Reports

Graying of Hair in Rats Fed a Ration Deficient in Lysine

As early as 1914, Osborne and Mendel demonstrated the essential nature of lysine for the growth of rats that were fed a diet containing zein as the sole source of protein. The rats were maintained at an almost constant body weight for 182 days, and they also showed no growth of hair (*1*). This result has been confirmed further by the studies of Rose (*2*) in which purified rations with mixtures of amino acids to simulate the composition of protein were supplied to rats. Smuts *et al.* (*3*) have also verified that lysine deficiency inhibits the body as well as the hair growth, but found no difference in the cystine content of the hair of normal and lysine-deficient rats.

In turkey poults, a deficiency of lysine has been shown to cause depigmentation of feathers (*4*); this implies an interference in the synthesis of melanin. It is of interest to find whether lysine deficiency has any effect on the graying of hair in a mammal such as the rat.

In the earlier studies, albino rats were used for determining lysine requirements and any graying tendencies would have been very difficult to notice. For this reason, black rats of the Long-Evans strain which are maintained in the animal husbandry department at the University of California, Davis, were used.

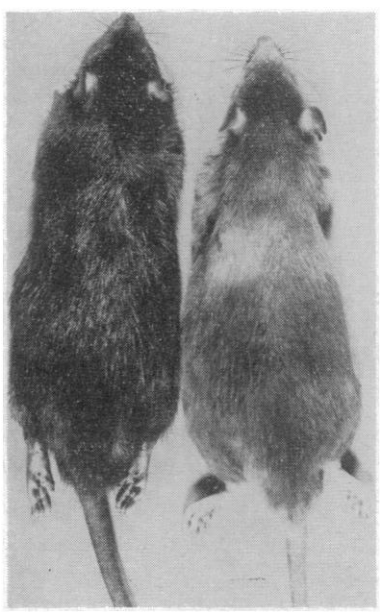

Fig. 1. Rats fed lysine-deficient and supplemented diets. Note the lighter coat color of the deficient rat on the right.

Five black male rats, weaned at about 21 days of age (not necessarily litter mates) were divided into two groups, A and B of 3 and 2 animals, respectively, and were maintained on a gluten-basal diet for a period of 25 days. Each 100 g of this ration contained the following components: glucose, 62.6 g; gluten (81 percent protein), 25.0 g; soybean oil, 5.0 g; HMV salt mix, 4.0 g; vitamin mix (Vohra and Kratzer, *5*), 2.0 g; choline chloride (25 percent), 0.8 g; DL-tryptophan, 0.12 g; DL-methionine, 0.1 g; dry vitamin A (10,000 units/g), 0.1 g; dry vitamin D_3 (1,500 units/g), 0.1 g; dry vitamin E (44 units/g), 0.1 g; biotin, 0.02 mg; and vitamin B_{12}, 0.001 mg. The rats were weighed two times a week and were found to gain an average of 0.8 percent of their body weight per day. After 25 days, the control group A was fed a sesame-basal diet (Vohra and Kratzer, *5*) which was slightly deficient in lysine and which has caused a depigmentation in turkey poult feathers. Group B was given the sesame-basal diet supplemented with 1.1 percent DL-lysine, which has proved to be adequate in preventing the depigmentation of poult feathers. Again, the feed and water were supplied *ad libitum*. A portion of the back of each rat was shaved to facilitate noting the change in color of the growing hair.

The sesame-basal diet produced growth of 3.5 percent daily gain, which was much more rapid than that produced by the gluten-basal ration, although it was not optimal. The addition of 1.1 percent of DL-lysine improved the growth of the rats to 4.1 percent daily gain.

The most noticeable difference in the two groups was in the color and texture of the hair coats (Fig. 1). The coats of the lysine-deficient rats were very much lighter in color and finer in texture than the dark black and coarse hair coats of the lysine-supplemented rats. This experiment has been repeated three times, and lysine deficiency has caused a graying of the hair each time.

From these experiments it may be concluded that lysine plays some role in the synthesis of melanin in the hair of rats as well as in the feathers of turkey poults.

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References

1. T. B. Osborne and L. B. Mendel, *J. Biol. Chem.* 18, 1 (1914); 20, 351 (1915).
2. W. C. Rose, *Physiol. Revs.* 18, 109 (1938).
3. D. B. Smuts, H. H. Mitchell, T. S. Hamilton, *J. Biol. Chem.* 95, 283 (1932).
4. J. C. Fritz *et al.*, *J. Nutrition* 31, 387 (1946); F. H. Kratzer, D. E. Williams, B. Marshall, *Poultry Sci.* 29, 285 (1950).
5. P. Vohra and F. H. Kratzer, *Arch. Biochem. and Biophys.*, in press.

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Spontaneous Rewarming of the Hypothermic Curarized Dog

That striated muscle plays a leading role in the regulation of body temperature is a widely accepted concept. It is not certain, however, that this is the only source of heat production which is actively regulated in the process of maintaining normal body temperatures or whether there are other heat-producing mechanisms that are subject to thermostatic control.

Many years ago it was postulated that either shivering or chemical regulation or both were involved in maintaining normal temperature levels in a cold environment (*1*). The term *chemical regulation* was never made clear but was intended to represent a rise in metabolism due neither to muscular activity nor to increased muscular tension (*2*). Chemical agents or calorigenic hormones or both were considered possibly responsible. The findings of increased oxygen consumption and succinoxidase activity in liver tissue after chronic exposure of rats to cold have been presented as a direct demonstration of increased metabolism of visceral tissue. The mechanisms of these increases were not made clear (*3*).

DuBois (*4*) believed it quite possible that imperceptible tensing of muscles could account for all so-called "chemical regulation"; Burton and Bronk (*5*) and Sellers *et al.* (*6*) demonstrated that there was increased muscular tension and electric activity with resultant increased oxygen consumpion before shivering became overt. Following acute exposure to cold of dogs anesthetized with thiopentone, Ross and Werner (*7*) believed that they observed an initial spontaneous re-