

Organoleptic Evaluation of Applesauce Fortified with Essence and Citric Acid^a

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COLOR, CONSISTENCY AND FINISH are quality characteristics which have been well standardized in the modern methods for manufacturing applesauce. However, there is a variation in flavor during the season because of varietal differences of apples for blending and the normal fluctuations in fruit maturity. Apple essence, prepared by the process developed at the Eastern Regional Research Laboratory (3, 4) was added to applesauce to stabilize the flavor level. Citric acid was added to increase the tartness.

EXPERIMENTAL PROCEDURE

Preparation of samples. Three types of essence were used. Two of the essences were from the same varieties of apples as were used for the sauce, one from the whole apples and one from the peels and cores. The third essence was from whole apples of the dessert type. The dessert blend contained Stayman Winesap (43%), MacIntosh (20%), Northern Spy (15%), and Baldwin (11.5%), plus small quantities (0.5%) of Jonathan, Grimes Golden, and Golden Delicious. Essence was added at various levels of concentration from 0.5- to 5.0-fold.^c In addition, citric acid, in concentrations of 0.1 and 0.2%, was added to some of the samples.

The applesauce was prepared from 4 parts of York Imperial, 1 part of Stayman Winesap, and 1 part of Rome Beauty apples at the Chambersburg, Pa., plant of Knouse Foods Cooperative, Inc., using standard commercial equipment. The essence (150-fold^d) was injected into the center of the cans of hot sauce, prior to closing, by means of a hypodermic syringe equipped with a long needle. The citric acid was added as a 50% solution. Applesauce from the same production line was used as control. The sauce was stored at 70° F. and samples removed for taste evaluation after 1 month and after 10 months.

Evaluation of samples by trained panel. For the evaluation, a panel of 20 judges and 8 alternates was selected from 55 candidates on the basis of the consistency of their judgment in scor-

ing applesauce. This was determined in 2 training sessions and 4 panel-selection sessions, using the same type of sauce samples and the same scoring methods as those to be used later in the actual evaluation.

For panel evaluation, 27 experimental samples were arranged in 6 series as indicated in Table 1. An incomplete block design would have been more suitable for making comparisons between samples in different series, but this was not possible because of the difficulty of preserving samples once they were opened.

Samples in each series were coded and presented in a randomized order. Judges were asked to score the samples on a 10 to 1 scale (10 = *best* and 1 = *poorest*). A sample of the control, arbitrarily given the score of 5, was included for the purpose of comparison but this value was not used in the tabulation of results. A hidden control sample was also included in each series. The score of the hidden control was used in the analysis of the data because it was felt that it would reflect any bias in scoring. Data were summarized and subjected to analysis of variance.

Evaluation of samples by consumer panel. The consumer panel consisted of approximately 150 members of the laboratory and office staff selected at random. For each test, the panel members were presented with 2 coded samples: a sample of fortified sauce and a sample of the control, and asked to state their preference. Order of presentation was varied so that the control was presented first to approximately 50% of the judges in each test. In the first few tests the code letters were written on the bottom of the sample cups so that the judges would not be influenced. In later tests, code letters of equal degree of bias were used as recommended by Ishler *et al.* (2).

RESULTS

Results of the initial flavor evaluation of sauce samples after one month's storage are recorded in Table 1. Each score is the average of 20 judgments. The 6 series differ in the type of essence used and in the presence or absence of added citric acid. Each of the 3 essences alone (Series A, C and F) gave a significant flavor improvement starting with 0.5- or 1.0-fold and increasing as the quantity of essence was increased. The one sample containing 5-fold essence showed no flavor improvement over the 3-fold level, and many of the judges remarked that this sample had a medicinal flavor.

Addition of 0.1% citric acid with various levels of essence gave flavor scores not significantly higher than the corresponding series containing no added acid. Samples containing 0.2% added acid showed no flavor improvement. Samples with added acid evoked a mixed response from the taste panel; some tasters preferred a tart sauce while an equal number of tasters objected.

