

# Vitamins in Walnut Meats

## studies made to determine content of vitamins thiamine, riboflavin, niacin

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**Placentia and Payne walnuts** contain 20% to 30% more of the vitamins thiamine, riboflavin and niacin than do Franquette walnuts.

Chemical, physical, microbiological and biological means of assay have been developed rapidly in recent years, but few of these methods are sufficiently specific and uncomplicated by the action of interfering substances to be acceptable without corroborating evidence. Most foods are of low vitamin potency and their accurate analysis is of primary importance in human nutrition. Each food presents a separate problem since each has different concomitant substances which may operate differently in the various methods of analysis.

A study of walnuts was undertaken in 1942 with these difficulties in mind and an effort was made to validate each of the methods used, by recovery experiments and by comparison with other methods.

The walnut samples used in this study, were grown in three districts in California and were of three varieties on *Juglans regia* rootstock: Placentia, Franquette, and Payne. The samples were collected from the same groves for four successive years and were selected from the best grade of nuts. They were stored both shelled and unshelled at 35° F.

Proximate analysis of the nuts indicated 14% to 16% protein, 64% to 67% fat, 1.8% ash, and 3% to 5% moisture. There were no significant variations in these nutrients among the three varieties or the four crops.

A study of the thiochrome and bio-assay methods for thiamine and of the fluorometric and microbiological methods for riboflavin was undertaken. Niacin determinations were by microbiological means. The validity of the chemical and microbiological procedures was judged by recovery of known amounts of the vitamins and by the reproducibility of results at the same and at different levels of concentration.

### Thiamine

Thiamine values obtained by the thiochrome procedure were larger when the adsorption purification method was used in 1943 than when isobutanol washing was substituted in 1946. Recovery experi-

ments indicated the same tendencies. If the results of the two series can be compared it would seem that the nuts retained 70% to 80% of the thiamine after 27 months in cool storage. The 1944 and 1945 samples analyzed by the nonadsorption technique after 18 or six months storage, in most cases were close to those found by the adsorption method of after 15 or three months storage of the 1942 and 1943 samples, respectively. The nuts stored in and out of the shells were alike in thiamine value. The Franquette variety had 20% to 30% less thiamine than comparable samples of the Payne and Placentia varieties.

The bio-assays allowed comparisons of samples stored 33 or 12 months. The 77% thiamine retention in these samples was similar to that of 1942 and 1943 samples stored for 27 months.

By rat-growth experiments the caloric intake per gram of gain was found to decrease rapidly as the thiamine level was raised. Fifty-four calories were used per gram gain in the negative group and a constant value of 15 calories per gram gain was reached when four, six and eight micrograms of thiamine were taken in per day. The four microgram-day level represented the most efficient utilization of thiamine and was also the level used in the walnut-fed groups. Variability of gain was the same in all groups.

Storage in or out of shells had no significant effect on thiamine retention as shown also by bio-assay. The Franquettes allowed less growth than the other two varieties. Three samples of 1945 Placentias, selected as to color, were found to vary in thiamine value, the dark-skinned kernels having 22% to 28% less than the light or amber as shown by both methods of assay.

In all comparable cases the rat-growth assay feeding laboratory rats a controlled diet with walnuts as the only source of thiamine, yielded higher thiamine values than the chemical procedure, with less discrepancy in the fresher samples. This may indicate the presence of some fluorescent substance extracted with the thiamine, quenched by the oxidative process, yet exerting its fluorescence in the unoxidized aliquot, thus producing high blanks. This theory is supported by the fact that dilution increased thiamine recoveries. In the course of aging, the inter-

fering substance might be decomposed. Recovery of added thiamine near 100% is not always a sound criterion for the validity of the method. In this case the biological assays which were carefully controlled indicated significantly larger values in both series of measurements. Loss or destruction of thiamine during analysis may be detected through recovery experiments, but false values by chemical determination due to interfering substances in the test material may still result. The rat-growth procedure, on the other hand, is likely to indicate the true physiological worth of the food and in low-potency food samples appears to have about the same degree of precision as the chemical method.

By the chemical method the Placentia, Franquette and Payne walnuts were found to contain 0.29, 0.24 and 0.31 milligrams per cent thiamine and by the biological method 0.40, 0.33 and 0.39 milligrams per cent. The latter values appear more likely to represent the true thiamine content of the nuts.

### Riboflavin and Niacin

Average values of three of six assays of the various walnut samples for riboflavin and niacin were obtained in the early summer of 1946.

There seemed to be little difference in retention of riboflavin in the kernels stored in or out of the shells, and little difference between crop years. This indicated good vitamin retention during storage for from six months to three years under these conditions. The niacin content of the kernels not stored in the shells was 11% to 13% higher than like samples stored in the shells. The dark-colored Placentias were 30% to 40% lower in riboflavin than the light or amber colored ones, but had the same niacin content as the light kernels.

A comparison of values obtained by the different methods revealed that the microbiological assays for riboflavin gave results about 20% lower than the fluorometric method. The discrepancy is difficult to explain, unless some fluorescent substance such as might be interfering in the thiamine assay is also operative here, this time to give high results. Recoveries of added riboflavin and the

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**IRRIGATED PASTURES IN CALIFORNIA**, by Burle J. Jones and J. B. Brown. Ext. Cir. 125, revised June 1949, by Milton D. Miller and L. J. Booher.

This circular discusses types of irrigation and average costs, and suggests suitable seed mixtures for individual counties.

**HOME FREEZING**, by Vera Greaves Mrah. Ext. Cir. 153, June 1949.

This circular gives specific instructions for freezing fruits, vegetables, meat, fish, poultry, eggs, and precooked foods.

## WALNUTS

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reproducibility of results were somewhat better in the fluorometric than in the microbiological assays. Range of values obtained by both methods must probably be accepted for the present.

The Placentia, Franquette and Payne walnuts contained 0.165, 0.120 and 0.155 milligrams per cent riboflavin by the chemical method and 0.125, 0.100 and 0.110 by the microbiological method.

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The Placentia nuts contained on the average 0.81 milligrams per cent niacin, the Franquettes 0.58, and the Paynes 0.73.

The walnuts contain about the same amount of thiamine as whole grain cereals—vitamin B<sub>1</sub>—most lean meat, liver, egg yolk and dried legumes, and considerably more than most other foods.

As a source of riboflavin—vitamin B<sub>2</sub>—walnuts may be classed with whole grains, lean meats, certain vegetables in the middle and upper range of riboflavin content such as cauliflower, broccoli, and most greens.

As a source of niacin walnuts are comparable with the few vegetables in the higher range of niacin content and superior to all other fresh vegetables and fruits, milk and eggs. They are not equal to the whole grains, dried legumes, fresh meats, and fish in this regard.

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