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THE FUTURE PRODUCTION AND MARKETING OF APPLE JUICE IN U.K.

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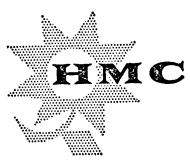

THE FUTURE PRODUCTION AND MARKETING OF APPLE JUICE IN U.K.

1. Introduction

The growing surplus of apples in Great Britain has for some years posed a problem in marketing to the apple growers of this country. New plantings, the results of research into the development of protective sprays, new root stocks and the improved husbandry of apple orchards are the causes of this surplus. Cold storage is not the complete answer to the problem, because it is expensive and provides only limited holding. Even if it were possible to hold apples over from a season of over-production to the next season, the general rise in production increasingly threatens a succession of surpluses. The world position too must be considered: the threat is of general over-production in relation to present consumption patterns.

The N.F.U. made a start on solving the problem in 1958 by commissioning Produce Studies Ltd. to investigate the problems of the apple industry. From the comprehensive report which was published in August 1959, it appeared that improvements in the marketing of apples in this country would be difficult to achieve until apples offered in the wholesale market were properly graded to standards which compared favourably with those imported from the Commonwealth and elsewhere. Promotional work to increase consumption would also depend largely on standard grading. To achieve standard grading without compulsion would involve the provision of incentives to growers not to market low grade fruit. New outlets must be found offering prices sufficient to discourage taking chances in the fresh markets with low grade produce.

It was considered that research into such outlets should be given priority. The National Farmers' Union accordingly approached the Horticultural Marketing Council in September, 1960 and requested its assistance in this matter. The Council accepted the task and formed, under the Chairmanship of Mr. Robert Hiller, a Committee on the Processing of Fruit. This Committee's terms of reference were to undertake technical and market research into the commercial practicability of possible outlets for substandard apples (and in due course for other fruit) and to advise the Council on future commercial exploitation of suitable outlets.

There were several outlets which could be considered. On the Continent and in North America increasing production of apples has led (as with citrus fruit in U.S.) to increasing dependence on processing outlets as salvage operations for low grade fruit. Among non-liquid products are frozen and dried apple, canned slices and apple pulp. Pectin is produced from pressed apple pomace, while animal feeding stuffs are prepared from the extraction residues or from fresh pomace. The largest outlet, however, is for apple juice manufacture. In Canada in 1959/60, commercial production was about 9,000,000 gallons,* in Switzerland in 1960 some 8,500,000 gallons, to which can be added about 5,500,000 gallons of farm production of "mout".† In the United States, 17 million gallons of apple juice were commercially packed in 1959, according to "Fruit". A paper prepared by Michigan State University suggests, however, that the commercial production was 20-21 million gallons together with the same amount of farm production, a total of 40,000,000 gallons. Consumption in the United States is, therefore, about one quarter of a gallon per head per annum, and this considerable production and consumption is achieved against a background of home grown citrus juice production of some 500,000,000 gallons per annum.

In comparison, the pure fruit juice market in U.K. is estimated at 4 million gallons in 1961, rising to about twice this in 1965. This only includes a very small proportion of apple juice: in "Fruit", 1961, it is suggested that the output of apple juice in U.K. made for sale as such totalled only about 100,000 gallons a year.

The Committee concluded that the most promising of the outlets was apple juice, particularly as scientific work on apple juices and blends undertaken by Long Ashton Research Station had been taken to the point where it was ready for exploitation.

This report, therefore, describes in detail the Council's research into the technical, economic and marketing problems of developing an apple juice industry in Great Britain.

* N.B. All references to gallons are to imperial gallons.
† Mout is fresh unclarified apple juice

2. *The Field of Research*

The bearing acreage of dessert apples in Great Britain is forecast to increase by approximately 10 per cent of 58,000 acres between 1957 and 1964. The bearing acreage of culinary apples is likely to fall by approximately 10 per cent to 43,000 acres in the same period. Productivity per acre, however, for reasons mentioned earlier, rises steadily. The Committee's conclusion is that *taking one year with another* there will be an annual surplus of the order of 100,000 tons in the foreseeable future, unless fresh consumption increases substantially. It must be pointed out that some of this 100,000 tons is unsuitable for high quality juice manufacture, being fruit which is too small, unripe, or over mature, or having progressive defects. Probably 50,000 tons on average is suitable for processing of this kind. Some small part of this probably already finds its way into processing outlets, particularly in surplus seasons, while in short seasons it will go to the fresh markets. The potential production of apple juice from this surplus would then be between $7\frac{1}{2}$ million and 15 million gallons a year, the former representing only a little more than one pint per capita per annum.

There is, therefore, no question of a general raw material shortage for a minimum target consumption well within the experience of other countries. The first research needed, however, was to see whether the acceptability of apple juice products in Great Britain was likely to be great enough to support an apple juice industry on this scale. The Council commissioned the Bureau of Commercial Research Ltd. to carry out a series of Placement Tests designed to assess the acceptability of each of six apple juice, or apple blended juice, products. The manufacture of sufficient of three of these products was undertaken at Long Ashton Research Station. Supplies of the remaining blends were purchased from Fruit Products (Faversham) Ltd. The research and its results are fully described in Chapter 3.

The results were generally favourable, for some products markedly so. They were made available to interested parties on payment of a fee, together with a technical paper on storage problems prepared by Dr. A. Pollard, M.Sc., Ph.D., of Long Ashton Research Station. An interim report by the Committee was published. In this report, attention was drawn to the problem of seasonal fluctuation in apple crops, since clearly investment could not be based firmly on uncertain raw material supplies.

The report and the research were discussed with a number of interested manufacturers. The supply uncertainty was, as expected, an inhibiting factor in some cases. It appeared to be primarily a problem of storage. To store the fruit was neither economic nor desirable: to store juice would involve a disproportionate investment in facilities apart from technical problems of quality maintenance. A solution understood to be used in other countries was the production of concentrates which could be stored in smaller, if more complicated, facilities. Direct research into technical problems of concentration and storage was undertaken by Long Ashton Research Station, and a study of the economics of the various processes available was commissioned from the Economist Intelligence Unit. The results of this work are recorded in Chapters 7 and 8.

The Council also undertook with its own staff an enquiry into growers' views about the supply of apples for processing—prices, quantities and contracts. The results of this enquiry are shown in Chapter 6.

In developing this work the Committee had in mind the possibility of grower control of some or all of the processes of apple juice manufacture and marketing. The conclusion was reached early on that the full activity would not generally be open to initiative by growers as they are at present organised. The investment required to achieve mass production of a standard product and to finance the marketing effort necessary, would generally be beyond the reach of existing co-operatives or groups, even if organisational and distributive problems could be overcome. (It was noted, of course, that East Kent Packers had established a subsidiary, Fruit Products (Faversham) Ltd., which was producing and marketing apple juice blended products under the trade name "Chippy". It is understood that since 1961, this Company has entered into distributive arrangements with the Lyons/Schweppes marketing organisation.) But if the complete activity was not obviously open to grower control, it was thought possible that concentration plants in grower ownership might give growers a share in the control, and profit of any development. The E.I.U. were, therefore, asked, in the economic study, to assess the practicability of grower owned concentration plants. It was also thought that the study of the apple juice industry abroad would throw light on opportunities for growers as well as illuminating general structure and development. It was decided to commission a study of the Swiss industry by the E.I.U. (Chapter 4), and Dr. Pollard made a survey of developments in North America which is reproduced in Chapter 5.

Before turning to the details of the various research work and in due course to conclusions, the

following summarises the intention of the work:

(1) To assess the acceptability, in non-economic terms, of apple juice products in U.K.

(2) To examine the structure and development of industries overseas and their possible relationship to development in U.K.

(3) To examine the technical and economic problems of apple supply—prices and availabilities, "smoothing" by concentration and storage.

