ANTISCORBUTIC PROPERTY OF VEGETABLES.

II. AN EXPERIMENTAL STUDY OF RAW AND DRIED POTATOES.

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The possibilities of preserving foods by desiccation are becoming recognized more and more. From some points of view drying is undoubtedly preferable to a great many other manipulations of foods to attain this end. However, such procedures should not be adopted without scientific proof that they do not affect adversely the foods dehydrated.

As part of a series of studies on the question whether or not the antiscorbutic vitamine in certain foods is destroyed at definite temperatures during drying we have already reported that under certain conditions cabbage (1), tomatoes (2), and orange juice (3) can be dehydrated so that the resultant dried products retain a significant amount of the antiscorby vitamine. Data are reported herein concerning the antiscorbutic value of potatoes subjected to various temperatures and treatments.

The white potato is probably our most staple article of diet. Several investigations have been conducted to determine the value of its nitrogen-containing compounds (4-6). Biological experiments are available concerning its content of inorganic salts and water- and fat-soluble vitamines (7). The antiscorbutic property of the potato has been studied somewhat, but we are in need of more information upon this point (1, 8-10).

General Procedure and Methods.

Details of the general procedure and methods are described in the first paper of this series (1). The experimental animals were healthy young guinea pigs. The basal diet used to produce
scurvy was made of heated soy bean flour, milk, yeast, paper pulp, calcium lactate, and sodium chloride in the proportions hitherto reported. Tap water was offered to the animals ad libitum. Necropsies were performed as soon as possible after death. Scurvy was diagnosed on the basis of the usual clinical manifestations and postmortem findings. The occurrence of pneumonia in some of the animals is ascribed to the possibility that their general resistance was lowered owing to the minimal intake of antiscorbutic vitamine. Almost all the experiments later described are of the preventive type.

Potatoes were fed raw and cooked. The daily allotment of the undried samples was 10 gm. per animal. The dried potatoes or potatoes dried and cooked were fed to each animal in daily quantities of 2.5 gm. On this basis every animal received approximately the same amount of total solids of potatoes equivalent to that contained in 10 gm. of the raw material. When raw potatoes were cooked they were chopped very finely, boiling tap water was poured on them, and the water was kept boiling for 15 minutes. When the dried potatoes were cooked, the powdered material was suspended in a little cold water, poured into boiling water, and the whole boiled for 15 minutes. Potatoes baked and dried were fed as a paste.

Treatment of Potatoes.

In the study of potatoes subjected to different treatments, especial emphasis has been placed on a consideration of dried potatoes. The temperature of drying and the treatment previous to drying have varied. All potatoes dried, with the exception of those baked and dried, were first peeled. The precaution to slice the potatoes and remove the eyes was taken because the nitrogen content of the skin is higher than that of the body of the potato. At present we do not know to what extent the antiscorbutic vitamine may be associated with protein, particularly cellular material. The drying of all samples except Sample F was by means of hot air in a specially constructed apparatus (2).

