CLXX. VITAMIN B₁ IN THE ANIMAL ORGANISM

III. THE MAXIMUM STORAGE OF VITAMIN B₁ IN VARIOUS SPECIES

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SEVERAL studies have been made of the influence of diet on the vitamin B₁ content of the tissues of the rat [e.g. Osborne & Mendel, 1923; Westenbrink, 1932; Brodie & MacLeod, 1935]. Leong [1937, 1] found that "saturation" of the tissues of the rat with vitamin B₁ occurred when the intake was about 30 I.U. daily and that no further increase of reserves could be found when the intake was raised above this level. The two main sites of storage were the liver and the skeletal muscle and the maximum concentrations of the vitamin in these two tissues were 2.6 and 0.6 I.U. per g. respectively. Similar studies have recently been reported by Schultz *et al.* [1939], whose findings were in general agreement with those obtained by Leong [1937, 1].

As such quantitative studies may contribute to our understanding of the function of this vitamin in the animal body, further investigations into the extent of its storage in other species (*viz.* guinea-pig, fowl and pigeon) were carried out. It appears established that below a certain level of intake (*i.e.* the level that will result in maximum storage) the concentration and also the amount that can be stored are directly proportional to the amount ingested [Leong, 1937, 1; Schultz *et al.* 1939]. It was therefore decided to determine only the levels of maximum storage in these experimental animals. The results will also be of interest as they will show whether or not the levels of maximum storage in the different species are of a similar magnitude.

EXPERIMENTAL

Adult animals were employed and they were kept on their respective diets (which were supplemented with large amounts of vitamin B₁) for a period of about 3-4 weeks. After this they were killed by decapitation and their tissues assayed for vitamin B₁. The following is a description of the diets.

Guinea-pig. The diet was made up of oats, bran and arachis oil, in which mixture was incorporated 20% of an activated acid clay. The latter contained about 125 I.U. of vitamin B₁ and was supplied through the courtesy of Dr A. Z. Baker. Since about 30 g. of food were consumed by each of the guinea-pigs per day, their daily intake was about 750 I.U. vitamin B₁, *i.e.* several hundred times the daily requirement. This diet was also supplemented with green cabbage every day.

Fowl and pigeon. The diet consisted mainly of oats and whole wheat. Each bird received by mouth about 250 I.U. of vitamin B₁ daily in the form of a watery suspension of 2 g. of the activated clay.

Method of assay. The bradycardia method [Drury & Harris, 1930; Birch & Harris, 1934] was employed for assaying the tissues. Comparative tests with

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graded doses of the International Standard were also carried out simultaneously. The responses produced by a given dose of the International Standard acid clay were of the same average magnitude as those obtained on previous occasions. The vitamin B₁ content of the substance under test was read off from a dose-response curve already published by Leong & Harris [1937]. Since it has been found [Leong, 1937, 1] that the combined reserves of the vitamin in the liver and skeletal muscle represent 80–90 % of the total amount stored in a “saturated” rat, only these two tissues were assayed.

RESULTS

The results are given in Tables I and II. For the purpose of comparison the results obtained for “saturated” tissues of rats [Leong, 1937, 1] have also been

Table I. *Maximum storage of vitamin B₁ in the muscle of the following species: guinea-pig, fowl, pigeon and rat*

Species	Animal no.	Days on diet	Cure of bradycardia days*	Average period of cure days	I.U. vitamin B ₁ per g.
Guinea-pig	1	23	1, 1	1.0	0.2
	2	26	2, 3	2.5	0.5
	3	30	1, 2	1.5	0.3
				Av. for guinea-pig	0.3
Fowl	1	20	1, 1	1.0	0.2
	2	25	2, 2	2.0	0.4
	3	29	1, 2	1.5	0.3
				Av. for fowl	0.3
Pigeon	1	21	4.5, 5.5	5.0	1.2
	2	24	4, 5	4.5	1.0
	3	26	4, 5	4.5	1.0
	4	30	6, 6	6.0	1.5
				Av. for pigeon	1.2
Rat [Leong, 1937, 1]				Av. for rat	0.6

* Each figure represents the result of one test.

Table II. *Maximum storage of vitamin B₁ in the liver of the following species: guinea-pig, fowl, pigeon and rat*

Species	Animal no.	Days on diet	Cure of bradycardia days*	Average period of cure days	I.U. vitamin B ₁ per g.
Guinea-pig	1	23	1, 2	1.5	0.6
	2	26	1.5, 1.5	1.5	0.6
	3	30	2, 2	2.0	0.8
				Av. for guinea-pig	0.7
Fowl	1	20	2, 2	2.0	0.8
	2	25	1, 2	1.5	0.6
	3	29	1, 2	1.5	0.6
				Av. for fowl	0.7
Pigeon	1	21	2, 2.5	2.3	0.9
	2	24	2.5, 3	2.8	1.1
	3	26	2, 3	2.5	1.0
	4	30	3, 3.5	3.3	1.4
				Av. for pigeon	1.1
Rat [Leong, 1937, 1]				Av. for rat	2.6

* Each figure represents the result of one test.

included in these tables. It will be seen that the maximum level of storage of the vitamin in the skeletal muscle was quite different for each species. Thus (see Table I), the maximum concentration in the muscle of the guinea-pig and the fowl was of the order of 0.3 I.U. per g., as compared with the value of 1.2 I.U. per g. for pigeon muscle and 0.6 I.U. per g. for rat muscle. The vitamin was present in the livers of the four species (viz. guinea-pig, fowl, pigeon and rat) in the following concentrations: 0.7, 0.7, 1.1 and 2.6 I.U. per g. respectively (see Table II).

In view of the high vitamin B₁ intake and the finding that "saturation" of rats' tissues was attained in a few days after rats were fed on diets rich in this vitamin [Leong, 1937, 2], it seemed reasonable to presume that the tissues of the animals used in this investigation were "saturated" with the vitamin. The correctness of this assumption is supported by the finding that there was no appreciable difference in the concentrations of the vitamin in, for instance, the muscles of the three guinea-pigs, even though guinea-pig no. 3 was not killed until about a week after guinea-pig no. 1 (see Table I).

Few data have been published in which the vitamin B₁ content of animal tissues has been assayed in terms of International Units and directly against the International Standard. For roast chicken, raw beef and raw mutton the following values have been reported by Baker & Wright [1935]: 0.4, 0.5 and 0.6 I.U. per g. respectively. It is not known whether these tissues were "saturated" with vitamin B₁, but it is interesting to note that these values are not far removed from those observed in the "saturated" tissues described in this paper. The vitamin B₁ content of pig muscle appears to be unusually high when compared with that of other animal muscles so far examined, as it was reported by Baker & Wright [1935] to contain 3.2 I.U. per g.

SUMMARY

The maximum level of storage of vitamin B₁ in the muscle and the liver of the guinea-pig, fowl and pigeon has been studied. The highest concentrations in the muscles of the guinea-pig, fowl, pigeon and rat were found to be 0.3, 0.3, 1.2 and 0.6 I.U. per g. respectively. The corresponding values obtained for liver were 0.7, 0.7, 1.1 and 2.6 I.U. per g. respectively.

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