THE EFFECT OF IMBALANCE IN THE "FILTRATE FRACTION" OF THE VITAMIN B COMPLEX IN DOGS[1]

THE graying of fur and damage to the adrenal cortex of rats first reported[2] from this laboratory as due to deficiency in the "filtrate fraction" of the vitamin B complex has been confirmed and extended in several other laboratories. Long-continued experiments are required for adequate observation of these deficiencies in dogs and these have now been under way in this laboratory for about two years. Even in very young animals several months are required for the development of overt symptoms of deficiency in any of the B vitamins, with the possible exception of B_1. Since these experiments appear to be the first in which dogs have been reared exclusively on crystalline vitamins and since some unexpected failures of nutrition occurred when certain vitamins were added to the deficient diet it seems desirable to offer this preliminary report.

Four lots of pure-bred cocker spaniels have been reared from weaning at four to six weeks of age on purified diet of washed casein, sucrose, crisco, salt mix, carotene and codliver oil, wheat germ oil and crystalline thiamin chloride, vitamin B_6 (pyridoxin) and riboflavin. The variables in all cases were (a) filtrate factor, that is the concentrated filtrate from fuller's earth-treated acetone extracts of yeast, (b) nicotinic acid and (c) pantothenic acid.[3] The filtrate factor preparation contained pantothenic acid, 0.6 mg per cc by rat growth comparison and traces of nicotinic acid. At first only filtrate fraction and nicotinic acid were used, but later crystalline synthetic calcium pantothenate was administered in some cases, either with or without the filtrate preparation. One litter of four dogs has been on the diet for nineteen months, a second group of six dogs for twelve months, the third litter of three dogs for eight months and the fourth litter of six dogs for six months.

There were nineteen dogs in the four experiments, but on three of these dogs, we will not report at this time. These three dogs were placed on salt-free (NaCl-free) diet, and this complicated the effect of the vitamin deficiencies in an unexpected way. The other sixteen dogs were found to react as described below.

(I) Three which were positive controls, receiving adequate amounts of all vitamins, are alive and well, although not quite as heavy as stock dogs of the same age.

(II) Two of which received no nicotinic acid, no pantothenic acid and no anti-gray preparation are alive and well, but with progressively graying fur. No black tongue sypmptoms have been seen, but inactivity, impaired digestion and sedate elderly behavior characterize these dogs. The third died of an infection after 6 months on the diet.

(III) Four received an ample amount of nicotinic acid but no pantothenic acid or "filtrate factor." Three of these are dead of progressive flaccid paralysis; one when helpless and near death was cured with filtrate fraction and is now, a year later, alive and well, her fur darkened.

(IV) Four were given ample amounts of "filtrate factor" and/or pantothenic acid but no nicotinic acid. Two of these are dead, one after showing slowly progressing paralysis over five or six months' time and one within three months. The third is now plainly showing the beginnings of the same condition and the fourth, which has received filtrate fraction for eighteen months, is still alive and apparently well. This dog has now been placed on pantothenic acid instead of filtrate fraction, since the latter is not entirely free from nicotinic acid.

(V) The two remaining dogs receive pantothenic and nicotinic acids but no "filtrate factor." After six months on the diet one of these dogs, the male, is still well, growing and so far showing no graying of the fur. However, the fur is dull and powdery instead of glistening black and the dog is beginning to show some failure of neuro-muscular control. The other animal, a female, has lost appetite and weight, and is exhibiting much more advanced failure of neuro-muscular control. Her condition is not as good as that of her brother which has at no time received any of the filtrate factors (Group II above).

The following conclusions appear to be justified by these results:

1. Dogs require one or more of the vitamins of the B complex in addition to thiamin, riboflavin, pyridoxin, nicotinic acid and pantothenic acid.

2. Young dogs which receive none of the filtrate fraction, that is, no nicotinic acid, pantothenic acid or so-far unidentified factors, survive, grow moderately well but exhibit gradual depigmentation of hair, lack of activity and elderly behavior.

3. The administration of nicotinic acid or pantothenic acid alone to animals receiving ample amounts of all necessary vitamins except those of the "filtrate fraction" results in their gradual loss of neuro-muscular control and sometimes sudden death.

Attention should be given to the possible danger of the administration of large amounts of certain vitamins such as nicotinic acid to persons subsisting on diets having multiple deficiencies. Fortification of foods with those vitamins such as thiamin or nicotinic acid which are available in large quantities may precipitate conditions worse than the subacute deficiency state produced by the usual diet balanced in its inadequacies. Improvement in all directions equally is essential.

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[2] Morgan, Cook and Davison, *Jour. Nutrition*, 15: 27, 1938; Morgan and Simms, *Jour. Nutrition*, 19: 233, 1940.

[3] We are grateful for gifts of crystalline pyridoxin and of calcium pantothenate from Merck and Company, Rahway, New Jersey.