

Food Value Tests with Carrots

long-term study initiated to determine effects of production practices on food value of vegetables

M. Yamaguchi, Betty Robinson, and John H. MacGillivray

The effects of farming procedures and marketing practices on the food value of carrots were investigated in a study which considered size of roots, age, harvest time, locality of production, variety, and other factors.

Imperator variety was used in all experiments excepting the tests on varieties. Analyses were made of roots from various areas in California that produce commercial carrots as well as of roots from the experiment grounds at Davis. Samples obtained from areas away from Davis consisted of three dozen bunches and were selected from various fields—of uniform sandy soils—being harvested for eastern shipment. Fields were 20 to 30 acres in size, and one to two acres of roots were available for selection at any sampling period.

All roots were thoroughly washed. The tops and any waste from the crown of the root and the tip were removed and weighed. The roots were cut in quarters, and one segment from each root was finely chopped. A three-pound sample was used for analysis. Duplicate aliquots were taken from the chopped sample. The data are expressed in terms of compounds per 100 grams of edible portion of the fresh root.

Since samples were brought to Davis for analysis from several areas in the state, a storage period of three days was chosen—with carrots placed in an insulated box with ice between the layers of roots—to provide sufficient time to obtain samples from Imperial Valley, 600 miles from Davis.

Two tests were made to check any changes in food value during this three-day storage period. Analyses were made immediately at harvesting and upon similar lots stored for three days in crushed ice. Because this study was important to the accuracy of other data, minor differences were recorded but none were of sufficient magnitude to be considered an impairment of food value. Storage for three days in crushed ice did not change the food value of carrots.

Root Size and Food Value

To determine the effect of root size on food value, bunches of five, seven and 12 roots per bunch were analyzed. The roots of the three sizes were selected in

the field at harvest time. The samples were obtained June 28 and November 28 near Soledad in the Salinas Valley, and on January 12 in Imperial Valley. Differences in composition were very small, phosphorus and vitamin A showing the greatest variations. Carrots with seven roots to the bunch were sometimes slightly higher in phosphorus and vitamin A than those with 12 roots. The roots had the following amounts of phosphorus per 100 grams of edible portion: 5-root size, 32 milligrams—mg—7-root size, 34 mg; and 12-root size, 30 mg. The complete values were omitted because the differences between categories for the ten nutrients were very small.

A carrot cut in cross section shows two distinct areas. The internal core—or xylem—can be separated from the external area—phloem. For the purposes of the experiment, a thin peeling was removed from the phloem section, since carrots are sometimes peeled.

The ascorbic acid and riboflavin were approximately the same in the three regions, and the protein content differed by only one tenth of a gram. The other constituents showed important differences. The phloem, which constitutes most of the carrot, was high in energy and vitamin A. The peeling was high in calcium, iron and thiamine; the xylem was high in phosphorus.

Effect of Age

Two lots of carrots grown at Davis were analyzed to determine the effect of age upon their food value. One group—planted August 5—reached marketable stage about November 25, and another group—planted January 12—reached marketable stage about June 21. Market stage is not limited to one harvest period but is thought to extend over a month from this selected date.

The first group of carrots started going to seed about March 18, which was the last sampling date, but only the good carrots were used for analyses. The second group did not go to seed during this experiment and were last sampled four months after first marketable stage. Since carrots are biennials, the second planting would not be expected to produce seed until the following spring. The roots were

sampled seven times in the first experiment and six times in the second experiment.

Time of Year and Area

As carrot plants approach the best time for harvest, the percentage of tops decreases. However, the following constituents increase: energy, calcium, vitamin A, and perhaps protein. These increases are gradual, some reaching their maximum after the optimum harvest stage. Ascorbic acid decreases slightly with the approach of the marketable stage as well as at older ages. The other constituents do not show consistent changes.

Samples for analysis were obtained from three areas in the state at the time they were harvested for market. The number of roots per bunch averaged about seven. The two major carrot-shipping areas in the state are Monterey County in the central coastal region and Imperial Valley in the southeast portion of the state. The soil type in Monterey County is a Hanford loam soil; Imperial County is a silty clay loam; and at Davis it is a Yolo sandy loam.

When the roots from different areas were compared, marked differences were noted. The Monterey roots were low in protein content but high in calcium. Imperial roots seem low in phosphorus. Iron was high in Davis carrots, and both Davis and Imperial roots were high in ascorbic acid. The carrots harvested during the winter months of November and January seemed somewhat higher in energy, protein, and iron, and low in both vitamin A and calcium.

The ratio of alpha to beta carotene was lower in the carrots grown in the cooler season, ranging in alpha-beta ratios from 0.19 to 0.29, as compared with those grown during the warmer season, when the ratios varied from 0.42 to 0.62. This was true in Imperator carrots grown in different areas of the state and in the test on varieties.

Varieties

Four of the more common varieties of carrots—Imperator, Red Core Danvers, Red Core Chantenay, and Nantes—

Concluded on page 10

CARROTS

Continued from page 4

were grown near San Jose for comparison as to composition.