The different ranges of temperature of drying were 35–40°, 55–60°, 75–80°, and baking at 204°, and then drying at 35–40°C. Potatoes dried at the first three ranges of temperature were
TABLE I.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Date dried</th>
<th>Date started using</th>
<th>Date finished using</th>
<th>Duration of drying</th>
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<tbody>
<tr>
<td><strong>Potatoes dried at 35-40°C.</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>July 10</td>
<td>July 12</td>
<td>July 30</td>
<td>6-8</td>
</tr>
<tr>
<td>2</td>
<td>“ 2</td>
<td>“ 31</td>
<td>Aug. 12</td>
<td>6-8</td>
</tr>
<tr>
<td>3</td>
<td>“ 3</td>
<td>Aug. 13</td>
<td>Sept. 16</td>
<td>6-8</td>
</tr>
<tr>
<td>4</td>
<td>“ 2</td>
<td>Sept. 17</td>
<td>Oct. 14</td>
<td>6-8</td>
</tr>
<tr>
<td>81A</td>
<td>Oct. 10</td>
<td>Oct. 15</td>
<td>Nov. 2</td>
<td>6</td>
</tr>
<tr>
<td>81B</td>
<td>“ 10</td>
<td>Nov. 3</td>
<td>“ 23</td>
<td>6½</td>
</tr>
<tr>
<td><strong>Potatoes dried at 55-60°C.</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>July 10</td>
<td>July 12</td>
<td>July 29</td>
<td>7</td>
</tr>
<tr>
<td>16(2)</td>
<td>“ 23</td>
<td>“ 30</td>
<td>Aug. 12</td>
<td>6½</td>
</tr>
<tr>
<td>19(1)</td>
<td>Aug. 1</td>
<td>Aug. 13</td>
<td>“ 29</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>July 17</td>
<td>“ 27</td>
<td>“ 31</td>
<td>6½</td>
</tr>
<tr>
<td>26(1)</td>
<td>Aug. 17</td>
<td>Sept. 1</td>
<td>Oct. 2</td>
<td>4½</td>
</tr>
<tr>
<td>27(1, 2)</td>
<td>“ 19</td>
<td>Oct. 3</td>
<td>Nov. 13</td>
<td>4½</td>
</tr>
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<td><strong>Potatoes dried at 75-80°C.</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>73(1, 2)</td>
<td>Oct. 7</td>
<td>Oct. 15</td>
<td>Dec. 4</td>
<td>3</td>
</tr>
<tr>
<td>74(1, 2)</td>
<td>“ 7</td>
<td>Dec. 5</td>
<td>Jan. 18</td>
<td>3½</td>
</tr>
<tr>
<td>189</td>
<td>Jan. 11</td>
<td>Jan. 19</td>
<td>“ 29</td>
<td>2</td>
</tr>
<tr>
<td>190</td>
<td>“ 11</td>
<td>“ 30</td>
<td>Feb. 8</td>
<td>2½</td>
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<tr>
<td><strong>Potatoes baked at 204°C. and dried at 35-40°C.</strong></td>
<td></td>
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<tr>
<td>109(1, 2)</td>
<td>Oct. 25</td>
<td>Oct. 29</td>
<td>Nov. 26</td>
<td>7½</td>
</tr>
<tr>
<td>114(1, 2)</td>
<td>“ 31</td>
<td>Nov. 27</td>
<td>Jan. 13</td>
<td>7½</td>
</tr>
<tr>
<td>148(1)</td>
<td>Nov. 21</td>
<td>Jan. 4</td>
<td>Feb. 5</td>
<td>8½</td>
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<td><strong>Potatoes treated with HCl and dried at 55-60°C.</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67(1, 2)</td>
<td>Oct. 4</td>
<td>Oct. 5</td>
<td>Nov. 6</td>
<td>4½</td>
</tr>
<tr>
<td><strong>Potatoes treated with acetic acid and dried at 55-60°C.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52(1, 2)</td>
<td>Sept. 21</td>
<td>Sept. 30</td>
<td>Nov. 2</td>
<td>4½</td>
</tr>
<tr>
<td><strong>Potatoes dried in vacuo at 55-60°C.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Oct. 15</td>
<td>Dec. 23</td>
<td>Feb. 11</td>
<td>10</td>
</tr>
</tbody>
</table>
sliced uniformly with a slicer in the open air and placed in the
drier in very thin layers for desiccation. The baked and dried
potatoes were placed in an oven at 204°C, kept there for 45 to 55
minutes until they were soft, then removed and scraped out of
the shells, put through a ricer, and placed in the drier in thin
layers on cheese-cloth to be dried at 35–40°C.

The Sample F potatoes were desiccated in a vacuum drier after
they had been sliced under water and dehydrated at a tempera-
ture of 55–60°C, for approximately 10 hours under a pressure of
less than 2 inches of mercury.¹

Two lots of potatoes were treated with acid before drying. One
lot was sliced and kept in approximately 2 per cent acetic acid
for 18 to 20 hours; the other in approximately 0.2 per cent hydro-
chloric acid for the same length of time. The slices were then
taken out of the acid, rolled in towels, and desiccated in the
special drier. Two other lots of potatoes were sliced and steamed
for 4 minutes before drying at 55–60°C.

