VITAMIN C REQUIREMENT DURING PERIODIC ADMINISTRATION OF THE VITAMIN

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K.M. Mikhailov [2] was the first to study the problem of the action of periodically administered vitamin C. He came to the conclusion that sources of vitamin C can be administered not daily, but at 2-day intervals. However, he did not study the problem of a consequent decrease in vitamin C potency, nor the extent of such a decrease.

In later experiments, an attempt was made to ascertain the amount of change in the potency of periodically administered vitamin C.

In his experiments, Hou [4] did not find any decrease in vitamin C potency when it was administered at 2-day intervals in comparison with daily administration. N. Bessonov and M. Voloshin [3] found, in the course of 50-day prophylactic experiments, that guinea pigs grew more slowly when the vitamin C was administered at 3-day and, especially, 6-day intervals than when it was administered daily.

Unfortunately, the small number of animals per group and the absence of data regarding the weight increase of individual animals makes a final decision impossible on the basis of this work. S.S. Zilva [5] studied the action of vitamin C in 90-day prophylactic experiments.

The administration of ascorbic acid at one or two day intervals had no marked effect on the growth of guinea pigs (in comparison with daily administration), but it is impossible to reach a conclusion as to whether the results were identical.

The guinea pigs definitely did not grow as well when the interval was 6 days as during daily administration of vitamin C, but the amount of reaction of vitamin C potency was not established in this case.

Since we did not consider the literature mentioned above sufficient to answer our question completely, we decided to carry out research employing a larger number of animals (in separate groups) than the authors cited used in their experiments. In addition, we used a larger dose of vitamin C as a basis than was used in the above experiments; this dose was closer to the guinea pigs' requirement of this vitamin and, so, of more interest from the standpoint of prophylaxis of vitamin deficiency states and of studying vitamin C requirements.

EXPERIMENTAL METHOD

We conducted three experiments on male non-albino guinea pigs. The guinea pigs used in the first experiment received unlimited amounts of carrots and cabbage as sources of vitamins C and A during the period before the experiment was begun, while those used in the second and third experiments received 25 mg of ascorbic acid and 0.25 mg of vitamin A per day.

Animals weighing up to about 300 g were used in the experimentation. They were divided equally among the groups, taking into account the increase in weight during the period prior to the experiment. The experiments

were prophylactic, lasting for 84 days. There were 17-20 guinea pigs in each group of the first experiment, 16-17 each in the second and 31-33 each in the third. The basic ration in the first two experiments was oatmeal and hay; in the third, it was oats, hay and bran (in unlimited amounts). In addition, the guinea pigs were fed 0.25 mg of vitamin A (in the form of vitamin A concentrate) and 15IU of vitamin D (in the form of irradiated ergosterol) daily during the experimental period and, in addition, ascorbic acid daily or periodically. In the first two experiments the ascorbic acid was administered in 2 ml, and in the third in 4 ml, of water*.

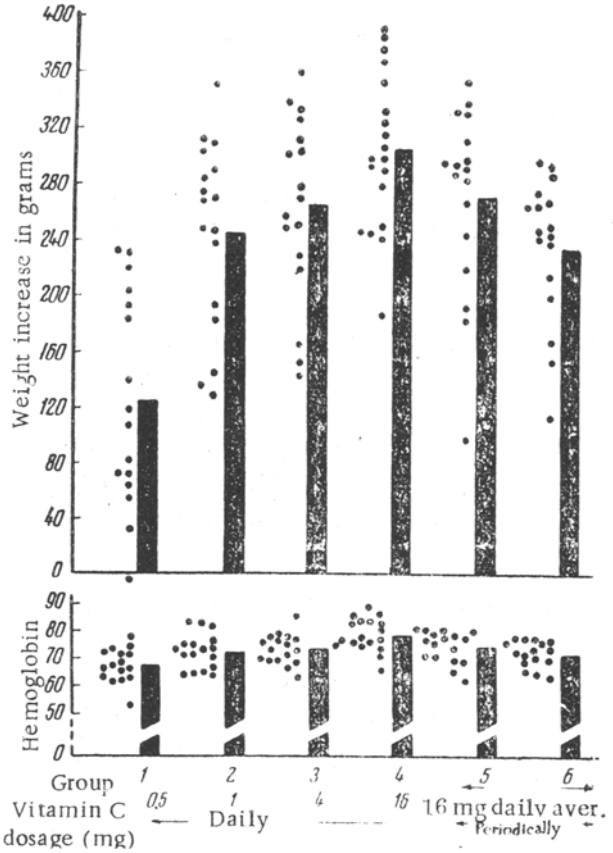

Fig 1 Weight increase during the 84 days of the first experiment and hemoglobin content (in hemoglobinometer units) of the blood on the 85th day of the experiment.
Data obtained for individual animals are indicated by circles; averages for the groups by columns. The fifth group received ascorbic acid twice a week; the sixth group, once a week.

