STUDY ON $^{32}$P METABOLISM OF TEETH AND BONES DUE TO C-AVITAMINOSIS

BY

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I INTRODUCTION

It is a generally accepted fact that C-avitaminosis contributes to the developmental disturbance, imperfect calcification, alveolar bone and paradental disorder of teeth and bones, which are brought back again to normal conditions by the supply of V.C.

The author here reports his findings of a study on the subject with $^{32}$P as a tracer.

II EXPERIMENTAL METHODS AND MATERIALS

1) Materials

Recourse was had to the Arcotonys guinea pigs ranging from 200 g to 250 g in weight, which were divided into the three groups of first (control animals), second (V.C deficient animals) and third (V.C supplied animals).

2) Methods:

a. Control feeding

The control animals were fed with the food of the following ingredients.

- Bean curd waste  59%
- Skim milk  30%
- Fresh butter  10%
- Salt  1%
- Liver oil  0.5 cc (Given once a week)

To the above food were supplemented fresh vegetables and fruits occasionally.

b. C-avitaminosis test

Adopting the method devised by Sherman, the V.C deficient animals were fed with the food of the following composition.

- Bean curd waste  56%
- Skim milk  30% (Its V.C was destroyed by means of heat)
- Fresh butter  10%
- Salt  1%
- Liver oil  0.5 cc (Given once a week)

c. V.C supply test

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To the V.C deficient animals of two-week and three-week duration respectively 10 mg of Ascortin solution was subcutaneously administered every day while they were still fed with the same food.

3) Experimental solution, Samples and Tracer test

The experimental solution was $\text{H}_2\text{P}^{32}\text{O}_4$ of $\text{P}^{32}$ contributed by A.E.C., $0.12\mu\text{c/cc}$ of which was subcutaneously administered into the dorsal region of the animals. Incisors, molars, jaw bone and femoral bone were used as samples and dental pulp as well as bone marrow were removed, the rest being ground to produce the dry calcified power. 0.1 g of each sample was measured by means of the Geiger-Müller counter.

4) Periods of Experiments

a. V.C deficient group

As regards this group, five periods (5 days, 7 days, 10 days, 2 weeks and 3 weeks) were distinguished following C-avitaminosis which was induced at the same time with the injection of $\text{P}^{32}$.

b. V.C supply group

To the respective groups of two-week and three-week V.C deficient animals V.C was daily supplied after the injection of $\text{P}^{32}$. Following the process, six periods were distinguished in them (5 days, 7 days, 10 days, 2 weeks, 3 weeks and 4 weeks), the same experiments being made over each period.

5) Observation

Methods of observation employed included both the overall and local symptoms, teeth and their peripheral organs, change in weight and growth rate of incisors which were made macroscopically, and by way of the observation means the electron microscope and radio-autography were used.

III EXPERIMENTAL RESULTS AND CONSIDERATIONS

1) $\text{P}^{32}$ metabolism

a. Metabolism of V.C deficient group

(i) Metabolism in teeth

In comparison with the control group, the V.C deficient group showed a gradual decrease in $\text{P}^{32}$ metabolism with 11-68% in the case of incisors and 12-70% in the case of molars. That is to say, as against 100 of the control group the deficient group after three weeks showed the reduced metabolism rates of 33% in incisors and 30% in molars respectively. About 3% of phospher metabolism disturbance was observed higher in the latter. The reason for this may be due to the fact that the alveolar bone was destroyed through scorbutic degeneration and the foundation of molars was badly damaged (Fig. 1).

(ii) Metabolism in bones

As contrasted against the control group, the deficient group showed a reduction in $\text{P}^{32}$ metabolism. As is the case with the teeth treated above (i), the reduction in $\text{P}^{32}$ metabolism advanced proportionally to the elapse of days. Against 100 of the control group, the reduced rate of the V.C deficient group was 25-26%.

(iii) Comparison between metabolisms in teeth and bones

Comparison between metabolisms in teeth and bones after three weeks (in-
Fig. 1. Incisor & Molar (C-avitaminosis test)

Fig. 2. Teeth & Bones (C-avitaminosis test)

Fig. 3. Teeth & Bones (V.C supply test)

cisors: 67% and molars: 70%; jaw bone: 74% and femoral bone: 75%) indicates 6% more in the latter. That the composition of bones is more susceptible to the influence of avitaminosis than teeth may account for this (Fig. 2).

b. Metabolism of V.C supply group

(1) Metabolism restoration in teeth

In comparison with the V.C deficient group, the V.C supply group showed a gradual restoration of phospher metabolism. As against 100 of the control group,
incisors restored their phospher metabolism by 36-93 % and molars 33-94 % form 5 days to 4 weeks.

(ii) Metabolism restoration in bones
As is the case with teeth, jaw bone as well as femoral bone showed a gradual restoration in their phospher metabolism from 27 % to 91 %, reaching the metabolism calculation of the control group in 3 or 4 weeks.

(iii) Comparison between metabolism restorations in teeth and bones
Following the supply of V.C, teeth restored by 33-94 % and bones restored by 27-91 % from 5 days to 4 weeks, the former gaining in restoration a slightly earlier than the latter. The reason for this may be that teeth are influenced by C-avitaminosis to a less degree than bones. Or it may be that dental composition contains more phospher. When a comparison is struck between the 2-week and 3-week deficient group as regards the metabolism restoration of phospher, the former shows a higher rate of restoration (Fig. 3).

Fig. 4. Electron-microscopic Findings of Enamel Surfaces of Controls, C-Avitaminosis Teeth & V.C Supplied Teeth

I
Control

II
2 weeks after C-avitaminosis

III
3 weeks after C-avitaminosis

IV
4 weeks after V.C was supplied (Against 3w, V.C deficient group)
2) Electron-microscopic findings

The electron-microscopic findings confirm the results of overall as well as local symptoms observations and tracer test. The V.C deficient group showed the roughening up and imperfect calcification of the tooth surfaces and they were restored to the normal conditions by the supply of V.C after 4 weeks or more (Fig. 4).

3) Radio-autography

The result of radio-autography is in conformity with that of tracer test. The thin distributed image which had appeared after 2 or 3 weeks of C-avitaminosis reverted to the normal conditions in 4 weeks or more by the supply of V.C (Fig. 5).

Fig. 5. Radio-autographs Taken of Control, V.C Deficient & Supplied Teeth

IV CONCLUSIONS

The above study on C-avitaminosis in teeth and bones with P\(^{32}\) as a tracer has furnished the following conclusions.

1. In the V.C deficient groups of both teeth and bones, the gradual decrease of phospher metabolism was indicated as compared against that of control groups.

2. After 2 or 3 weeks, phospher metabolisms reduced by 47-70% in teeth and 51-75% in bones. Comparison between incisors and molars shows that the latter has a slightly higher rate of phospher metabolism.

3. Phospher metabolism in teeth and bones was gradually restored by the supply of V.C. It reaches that of control groups in 3 or 4 weeks.

4. When the restoration rate of phospher metabolism in teeth is compared with that of bones, the former indicates an earlier period of restoration. This is
clearly borne out by a comparison between the 2- and 3-week groups.

5. The results of macroscopic observations of the experimented teeth which included growth rate, transparency, color-shade and roughening up of the surface and its recovery have been found to be in conformity with that of tracer test.

6. The results of both electron microscopy and radio-autography have been also found more or less identical with that of tracer test, the same tendency being observed.