All the dried potatoes were gray-colored except those sliced
under water and dried in a vacuum, those treated with acid
before drying, those baked and dried, and those steamed and
dried. This would seem to indicate that enzyme action had
been either inhibited or destroyed in these last named products.
Details of drying and using are given in Table I.

RESULTS.

It has been demonstrated that a guinea pig fed the basal soy
cake diet alone will develop clinical manifestations of scurvy in
2 to 3 weeks. Unless at this juncture proper measures are insti-
tuted the animal will die in about a week. A critical review of
the appended charts shows the following results with differently
treated potatoes tested as antiscorbutic supplements to the basal
soy cake diet.

In Chart I it is seen that 10 gm. of raw white potato have pro-
tected the guinea pigs against scurvy for the duration of the
experiment, 129 days—a period in some cases at least six times as
long as that in which scurvy would have developed in the absence
of antiscorbutic material.

¹ Our best thanks are due Dr. K. G. Falk for kindly supplying us with
this material.
Chart II represents a number of animals which received daily 10 gm. of raw potatoes cooked in water at 100°C. for 15 minutes. There has been no appreciable reduction of the antiscorbutic potency of the potato by this treatment. However, such is not the case if the cooking at 100°C. is continued for 1 hour as shown in Chart IV.

Chart III shows that the antiscorbutic vitamine in raw potatoes cooked for 15 minutes at 100°C. in a weak acid solution, as 0.5 per cent citric acid, is not entirely destroyed by such treatment.

Chart V shows the outcome of feeding daily 2.5 gm. of vacuum-dried potatoes heated in water for 15 minutes at 100°C. The results are not conclusive but indicate that a great part of the antiscorbutic vitamine has been destroyed by this treatment.

Chart VI represents a set of animals to which were fed potatoes dried at 35-40°C. for 6 to 8 hours. Such treatment yields a dried potato which has lost a significant amount of its antiscorbutic potency. A large enough supplement of such potato may afford a slight protection but if the product is heated for 15 minutes in water at 100°C. its value as an antiscorbutic agent is further lessened (Chart VII).

Chart VIII demonstrates that potatoes dried in a blast of air at 55-60°C. for 4 to 6 hours retain some of the antiscorbutic vitamine. However, the quantity of this unknown is further reduced by heating the potatoes in water at 100°C. for 15 minutes (Chart IX).

Charts X and XI show that potatoes dried at 75-80°C. for 2 to 3 hours do not retain so much of the antiscorbutic vitamine as potatoes dried at 55-60°C. for 4 to 6 hours. This statement is based on the fact that several animals showed signs of scurvy on the raw dried potatoes (Chart X) and those guinea pigs represented in Chart XI died in about the usual length of time from the disease. Both of these facts are in striking contrast to the results in Charts VIII and IX.

Chart XII shows that potatoes first heated in the skins at a high temperature and then dried at a low temperature retain enough of the antiscorbutic vitamine in the daily allotment fed to afford the animals protection against scurvy.

Charts XIII and XIV show that treatment with dilute acid (either mineral or organic) before drying does not improve the
method of desiccation so far as the antiscorbutic vitamine is concerned.

Chart XV shows the result of feeding potatoes steamed 4 minutes and then dried at 55–60°C. This procedure apparently does not destroy all the antiscorbutic vitamine as some protection was afforded the animals.

Chart XVI shows that potatoes steamed 4 minutes and then dried at 55–60°C, and cooked 15 minutes in boiling water are no longer antiscorbutic agents.

Chart XVII shows that the skins from baked potatoes when dried at 35–40°C, possess no antiscorbutic value.

DISCUSSION.