(4) To draw conclusions helpful to the development of an apple juice industry in U.K. with special reference to grower control if this appeared practicable.

3. *Market Research — Acceptability Tests*

This chapter contains the main body of the report by the Bureau of Commercial Research. Certain tables have been omitted to conserve space.

The research study carried out was designed to assess the possible relative acceptability of two pure apple juices and four apple juice blends, in order to evaluate their relative marketing possibilities: to evaluate these against a common standard and at the same time to gain some indication of the influence of a blend description (e.g., "Apple and Orange") on acceptability.

The two apple juices and four blended apple juices used for this research were:—

(a) Apple and Apricot (Chippy)
(b) Apple and Raspberry
(c) Apple and Pineapple (Chippy)
(d) Clear Apple (Carbonated)
(e) Opalescent Apple
(f) Apple and Orange (Chippy)

METHOD

The method used in the case of five of the six juices (i.e., excepting Apple and Orange) was that of single placements. Thus each of these juices was assessed individually. This method was considered to be, in general, a more realistic measure of market acceptability than would have been the case with tests involving paired or multiple comparisons between the juices.

In order, however, to achieve the two secondary objectives, the method of double placement was used in the case of the Apple and Orange blend.

A leading brand of orange juice, Trout Hall, which is already on the market, was used to provide a "Bench mark" which would help to put into realistic perspective the absolute acceptabilities achieved by each of the other juices. For the purposes of the study, all identification of Trout Hall was removed, and it was re-labelled "Orange II".

In order to assess the influence of blend-description, the Apple and Orange blend was presented in two ways, one where it was labelled "Apple and Orange Juice", and one where it was labelled "Orange Juice II".

For these two secondary objectives, two samples were set up. Members of one sample received a can of the orange blend labelled "Orange Juice" together with a can of Trout Hall. Members of the other sample received a can of the orange blend labelled "Apple and Orange Juice" together with a can of Trout Hall. In both samples, informants were asked to assess the products in absolute terms, and to compare one against the other.

In total, therefore, seven samples were set up (viz.: one each for Apricot, Raspberry, Pineapple, Carbonated Apple, Opalescent Apple, Apple and Orange/Trout Hall, and Council Orange/Trout Hall).

Each sample consisted initially of some 216 households of the AB, C1 and C2 social grades. In each case, one-third of these households was distributed in each of the three areas, Greater London, Greater Birmingham and Greater Manchester. Within each conurbation, starting addresses were selected, and either 10 or 11 placements made along a predetermined route from each starting address.

Recalls were made on each household in the seven samples about a week after the placement. The structures of the original sample and of the sample which was successfully re-contacted are given in Appendix A.

SUMMARY OF RESULTS

1. *OVERALL ACCEPTABILITY OF FRUIT JUICES.*

(i) *Fruit Juices acceptability ratings.*

Each of the fruit juices was assessed by separate samples of households on a scale to discover its overall acceptability.

The acceptability ratings for each were as follows: 1st—Apricot (+2.27)=2nd—Carbonated Apple, and "Apple and Orange" (each +2.04): 4th—Pineapple (+2.02)=5th—Opalescent Apple (+1.6)=6th—Raspberry (+1.4)=7th—Council Orange (+1.24)=8th—Trout Hall Orange (+1.18). *Table A.*

(ii) *Statistical note on mean acceptability ratings.*

With a series of mean (or average) acceptability ratings obtained from a sample survey, certain statistical tests can be applied to ascertain whether differences obtained are *real* differences among the 'universe' or whether they could have occurred by chance.

In the above series of mean acceptability ratings we can assume that where differences of more than 0.5 occur, these differences, obtained from samples of approximately 200 people, are significant. That is to say, when these results are projected onto the population at large, a *real* difference exists in attitudes to the various fruit juices.

(iii) *Acceptability ratings by sub-groups.*

The ratings were broken down further by such factors as age and social grade* of housewife informants. Differences between these sub-groups tend to be small and of only limited significance.

Apricot, Raspberry, Opalescent Apple, and Council Orange were rated more highly by households with children than by those without. The ABC1* social grades have a higher rating than the C2 grade to Raspberry, Apple and Orange, and Trout Hall Orange, but a lower rating to the other juices.

Table B.

(iv) *Individual's opinion of the blends.*

The Apricot, Raspberry, Pineapple, Opalescent Apple and Carbonated Apple were placed singly with households. Housewives from these households were asked about the attitude of each member of the household to the juice placed. Pineapple appears to be the most acceptable by this rough measure. 70% of the individuals trying Pineapple and 64% trying Apricot were said to like it "very much".

If figures for the 5 juices are added together, a clear pattern emerges. There is virtually no difference in opinion of the juices between males and females. Children of up to 15, however, are shown to hold a much more favourable opinion of the blends than adults.

*Note : The Social grades are classified by income, and by class as determined mainly by the occupation of the head of the household. They are based on the standard criteria recommended by the Institute of Practitioners of Advertising. The highest of the six grades is thus A, and the lowest E.

2. *COMPARATIVE ACCEPTABILITY OF THE FRUIT JUICES.*

(i) *Comparison between Council Orange when labelled "Orange" and when labelled "Apple and Orange".*

Council Orange was given a mean acceptability rating of +1.24 when it was labelled "Orange", and of +2.04 when it was labelled "Apple and Orange". *Table A.* On the whole, "Orange" was slightly more acceptable to younger informants, households with children and households of lower social grade. "Apple and Orange" was more acceptable to households with no children and households of higher social grade.

Table B.

As we shall see, Council Orange was preferred to Trout Hall Orange by a bigger margin when it was labelled "Apple and Orange" than when it was labelled "Orange". This difference in acceptability was solely due to adults. Children found "Orange" and "Apple and Orange" equally acceptable. It appears that the greater acceptability of "Apple and Orange" is partially due to certain expectations which the name aroused amongst adults.

(ii) *Comparison between Council Orange and Trout Hall Orange.*

Trout Hall's acceptability rating (+1.18) was lower than any of the Council juices. Council Orange rated +1.24, and "Apple and Orange" rated +2.04. Trout Hall's rating was less than +1.18 when it was placed together with Council Orange, and more than +1.18 when placed together with Apple and Orange.

Table A.

This picture is repeated when we study the preference of all household members for the Council Orange blend or for Trout Hall. 46% claim to prefer Council Orange to Trout Hall, and 53% claim to prefer "Apple and Orange" to Trout Hall. 36% preferred Trout Hall to Council Orange, and 36% preferred Trout Hall to Apple and Orange.

It is clear that Council juices are more acceptable than Trout Hall to most informants. But this fact should be treated with a certain amount of caution, since the Council juices and Trout Hall are to a large extent different kinds of product, and certainly appeal to different sets of consumers.

(iii) *Comparison between Council's products and soft drinks last bought.*

Out of all households trying the fruit juices, 41% compared the Council juice favourably with the soft drink they had last bought, 34% compared it unfavourably, and 16% thought that it was about the same.

The Council juices compared most favourably with carbonates, and least favourably with squashes and cordials.

3. *FAVOURABLE AND UNFAVOURABLE ASPECTS OF THE INDIVIDUAL FRUIT JUICES.*

(i) *Reasons for the comparison with soft drink last bought.*

Council juices were compared favourably with the drink last bought for various reasons, none of which were cited at all frequently. The principal reasons were "Fruitier/real fruit flavour" (especially Raspberry—11%, and Apricot—7%), "more flavour/tastier/richer," and "refreshing/thirst-quenching" (especially Carbonated Apple—6%). Pineapple was compared favourably by 6% because it was "unusual", and 4% compared Council Orange favourably on the grounds that it was "not so sharp/sweeter".