In the first experiment (Fig. 1), the 1st, 2nd, 3rd and 4th groups received, respectively, 0.5, 1, 4, and 16 mg of ascorbic acid per day; in the second experiment(Fig. 2), the 2nd, 3rd and 4th groups received 1, 4, and 16 mg, respectively; and in the third experiment (Fig. 3) the 1st, 2nd and 3rd groups received 1, 10, and 20 mg respectively.

EXPERIMENTAL RESULTS

Daily Administration of Vitamin C

The losses in the first two experiments had a random character; 1-2 guinea pigs per group, regardless of the vitamin C dosage they were receiving. It was only possible to connect the losses in the first group of the first experiment with low ascorbic acid dosage. A considerable number of guinea pigs died of pneumonia in the third experiment, and a relationship was observed between the percentage of animals lost and ascorbic acid dosage. In the group receiving 1 mg, 38% of the guinea pigs died; in the one receiving 10 mg, 21% died; and in the one receiving 20 mg, 3%. Thus, in the third experiment, the losses can be considered to be related to vitamin C dosage.

The increase in weight during the 84 days of the experiment was greater among the guinea pigs which received larger doses of vitamin C, in all three experiments. Mathematical analysis of the groups of results in the first two experiments established that there was a significant difference ($t > 3$) between the results obtained with ascorbic acid doses of 1 and 16mg; 4 and 16 mg, and, in the first experiment, between doses of 0.5 and 1; 0.5 and 4; 0.5 and 16 mg. In the third experiment there was a significant difference between the results obtained with doses of 1 and 10 mg, and 1 and 20 mg.

Thus, in all three experiments, increase in weight could be regarded as a criterion of the vitamin C condition.

We determined the hemoglobin in the blood by Sahli's method. The results are reported in hemoglobinometer units. In the first experiment a significant difference ($t > 3$) was obtained between the results from ascor-

*Guinea pigs which were receiving vitamic C periodically were given as much water on the days when they did not receive the ascorbic acid as the groups fed ascorbic acid daily.

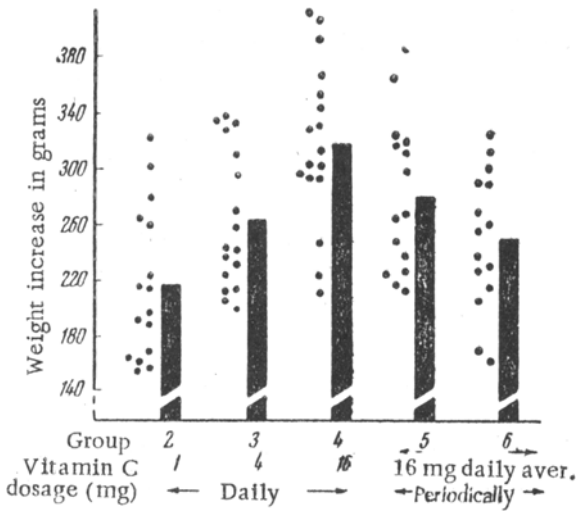

Fig 2. Weight increase during the 84 days of the second experiment. Group 5 received ascorbic acid twice a week; Group 6 once a week.