The taste panel evaluation of the sauce after 10 months' storage (Table 2) shows a slight decrease in flavor. This may have

TABLE 1
Flavor scores for applesauce after 1 month

| Series | Type of essence added | Added citric acid | Average taste panel score | | | | | | F value | LSD P = .05 | |
|--------|-----------------------|-------------------|---------------------------|--------------------|-----|-----|-----|-------|---------|-------------|-----|
| | | | Hidden control | Added essence-fold | | | | | | | |
| | | | | 0 | 0.5 | 1 | 2 | 3 | | | 5 |
| A..... | Sauce blend | none | 5.2 | ..... | 6.2 | 5.8 | 7.8 | 8.3 | ..... | 14.8** | 1.0 |
| B..... | Sauce blend | 0.2% | 5.1 | 5.5 | 5.0 | 5.3 | 6.0 | 5.7 | ..... | ns | |
| C..... | Peels and cores | none | 5.4 | ..... | 5.7 | 6.8 | 6.6 | 7.6 | 7.3 | 4.8** | 1.1 |
| D..... | Peels and cores | 0.1% | 5.1 | 5.2 | 6.7 | 6.8 | 6.3 | 7.9 | ..... | 7.5** | 1.1 |
| E..... | Peels and cores | 0.2% | 5.2 | 5.1 | 6.4 | 6.2 | 6.5 | 6.4 | ..... | ns | |
| F..... | Dessert blend | none | 5.1 | ..... | 6.0 | 6.4 | 7.0 | ..... | ..... | 3.6* | 1.2 |

ns—not significant at 5% level.

*—significant at 5% level.

**—significant at 1% level.

TABLE 2
Flavor scores for applesauce after 10 months

| Series | Type of essence added | Added citric acid | Average taste panel score | | | | | | F value | LSD P = .05 | |
|--------|-----------------------|-------------------|---------------------------|--------------------|-----|-----|-----|------|---------|----------------|-----|
| | | | Hidden control | Added essence-fold | | | | | | | |
| | | | | 0 | 0.5 | 1 | 2 | 3 | | | 5 |
| A..... | Sauce blend | none | 5.7 | .... | 6.5 | 6.8 | 6.3 | 6.7 | .... | ns | |
| B..... | Sauce blend | 0.2% | 5.4 | 4.8 | 5.5 | 4.4 | 5.5 | 5.4 | .... | ns | |
| C..... | Peels and cores | none | 5.6 | .... | 6.6 | 6.0 | 6.9 | 7.1 | 7.1 | ns | |
| D..... | Peels and cores | 0.1% | 5.1 | 5.5 | 6.1 | 7.0 | 5.6 | 7.1 | .... | 2.6* | 1.4 |
| E..... | Peels and cores | 0.2% | 5.3 | 4.9 | 6.5 | 6.2 | 5.7 | 6.4 | .... | ns | |
| F..... | Dessert blend | none | 5.0 | .... | 5.6 | 6.2 | 6.5 | .... | .... | 5.7** | 1.1 |

ns—not significant at 5% level.

*—significant at 5% level.

**—significant at 1% level.

resulted from an actual loss of essence or from the masking effect of off-flavors. Only two series (D and F) now show flavor improvement at the 5% level of significance. Data obtained on similar samples by a taste panel consisting of 4 members of the quality control laboratory of Knouse Foods Cooperative, Inc., agreed closely with the results recorded in Tables 1 and 2.

In order to gain a better comparison between samples from the 6 different series, the panel was asked to evaluate the samples containing 2-fold essence. This was done at both the 1-month and the 10-month storage periods (Table 3). In this

TABLE 3
Comparison of sauce samples containing 2-fold essence

| Series | Type of essence added | Added citric acid | Avg. score after storage | |
|--------|-----------------------|-------------------|--------------------------|-----------|
| | | | 1 month | 10 months |
| A..... | Sauce blend | none | 6.7 | 6.4 |
| B..... | Sauce blend | 0.2% | 4.5 | 4.9 |
| C..... | Peels and cores | none | 6.7 | 6.6 |
| D..... | Peels and cores | 0.1% | 6.8 | 5.7 |
| E..... | Peels and cores | 0.2% | 5.2 | 5.6 |
| F..... | Dessert blend | none | 4.9 | 4.6 |
| G..... | Hidden control | none | 5.2 | 5.3 |

comparison, the "peel and core" essence and the sauce blend essence rated very high, but the "dessert blend" rated very low. The sauce containing 0.1% added citric acid rated high at one month but not at 10 months. This latter result appears to be erroneous because subsequent tests by both trained and consumer type panels have shown that this combination of additives held up very well on storage. In general, any flavor improvement persisted during 10 months' storage at 70° F.