9% of those trying Carbonated Apple and 8% of those trying Opalescent Apple claimed to "prefer orange flavour" as their reason for comparing them

unfavourably with the soft drink last bought. This was the most frequent reason for unfavourable comparisons. Other reasons were, "not so refreshing," especially Apricot (8%) and Raspberry (6%), and "too sweet/sickly", again mainly in connection with Apricot and Raspberry. The Opalescent Apple juice was thought by 8% to be weak in taste. *Table C.*

(ii) *Reasons for the comparison between Council's Orange blends and Trout Hall.*

16% preferred one of the Council Orange blends to Trout Hall because it was sweeter, or not so sour and bitter. 9% of those trying Council Orange but only 1% of those trying "Apple and Orange" gave "tastes more of oranges" as a reason for preferring the Council blend to Trout Hall.

The principal reasons for preferring Trout Hall were "real orange taste" (8%) and "stronger flavour" (8%). Trout Hall's stronger flavour was mentioned more frequently when it was placed with Council Orange than when it was placed with "Apple and Orange".

(iii) *Particular likes about the fruit juices.*

When informants were asked what, if anything, they specially liked about the fruit juices, the answer which was most frequently given was "refreshing/thirst-quenching". 22% of those trying Carbonated Apple gave this answer.

Many informants liked the fruitiness, or the natural fruit flavour, of the fruit juices. Thus, 40% of those trying Apricot said 'like fruity, apricot taste'. Other figures for those liking the fruitiness were: "fruity, apple flavour" (29% of Opalescent Apple, and 28% of Carbonated Apple): "fruity, pineapple flavour" (27%); "fruity, raspberry flavour" (27%): and "fruity, orange flavour" (17% of Trout Hall, 14% of Council Orange, and 4% of Apple and Orange).

Other attributes of the blends which received favourable mentions included "the sweetness of Council Orange (12%), the new and different flavour of "Apple and Orange" (7%) and the sharp, less sweet taste of Pineapple. *Table D.*

(iv) *Particular dislikes about fruit juices.*

It was the degree of sweetness that prompted the largest number of unfavourable comments on the fruit juices. Raspberry was often thought 'too sweet' (18%); Trout Hall (25%), Carbonated Apple (20%) and Opalescent Apple (18%) were frequently considered 'too sharp and sour/not sweet enough'. 13% believed Opalescent Apple to be weak in taste, and 16% thought this of Council Orange. 8% gave 'tasted like cider' as a special dislike about Carbonated Apple, compared with 10% who had given it as a special like. *Table E.*

(v) *Claimed intention to purchase.*

Informants were asked about their likelihood of buying the product they had tried. Carbonated Apple (71%) and Apricot (69%) were the juices most likely to be bought and Opalescent Apple (57%) and Council Orange (54%) were the ones least likely. It should be borne in mind that these are responses to a hypothetical situation which may not be substantiated in a real purchase environment.

Most informants were unable to give specific reasons why they would buy the product. Normally it was because the family liked it, or because it was nice for a change, or they would buy it provided it were not too expensive. (This last comment was especially true of Pineapple blend). "Apple and Orange" would be bought on the grounds that it was 'more refreshing' (8%) or 'new and unusual' (14%).

Informants were again vague on why they would be unlikely to buy the blend. More specific answers which were given tended to be due to the product's over-sweetness or over-sourness.

(vi) *Attitudes to the Council juices summarized.*

Apricot is liked largely because of its fruitiness but is often found too sweet.

Raspberry also is liked because it is fruity, but again suffers occasionally through over-sweetness.

Pineapple is liked for a variety of reasons, but is sometimes thought of as being in all probability too expensive.

Carbonated Apple is refreshing, and its taste of apples or cider appeals to a certain number. On the other hand, not everyone likes apple-tasting drinks, and some think Carbonated Apple is not quite sweet enough.

Opalescent Apple is liked on account of its fruitiness and its real apple taste, but is sometimes thought to have a weak flavour and not to be sweet enough.

Council Orange is liked because it is not sharp or sour, and because it tastes of real oranges. Like Apple and Orange, it has no strong negatives.

The main favourable attribute of "Apple and Orange" is its unusual taste, but it is also quite often found refreshing and thirst-quenching.

4. *DETAILS OF THE SOFT DRINK LAST BOUGHT.*

(i) *Last occasion when soft drinks bought.*

65% of the total sample had bought a soft drink within the last 7 days, and a further 24% from 8 days to 1 month ago. Housewives aged under 45, with children, and in the C2 social grade had bought soft drinks more recently than other informants.

(ii) *Type of soft drink last bought.*

57% of housewives in the survey had last bought a squash or cordial, 24% had last bought a carbonate, 10% had last bought a fruit juice, 6% had last bought Ribena, and 3% had last bought another type or could not remember which type they had bought.

Squashes were bought slightly more by the over 45's, and carbonates by the under 35's and those with children. Fruit juices were bought more frequently by informants in the ABC1 social grades than by those in the C2 grade.

(iii) *Fruit Juice last bought.*

The brands of fruit juice receiving most mentions were Britvic, Libby and P.L.J. Each of these 3 brands was bought by 13% of housewives last buying fruit juice. Trout Hall was bought by 2% of those last buying fruit juice.

34% of those last buying fruit juice had bought orange, 19% grapefruit, 16% lemon and 13% pine-apple.

(iv) *Brand of soft drink last bought.*

The leading brands of soft drink which were bought on the last occasion were Suncrush, Sunfresh and Corona, each of which were bought by 10% of the total sample. Brands bought differed only slightly with social grade, family composition and housewife's age.

(v) *Flavour of soft drink last bought.*

The flavour of the soft drink last bought by 60% of the sample was orange. 14% had bought lemon, and 7% blackcurrant. Younger informants and those with children, had bought orange in more cases and lemon in less cases than older informants and those without children.

(vi) *Container of soft drink last bought.*

95% of all informants had last bought a bottled soft drink, and 4% had last bought a canned soft drink.

4. *The Swiss Apple Juice Industry*

This study was commissioned from the Economist Intelligence Unit Limited with the intention of finding out what lessons could be learnt for an incipient British industry from the growth and structure of the Swiss industry. It was also in mind that the information about the Swiss structure might indicate ways in which British growers could retain an interest in development over and above raw material supply.

The terms of reference included:—

(a) Market development over the past 10 years.
(b) Products, prices, trade discounts.
(c) Organisation of production and distribution.
(d) Construction equipment used and available.
(e) Varieties of apples used.

Section I—The development and size of the Market

Historical

It is considered that the key to the apple juice market in Switzerland lies in the degree of protection and economic support given to Swiss agriculture generally since pre-war days. Apple juice production was also stimulated during the Second World War, when shortage of sugar created additional demand for sweet drinks, of which apple juice was most suitable because it could be domestically produced. Pre-war apple surpluses provided the basis for spirit, cider and juice production and post-war economic policy and import restrictions have encouraged the maintenance of unprofitable apple production and thus a surplus of apples. Under a regulation adopted by the Régie Fédérale des Alcools in 1932, and as provided in the 1951 Agricultural Act, the Régie and the Fruit Union Suisse have attempted to solve the problem of surpluses by adapting production and utilisation of fruit to the new market situation and by restricting excessive consumption of spirits. Over the past five years trade circles in Switzerland consider that there has been a gradual increase in the apple juice consumption but this is rather due to population increase than to changes in consumer taste.

The size of the industry

Today there are some 300 cider and apple juice factories in Switzerland, ranging in size from the very small family concern to the large co-operative or limited company. The majority are in the Swiss German part of the country.

Numerically, the very small concerns are preponderant, followed by the limited companies, of varying sizes—and lastly come the co-operatives and the federations of agricultural co-operatives.

Measured by the size of output and investment, however, the more important producers are undoubtedly the powerful federations of agricultural co-operatives, most of them, again in the German-speaking part of the country.

