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MATURITY WORK ON AVOCADOS

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Mr. Chairman, friends and fellow members of the Avocado Association:

I have been requested to present for your consideration this morning some phases of one of the problems confronting the avocado grower, "The Maturity Problem." Briefly stated, this problem consists in arriving at the time in the growth of the avocado when it can be harvested with best results, both as to storage and to quality. There is a period in the development of all fruits when they can be harvested with optimum results. The problem is to find this period.

One of the first points to be considered is what constitutes maturity. The question may be considered from two points of view: firstly, as to commercial maturity; secondly, as to natural maturity. A definition of the first class may possibly be arrived at, but I know of no one who will hazard a definition to cover maturity as conceived by nature. At first thought, we might suggest that when the seed within the fruit has advanced sufficiently to sprout and reproduce the plant, that the fruit is naturally mature; but it is notoriously the fact that seeds from green fruit will sprout and reproduce. On the other hand, if we await the time when the seed has sprouted within the fruit, we have usually waited until the latter has passed the period where its best eating quality is found. Natural and commercial maturity cannot be correlated, for manifestly many things are sold and eaten before they are naturally mature. Commercial maturity may be said to be that stage of growth at which the fruit may be harvested with equal satisfaction to the producer and the consumer alike. The producer ever seeks to put his product on the market physically sound, while the wise consumer ever seeks fruit that has developed its full size and flavor. There is no definite natural point at which one can say a fruit is commercially mature. Some persons of peculiar tastes will enjoy fruit which is much too acid for the average consumer, and some will not care for it until it is so far advanced as to seem insipid to the great majority. After giving the matter considerable thought for several years, I have come to the conclusion that the only reasonable way to handle the question is to set a purely arbitrary standard which should be as low as good marketing practice will permit. This, it is true, will not place before the public a product of which the great majority of growers should feel proud. The standard must be high enough so that the fruit on reaching the market will not turn the majority of the buying public against the crop as a whole. Any standard which will not accomplish that is worse than useless. This, of course, is not satisfactory to the market hog, who would dispose of his crop at the greatest profit to himself alone and let the other growers look out for themselves. Nor is it entirely satisfactory to the idealist who would make it much more severe. The former, however, is a public nuisance which should be abated, and the latter has his remedy in his private brands where he can regulate the quality of his output to his own

satisfaction.

Some fruits undoubtedly develop the best eating quality when left to mature upon the plant, but this is not the case with all fruit. Certain varieties of apples and pears are always harvested before maturity in order to develop their maximum flavor, and in some cases several weeks of storage are necessary. Bananas, for instance, are harvested green in the tropics, even when they are intended for local use, and are said to develop a better flavor thus than when left on the plant to mature. It must be confessed, however, that the depredations of birds and insects upon the maturing fruit have had no little part in bringing about this custom.

The above mentioned fruits increase their sugar content after removal from the tree, as they have stored within the fruit material from which sugar is produced. Other types of fruits, however, do not materially increase their sugar content after harvesting. In our experimental work with citrus fruits we have failed to find evidence of any increase in sugar content after the fruit is removed from the tree. There is, however, a decided decrease in the acid content, which is sometimes mistaken for an increase in sweetness.

It is apparent then, that some fruits may be harvested some little time before they are ready to eat, while others should be left upon the plant as long as possible.

In the case of the avocado, the flesh contains no starch from which sugar can be produced after harvesting; indeed, sugar plays no appreciable part in the composition of its flesh, and in all probability gives no indication of maturity. In fact, so far as the limited data on hand go, they show less sugar by far in the matured fruit than in the green. Apparently also the sugar decreases after the fruit is removed from the tree.

We must, therefore, turn to other constituents to determine the maturity of the fruit, and naturally the oil content presents the best indication of success. From what the oil content of the avocado is derived, I cannot say at this time. I can say that in all the varieties examined by us the oil content increases as the avocado matures. The actual amount of oil in some varieties increases to a slight extent after the fruit is removed from the tree. With varieties that are now mature, there has been an increase of nearly 400% in the oil content since we began the analysis in September.

If the oil content is the best indication of the maturity of the fruit, the question at once arises as to the practicability of such a standard to the grower. Manifestly one of two things must be accomplished in order to make it possible for him to utilize the information. Either a simple method for the determination of oil must be devised or the oil content must be correlated with some physical characteristic of the fruit which can be readily distinguished. Fortunately both methods seem possible of accomplishment. It does not seem at all difficult to adopt the Babcock test, used for fat determinations on milk, to properly prepared avocado pulp. Also there are certain characteristics developed by the fruit as it matures which it may be possible to utilize as an indication of maturity. At the present price of avocados, the oil determination method, it is believed, will not become popular, for manifestly the fruit will have to be destroyed for the test, so that we are concentrating on the study of the correlation method.

With many fruits, it is easily possible to predict maturity from the physical characteristics

of the fruit. Usually color is thought to be the first evidence of ripening, and often is. But it is also true that some fruits color before they become palatable. Next to color, the "feel" of the fruit is most often used; not many fruits can be left on the tree, however, long enough to become soft, as the shipping quality would be lost. The color of the stem is also an indication of maturity. With some fruits the color and condition of the seed or seeds is sometimes used. In the case of Bartlett pears, the color of the seed is taken by many growers as an indication of ripening, and also the ease with which the stem can be broken from the branch.