Consumer preference studies were made on a few of the more promising samples to determine the quantity of essence required to give a significant flavor improvement. Figure 1 shows the percentage of preference for sauce fortified with 3 levels of essence from peels and cores. The sauce containing 1.25-fold essence was a mixture of equal parts of sauce containing 0.5- and 2.0-fold. The dotted line represents the percentage of preference required for significance (P = .05) as calculated by the formula of Boggs and Hanson (1). By interpolation it was found that slightly less than 1.5 fold essence would be required to give a preference at the 5% level of significance. By referring to Table 1 it can be seen that the trained panel found a significant flavor improvement with peel and core essence at a level below 1-fold.

Sauce containing 1.25 fold peel and core essence was submitted to the consumer panel again after 10 months' storage. The panel preference was 64.3%, indicating that there was very good flavor retention.

The following season, 1954-55, a quantity of sauce was prepared containing 2-fold "peel and core" essence plus 0.1% citric acid. An untrained panel of 180 judges showed a preference of 59.5% for this sauce after one-month of storage, and 74.7% after 6 months. These results confirm the stability of the flavor improvement during storage.

DISCUSSION

Essence derived from apple peels and cores appears to be as good as that derived from whole apples for

fortifying the flavor of applesauce. Peels and cores constitute a sizeable byproduct of the manufacture of sauce and the various sliced-apple products. The usual ratio between these products and peels and cores is 2:1. Thus, a plant preparing sauce could produce enough essence from these byproducts to fortify the entire pack at the 0.5-fold level, or one-third of the pack at a level of 1.5-fold.

At the present price of apple essence (\$5 per gal. of 150-fold, 1955-56 season) it would cost 12 cents per case of No. 303's to fortify sauce at the 1.5-fold level. Addition of 0.1% citric acid would cost an additional 2.1 cents per case. In a plant producing both sauce and essence it is quite possible that the essence could be prepared at a cost somewhat below the current market quotation.

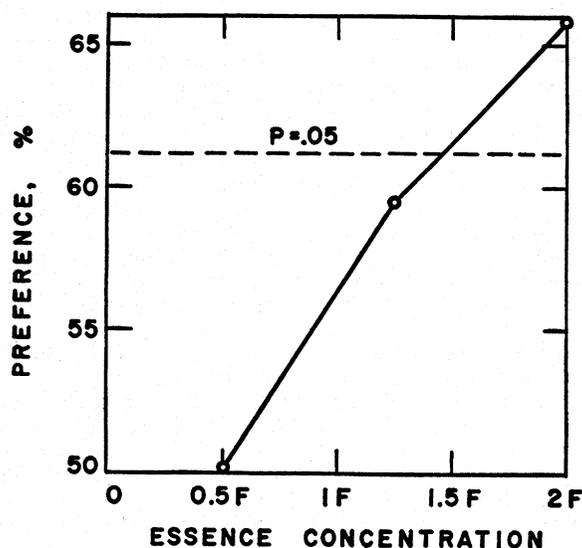


Figure 1. Consumer panel rating of apple sauce.

The mechanics of adding essence or citric acid to sauce should not be difficult. There are several machines available for adding measured amounts of a liquid to individual containers at a high rate of speed. However, it would probably be cheaper and more susceptible to accurate control to proportion the essence into the sauce stream before it reaches the filler.

Traditionally apple sauce has been a low-cost, low profit-margin item. The individual processor will have to decide if the improved product flavor would justify the added cost of manufacture.

SUMMARY

Applesauce flavor was improved by the addition of apple essence. The essence from peels and cores, a byproduct of sauce manufacture, gave satisfactory results. The flavor improvement diminished only slightly during 10 months' storage at room temperature.

Addition of 0.1% citric acid gave a pleasant tartness to the sauce but 0.2% added citric acid made the sauce too tart for most tasters.

Approximately 1.5-fold added essence was required to show a significant flavor improvement as judged by a small consumer panel.

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