Production

The size of and trends in domestic agricultural and industrial production of apple juice and concentrates is illustrated in tables I and II below. It is important to note the considerable production of apple juice by farms. This "home" production is not marketed commercially, but consumed on the farm.

It should be emphasised that the total figures in table II are of *production*. Real consumption in any period will differ because apple concentrates are not included, and because on the other hand, much of the apple juice marketed in Switzerland is mixed with diluted apple juice concentrate.

TABLE I

Total Production of Apple Juice and Fresh Apple Juice in Switzerland

(derived from Table II)

1955	14,000,000 galls.
1956	15,000,000 galls.
1957	8,500,000 galls.
1958	20,000,000 galls.
1959	11,000,000 galls.
1960	14,250,000 galls.

TABLE II

Analysis of Production of Fruit Juices in Switzerland

	Mixed Farms			Fruit Processed		Production by Industrial Enterprises				
	Apple Juice 1,000 galls.	Pure and mixed ciders 1,000 galls.	Industrial Enterprises Number	Cider Apples 1,000 tons	Cider Pears 1,000 tons	Fresh Apple Juice (Moût) 1,000 galls.	Apple Juice 1,000 galls.	Pure Cider 1,000 galls.	Mixed Cider 1,000 galls.	Concentrated Fruit Juices tons
1955	6,600	8,800	358	58.4	97.5	2,530	4,818	13,662	88	4,500
1956	6,160	14,960	322	101.5	15.1	2,508	6,270	7,524	154	3,200
1957	2,200	2,200	339	48.2*	11.8	1,122	4,114	6,930	66	200
1958	10,560	15,840	314	265.1	181.8	4,202	5,852	43,538	44	16,400
1959	2,860	7,040	302	51.2	40.7	3,410	4,752	6,292	44	1,200
1960	5,720†	7,480†	276	132.4	124.4	3,916	4,598	25,520	88	7,600

*Of which 44,000 tons of foreign fruit.
†Provisional.

Exports

As will be seen from the table below, the export of apple juice is subject to extreme fluctuation, while the export of apple concentrate rose spectacularly in 1959 and 1960. In the former year also, apple aromas appeared in the export field for the first time.

TABLE III

Exports of Apple Products

	Cider	Apple Juice	Apple Concentrates	Pear Concentrates	Apple Aroma
	1,000 galls.	1,000 galls.	tons	tons	tons
1955	1.69	138.6	207	235	
1956	0.97	1,381.5	562	1,385	
1957	0.68	429.3	202	1,567	
1958	0.37	360.7	264	2	
1959	—	859.4	2,719	1,299	23
1960	0.42	572.0	2,343	624	11

The principal traditional Swiss export market for apple juice and apple concentrate is Germany. Small quantities of apple juice go to France, Belgium, the Netherlands and Italy; and small quantities of apple concentrate go to the United Kingdom, Sweden, the United States, Canada and the Netherlands.

Consumption

The following table is of per capita consumption figures supplied by the Régie des Alcools.

TABLE IV

Per Capita Consumption of Apple Juice and Grape Juice in Switzerland
(pints)

	Apple Juice			Grape Juice	Grand Total
	Opalescent (fresh)	Clear (pure)	Total		
1949/50	3.17	20.8	23.97	1.41	25.38
1950/51	3.17	19.9	23.07	1.23	24.30
1951/52	3.00	18.5	21.50	1.23	22.73
1952/53	2.64	19.4	22.04	1.41	23.45
1953/54	2.64	18.7	21.34	1.41	22.75
1954/55	2.46	18.1	20.56	1.76	22.32
1955/56	2.82	18.8	21.62	2.11	23.73
1956/57	2.64	18.5	21.14	1.94	23.08
1957/58	1.06	10.7	11.76	2.46	14.22
1958/59	4.05	23.6	27.65	1.94	29.59
1959/60	3.52	13.4	16.92	2.46	19.38
1960/61*	3.34	16.5	19.84	2.46	22.30

*Provisional.

The figures in the columns "opalescent" and "clear" are not comparable. Although both sets are compiled by the Régie Fédérale des Alcools, those in the column "opalescent" are based on sales by industrial producers only, those in the column "clear" include sales by industrial producers plus the estimated production by farmers. In years when the apple harvest is poor the industrial producer can compensate by increasing the amount of concentrate in the apple juice he markets, and also by importing apples (usually from Austria or Italy). On the other hand, the farmers' production depends entirely on the size of the harvest. A poor harvest, such as the 1957 one, will cause the farmers' production to drop more sharply than that of the industrial producers. It is estimated that the fall in apple juice production between 1956 and 1957 was 64 per cent for farmers and 38 per cent for industrial producers.

The following figures show apple juice sales by industrial producers only:

TABLE V

Volume of Apple Juice sold by Industrial Enterprises in Switzerland

(1,000 galls.)

Commercial Year	Opalescent	Clear	Total
1956/57	528	6,028	6,556
1957/58	704	5,280	5,984
1958/59	374	4,840	5,214
1959/60	374	6,864	7,238
1960/61	286	5,544	5,830

For clear apple juice a comparison can be made with the production figures in Table II, remembering that these come from a different source.

TABLE VI

Year	Production ('000 galls.)	Volume of Sales ('000 galls.)	Difference ('000 galls.)
1956	6,270	6,028	− 242
1957	4,114	5,280	+1,166
1958	5,852	4,840	−1,012
1959	4,752	6,864	+2,112
1960	4,598	5,544	+ 946

Where sales exceed production, the difference was made up by the use of concentrate.

Although consumption and production in Switzerland both vary, this is primarily due to farm production and consumption and not to variations in industrial production disposed of through a régime of managed prices. The consumption figures are said to suggest a rather static industrial market in which demand varies with population changes, rather than from changes in taste.

Section II—Products and Prices

Pure (or clear) apple juice

Pure apple juice is obtained from the pressing of surplus table fruit and of varieties of cider apples grown for this purpose in Thurgovie. Residual "Fruit cake" (marc) is used as animal fodder, and surplus fluid is acquired by the Régie Fédérale des Alcools for distillation. The pure apple juice is then clarified, pasteurised and sterilised before being stored in large inoxidable cisterns, in a state of carbonic saturation (1.5 kg. CO_2 per hectoliter of juice equal to 2.4 ozs. CO_2 per gallon of juice) to prevent fermentation, and kept at a temperature below 15°C. (59°F.) and atmospheric pressure of 7.5. The storage of pure apple juice in Switzerland is almost always by means of the Boehi system, that is, under high pressure.

Federal legislation, prohibits the addition of any chemical products to prevent fermentation. This adds to the relative cost of storage in view of the fact that competitive products such as lemonade can be treated with anti-ferments. Thus in the case of apple juice, the state of non-fermentation must be attained solely by means of pasteurisation, sterilisation and special storage conditions.

Fresh apple juice, opalescent (moût)

"Moût", as it is called in Switzerland, is fresh, unclarified apple juice. It is bottled, pasteurised and marketed immediately.

Sales of "moût" start at the harvest season, in the autumn, and continue up to December. During this period publicity campaigns encourage consumers to drink "moût" for health reasons, emphasising the fact that the juice is fresh and that it should be consumed immediately, implying that "moût" cannot be stored or kept for any length of time.

The price of moût is very much lower than the price of clear apple juice (see page 12) and it is undoubtedly marketed to get rid of surplus production and in particular to relieve storage expenses. Furthermore, it provides a useful brand differentiation and under the label of "cure de moût" (fresh apple juice cure) reaches a greater number of consumers than does clarified apple juice. But from the manufacturer's point of view, the price of moût allows only a negligible profit.