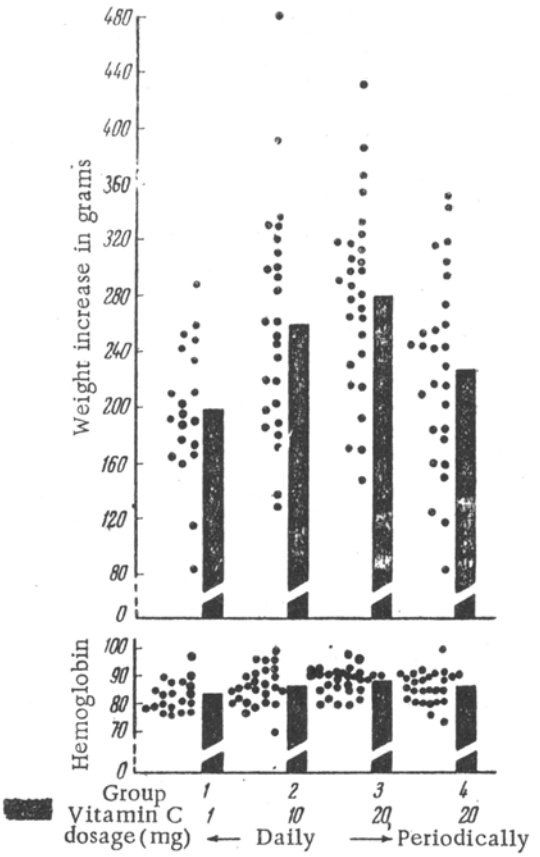

Fig. 3. Weight increase during the 84 days of the third experiment and hemoglobin content on the 85th day. Group 4 received ascorbic acid twice a week.

bic acid doses of 0.5 and 4 mg; 0.5 and 16 mg; while the value of t (2.93) was large for doses of 1 and 16 mg. In the third experiment, there was a significant difference between 1 and 20 mg doses of ascorbic acid. Therefore, the hemoglobin content of the blood could also be used as an indicator of the vitamin C condition in these experiments.

Thus, in all three experiments, increase in weight during the 84 days of the experiment could be used as an indicator of the vitamin C condition in order to determine the potency of the vitamin C during daily administration; while in the first and third experiment the hemoglobin content of the blood, determined at the end of the 84-day period, could also be used.

Periodic Administration of Vitamin C

In the first and second experiments, 16 mg of ascorbic acid (calculated on a daily basis) was introduced weekly (6th group) and semi-weekly (5th group).

When the vitamin C was introduced at weekly intervals, the weight increase was less than that of the fourth group, which received the same dose of ascorbic acid daily ($t > 3$ even for each experiment separately), and less, also, than that of the group which received doses one-fourth as large (4 mg, 3rd group).

Hemoglobin determinations (in the first experiment) gave analogous results, and the difference between data for the 6th and 4th groups is statistically significant.

Consequently, when vitamin C was administered at weekly intervals, its potency was one-fourth the potency when it was introduced daily.

When the ascorbic acid was administered at semi-weekly intervals in the first and second experiments (5th group), the weight increase was less than that of the 4th group, which received the same amount of ascorbic acid in daily doses but greater than that of the 3rd group which received one-fourth the dosage daily. Analogous results were obtained through analysis of hemoglobin content (in the first experiment).

In the third experiment, the guinea pigs given Vitamin C weekly received 20 mg of ascorbic acid calculated on a daily basis (4th Group). 10% of the animals in this group died, locating it between the groups which received 20 mg and 20 mg daily.

The weight increase was less than that of guinea pigs receiving the same dose of Vitamin

C daily (Group 3) and less, even, than of those receiving half the dosage daily (Group 2). Analogous results were obtained by the determination of blood hemoglobin.

Mathematical analysis of the results of the 3rd experiment established that there was a significant difference between the groups receiving equal amounts of ascorbic acid semi-weekly (calculated on a daily basis) and daily with respect to weight increase ($t > 3$). The significance of the differences found in the rest of the experiments is substantiated by the fact that the results of all subsequent experiments were consistent.

The material presented above indicates that the potency of vitamin C is $\frac{1}{2} - \frac{1}{3}$ less if it is administered twice a week.

The results obtained in these experiments differ sharply from those we obtained in analogous experiments carried out with vitamin A [1]: in the latter case, we could find no perceptible decrease in the potency of that vitamin in the course of weekly administration. This difference in the "behavior" of the two vitamins is explained basically by the difference in the body's capacity to store them.

The third experiment involved another group of guinea pigs (the same number as used in the other groups of this experiment), which received daily doses of 30 mg of ascorbic acid. The weight increase of this group in the course of the experiment was not higher, but lower, than that of guinea pigs receiving daily doses of 20 mg of ascorbic acid. Thus, guided by weight increase, 20 mg of ascorbic acid should be regarded as the minimum daily requirement; consequently, the ascorbic acid dosage which the guinea pigs received in periodic doses (16-20 mg calculated on a daily basis) approximated their daily requirement.

Can periodic administration of vitamin C be offset by increasing the dosage commensurately with the decrease in potency (doubling or tripling the dosage if the intervals are semiweekly; quadrupling, if weekly)? Apparently not, since vitamin C dosages above a certain amount are of no value to the organism, whose body cannot store the vitamin. As a result, the danger arising from vitamin C introduction at given intervals cannot be avoided by a simple increase in dosage.

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