The test roots were harvested at the proper stage for market. Two lots were grown in the same area; one was harvested in August and the other in February. Examination showed some variation in composition within the four varieties. Imperator seemed to be high in composition for several of the constituents—dry matter, energy, calcium, and phosphorus. The Nantes variety was low in phosphorus, vitamin A, and riboflavin. Imperator seemed relatively high in many of the nutrients. The differences between varieties as to waste in preparing the roots were not important.

The results of the tests reported here are a survey and indicate possible trends, since the experiments and plots were not replicated and therefore cannot be statistically analyzed.

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L. J. Clemente, J. W. Perdue, and Laura Morse, University of California, Davis, assisted in the experiments described in the foregoing article.

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BROILERS

Continued from page 6

broilers; and c, through their oversetting and undersetting practices.

The first two of these factors have their principal influence on long-run changes in output; the last principally affects short-run changes. Except for these factors, hatcheries acted in the capacity of suppliers of chicks in accordance with the orders of their customers.

During the year of this study, California broiler chick hatcheries appeared to be a neutral influence on short-run changes in output in that there was little evidence that they made significant production decisions other than decisions to utilize their excess production capacity, to take advantage of changes in their customers' minds, and to avoid surpluses. The chicks hatched as a result of these decisions represented a small proportion of their total output.

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California, Los Angeles, when the above-reported study was made.

The above-reported study is part of a larger project which will include analyses of the role of hatcheries, financing agencies, processors, and broiler producers on broiler output fluctuations. The over-all project is being conducted by the Western Regional Poultry Marketing Committee, WM-7.

POINSETTIA

Continued from page 3

develop properly. These deformed bracts are unable to reach maturity but abscise and leave the open center commonly seen in plants of the Henrietta Ecke variety.

Plants which were grown under maximum light intensities—about 3,000-foot candles—produced flowers with normal central bracts. Plants under low light intensities—500- to 600-foot candles—abscised bracts readily. Furthermore, plants grown under high light conditions had larger outer bracts, a more intense color, were shorter, and were generally more desirable plants than those grown under low light conditions.

Quality plants of the double-type Henrietta Ecke variety can be produced and timed for the Christmas holiday trade by growing the plants under high light intensity conditions—with modification of usual watering and fertilizing practices—and by later propagation to avoid too tall plant growth. Such changes may take some time, but when growers do make them, the public will be rewarded with top quality double poinsettias.

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PONDEROSA

Continued from page 7

demonstrated in the first experiment. It may well be that within the completely artificial system that was set up in these experiments, vapor pressure gradients exist which do not exist under natural

GROUND PEARL

Continued from page 5

festations have been encountered in heavy clay soils.

Since ground pearls have been found on grape roots 24" deep—which was the approximate extent of root penetration—it seems likely that they may be found even deeper.

Insect Described

The adult female of this pest has well-developed forelegs bearing strong claws. She produces an egg sac of white waxy filaments and deposits within it over 100 eggs, which are pinkish-white in color. The dead body of the female closes off the end of the egg sac. Hatching observed in 1954 began during the latter part of June and continued into late July. The crawlers are elongate, slender, and quite active. They attach themselves by means of their needlelike mouthparts to a fine rootlet and eventually secrete the hard, glassy covering characteristic of the intermediate pre-adult stages. It is from the appearance of these later immature stages—globular in shape and with a pearly, faintly yellowish-green color—that the common name ground pearl is derived. Other details of the life history of this potential pest to California grapes are at present unknown.

Additional studies of this subterranean scale insect are planned, including chemical control tests.

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soil conditions. Continuing work should provide the answer.

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Water Removed from Flask

Accumulative total in milliliters

| Elapsed time (days) | Live seedlings started May 1 | | | | Live seedlings started July 1 | | | | Dead seedlings | | | |
|---------------------|------------------------------|------|------|------|-------------------------------|-----|------|------|----------------|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 1 | 1.5 | 1 | 1.5 | 1 | 3 | .5 | 1.5 | .5 | 0 | 0 | 0 | 0 |
| 4 | 6 | 5 | 6 | 5 | 5.5 | 1.5 | 4.5 | 3.5 | 0 | 0 | 0 | 0 |
| 7 | 17 | 8.5 | 10 | 8.5 | 7.5 | 2.5 | 6.5 | 6.5 | 0 | 0 | 0 | 0 |
| 13 | 30.5 | 11.5 | 16.5 | 13.5 | 10.5 | 4.5 | 10 | 11.5 | 0 | 0 | 0 | 0 |
| 19 | 36 | 14 | 28 | 21 | 11.5 | 6 | 13 | 13.5 | — | — | — | — |
| 25 | 65 | 17 | 40 | 29.5 | 13.5 | 8 | 16.5 | 16.5 | — | — | — | — |
| 31 | 82 | — | 62 | 45 | 14.5 | 9 | 20.5 | 18 | — | — | — | — |