Attempts have been made by Holst and Frölich (8) and by Chick and Hume (9) to demonstrate experimentally with guinea pigs that raw potatoes contain antiscorbutic material. These investigators failed to succeed because they could not induce the animals to eat the raw food. A little difficulty of this nature was experienced by us with only one animal (Chart I). The reason for our success is attributed to the fact that animals 6 to 8 weeks of age were used and presumably they had not yet developed a discriminative taste. The amount of raw potato fed per guinea pig per day (10 gm.) was the same as has been reported satisfactory for cabbage and tomatoes. That the actual intake of antiscorbutic vitamine was not the same per gm. of substance of each of these foods is very probable if we associate this substance with either the water or total solid content of the foods. The minimal amount of raw potato which will protect a guinea pig against scurvy has not been determined. However, that slightly less than 10 gm. per day is about the lower limit to suffice for protection is indicated from the feeding curve of Animal 204 which from the 35th day to the termination of the experiment, 108 days, consumed on an average about 7 gm. of raw potato daily.

The influence of heat upon the antiscorbutic vitamine appears to be related not only to the degree of temperature but to the duration of the treatment, the reaction, the enzymes present, and the manner of heating.
A temperature of 35–40°C for 6 to 8 hours seems to be more destructive than 55–60°C for 4 to 6 hours, and the latter is scarcely as destructive as 75–80°C for 2 to 3 hours. This conclusion is based on the results obtained with potatoes dried at these temperatures and fed uncooked and cooked for 15 minutes at 100°C. With 2.5 gm. of potatoes dried at 35–40°C and fed without further treatment, death from scurvy was slightly delayed; with 5 gm. life was certainly prolonged. One out of four animals on a daily dose of 2.5 gm. of potatoes dried at 55–60°C showed signs of scurvy at death; also one out of three animals on potatoes dried at 75–80°C showed signs of scurvy at death. If these dried products are further heated in water at a temperature of 100°C for 15 minutes and then fed to guinea pigs in amounts equivalent to 2.5 gm. of dried material, there is certainly no protection with the 35–40°C and 75–80°C products while there is some with the 55–60°C material.

When potatoes are baked for a short time at a high temperature and then dried, a product is obtained which affords protection against scurvy. Thus it appears possible that the factors involved in the destruction of the antiscorbutic vitamine are not only the degree of heat and the duration of the heating but also the enzyme content and the reaction of the food being dried. Until further light is thrown upon the problem it seems plausible to assume that at any temperature below 80°C, the enzymes are functionating. For example, all potatoes dehydrated below this temperature darkened during the desiccation. Furthermore, samples of these same products tested 9 months after drying showed that they still contained oxidases. The temperature of 35–40°C is probably the optimum one for the enzyme action; and the duration of drying at this temperature being very long allows several hours for continuous activity. In the case of drying at 55–60°C and 75–80°C there is undoubtedly some enzyme action, but the time is reduced. The slight difference in the antiscorbutic value between the products dried at 55–60°C and at 75–80°C and then cooked may be accounted for on the basis that at the higher temperature there is more destruction due to the duration of this greater heating and to the reaction. In the case of baking and drying the enzymes are destroyed in a very short time; also the product is subjected to the high tem-
perature for a short period and thus high heat and reaction have little time to act together.

It was thought that some light could be thrown upon the possible effect of enzyme activity and reaction by steaming the potatoes and by treating them with dilute acids before drying. These procedures undoubtedly destroyed the enzymes and permitted a distinct acid reaction during the course of drying, as proved by proper tests. Nevertheless the resultant dried products were unsatisfactory. The above manipulations are open to criticism in several respects: the acid may have extracted most of the antiscorbutic material; or it may have decomposed it; or the combined heat and acid may have destroyed the vitamine.

Holst and Frölich thought that "the active constituent of antiscorbutic food must be of an enzyme nature because exceedingly small amounts of antiscorbutic food exercise such specific action and the substance in some cases is thermolabile." The results with raw potatoes heated at 100°C. and at 204°C. and dried do not support such a contention; they do, however, lend defense to the idea that enzymes under favorable conditions of temperature and reaction may play a rôle in the destruction of the antiscorbutic vitamine.

