THE DIGESTIBILITY OF TEPARY BEANS

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The tepary bean, *Phaseolus acutifolius*, is a native North American crop plant and has long been grown in Sonora, Mexico, and in Arizona, by the Indian agriculturists. Bailey (1, p. 462–463) states that the Papago and Pima Indians cultivated tepary beans from prehistoric times and "in all probability they formed one of the principal food crops of that ancient and unknown agricultural race." The plant forms a low, trailing bush, with many slender, diffuse branches which lie close to the soil. Tepary beans are distinctly a dry-land crop grown for the beans and rarely if ever for forage. The continuous growth with formation of seed pods, which is characteristic unless frost or disease interferes, is a disadvantage if the beans are grown in the moister regions of the United States. In the dry regions it appears that tepary beans will make a larger crop on less rain than any other known species of bean. There is therefore a large range of territory in California, Arizona, and New Mexico where their culture could be widely extended if a regular market demand existed for them.

The largest extension of tepary-bean culture probably took place in 1917, when California alone produced over 150,000 bushels. The market price was not satisfactory, and later crops have been considerably smaller.

Although somewhat smaller than navy beans the tepary resembles them very closely and may be readily mistaken for them. Forty-seven color types have been isolated by the Arizona Agricultural Experiment Station, but only the white tepary beans have entered bean-trade channels of the United States. Considerable attention has been given to tepary beans and their culture and use as food at the Arizona Agricultural Experiment Station (4) and the California Agricultural Experiment Station (5, 17).

Much is known about beans and other common legumes as food, as a result of experiments carried on by many investigators. However, in the case of the tepary bean little information has been available with respect to food value beyond the analyses showing the chemical composition the fact that this bean is an important food crop where grown, that it is wholesome, well flavored, may be prepared in much the same ways as other dry beans, and that it is held to be a nutritious and sustaining food by those who have long used it. As in the case of most dry beans soaking is a necessary preliminary to cooking, or at least it shortens the cooking period. It is interesting to note that when soaked the skin of tepary beans wrinkles more quickly than does that of navy beans. In preparing tepary beans for the table Jaffa (17) recommends soaking them for 15 to 30 minutes and then draining and boiling in fresh water for about three hours.

Of beans, peas, and other dry legumes it may be said that they provide protein and carbohydrates (chiefly starch) in about equal amounts and in many cases some fat. That the range is rather wide is evident when one recalls that the soybean, like the peanut, is rich in fat, but when well ripened it contains no carbohydrate in the form of starch. In these respects the tepary bean obviously resembles the navy bean rather than the peanut or the soybean. With respect to the digestibility of the more common legumes, considerable information is available, chiefly as a result of investigations carried on by the United States Department of Agriculture and its collaborators.

A series of 70 experiments on the digestibility of navy beans, red kidney beans, and several varieties of cowpeas was made at the University of Tennessee (31). Generally speaking, the experiments show that the legumes were as well digested and assimilated as are the coarser cereal products, and that in some instances the digestibility was as great as that of the finer grades of flour. The investigations as a whole, it is stated, demonstrate the

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1 Received for publication June 21, 1924—issued January, 1925.
2 Reference is made by number (italic) to "Literature cited," pp. 205-208.
important place which legumes may fill in the diet as economical and palatable sources of protein, though later studies have shown that most legume proteins can not be considered complete. However, a diet containing meat, milk, eggs, and similar foods would supply this deficiency.

Digestion experiments have been made in connection with the food work of the United States Department of Agriculture with soybeans and with peanuts (15) cooked until soft in a household pressure cooker. The legumes formed the principal part of a simple mixed diet. The experiments show that steam-cooked peanuts were well assimilated, the coefficient of digestibility of the protein being 79.9 per cent. Large quantities of these legumes were consumed throughout the experiments, no physiological disturbances being noted. The report also points out that as regards nutritive and biological value, there is evidence to justify the belief that soybeans and peanuts are especially valuable as food in comparison with other legumes which had been similarly studied. The literature of this phase of the subject is summarized in the bulletins cited.

**EXPERIMENTAL METHODS**

The experimental methods used with tepary beans were those followed in digestion experiments conducted by the United States Department of Agriculture and described in earlier publications (2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29).

The subjects were men apparently in good health and well instructed in the experimental routine. The necessary analyses of food and feces were made by standard methods. The tepary beans used in the experiments were obtained through the courtesy of one of the correspondents of the department. The beans were prepared by soaking over night and then cooking for an hour under 15 pounds pressure. The beans were eaten with a basal diet of bread, butter, fruit, and sugar. The results of the five experiments are summarized in Table I.

**TABLE I.—Summary of digestion experiments with tepary beans in a simple mixed diet**

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrate</th>
<th>Ash</th>
<th>Estimated digestibility of tepary bean protein</th>
<th>Estimated digestibility of tepary bean carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>901</td>
<td>86.3</td>
<td>99.8</td>
<td>88.1</td>
<td>81.4</td>
<td>84.8</td>
<td>97.9</td>
</tr>
<tr>
<td>902</td>
<td>78.7</td>
<td>92.3</td>
<td>88.2</td>
<td>75.6</td>
<td>74.4</td>
<td>100.0</td>
</tr>
<tr>
<td>903</td>
<td>80.4</td>
<td>94.2</td>
<td>98.1</td>
<td>77.3</td>
<td>74.6</td>
<td>98.4</td>
</tr>
<tr>
<td>904</td>
<td>73.4</td>
<td>91.9</td>
<td>96.7</td>
<td>65.9</td>
<td>67.1</td>
<td>96.4</td>
</tr>
<tr>
<td>905</td>
<td>82.8</td>
<td>93.7</td>
<td>97.9</td>
<td>72.9</td>
<td>78.7</td>
<td>97.4</td>
</tr>
<tr>
<td>Average</td>
<td>80.3</td>
<td>93.2</td>
<td>97.8</td>
<td>74.6</td>
<td>75.9</td>
<td>98.0</td>
</tr>
</tbody>
</table>

The subjects ate, on an average, 70 gm. of protein, 69 gm. of fat, and 394 gm. of carbohydrate, with an energy value of 2,475 calories, per man per day. The beans supplied on an average 40 gm. of protein and 99 gm. of carbohydrate per man per day. The protein of the beans was 76 per cent utilized, which agrees closely with the value of 78 per cent for navy and red kidney beans found by Wait (31), and 77.9 per cent found by Mendel and Fine (30) for navy-bean protein. The carbohydrates of the tepary beans were on an average 98 per cent digested, which represents almost complete utilization and is somewhat higher than the value of 96 per cent found by Wait for navy-bean carbohydrates. The subjects reported that they remained in their usual normal health throughout the experimental period.

**SUMMARY**

A study of the digestibility of tepary beans for purposes of comparison with similar legumes shows that tepary beans are well utilized by the body and are a valuable food.
LITERATURE CITED


Langworthy, C. F., and Holmes, A. D.

Mendel, L. B., and Fine, M. S.

Merrill, A. T. and Wait, C. E.

Wait, C. E.