Apple concentrates

Several types of concentrates are manufactured: the standard concentrate (concentration to 38° Beaume; evaporation of eight parts of water); increasingly the half-concentrates; and the concentrates with separation of aromas. Concentrates are sometimes used as sweetening agents, de-acidified if necessary. Half-concentrates are said to give a better product on dilution to juice strength, than full-concentrates, and can thus justify the extra capital costs referred to in Chapter 8.

Storage of full concentrate presents no problem. It is kept in large enamelled or metallic cisterns and its own sugar content is sufficient (700 gr. per litre) to guarantee conservation, although refrigeration is desirable. Half-concentrates, however, require refrigeration to maintain stability. (See Chapter 7).

Apple concentrates are a comparatively recent innovation in the retail market and most of the product is used to "stretch" pure apple juice, particularly in the summer when stocks of pure apple juice are running low. Trade circles admit that this is common practice, though it is, of course, not publicised. Juice obtained solely from the dilution of concentrates is rarely marketed as the concentrate has a slightly different taste and manufacturers are anxious to maintain the homogeneity of their product.

There is no legislation prohibiting the addition of diluted apple juice concentrate to pure apple juice and to market it under the latter label.

Blended apple juices

A number of mixtures are bottled and marketed in Switzerland. Their composition varies with prevailing consumer preferences. The most usual products to be found on the market contain a mixture of apple juice with either orange juice, grapefruit juice, raspberry juice or lemon juice. These drinks are sometimes carbonated, although consumer tastes are tending towards uncarbonated drinks. This point is particularly important with apple juice where emphasis is laid on the pureness of the drink. Most of the competitive products, such as Coca-cola or lemonades are nearly all carbonated and it is, therefore, considered that apple juice will sell better as an uncarbonated drink.

Prices

Following is a brief outline of the structure and various organisations which determine Swiss fruit policy and prices.

Swiss fruit policy is based on the revised "Alcohol Law" of 1949, the object of which is to control production and consumption of alcohol by means of a state monopoly and the "Agricultural Law" of 1951 which sets out to guarantee the domestic producer a minimum income by protecting him from foreign competition.

The executive body is the Régie Fédérale des Alcools, in Berne, which works in close collaboration with the Fruit Union Suisse, the powerful fruit and vegetable cartel. Between them they have command of a wide range of measures including price fixing, subsidies and import restrictions. The "Fruit Union Suisse" is recognised by the Federal Authorities as the official organ for the Swiss market for fruit and vegetables.

Its main functions are the development of:

(i) fruit growing and the improvement of quality,

(ii) the fruit processing industries, and in particular, the manufacture of apple juice, of concentrates, of pectin and of dried and canned fruit,

(iii) domestic production, distribution and consumption and their co-ordination,

(iv) technical improvements in the fruit industry,

(v) research and scientific experiment on the production and processing of fruit.

The Fruit Union implements the regulations of the Régie Fédérale des Alcools concerning quality of fruit. For this purpose it has set up a vast system of inspection, covering the principal markets in the country, and also customs offices to control the quality of exported produce.

The members of the Fruit Union, who number roughly one thousand, and who pay substantial fees, are mainly co-operatives of fruit producers, private enterprises and commercial firms dealing in fresh fruit or in processing.

The eight specialised commissions of the Fruit Union, one of which is entirely concerned with cider and apple juice, establish the guiding prices for fruit and vegetables basing them on the harvest evaluations submitted by the "Union Suisse des Paysans" at Brugg.

This function has led the Union to develop regional fruit exchanges in all the main markets, where producers, wholesalers and industrial producers meet to discuss the minimum and maximum compulsory prices for different categories of fruit. Prices are fixed according to the size and quality of the expected harvest with the object of ensuring greater price stability over a period of time.

The Régie Fédérale des Alcools also guarantees a minimum price to all apple producers based on information and studies undertaken by the Union Suisse des Paysans and the Fruit Union. In practice, political pressure from these vested interests influence the minimum price level. Each year, the Régie Fédérale des Alcools publishes a number of instructions concerning the use and minimum prices of apples and its derivated products.

To determine the price of apple juice and cider, the country is divided into four groups of cider producers, Basel, Berne and Suisse Romande, Occidental Switzerland, and Zurich. Representatives from each meet annually under the auspices of the Fruit Union when the prices are fixed in accordance with harvest prospects and manufacturing costs. Variations throughout the country do not exceed 2 cents per litre (about 0.4d.).

The overwhelming majority of apple juice producers belong to the Fruit Union and even firms outside the trade association usually abide by the posted prices. Members contribute to a fund which is used for boycotting dissident members but such an extreme measure is invoked only occasionally.

Price Levels

The table below gives a comparative picture of the prices for apple juice and its competitive products. Variations within the country are negligible, but the basic price may vary slightly from year to year, according to the size of the harvest.

TABLE VII

Fruit Juice Prices in Switzerland

Product	Wholesale Price (Sw.Fr. per litre)	Wholesale Price (equivalent to pence per pint)	Retail Price (Sw.Fr. per litre)	Retail Price (equivalent to pence per pint)	Approximate Retail Margin (per cent)
Pure apple juice*	0.62—0.70	7d.—8d.	0.90—1.00	10d.—11½d.	30
Opalescent (moût)	0.38	4½d.	0.45	5d.	15.5
Grape juice (moût)	1.12	1/1d.	1.45	1/4½d.	22
Orange juice	0.55—0.75	6d.—8½d.	0.75—0.95	8½d.—11d.	23
Sinalco (mixture)	0.68	8d.	0.95	11d.	28
Coca-cola	0.79	9d.	1.07	1/0d.	26

* including apple juice diluted from concentrate.

Official regulations concerning the manufacture of apple juice

The designation of apple juice applies to a drink consisting of the juice of pip-fruit* freshly pressed, obtained by appropriate treatment before fermentation sets in. It is permitted to add pure or diluted concentrated fruit juice, carbonic acid and small quantities of caramel. The use of substances admitted for the usual cellar treatment is also permitted.

—The fruit juice must be completely free of any mould, of live yeast and bacteria and must not have undergone any alterations whatsoever.

—It is permitted to add to grape juice and fruit juice, in order to preserve them, only sulphurous acid in the proportion of 80 milligrams per litre maximum, calculated as total sulphurous acid.

—Within a maximum volume of 200 cm^3 not the slightest trace must be found of lethal metallic combinations, such as arsenic combinations, lead or zinc. Copper content must not be over 10 milligrams per litre.

—Alcohol content of such drinks must not be over 0.7 per cent of the volume.

* Note that the definition is not confined to apples—hence the addition of pear juice is made legally possible.

Section III—Organisation of Production and Marketing

Apple Growing

The present state of Swiss apple production as well as of other fruit, is illustrated by the number of fruit trees in the country. Recently available figures show a reduction of 14.6 per cent in 10 years in the total number of fruit trees, a reduction which has been encouraged by the Régis Fédérale des Alcools and the Fruit Union as part of the programme for improving the quality of the products. Paradoxically, however, this process has been slowed down by the various protectionist measures adopted, such as price fixing and import restrictions. Clearly, the Swiss peasant is reluctant to eliminate or replace his unprofitable trees while he is assured of a minimum price for their yield.