What is the relation of growth and maintenance to the experimental diet employed and to scurvy? Givens and Cohen have found that their basal diet was perfectly satisfactory to produce normal growth in the rat. It is then logical to assume that the diet contains among its satisfactory components the fat-soluble and water-soluble vitamines. This idea is further supported by the fact that Givens and McClugage were able to maintain pigeons in good health for a very long period on this diet. If this diet is fed alone to guinea pigs scurvy will develop. Growth, as indicated by an increase in weight, will proceed for a short time during the development of scurvy and is arrested only when the disease has progressed to a marked stage. Maintenance can be secured for only a few days during the rapid development of the malnutrition. A decline sets in very shortly and death soon follows unless a suitable addition of antiscorbutic vitamine to the dietary is made.

The experiments herein reported lend striking confirmation to the belief that there is a third type of vitamine—one protecting
against scurvy. Osborne and Mendel (11) have found from long experience that 0.2 gm. of dried brewer's yeast per rat per day is sufficient to promote normal growth. The basal diet used for producing scurvy contained more than twice that amount. There is no basis to warrant the allegation that the drying of the basal diet or potatoes has destroyed either the fat- or water-soluble vitamin. Chick and Hume (9) and more recently Daniels and McClurg (12) have shown that the water-soluble vitamin is not destroyed by long exposure to a temperature of 100°C. Furthermore Osborne and Mendel (13) have reported that drying spinach at 55–60°C. does not apparently destroy either of the above named factors.

In an interesting study of the dietary properties of the potato McCollum and associates (7) have demonstrated that this food is deficient in calcium, sodium, chlorine, the quality of protein, and the fat-soluble vitamin. All these limiting factors have been supplied in the basal diet used in our experiments.

Holst and Frölich were unable to induce guinea pigs to eat either fresh uncooked or dried uncooked potatoes. They therefore resorted to the use of cooked potatoes. The cooking was for approximately ½ hour in salt water. As dried products they used commercially dried potatoes (concerning which no details are given other than the potatoes were first soaked in dilute sulfuric or hydrochloric acid before dehydrating), potatoes dried in the air at 37°C., and some dried in vacuo at 30°C. The animals received no other food except potatoes. With fresh cooked potatoes given ad libitum there was apparently almost complete protection from scurvy up to 127 days. However, death ensued sooner or later and there was a marked drop in weight of all animals. This can be explained now in the light of McCollum's experiments with rats whereby it has been determined that the potato is deficient in several respects. Holst and Frölich found with potatoes commercially dried, air-dried at 37°C., and vacuum-dried at 30°C. and then cooked that there was no protection against scurvy.

Our results with fresh potatoes cooked and with potatoes dried at 35–40°C. and cooked confirm those of Holst and Frölich. With fresh potatoes cooked the findings herein reported are in accord with the experience of Chick and Hume.
500 Antiscorbutic Property of Vegetables. II

BIBLIOGRAPHY.

Key to Charts.

Sup. = Supplemental intake.
S. C = Basal soy cake diet.
Pn. = Pneumonia.
S = Scurvy.
S? = Scurvy questionable.
Pn. S? = Pneumonia with questionable scurvy.
Pn. I. = Pneumonia and impaction of the intestines.
I = Impaction of the intestines, cecum.
? = Cause of death a question.
OK = Animal apparently recovered.
* = Termination of the experiment.
† = Death.

The growth curves, which are self-explanatory, are separated from the feeding curves by a large heavy base line which extends out to the left under the weight figures. The feeding curves, always at the bottom of the chart, are plotted on a basis of 4. In these curves there are five equal subdivisions between the base lines. Consequently if an animal were eating all his food the curves of supplemental and basal intakes would be parallel to the base lines four-fifths of the distance above them. The number of the animal to which the feeding curves belong is always placed on the left opposite the base line separating the curve of supplemental intake (Sup.) from that of the intake of the basal diet (S. C). The curve of the supplemental intake is always above that of the basal food intake. The time relation is the same for all curves; that is, 20 days to each square.

