7.07 g/100 g bw, a significant increase of 6.32% ($t=2.33$).

The group of animals receiving T_4 was continued and 500 μg HCA was added. Food intake was reduced slightly to 14.24 g/day and 6.16 g/100 g bw, a decrease of 2.07%.

The group of rats receiving HCA was continued and 3 μg/100 g bw of T_4 was added. Food intake was 13.96 g/day or 6.62 g/100 g bw, a reduction of only 0.45%.

A group of 16 rats weighing a mean of 256 g had a normal mean food intake of 15.28 g/day or 5.97 g/100 g bw. Growth hormone at a level of 1 mg/day was then administered for 10 days followed by a food intake determination of 6 days. During 16 days of treatment the rats gained a mean

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TABLE I. Effect of Thyroxine, Hydrocortisone and Growth Hormone on Food Intake.

Treatment	No. of animals	Body wt, g	Normal food intake/day Total, g	Normal food intake/day g/100 g bw	Post-treatment body wt, g	Food intake/day treatment Total, g	Food intake/day treatment g/100 g bw	Duration of treatment, days	% Change in food intake
T_4*	16	221	13.60	6.29	233	14.55	6.38	9†	+1.43
HCA†	16	215	14.03	6.65	214	15.04	7.07	9†	+6.32
T_4 + HCA	16	221	13.60	6.29	223	14.24	6.16	9	− 2.07
HCA + T_4	16	215	14.03	6.65	210	13.96	6.62	9	− .45
GH‡	16	256	15.28	5.97	280	15.84	5.73	16	− 4.02
GH + T_4					293	15.39	5.19	14	−13.07
GH + T_4 + HCA					291	14.53	5.05	12	−15.41

* Thyroxine (T_4) at level 3.0 μg/100 g bw/day.
† Hydrocortisone acetate (HCA) at level of 500 μg/day.
‡ Growth hormone (GH) at level of 1 mg/day.

of 24 g. Daily food intake increased to 15.8 g/day but due to the gain in weight declined to 5.73 g/100 g bw, a decrease of 4.02%.

At the end of 16 days of GH treatment, thyroxine at level of 3 μg/100 g bw was added to and administered with GH for 13 days. Food intake declined from 15.84 g/day and 5.73 g/100 g bw to 15.39 g/day and 5.19 g/100 g bw, a decrease of 13.07%. During this period, bw increased from a mean of 280 to 293 g.

Next, HCA was added at a level of 500 μg/day and T_4 and GH continued. Mean daily feed consumption declined from 15.39 g/day and 5.39/100 g bw to 14.53 g/day and 5.05 g/100 g bw, a decline of 15.41%.

Discussion. During the 20-day lactation period of rats there is approximately a 3-fold increase in daily feed consumption(2). Milk yield measured following a 10-hour period of separation of the young from their mothers, indicates an increased secretion up to the 18th day(7). In a series of studies in this laboratory, optimal levels of several hormones which increase the intensity of milk secretion have been determined(8).

In other studies, the influence of thyroxine on food intake has been reported(9,10). It was shown that T_4 increased food consumption. In the present study, T_4 injected at the level of 3 μg/100 g bw/day, which is optimal for stimulating increased lactation, did not significantly increase food consumption.

In previous studies with cortisone acetate at levels of 2 to 4 mg/day(11,12) both growth and feed intake were reduced. In a study in this laboratory, normal lactation was maintained in adrenalectomized rats with 500 μg HCA/day(4). In the present study this level of HCA stimulated a significant increase in food consumption. However, when T_4 and HCA were administered together, there was no significant additional effect on food consumption.

The injection of 1 mg GH/day for 16 days stimulated increased mean body weight 24 g during a period of 16 days. However, mean daily food consumption per 100 g bw during the last 6 days of the experiment declined slightly due to the increased body weight. When T_4 was added at level of 3 μg/100 g bw/day to GH food intake was reduced slightly and was further reduced when HCA was added.

Under the conditions of this experiment simultaneous administration of T_4, HCA and GH to non-lactating rats did not increase food consumption but rather had a slight reverse effect. It is possible that levels of the hormones which are optimal for lactation are excessive in the non-lactating rat. If true, then the objective of the experiment can not be realized.

Summary. The mean daily food intake of female Sprague-Dawley-Rolfsmeyer rats weighing 200 to 270 g was determined during 6-day periods. Then Na L-thyroxine (T_4), hydrocortisone acetate (HCA) and growth hormone (GH) were administered separately and together to determine their influence on food consumption. T_4 had a non-significant effect, HCA induced a significant increase of 6.32%, whereas GH increased total food in-

take slightly but based on a 24 g increase in bw, the food intake/100 g bw was reduced 4.02%. The combination of 2 or 3 hormones in all cases depressed food consumption/100 g bw.

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Verification of L-Ascorbic-1-C^{14} Acid Catabolism to Carbon^{14} Dioxide in the Human by Liquid Scintillation Counting. (29747)

SUSANNE L. VON SCHUCHLING AND ARTHUR F. ABT
(Introduced by Kung-Ying Tang Kao)
Veterans Administration Center, Martinsburg, West Va.

We have previously noted a new excretory pathway for ascorbic acid catabolism in man, the respiratory tract(1). Our data were obtained from 4 human volunteers. We were the first to establish that in man and the monkey(2), the major portion of ascorbic acid is excreted within the first few hours following ingestion, both through the expired air and the urine in a manner similar to that reported for the guinea pig(3,4).

Baker *et al*(5) reported on the catabolism of D-glucuronolactone-6-C^{14} and L-ascorbic-1-C^{14} acid. They noted that L-ascorbic-1-C^{14} acid was synthesized from D-glucuronolactone-6-C^{14} in the human. This is not in agreement with Grollman and Lehninger(6). Similarly their statement(5), that no L-ascorbic-1-C^{14} acid was catabolized and expired as $C^{14}O_2$ in man, is in contradiction to our reported findings(1).

Later Baker *et al*(7) studied the catabolism of the degradative intermediates of L-ascorbic-1-C^{14} acid in man and noted that, in contrast to intact ascorbic acid, when the degraded material was ingested by human subjects, carbon^{14} dioxide was found in the expired air. They stated that in 2 human subjects given the degraded substances "C^{14} activity of the respiratory CO_2 returned to background activity in 6-13 hours. However, C^{14} activity of the respiratory CO_2 of the subjects was measured at 24-hour intervals during a 5-day period following the first day of experiment."

Baker concluded that Abt *et al*(1) used similarly degraded L-ascorbic-1-C^{14} acid and that the observed carbon^{14} dioxide was therefore not a true metabolite.

The instability of vitamin C in solution is a well established fact(8). We have been cognizant that "Ascorbic Acid is one of many compounds that may undergo degradation during aging in solution"(9).

Due to the importance of accurately establishing the catabolism of ascorbic acid and its relation to human nutrition, we have obtained new data from a fifth volunteer, which we report here. We are presenting a paper chromatogram and a radiochromatogram prepared from the labeled L-ascorbic-1-C^{14} acid used in the human study here presented. This has been a routine procedure in all our