CCLXXX. THE VITAMIN B₁ CONTENT OF FOODS

II. ADDITIONAL VALUES

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WE have previously published the vitamin B₁ values of about 80 foods [Baker & Wright, 1935]. The following additional values have been obtained by the same technique. A few figures for breads, some of which have been published elsewhere [Baker *et al.* 1937], are included for convenience of reference. Values are given in terms of International units.

Material	Dose (g.)	I.U./g.	Remarks
Meat, offal and fish			
Raw lean beef	4	0.3 -0.5	0.5 previously published
	6	0.4	
Cooked tongue	4	0.3 -0.45	—
Stewed steak	6	0.1 -0.2	—
Stewed rabbit	4	0.2 -0.4	Same sample
	6	0.2	
Stewed tripe	6	Less than 0.2	—
Fried sweetbread	4	0.2-0.4	—
Fried bacon	0.5	2.8 -4.8	Cf. roast pork 3.2, boiled ham 2.2
Fried herring	4	0	—
Dairy produce			
Sweetened condensed milk	5	0.4 -0.6	Cf. raw milk 0.23
Vegetables			
Cooked haricot beans	4	0.4 -0.6	Cf. raw 1.2
	6	0.35-0.6	
Cooked butter beans	4	0.2 -0.3	—
Raw green runner beans	4	0.25-0.75	—
Raw cauliflower	4	0.4 -0.5	Previous value 1.1
Raw marrow	8	0.1 -0.2	—
Raw fresh peas	1	1.6 -2.8	—
Cooked fresh peas	4	0.8 -1.1	Same sample
	2	1.0 -1.2	
Raw dried peas	1	4.2 -4.8	Cf. canned peas 1.2
Cooked dried peas	3	0.15-0.45	—
	5	0.2 -0.4	
Stewed onions	4	0.3 -0.5	Cf. raw 0.4
Fruits			
Black currants	5	0.0 -0.2	—
Blackberries	5	0.0 -0.2	—
Melon	10	0.1 -0.2	—
Fresh ripe peach	4	0.1 -0.4	—
Canned peach	5	0.1 -0.3	—
Syrup from peach	—	Traces only	—
Raspberries	6	0.25-0.35	—
Red currants	5	0.1 -0.2	—
Strawberries	4	Traces only	—
Cereals			
Boiled rice	8	—	—
Ground rice	8	0.15-0.35	—
Sago	8	—	—
Tapioca	8	—	—

Material	Dose (g.)	I.U./g.	Remarks
Cereals (<i>cont.</i>)			
Semolina (1)	8	0.35-0.45	2 different samples
(2)	4	0.55-0.65	
Millet (Juba)	3	0.6 -1.0	—
	2	0.8 -1.2	
Oatmeal	1	1.1 -1.7	Previous figures 3.25, 1.4
	2	1.0 -1.2	
Rolled oats	1	1.8 -2.7	—
	2	1.45-2.0	
Miscellaneous			
Black treacle W. Indian	1	—	—
Breads			
Special brown (London): Sample (1)	3	0.45-0.6	Cf. previous values of other brown breads, 0.5, 0.7, 0.5
Sample (2)	3	0.6 -1.0	
Special brown (Cheshire)	3	1.2 -1.4	Cf. previous values for wholemeal bread, 1.1, 1.2, 1.2
			Probably in the germ bread class.
			Cf. previous values of other germ breads, 1.2, 1.65, 1.7
Wholemeal stone-ground (Cambridge)	4	0.4 -0.6	A bread definitely lower in vit. B ₁ than others known to be wholemeal
	3	0.35-0.45	
Austrian, Sample (1)	3	0.5 -0.7	Cf. also previously published values for white bread; 4 samples London 0.14, 0.14, 0.15, 2.0; 1 sample Scotland 0.24; white with malt, 2 samples, 0.35, 0.35
Sample (2)	3	0.5 -0.9	

These foods have all been assayed by the rat-bradycardia method of Birch & Harris [1934], and since this method has been in use in this laboratory for 4 years a few comments may be useful.