As an example of the food curves, take No. 203, Chart I. On the 1st day this animal ate one-fourth his supplemental intake, on the 2nd and 3rd days one-half, and on the 4th day and every day thereafter he ate all of it. The basal diet curves (S. C) are read in the same way depending upon the depth of the break on the basis of 4.
CHART III. 10 gm. of fresh potatoes were cooked for 15 minutes in 11 cc. of 0.5 per cent citric acid and fed to the guinea pigs in this group. The volume of diluted acid chosen was such as to yield a very thick paste at the end of the cooking time. Unfortunately only two of the animals in this group consumed the entire daily supplement of potatoes and the experiments had to be terminated at 60 days for business reasons. However, the indications are that the amount of citric acid used was not destructive and it may have been beneficial. That the latter may be the case when the cooking is for 1 hour is noted in Chart IV.
CHART IV. These curves show that 10 gm. of potatoes cooked for 1 hour at 100°C, have their vitamine content so much reduced that scurvy is not prevented. The disease could not be arrested by feeding 15 gm. of potatoes so cooked. In the case of Nos. 466 and 468 scurvy was checked by feeding 10 gm. of potatoes cooked in 11 cc. of 0.5 per cent citric acid for 1 hour. This would seem to indicate that a slight organic acidity may prevent some of the deleterious action of heat upon the antiscorbutic vitamine.

15 = 15 gm. of potatoes.
10 C = 10 gm. of potatoes cooked in 11 cc. of 0.5 per cent citric acid 1 hour.
CHART 1. This chart shows that a small daily allotment of raw potatoes will prevent the occurrence of scurvy in guinea pigs. 10 gm. of raw potatoes were consumed by each animal except No. 204 whose average intake was about 7 gm. However, this lessened intake did prevent the appearance of any external scurvyic manifestations within the experimental period. Pneumonia accounted for the death of all animals in this group. In the case of No. 205 death was undoubtedly due to pneumonia, but whether it was complicated by scurvy is a question. At autopsy this animal showed a few subcutaneous hemorrhages. As the animals increased in weight and age more food was needed as is shown by the way all of them responded to a daily addition of 5 gm. of soy bean flour heated for 30 minutes at 20 pounds pressure.

5 gm. SF = 5 gm. of heated soy bean flour added to the diet.
Chart II. These curves show that a daily allotment of 10 gm. of raw potatoes cooked for 15 minutes will protect guinea pigs against scurvy for a very long period. Most of these animals lived as long as those on raw potatoes, in Chart I, but one guinea pig (No. 206) had definite signs and two others questionable evidences of scurvy at death. It therefore seems safe to conclude that even heating the potato at 100°C. for 15 minutes does slightly diminish the content of antiscorbutic vitamin.

5 gm. S F = 5 gm. of heated soy bean flour added to the diet.
Chart V. These curves represent the result of feeding potatoes dehydrated at a low temperature in vacuo. This mode of desiccating potatoes yields a product which is not entirely devoid of some antiscorbutic property if one can judge by the fact that the onset of scurvy has been delayed. $5 = 5$ gm. or a double dose of potatoes fed.
CHART VI. The animals in this group were fed potatoes which had been dehydrated at 35-40°C. Such a product contains practically no antiscorbutic potency. That it is not entirely free of the antiscorbutic vitamin is shown in the case of No. 233 which was fed 5 gm. of the dried potatoes daily after the appearance of scurvy. This animal was maintained for 60 days after the appearance of the disease but finally succumbed regardless of the double daily dose of dried potatoes.

5 gm. = 5 gm. or a double dose of potatoes fed.
55/60 = Potatoes dried at 55-30°C. substituted for those dried at 35-40°C.
These curves show that potatoes dehydrated at 35-40°C. and then cooked for 15 minutes at 100°C. afford no protection against scurvy. The amount here fed corresponds to 10 gm. of raw potatoes which, as is seen from Chart I, will protect guinea pigs against the disease.
Chart VIII. These curves demonstrate that potatoes dehydrated at 55-60°C. contain enough of the antiscorbutic essential to prevent the development of scurvy over a period three times as long as that in which the disease would appear if no protection were afforded. Three of the animals (Nos. 235, 225, 226) showed no signs of scurvy at the time of death (90 days after beginning the experiment); succumbing in the case of the first two to pneumonia and the other to an apparent impaction. No. 236 would not eat the potatoes and accordingly developed scurvy; with 10 gm. of fresh tomatoes cooked 15 minutes at 100°C, it was cured and carried for over 100 days when removed from the experiment. No. 224 showed some external indications of scurvy, as tender joints, at 45 days; however, it shortly improved and at death, 45 days later, showed questionable signs of scurvy.