TABLE VIII

The Swiss Fruit Tree Population

Type of Tree	No. of Trees in 1961	Increase and Decrease over 1951 Number	Per Cent
Apple	7,434,000	− 792,000	− 9.6
Pear	4,021,000	− 812,000	− 16.8
of which cider varieties	(942,000)	−(503,000)	−(34.8)
Cherry	1,856,000	− 440,000	− 19.2
Plum	2,735,000	− 707,000	− 20.5
Peach	311,000	− 209,000	− 40.3
Apricot	782,000	+ 180,000	+ 30.0
Quince	109,000	− 78,000	− 41.6
Walnut	411,000	− 171,600	− 29.4
Other	13,000	+ 1,300	+ 11.1
	17,672,000	−3,028,300	− 14.6

However, production of fruit has not diminished at the same rate as the number of trees, and in some cases, it has even increased. A comparison based on an annual average for the years 1948-1950 and 1958-1960 shows the following changes in the output of fruit:

Percentage Changes in Swiss Fruit Production
1948-50 *and* 1958-60

Apples	− 7.1
Pears	− 6.1
Cherries	+ 1.9
Plums and Prunes	+23.8
Walnuts	+ 7.3

Apple growing in Switzerland is undertaken on both mixed farms, and on specialised fruit farms. Industrial concerns manufacturing apple juice do not invest in their own orchards, but in the case of co-operatives the situation is reversed, and it is the apple growers who invest in industrial equipment. There is little economic incentive for manufacturers to invest in the production of apples in view of the fact that farming in Switzerland is largely dependent on government subsidies and is not competitive without them. Furthermore, Switzerland is a surplus producer of pip-fruit, and often has to cope with a glut.

In 1951 approximately 6,000,000 trees were on mixed farms and about 1,000,000 on fruit farms.

Although up-to-date details are not available as to the distribution of apple trees between mixed farms and specialised fruit farms, it is clear that the reduction in trees mainly occurred on mixed farms. It is known that in the Valais, for example, a region of specialised fruit farms, the tree population has risen by one-and-a-half million over the ten years. The fruit farms produce mainly dessert fruit, most of the special cider or processing varieties coming from mixed farms, particularly in the canton of Thurgovie. The fruit farms tend naturally to produce higher quality fruit and not much of their crop goes to the industry except in glut seasons.

TABLE IX

Utilisation of Swiss Apple Harvest

(percentage)

Year	Cider and other Processing Apples	Table Apples
1952	53	47
1953	45	55
1954	57	43
1955	36	64
1956	54	46
1957	12	88
1958	59	41
1959	43	57
1960	46	54

The term "cider" is used for varieties grown specially for industrial use, whether in the manufacture of fermented cider, or one or other of the apple juices.

The varieties mainly used are:—

(a) Cider apples and pears such as the "Mostapfel" and the "Thurgavweinapfel" which are very

acid and grown especially for the industry, principally in the canton of Thurgovie on mixed farms.

(b) Table apples (and pears) such as :—
Menznaver Jäger
Bohnapfel
Sauergrauech
Glockenapfel
Jonathan
Boskoop
Goldparmäne
Gravensteiner
Bernerrosen

The great bulk of these table fruits is grown on specialist fruit farms.

The proportion in which (a) and (b) are used for making apple juice and cider varies greatly from year to year. In 1961 the proportions used were roughly 75 per cent of cider fruit and 25 per cent of table fruit. In 1962 it is estimated that the proportions will be around 50 per cent of each category.

Table fruit is divided in 1st and 2nd class grades. These categories are elastic. The surplus 2nd class apples are usually those used for making apple juice.

In a year of poor harvest a greater proportion of cider apples will be used in the juice processing industry as the small supply of table fruit will be marketed as such. Also, in a year of poor harvest, a marginal quality of apples will be used by the industry. Ultimately, producers resort to imports.

Similarly, in a good harvest year, a relatively larger proportion of surplus table apples will be used by the industry.

It is apparent that the basis of the Swiss apple juice industry varies with the harvest. This fluctuation is explained by the differences in price of cider and table apples. The price for cider apples during the last ten years has not varied above or below Fr. 10-12 per hundred kilos (approximately 168/- to 201/- per ton). In a good harvest year, when there is a surplus of table fruit and it is sold to the apple juice industry, the price varies between Fr. 8-10 per hundred kilos (approximately 134/- to 168/- per ton).

Apple Juice Manufacturing

All manufacturers of cider produce apple juice and fresh opalescent apple juice, as well as other products. There are no plants manufacturing only apple juice. The number of industrial enterprises engaged in cider and apple juice production in 1960 is 276 (Table I). These represent 80 per cent to 90 per cent of total production, the balance being made up of very small enterprises.

The decrease in the number of industrial enterprises since 1955 is typical of the trend towards concentration, with larger concerns absorbing the smaller and less efficient ones. The opportunities of larger capital investment and greater marketing facilities are factors likely to increase this trend in the future. This is a logical development in a market where the price of raw material and the prices of finished products are already fixed. Any further gains can only be made by rationalising production, that is by concentration.

A cross section of the 61 more important firms listed in trade bulletins and publications reveals that limited companies and co-operatives each account for 41 per cent of the total, and private concerns only 18 per cent. The federations of agricultural co-operatives, such as the V.O.L.G., the V.L.G.N. and the V.L.G.Z. have the most at stake in the form of capital investment.

Operating costs

It is difficult to obtain information on productive capacity and operating costs for apple juice and concentrate manufacturing in individual enterprises, but the following general conclusions are relevant.

In general, it would seem that no company marketing less than one million litres of apple juice per annum can really operate successfully. A particular problem of smaller producers is the amortisation of machinery investment. Although the Fruit Union takes into account an average cost of production in fixing the basic price for apple juice, small firms have obvious difficulties in competing. Metallic cisterns and refrigeration equipment represent a substantial investment. They are used once a year and their contents gradually marketed according to demand. Towards the end of the year they lie practically empty with no alternative profitable use.

This problem is emphasized in the case of both concentration and pressing equipment. In normal harvest years, these machines can be expected to work at full capacity for only two months of the year, and their rate of amortisation is five-sixths less than that of a machine working full out for the whole year.

The larger concerns overcome this investment problem by setting off such expenses against the production of other foodstuffs and by a greater range of products. They can also more easily afford the equipment for the concentration of apple juice, and the concentrated product in turn reduces the price of storage.

Smaller firms resort to other means. Some have tried to specialise in bottling, some in by-products such as fodder cake, whilst others produce their apple juice and have it stored and bottled by one of the larger concerns. Some firms have diversified and now manufacture different kinds of alcoholic beverages made from fruit and even distribute alcoholic and other beverages not of their own making.

Marketing and distribution

The productive capacity of Swiss apple juice is disproportionate to the marketing possibilities and outlets. The root of this problem is in the excess production of apples in Switzerland, the large number

of producing concerns and the competition provided by other beverages. The Fruit Union tries to encourage the consumption of apple juice by means of advertising for which it allocates a budget of Fr. 700,000 (£58,300) per annum.*

Another handicap is fluctuation in supplies and quality. In years of very poor harvests (such as 1957), cider fruits and apple concentrates have to be imported, and to the "pure" apple juice which is marketed, is usually added a fair proportion — sometimes up to 10 per cent and more—of pear juice or pear concentrate.

In fact, even during normal harvest years, many firms add pear juice to the sweet cider. It is argued that its flavour provides an agreeable blend. However, it is reasonable to assume that the very depressed price of perry pears (equal to £5 per ton in 1961 for pears, against £10 to £11 per ton for cider apples of good quality) provides a cheap ingredient which helps to maintain the price of the final product. Moreover, since many of the cider factories are co-operatives in which the apple and pear producers have an interest, it seems reasonable that they should use this convenient outlet for pears.

In normal years, however, the consumption of apple juice does not correspond with either the supply of cider fruits or with the apple juice productive capacity and many factories cannot work full out because of the restricted outlet for their product.

Furthermore, the relatively low sales within the country are not offset by the rising exports of fruit juice, concentrates and such derived products as pectin and fruit fodder (marc). Swiss exporters of such products complain of acute foreign competition which they say is not always fair.

On the domestic market, the sale of bottled apple juice, in small units as opposed to sales in casks or barrels, helped to increase its consumption by creating new outlets through retail shops and self-service stores.

Today, apple juice is marketed in bottles of 1 litre ($1\frac{3}{4}$ pints), 6 decilitres (1 pint), $\frac{3}{8}$ litre, ($\frac{2}{3}$ pint), 3 decilitres ($\frac{1}{2}$ pint), 2 decilitres ($\frac{1}{3}$ pint).

