Proceedings
of the
Society
for
Experimental Biology and Medicine

VOL. 54 DECEMBER, 1943 No. 3

SECTION MEETINGS

ILLINOIS	
University of Chicago	November 9, 1943
IOWA	
State University of Iowa	November 18, 1943
PACIFIC COAST	
Stanford University	September 22, 1943

14396

Heightened Thiamine and Choline Requirements in Tropical Heat.

C. A. MILLS. (Introduced by S. Tashiro.)

From the Department of Experimental Medicine, University of Cincinnati.

Keys[1] recently dismissed our findings of heightened thiamine and choline requirements in tropical heat with the brief statement that they were unconvincing. The only basis given for his conclusion was his own study of human subjects exposed to high temperatures *for only one week or less*. In this brief interval of heat exposure, he failed to find any improvement in work performance with accessory vitamin administration (with men on regular army rations).

Reference to the published literature would have shown that no deficiency effects should have been expected in so short a period. Rat growth and food consumption rates begin to show the influence of vitamin deficiency only during the second (or some subsequent) week. This was plainly stated and made clear in the data presented in our paper on heightened thiamine need in the heat.[2] Others[3] have shown that the metabolic adaptation to change in environmental temperature begins in the second week of exposure and is largely accomplished by the end of the third week. Human tests *covering one week or less* therefore have no valid bearing upon the problem and provide no basis for a conviction one way or another.

Since any real heightening of vitamin requirement in tropical heat is a matter of great importance in human and animal nutrition, it is well to eliminate every possible uncertainty. With all vitamins added to our diet mixture and new food given only once or twice a week, it was possible that the destruction of thiamine and choline was more rapid in the feed jars at 90°F than at 68°F and that this may have been the basis of the apparent heightening in requirement. To test this point we kept the diet stocks in a refrigerator and fed only one day's supply at a time, discarding all left-over food. Weanling white rats (Sprague-Dawley males) were divided into groups of 4, 2 to the cage. Daily

1 Keys, Ancel, *Fed. Proc.*, 1943, **2**, 164.

2 Mills, C. A., *Am. J. Physiol.*, 1941, **133**, 525.

3 Gelineo, S., *Amn. de Physiol.*, 1934, **10**, 1083; Lee, Robert C., *J. Nutrition*, 1942, **23**, 83.

record was kept of body weight and food consumption. Diets used were the same as previously described[4] except for the addition of vitamin K (2-methyl-1,4-naphthoquinone, 5 mg/kg) and vitamin E (a-tocopherol, 50 mg/kg). The diet containing 1 mg thiamine and 0.75 g choline per kilo of food gives optimal growth at 68°F, while for the same growth rate at 90-91°F 2 mg thiamine and 5 g choline are needed. The following results were obtained after 5 weeks of fresh daily feedings of these diets to 3 series of rats in the heat and cold:

	Wt gain 3rd, 4th, 5th wks, g	Food eaten in same period, g
Optimal cold room diet:		
Rats kept at 68° F	72.50 ± 4.16	284
Rats kept at 90-91°	42.50 ± 2.12	169
Opt. hot room diet:		
Rats kept at 90-91°F	70.83 ± 1.54	201

The difference between the 2 groups in the hot room (28.33 ± 2.70) would almost never occur by chance alone. This sharply reduced rate of growth, seen when the cold-room diet is used for rats kept in the heat, agrees with all our former results obtained with weekly or semi-weekly feedings. It therefore cannot be vitamin loss on standing exposed to tropical warmth which accounts for the higher thiamine and choline needs in this environment.

Until carefully controlled and adequately planned investigation has shown that thiamine and choline requirements *are not increased* in hot environments, it would seem that our positive findings in the matter should not be dismissed.

[4] Mills, C. A., *Arch. Biochem.*, 1943, **2**, 159.

14397

The Presence of a Choline-like Substance in Several Injectable Solutions of Liver.*

J. E. DAVIS AND M. J. C. ALLINSON.

From the Department of Physiology and Pharmacology, University of Arkansas School of Medicine, Little Rock.

It has been shown that experimental polycythemia may be depressed in dogs by the feeding of raw liver or the injection of a purified solution of liver,[1] and also by the feeding of choline hydrochloride.[2] Jacobs[3] has reported that a crude solid liver extract which is effective in the treatment of pernicious anemia contains at least 1% of choline. We have reported the presence of choline in Stomach U.S.P. and the effectiveness of the latter in reducing experimental polycythemia in dogs.[4]

The purpose of this investigation was to determine whether highly purified parenteral solutions of liver contain any choline or choline-like activity.

Methods. Seven injectable solutions of liver, which are available in the market, and which bear labels giving their anti-pernicious anemia potencies in U.S.P. units were obtained. These were tested for possible vasodepressor activity on dogs anesthetized by pentobarbital sodium (30 mg/kg). The extracts were injected intravenously, and the mean carotid arterial pressure was recorded from a mercury manometer.

In further experiments, 6 of the liver extracts were acetylated by the method of Mentzer *et al.*[5] modified to the extent that acetic anhydride was used instead of acetyl chloride. Choline hydrochloride when acetyl-

* Research paper No. 541, Journal series, University of Arkansas.

[1] Davis, J. E., *Am. J. Physiol.*, 1938, **122**, 397.

[2] Davis, J. E., *Am. J. Physiol.*, 1939, **127**, 322.

[3] Jacobs, H. R., *J. Lab. and Clin. Med.*, 1938, **24**, 128.

[4] Davis, J. E., in press.

[5] Mentzer, C., Corteggiani, E., and Carayon-Gentil, A., *Bull. Soc. Chim. Biol.*, 1939, **21**, 503.