T = Tomatoes introduced into the diet.
CHART IX. Potatoes dehydrated at 55-60°C, and then cooked for 15 minutes at 100°C, were fed the guinea pigs represented by the curves. The daily supplement was 2.5 gm. of dried material. None of the animals was protected against scurvy. Such antiscorbutic potency as may remain after dehydration at 55-60°C is apparently rendered nil by the short cooking process at 100°C.
CHART X. 2.5 gm. of potatoes dehydrated at 75-80°C. were fed as a daily allotment to this group of animals. Such a product undoubtedly contains some of the antiscorbutic vitamine but the amount is certainly not equivalent to that contained in potatoes dried at 55-60°C.
CHART XI. 2.5 gm. of potatoes dried at 75-80°C. were cooked for 15 minutes at 100°C. and fed to this group of guinea pigs. No protection against scurvy was afforded the animals even when the dosage was doubled. Again the destructive effect of cooking at 100°C. on the antiscorbutic vitamine is shown.

\[ S = 5 \text{ gm. or a double dose of potatoes fed.} \]
Chart XII. Potatoes were baked in the skins for 45 to 55 minutes at 204°C., then scooped out, and dried at 35–40°C. This dried product was fed in 2.5 gm. doses daily and protected the guinea pigs against scurvy. All the animals died from pneumonia showing none of the lesions of scurvy. It seems indicated from these experiments that subjection for a short time to a high temperature and then drying at a low one is less destructive than drying at a low temperature alone.
CHART XIII. Potatoes were soaked over night in dilute hydrochloric acid, dried at 55-60°C., and then cooked for 15 minutes at 100°C. 2.5 gm. of dried material so treated afforded no protection against scurvy. In previous experiments (Chart IX) it is seen that the animals lived longer on the potatoes dried at 55-60°C. and cooked 15 minutes than the animals represented by the above curves. The mineral acid in connection with the heat employed or the extraction of the vitamin by the acid treatment or both factors combined lessened the antiscorbutic potency of the product.
Chart XIV. Potatoes soaked over night in dilute acetic acid, dried at 55-60°C., and then cooked for 15 minutes at 100°C. were fed to guinea pigs in this group. This product was ineffective in preventing scurvy.
CHART XV. Potatoes steamed for 4 minutes and then dried at 55-60°C. were fed to the guinea pigs represented by the above curves. One animal died at 43 days from pneumonia showing signs of scurvy. Accordingly all animals were transferred to 2.5 gm. of potatoes dried at 75-80°C. Two of them died from pneumonia showing scorbutic symptoms; the other one was apparently improved at 70 days when the experiment had to be terminated.

75/80 = Potatoes dried at 75-80°C, substituted for those dried at 55-60°C, after a previous steaming for 4 minutes.
CHART XVI. Potatoes were steamed for 4 minutes, dried at 55-60°C., and cooked for 15 minutes at 100°C. A daily dose equivalent to 2.5 gm. of dried material failed to afford these animals any protection against scurvy, even when the dose was doubled.

5 = 5 gm. or a double dose of potatoes fed.
The potato shells from the baked potatoes were dried at 35-40°C. and 2.5 gm. fed daily. This material even in a double dose failed to protect the animals against scurvy.

$5 = 5$ gm. or a double dose of potato shells fed.
ANTISCORBUTIC PROPERTY OF VEGETABLES: II. AN EXPERIMENTAL STUDY OF RAW AND DRIED POTATOES
Maurice H. Givens and Harry B. McClugage


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