This diversification in packing has, of course, added to the price of the drink in so far as additional investments had to be made in the form of buildings, bottling and packing plants. Producers also complain that transport costs are heavy.

In the main, only the large producers market their brands throughout Switzerland. Smaller producers who do not have access to the same marketing facilities (for example, organised transport, depots, travelling salesmen, advertising funds) are restricted to a regional market. This is the case with the Suisse Romande producers who have, in addition, to compete on their own regional market with the better publicised Swiss German brands.

* Advertising of all types of fruit juice.

Distribution

Marketing and distribution of apple juice is not regulated by the Fruit Union, except as regards price. It is customary for large and medium producers to have a few travelling salesmen. The smaller firms make their sales either directly or through a wholesaler.

Again, the larger producers have their own delivery vans and depots in the larger consumer centres. The medium and smaller producers use the depots of mineral water wholesalers who also distribute their product to the various retail outlets. Very few of these wholesalers work exclusively for one apple juice producer; most of them handle five or six brands. These aspects of marketing and distribution again contribute to the expansion of the market for the larger producers.

Regular outlets for apple juice are groceries and other retail foodshops, restaurants, cafes, hotels, bars, etc. The large self-service chain stores, Migros and Coop are also providing important new outlets. Both these organisations have acquired interests in apple juice factories in the Swiss German part of the country.

Section IV—Concentration Plant and Storage

Concentration plant

When concentration of fruit juice was first applied on an industrial scale, Switzerland imported fruit juice concentration machinery from abroad, mainly from Germany, its traditional trading partner. But as this sector of the fruit juice industry developed, machines were adapted for local use and finally built in Switzerland. According to trade circles, over half, at least, of the concentration equipment in operation in the country today is domestically manufactured.

The main manufacturers of plant for the concentration of fruit juices are:—

Company	Product
Bell Maschinenfabrik AG, Kriens LU	all machines for food industry
Bertrams	evaporation plants with or without thermo-compression
Kasag	specialised in milk industry machinery
Klaus	extraction apparatus
Koehler, Bosshard	beverages and food industry machinery
Bucher-Guyer AG, Zurich	
Buss AG, Basel	vacuum evaporation plants
Schmutz & Bähler AG, Berne	

All other equipment needed for the manufacture of apple juice is also manufactured in Switzerland.

Scientific research is today a determining factor in the development of fruit juice concentration techniques. A method has been developed whereby the water content of the juice is extracted by a "freezing" process. This has the considerable advantage of requiring seven times less energy than the same results obtained by concentration through evaporation. However, this method cannot for the present be applied on an industrial basis.

Different degrees of concentration are produced, although the standard is 38° Beaumé. Half concentrates are produced with a view to solving the expensive storage problem (see below). Nevertheless, manufacturers are of the opinion that concentration affects the taste of the juice and therefore the quality of the final product. It is believed that much can be done in the field of "taste" research, but the cost of such a programme is not within the means available to the industry.

New methods of drying fruit juices are also being experimented with in the hope that cheap and effective storage could solve the problem of marketing surpluses.

Half-concentrates

Some twenty-five to thirty firms manufacture half-concentrates in Switzerland. The process has been known for many years but has only recently been applied to large quantities of apple juice.

There are three advantages of half-concentrates from the manufacturers point of view:—

(a) Shorter manufacturing time, therefore lower costs.

(b) Tariff advantages for export.

(c) Better quality product on dilution to juice strength.

The half-concentrates are stored under CO_2 pressure at a low temperature. Rediluted half-concentrates are not marketed separately, but are sold diluted and mixed with clear apple juice.

Section V—Summary

The key to the apple juice market in Switzerland lies in the degree of protection and economic support given to Swiss agriculture generally which dates from the defensive atmosphere of pre-war days. The demand for apple juice was reinforced when the Second World War shut off foreign supplies of sugar. Although economic conditions have altered in the post-war world producer interests have continued to exercise a dominant influence over policy and have been able to prevent the apple-growing industry from being reduced to a more economic level, by price policy and import restrictions. The apple juice industry is thus primarily based on apple surpluses grown mainly by small peasant producers on mixed farms under protected conditions.

The main products manufactured from apples in Switzerland are cider, pure apple juice, opalescent apple juice, apple concentrate, apple aromas, fruit vinegars and soft drinks. The great majority of the cider factories manufacture several of these items and there are no plants manufacturing pure apple juice only. Prices are not freely determined in the market but by minimum price schemes for apples established by the Régie Fédérale des Alcools and posted prices for juice products agreed on by the Fruit Union (through representatives of growers in various regions) after evaluating harvest prospects and manufacturing costs. Its main competitor in fruit juices in terms of price would appear to be orange juice. Retail margins are on the high side.

Apple growing in Switzerland is both a specialised activity on fruit farms as well as a feature of traditional mixed farming. Most of the fruit used in the juice industry comes from the mixed farms, except in glut seasons. Industrial manufacturers of apple juice have not found it worthwhile to procure orchards but growers' co-operatives, on the other hand, practise formal integration by the purchase of pressing equipment. In the processing sector itself, concentration is growing in the form of absorption of the smaller units by the larger co-operatives.

The main factor operating against the small concern is the high cost of capital investment in relation to capacity. In order to meet the problem of optimum output various measures have been tried out such as the manufacture of by-products and diversification.

In general, the bulk of apple juice production is distributed through wholesalers but the leading brands are marketed through the companies' own retailers.

A considerable range of fruit juice equipment, in which the country appears to be self-sufficient, is manufactured in Switzerland.

Section VI—Conclusions

The E.I.U. is not responsible for these conclusions, which are intended to bring out factors relevant to the U.K.

The particular historical circumstances which produced the Swiss apple juice industry are not present in the U.K. It is mainly based on the surplus apple crop resulting from the disappearance of the export markets necessary to consume the production of the heavy plantings made early in the twentieth century. The size of the industry is based rather on the size of the surplus apple crop than on the size of demand—which tends to be stagnant.

The order of the surplus compared with the U.K. position is suggested by the following figures. In 1960 Swiss total apple production was 261,000 tons of which it is provisionally estimated that 54 per cent was used as "table" fruit, the balance for cider, juice and fodder. This is for a population of only 5.4 m.! The U.K. apple crop, including cider apples, in 1960/61 was about 687,000 tons for a population of 52 m.! The pressure of crop on population is very much less in the U.K.

While apple juice has always been popular in Switzerland, it obtained a special command over public taste during the Second World War, in circumstances exactly the reverse of those existing in the U.K. today, i.e., sugar deficiency.

The evidence produced by E.I.U. suggests that much, if not most, of the fruit used in the industry is of "cider" varieties, and it does not look likely that the Swiss industry could survive only on surplus dessert varieties. The latter, to begin with, are only cheap enough for the industry in glut seasons, whereas "cider" apples are available at apparently economic prices every year. The question must arise in U.K. as to whether special varieties for juice manufacture will have to be grown, both for economic reasons and for reasons of blending and taste.

There is, of course, no equivalent control of prices in the U.K. to that exercised in Switzerland by the Regie Federale des Alcools and the Fruit Union Suisse. It is difficult to assess the effect on the Swiss juice industry of the regime of controlled buying and selling prices : the continuous concentration of businesses suggests that the industry has developed too much capacity, under this regime. It is likely, of course, that removal of the price controls, and the removal of protection from apple growing, would produce radical changes in the industry. For this reason, and the others mentioned above, it should not be assumed that, because the Swiss each drink three gallons of juice in a year the British will do the same. On the other hand, because direct comparison is difficult, it should not be assumed that English circumstances are necessarily opposed to the development of an apple juice industry: it can only be said from this study that some of the unusually favourable Swiss circumstances are absent in the U.K. Much the same conclusion can be reached in regard to grower control (41 per cent through co-operatives, of the cider industry). This must largely follow from grower control or influence over price fixing, both for apples and juice. It could not be assumed that the co-operatives would have reached the same industrial eminence if the industry had operated in a free economy.