Values obtained are in good agreement with those published by other workers, e.g.:

Material	Value by bradycardia method I.U./g.	Values reported by other workers, I.U./g.
White bread	0.14-0.2	0.12-0.15 [Harris, 1937] 0.17-0.25 [Copping & Roscoe, 1937]
Brown bread	0.5 -0.7	0.6 [Morgan & Frederick, 1935, 1]
Whole wheat bread	1.15, 1.2	1.17, 1.3 [Morgan & Frederick, 1935, 1]
Wheat, whole grain	1.2 -3.4	1.5 [Scheunert & Schieblich, 1937]
Bran	1.3, 3.0	3.6 [Leong & Harris, 1937]
Wheat germ, raw	4-22 (118 samples)	7.6-9.4 [Morgan & Frederick, 1935, 2]
Brewer's yeast	6.0 -23	16-18 [Chick & Jackson, 1932] 18-20 [Birch & Harris, 1934]
Banana	0.5	0.3-0.6 [Van Veen, 1935]
Potato	0.4	0.3-0.6 [Van Veen, 1935]
Lean beef	0.5	0.3-1.0 [Van Veen, 1935]
Raisins	0.75	0.5 [Morgan <i>et al.</i> 1935]

Assays repeated after long intervals have been found to give consistent results, e.g.:

	I.U./g.
White bread, sample (1) assayed 1935	0.0-0.2
(2) assayed 1936	0.1-0.2
(3) assayed 1937	0.1-0.3
Whole wheat, 1 sample, 1st assay 1935	1.6-2.4
2nd assay 1936	1.9-2.1

Recently Robertson & Doyle [1937] have called attention to various difficulties in the use of the method. They find wide differences in the rats' heart rate as recorded at two portions of the same electrocardiographic tracing and also occurring after a short interval without dosage of any vitamin B₁. As the result

Fig. 1. Heart rates recorded daily. Seven rats taken consecutively from the record book.

of experience involving over 80,000 readings, we do not find these difficulties serious. Irregularities such as extra systoles and dropped beats occur sometimes, though not often, and in these cases it is important to note that it is the rhythm which is being counted, not the actual number of beats. In electrocardiographic tracings 8–10 in. long, we do not find a variation greater than 5–10 beats per min., representing 1–3 % of the total heart rate and only a fraction of the variation which is brought about by an increased intake of vitamin B₁.

The accompanying graphs (Fig. 1) are records of the behaviour of a group of 7 consecutive rats taken from the daily record book. These show that the heart rate after a dose—as seen in 24-hourly readings—rises steeply and gradually drops to the initial level.

Fig. 2. Records of the heart rates of 2 rats measured 24-hourly and also at more frequent intervals to show the progressive rise or fall in heart rate. —○— All readings. --- 24-hour readings.

The records of rats nos. 135 and 57 (Fig. 2) show further that readings taken at more frequent intervals fall into place with the 24-hourly ones.

The rats' heart rate is, however, sensitive to very small variations in vitamin B₁ intake, and, while this is an advantage in permitting the assay of substances containing traces of the vitamin, it necessitates stringent care in practice to keep a continuous check on the basal diet by having 2 or 3 animals always as negative controls. That this is necessary is shown by the fact that a yeast sold commercially in America for use in vitamin B₁-deficient diets, and guaranteed to be free from vitamin B₁, was found electrocardiographically to contain about 1 I.U. vitamin B₁ per g. This amount in the yeast of a basal diet had actually been the cause of some puzzling results which were later explained when the presence of vitamin B₁ was known. On a basal diet completely devoid of vitamin B₁, the heart rate of a rat, if already dropping, becomes slower every day until death occurs with a rate usually of less than 300 beats per min. (see negative control graph, Fig. 3).

Fig. 3.

Fig. 4.

Fig. 3. Negative control records.

Fig. 4. The cardiographic response of the rat's heart to International Standard vitamin B₁. Composite curve from over 260 readings at each of 3 dose levels. o—o Duration of cure/dose. x—x Duration of cure/log dose.

15 mg. Int. St.	25 mg. Int. St.	40 mg. Int. St.
3.1 days (283 readings)	4.6 days (280 readings)	6.0 days (260 readings)

As in all biological assays, it is necessary to test the unknowns simultaneously with the standard of reference. In this laboratory three levels of international standard have been fed weekly and from the results obtained a considerable amount of information has been collected concerning the response to this substance. The curve shown in Fig. 4 was obtained from over 260 readings at each level and is logarithmic in form. There is little difference between the curves obtained from weekly readings and this composite curve, a fact which emphasizes the specificity of the cardiac response to vitamin B₁ and its independence of disturbing factors.

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