

IS POLISHED RICE PLUS VITAMINE A COMPLETE FOOD? BY CASIMIR FUNK.

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IN previous papers on this subject (1) I have described in detail the methods of preparation of the vitamine-fraction from yeast and other foodstuffs and also the curative action of this substance on beri-beri pigeons. Since then several authors, whose work is fully discussed elsewhere (2), have expressed the view that the vitamine-fraction isolated in this way, although possessing very marked curative effect, is unable to sustain life and maintain the weight of birds fed on polished rice.

Since my last publications on the chemistry of the vitamine-fraction I have repeated the fractionation of yeast three times, following exactly the same procedure, and have succeeded in each case in isolating a crystalline vitamine-fraction, melting at 210–213° with the chemical characters described. Having thus prepared a few grams of this substance I thought it advisable to investigate fully its curative and protective value. Not less than 22 pigeons were cured with this preparation, the dose varying from 2–4 mgr. administered intramuscularly. The cure was effected usually in less than three hours and the effect lasted as a rule for 3–7 days, the pigeons being kept exclusively on polished rice. After this time the symptoms appeared again, in five cases however I succeeded by an administration of a second dose in curing the disease again, but the effect lasted only for two days. In four cases it was attempted to keep pigeons on polished rice by injecting one mgr. of the vitamine-fraction every day, but it was impossible to keep the birds alive for more than nine days. If however after the injection of the curative dose or even two days after the cure, normal food (maize) was given, the birds remained healthy. We have at present in our institute three pairs of pigeons, which were cured by injection of vitamine nine months ago, and which have

subsequently bred and produced perfectly healthy, normal young birds.

Besides its action on beri-beri, the effect of injections of vitamine-fraction from yeast on the power of stimulating the growth of young chicks, which had been arrested by feeding exclusively on unpolished (red) rice, was investigated, as reported elsewhere (3), but not the slightest effect of the injections was observed.

These experiments show that although by the methods of isolation of the vitamine-fraction, described in my previous papers, one can extract a substance from yeast, rice-polishings etc., which cures beri-beri in pigeons, and as Vedder and Williams(4) have shown also in man and fowl, this substance loses the power possessed by the material from which it was extracted (yeast, rice-polishings) of maintaining life and weight of the animals in experiment.

It also was observed that the vitamine-fraction could be kept in a crystalline state for over eight months without losing a trace of its curative power.

Recently I have obtained the vitamine-fraction from yeast by a method which will be described later on, the action of which is so complete that I thought it worth while to publish the experiments. For the sake of economising the material only six pigeons were used. The birds were kept exclusively on polished rice throughout the experiment. Four of these pigeons were cured by a single injection of the new vitamine-fraction, they recovered in time varying from one to three hours, showing appetite immediately on recovery, increased in weight during the first days after the cure and maintained the gained weight for about a week. After this time they slowly lost weight again and developed beri-beri after 12, 14, 14 and 15 days respectively. The two other birds which recovered after one injection, fed themselves on polished rice, the dose of vitamine being repeated every four days. There was no evidence of beri-beri symptoms. The two pigeons lived for 29 and 32 days respectively and eventually died of sepsis, as shown by the post mortem examination, due to the curative solution being kept for over a month. The sterilisation was not possible on account of the destruction of vitamine by heat. The post mortem examination also showed, that there was no disappearance of thymus, which always takes place as shown in collaboration with Dr Mackenzie Douglas(5) in beri-beri pigeons.

It must be especially emphasized that the new vitamine-fraction was also entirely devoid of phosphorus and possessed at the same time

the anti-neuritic, appetising and weight-keeping properties. This in my opinion proves that polished rice plus vitamines constitutes a complete food. These experiments show at the same time that contrary to the opinion expressed by several authors there is no necessity, in any case at the present moment, to assume the existence of several vitamins, one for curing the nervous symptoms and another one for the maintenance of the body weight.

The fact that even this complete life-sustaining action is brought about without the help of lipoids or other substances containing phosphorus shows that the physiological importance of lipoids in this regard must not be attributed to lipoids but to vitamins which in the crude state are soluble in lipid-solvents.

Experimental.

Out of the four pigeons used for the single dose curing experiments, one which was fed on the so-called synthetical diet (caseinogen, starch, fat, sugar and mixture of salts), according to the experiments which were described elsewhere (6), developed typical beri-beri in 29 days. This animal was injected with 2 mgr. of the vitamines-fraction and completely recovered three hours afterwards. The weight of the bird which immediately after recovery ate polished rice freely, was as follows:

24/2/14	...	...	200 gms.
25/2/14	...	...	220 „
1/3/14	...	...	210 „
9/3/14	...	...	180 „

On Mar. 10, that is to say 14 days after recovery the beri-beri symptoms reappeared, the bird died on the 13th.

The other three birds in this experiment developed beri-beri on polished rice. They were treated with a dose containing two mgr. of the vitamines-fraction injected intramuscularly and recovered between 2-3 hours after the injection. Two days after the recovery they gained between 10-20 grm. in weight, a gain which was maintained throughout the first week. These three pigeons developed beri-beri after 12, 14 and 15 days respectively.

Two other pigeons which developed beri-beri on polished rice after 20 and 22 days respectively were injected with 2 mgr. of the solution of the crystalline vitamines-fraction. One bird was completely cured after three hours, the other after two hours. Immediately after the cure they

began to pick up the rice and fed themselves throughout the experiment. Every few days the injections were repeated and the birds were kept in permanent health one for 29 the other for 32 days. As the weight of the birds were very near each other, both animals were weighed together and the average weight recorded. The table below shows the time of the injections and the weights.

Day	Injections	Weights	Day	Injections	Weights
1	2 mgr. each	220 gms.	13	1 mgr.	250 gms.
4	—	240 „	17	1 mgr.	250 „
6	2 mgr.	245 „	19	1 mgr.	—
7	—	260 „	21	—	240 „
8	2 mgr.	—	22	1 mgr.	—
10	—	255 „	25	—	242 „
11	1 mgr.	—	29	1 mgr.	—

The two birds died without a trace of beri-beri symptoms and the post mortem examination has shown that in both cases the cause of death was sepsis, pyaemic abscesses being found in the liver. The sepsis was due to the fact that the solution of the vitamine which was kept in the cold room for over a month could not be sterilised. In both cases the thymus gland presented the appearance seen in healthy birds.

CONCLUSIONS.

1. The experiments show conclusively that polished rice and vitamine constitute a complete food.
2. There is no justification at the present moment to accept the necessity of two different vitamines, one for curing the nervous symptoms and one for maintenance of body weight.
3. The vitamine-fraction used in the above experiments being entirely free from phosphorus we are justified in saying that the physiological importance ascribed in late years to lipoids and substances soluble in lipid solvents as regards their bearing on deficiency diseases must not be attributed to lipoids but to vitamines which are accidentally extracted in the same process.

REFERENCES.

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