One naturally looks to the seed as a good indication of maturity, but this examination is not available in the case of the avocado at present, as the fruit is too expensive. We have been observing carefully the appearance of the seed as the fruit grows, and there is a marked change, but the only indication given from the outside is the loosening of the seed in its cavity and when this stage is reached, the fruit of some strains at least is over ripe. Advanced maturity is often indicated by the facility with which fruit separates from the twig, but too often this takes place only after it is too ripe for commercial use. The avocado separates naturally from the fruit spur in two places, one at the junction of the fruit and its stem, the other at the point where the fruit stem is attached to the parent plant. In our experience, many strains of avocados are mature enough to store before they will separate readily at either point. So far, the physical characteristics which seem to us to give the best indication of maturity are the color of the fruit and of the stem.

In conclusion, a word about the work which we are doing and plan to do in the future will not be amiss. This year the maturity work has been confined to the eight varieties recommended by the Association as the standard fruits for commercial growing, namely, Biakeman, Dickinson, Fuerte, Lyon, Puebla, Sharp-less, Spinks and Taft. Of these the Puebla and Fuerte are finished. Owing to unforeseen difficulties, the work on the Puebla was not started until rather late for this variety, and the wind storm of last November shook a great many fruits from the tree, so that the results in this case will be somewhat meagre this year. The work on the Fuerte is about over, and a full line of monthly samples, beginning with September, have been finished. Here we were able to secure a tree with ample fruit for analysis, and have been fortunate in having but few drops until late in the season.

The Biakeman tree has not as much fruit as we would like to have, but will be sufficient to furnish valuable data on which to base future work. The Lyon tree was young but was well supplied with fruit and analyses are still being made. The Dickinson tree is also in satisfactory shape and has sufficient fruit to carry the analyses well past the ripening stage. The fruit on the Taft tree we overestimated and drew upon too heavily for the first samples. We have had enough, however, to bring the analyses to date. Work on the Spinks was not begun until after the first of the year, so that we will have ample fruit to satisfy our needs.

This year the plan has been to select typical trees, and begin the analyses several months before there was any question as to the maturity of the variety. We have taken a sample every month, using 6 fruits to a sample where the supply permitted. These samples were divided into two equal parts, the first of which was analyzed immediately, the second wrapped in paper and stored at laboratory temperature until it softened, before analysis was made. The two sets of data thus obtained are calculated to the

moisture free basis for comparison, and the changes taking place on storage determined.

This year rather full analyses are being made; if after studying the data obtained, it appears that some of the constituents do not materially change with the maturity of the fruit, we can omit their estimation next year. Mr. Church, who is doing the analytical work this year, is determining the percentage of rind or skin, of seeds and of pulp, the specific gravity of the fruit, the percentages of moisture, mineral matter, oil, and crude fiber in the flesh. Notes are also being taken of the physical characteristics, such as color of the skin and stem (where it is known), "feel" of the fruit, whether it appears leathery or soft, color of flesh, whether flesh separated readily from skin, color, odor and condition of seed. Already I can assure you that you will find these data most interesting, and I believe profitable. One year's work on one tree of each variety will not be sufficient to establish a standard, of course, but it will give us a pretty good idea of the work needed in the future. We would like to extend the collaborative work next year, taking up the composition of the fruit from bud selection trees, and extending the analyses to new varieties which show sufficient promise to warrant the work. A few such analyses have been made this year. There is also much interesting work on the composition of the avocado, and its seed, both of which present a new field of work to the research chemist.

MISCELLANEOUS AVOCADO SAMPLES.

No.	Variety	Date picked 1917	Aver. Wt. oz.	Sp. Gr.	Skin %	Pulp %	Seed %	Water %	Ash %	Protein %	Fat %	Total Sugar %
4.	Lambert	3/13	10.2	1.0270	8.8	68.0	22.9	74.6	1.26	2.47	15.21	1.33
6.	Monroe	3/29	13.8	.9256	11.6	62.1	26.2	74.9	1.11	2.04	15.89	0.90
8.	Surprise	4/11	16.7	.9996	7.7	70.1	22.2	81.3	1.15	2.38	10.07	1.50
9.	Dickey A.	5/21	17.3	1.0239	8.1	72.4	19.1	73.8	1.26	2.32	11.60	0.31
11.	Challenge	7/13	19.8	1.0074	5.4	74.0	20.2	81.4	1.09	3.18	10.90	0.62
13.	Caribou	7/17	12.2	1.0360	9.7	65.5	24.6	75.8	1.75	2.92	13.44	0.71
14.	I. X. L.	7/17	25.8	.9782	11.6	76.3	11.8	78.9	1.54	2.81	12.55	0.41
17.	Murietta Seedling, Buttercup	7/24 1919	12.2	1.0280	12.9	62.5	24.2	75.6	1.24	1.93	14.91	0.27
22.	Linda	8/22	27.6	.9937	11.3	72.4	15.8	78.9	1.31	1.79	13.36	0.72
30.	Dickey A.	10/ 3	7.6	.9895	13.3	78.6	8.1	85.4	0.65	1.75	6.37	1.56
33.	Seedless Fuerte	10/16 1920	.85	1.0104	10.2	88.1	.....	78.5	1.04	2.36	10.62	1.43
58.	Seedless Guatemalan	1/ 7	15.2	.9548	14.7	66.0	19.2	65.9	1.89	1.73	24.89	1.00
64.	Seedless Fuerte	1/30	.88	1.0093	13.9	85.3	.....	64.6	1.37	1.71	24.92	0.59
67.	Mexican, No. 15	1/30	16.5	.9288	10.7	80.2	9.5	80.3	1.08	1.97	11.51	0.67
73.	Seedling, Dutton	2/21	9.2	1.0202	8.9	68.6	22.5	81.2	1.06	2.26	11.09	0.66
94.	Seedling, A. Campbell	4/18	11.0	.9701	11.3	69.6	18.9	72.2	1.27	2.75	19.26	.....

(From Citrus By-Products Laboratory).