^{75}Se-Selenomethionine Turnover Rate During Growth and Aging in Rats[1] (34687)

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Protein metabolism in young animals expresses both synthesis and renewal synthesis, whereas in old animals, when growth has ceased, it is primarily the expression of renewal synthesis. Data on protein metabolism in relation to age have been inconclusive. Investigators using conventional nitrogen balance techniques have found that with advancing age the minimum nitrogen requirement is increased (1, 2), decreased (3), and unaltered (4). Recent studies on amino acid turnover rate in various tissues suggest a greater turnover rate in old rats than in young rats (5–7). Similarly, the increased RNA in the cells of aged mice has suggested increased protein turnover with age (8). In contrast, a study on total body protein turnover rate in rats aged 10, 13, and 24 months indicates a stability of protein turnover throughout the life cycle of the rat (9). The preceding conclusion, however, does not include data on the ages from weaning to 10 months. The present paper presents data on total body ^{75}Se-selenomethionine turnover rate as an index for protein metabolism of young and old rats ranging in age from 1 to 20 months.

Materials and Methods. Male albino rats of the Holtzman strain were placed in the laboratory at about 23 days of age. Fifty-seven rats were divided into 5 age groups. The ages at the data of injection of ^{75}Se-selenomethionine were approximately 30, 150, 240, 450, and 600 days. All rats were kept in suspension cages in a room with the temperature constant at 28 ± 2°. Water and standard laboratory chow were available *ad libitum*. The method of using ^{75}Se-selenomethionine as an index of protein metabolism was discussed previously (10, 11). Each rat was injected intraperitoneally with 0.5 or 1.0 μCi in physiological saline. At 48-hr postinjection the whole body activity was assayed in a 2-pi liquid scintillation whole body counter (12) on alternate days for a period of 16 days. The turnover (k) of ^{75}Se-selenomethionine was calculated as described by Yousef and Luick (11). The k is defined as the fraction of the body's protein pool turned over per day.

The data were subjected to statistical analysis using the Student's t test.

Results. The incorporation of the injected ^{75}Se-selenomethionine into newly formed proteins in various tissues was established previously in rats (9, 10) and mice (11). The data on the biokinetic characteristics of selenomethionine in rats of different ages are shown in Table I. A comparison between the

TABLE I. ^{75}Se-Selenomethionine Turnover Rate in Rats of Different Ages.

Group	Age[a] (days)	No. of animals	$k^b \times 10^2$
1	30	12	6.19 ± 0.11
2	150	16	5.01 ± 0.18
3	240	10	4.57 ± 0.15
4	450	10	3.99 ± 0.13
5	600	9	3.80 ± 0.39

[a] Age at injection of selenomethionine.

[b] k is the fraction of the body's protein pool turned over per day.

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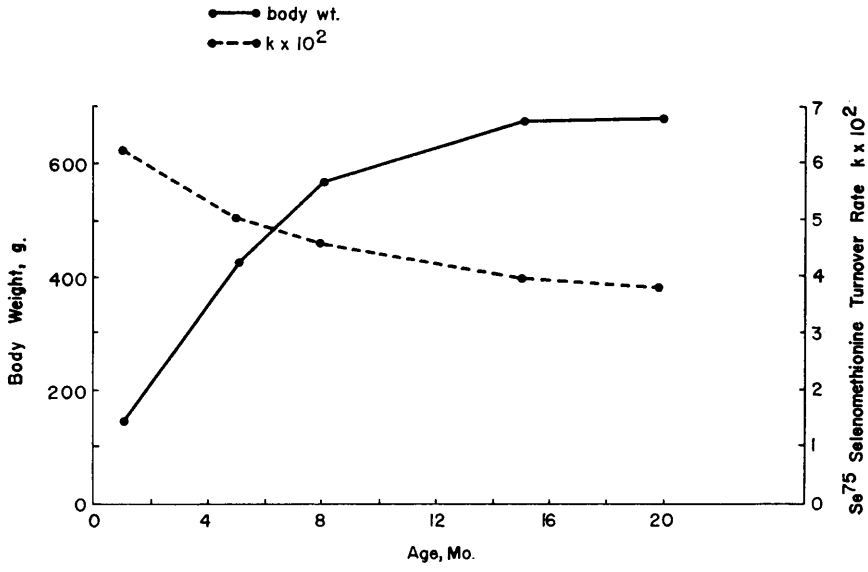

FIG. 1. Effect of age on ^{75}Se-selenomethionine turnover rate and the relation to growth in male rats.

5 age groups indicates that protein turnover is relatively rapid in young rats up to approximately 150 days of age. This higher protein turnover coincides with the rapid increase in body weight as shown in Fig. 1. Beyond 150 days of age, protein turnover rate is lessened. In other words, protein turnover rate decreased gradually with advancing age, *i.e.*, 19% between 30 and 150 days, 9% between 150 and 240 days, 12% between 240 and 450 days, and 5% between 450 and 600 days. Thus protein turnover rate in 600-day-old rats was 39% lower than that of 30 day rats.

Discussion. The most important conclusion from this study is that protein turnover rate is rapid in young rats up to 150 days of age, and stable beyond the ages of 240 to 360 days. This conclsion disagrees with that of Mende and Viamonte (9) who stated that protein turnover, as measured by an internal indicator, is a very stable function throughout the life cycle of the rat. The data presented in Fig. 1 indicate that in the early age (less than 150 days) of the life cycle, rats need more protein not only for growth but because of their higher metabolic rate and the rapid turnover rate of other nutrients. Kibler *et al.* (13) presented data on metabolic trends during the life-span of the Holtzman rats. They found that metabolic rate and food intake per unit of body weight is high up to 100 days of age and almost stable beyond 200–300 days of age. This is in agreement with our conclusion on protein turnover rate of the same strain of rats. The reason for for the stable protein turnover rate beyond the age of 240 days may be due to the fact that activity is the major function for which caloric requirements are needed, and activity, unlike growth, does not involve additional expenditure of nitrogen. Data on amino acid turnover rate in some tissues suggest a greater turnover in old than in young rats. However, the total body protein turnover rate as shown in Table I is significantly higher for rats younger than 150 days. The discrepancy here indicates that protein turnover does not increase in all tissues of the old rats. For example, Yiengst *et al.* (14) found a decrease in muscle mass of old rats and in protein content of muscles in old rats. Also, Andrew *et al.* (15) showed a decrease in the postmitotic units of the skeletal muscles in old age; however, the liver showed evidence of little or no loss of such units in old age. Based on the results reported to date, there is a need for further studies to establish the turnover rate of additional tissues other than

liver and kidney of the same rats from weaning age to senility.

Summary. ^{75}Se-selenomethionine turnover rate was used as an index for protein metabolism in rats ranging in age from 30 to 600 days of age. The data indicated that protein turnover rate was more rapid in young (150 days or less) than in old rats (600 days of age) and this rate is stable beyond 240 and 360 days of age.

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