5. *Developments in Canada*

The Fruit growing industry

The production of apples in Canada (15-16 million bushels, i.e., about 300,000 tons), is about half that of the U.K. In order of importance the provinces are British Columbia, Ontario, Quebec and Nova Scotia. Organisation of the industry has gone furthest in British Columbia in fresh fruit sales and processing. In Nova Scotia the growers suffered the loss of their overseas markets during and after the last war and processing is now a main outlet for apples. It was noted that extensive direct roadside sales were made in all the areas visited and especially in British Columbia and Ontario. Everywhere a desire was expressed for more overseas markets, either of fruit or of products, and there was anxiety about the effects of the entry of Britain into the Common Market.

A movement towards greater efficiency in grading and fruit handling was evident: the use of bulk bins and mechanised movement of fruit and products appeared most advanced in British Columbia. Some growers in Nova Scotia still resisted progress in packaging and presentation and clung to the use of barrels. Mechanical harvesting did not seem far advanced in Canada, but was being studied at the Geneva Experiment Station; unfortunately, the equipment was elsewhere in New York State at the time. The training of grapes for subsequent mechanical picking was noted.

British Columbia

The developments since 1946 have led the British Columbia Fruit Growers' Association to form two companies, B.C. Tree Fruits, Limited, that deals with all graded fruits, and Sun-Rype Products, Limited, that processes fruit not saleable on the fresh market. The second company now has three processing plants that have in recent years returned from the sale of products one million dollars annually to the growers. The largest plant at Kelowna at the peak of the season turns out 15 car-loads of products daily: the total intake of fruit for 1962/63 is expected to be 32,000 tons.

Fruit is taken from general supplies and it is not found economic to grow for processing alone, though it was commented elsewhere that overpublicity for products had in some years robbed the fresh market. From 25 per cent to 30 per cent of the apple crop is processed and some 10 per cent to 12 per cent is used for sauce and pie fillings, C. Grade being used for these. Mixed grades are used for juice production. Of the main variety McIntosh about 30 per cent comes into C Grade.

The average processing apple price in 1961 was $50 per ton which, less packing charges, left the grower with $23 per ton (just under £8). This included some market fruit with the lower grades. In this year a higher price had to be paid to secure sufficient fruit for sauce and pie filling ($63). There

seems to have been some variation in prices in recent years. Juice apples were said to be down to $28-$30 in some seasons (£10 level), whereas there is usually only a difference of $5 between C. Grade and cull fruit. Processors usually consider a reasonable average apple price to be $45 but the growers would prefer $50. Apparently handling charges can be excessive and to the detriment of both parties: they have reached $38 ton in some instances.

Ontario

Co-operative processing is not well developed in Ontario but there is a general increase in farm co-operatives. Agreed prices are negotiated each year, but contracts are firmer for wine grapes than for apples. Although some millions of gallons of apple juice are made in Ontario this is essentially a salvage operation and prices can be as low as 25 cents per bushel (about £4/ton). On the whole, processors consider that courts of arbitration have tended to keep apple prices up in Ontario.

Across the border in N.Y. State relations between growers and processors are said to be good but growers' co-operatives are proposing to enter the processing field. The products industry is being gradually concentrated into fewer hands. Both Federal and State marketing organisations are in existence.

Nova Scotia

Apple production in Nova Scotia is now about half the pre-war figure and the proportion of fruit processed has risen from 20 per cent to over 60 per cent of the crop. Some of the original plantings of culinary varieties have been replaced by McIntosh and Delicious and the growers now find themselves in direct competition with other areas better suited to these varieties. The forecast for the 1963 crop is 2,300,000 bushels as against 3 million in 1962.

Processing is essentially a salvage operation and prices are lower than in British Columbia: they have been down to the £5-£6/ton level for juice apples. Even so, solid pack apples have not been able to meet competition from some other areas (Eire was mentioned). In the years 1956-58 apple prices less containers were, for fresh fruit at the farm, about £13-£14, for canning apples £10-£13, while the average for processing apples was £8-£9.

With an increased demand from the housewife for processed as against fresh apples, the position is considered to be improving and growers are concentrating on varieties suitable for these products. The prices offered are tending to rise (C. R. Retson, The Economist Annalist, June, 1960).

Products

Apple sauce was everywhere looked upon as a remunerative outlet for apples and it was hoped that the product would become as popular in Canada as it is in the U.S.A. A desire for increased sales in the U.K. was also noted, but it was admitted that this would require a publicity campaign and some change in eating habits. In British Columbia sauce and pie fillings account for over a third of the apples processed, and great attention is paid to the quality of these products. In Nova Scotia the proportion going into canned apple and sauce is much the same. Fruit pies were found everywhere available in restaurants and roadside cafes with apple as the staple product; others generally on sale were cherry and blueberry and, in the U.S.A., elderberry seemed popular.

Clear apple juice was found generally available in Canada although no extensive publicity was noticed; it was usually the cheapest fruit juice offered. In Montreal some juice purchased was of indifferent quality and tasted of preservative. In Ontario and Nova Scotia the juice was of good quality and the acid/sugar balance was similar to that in northern Europe: in British Columbia the juices, both clear and opalescent, were of high quality but much sweeter in taste.

In Ontario and Nova Scotia juice production is still considered a salvage operation whereas in British Columbia juice now appears to be holding its own with other products. It was everywhere stated that there was no future in the manufacture of low grade concentrate (i.e., without volatiles and stored without refrigeration). Such material is still cheaply available in Europe and the only market appears to be for cheap drinks (cf. export of Canadian concentrate to Mexico). There was, however, an interest in high quality concentrate for subsequent dilution to juice but no extensive development was seen.

Methods of production

For sauce and pie fillings the fruit used was of good quality, especially in British Columbia and much fruit used was merely out-graded because of lack of colour: no rubbish was allowed to go through the production line. A lower grade was used for juice but it was understood that only sound fruit was used. At Sun-Rype the waste from peeling and coring was pressed for concentrate for use in juice blending.

The opalescent apple juice made in British Columbia was more turbid than that made in Long Ashton trials. This may be partly a question of variety, McIntosh is used in Canada, or it may be due to the use of the Rietz Disintegrator for milling. The juice is stored in can in non-refrigerated buildings and maintains its quality for at least a year: a 1960 sample tasted had no marked off-flavour but had lost some quality. This stability may be the result of several factors: the variety of apple, the quality of the can, the low winter temperature, or the speed of operation (20 minutes from fruit to can).

In Canada clear juices are all clarified by gelatine/tannin as this is said to give a juice that remains clear on storage. However, in recent discussion with Dr. H. Lüthi of the Wädenswil Research Station, the writer understands that in Swiss practice enzyme clarification gives the more stable product.

In British Columbia 30-35% of the apple juice made is opalescent. Some is made for Sun-Rype Products in Ontario, but elsewhere only clear juice is manufactured. The opinion in the east was that the clear juice was more generally popular.

The standardisation of apple juice blends in Canada remains a problem. The manufacture of pure opalescent apple juices early in the season and blends later offers some solution, but bulk storage would have many advantages. The conventional Böhi storage under pressure and with refrigeration is seen to be expensive but manufacturers are apprehensive of embarking on sterile storage without pressure, as the method is unfamiliar to them. Sterile storage is, however, in operation in Canada by Heinz for partly concentrated juice transport, and it is now in use for apple and grape juices in France using nitrogen as head-space gas.

Storage of juice in tanks with refrigeration was seen in New York State where it has been used for many years for grape juice. The juice is flash-pasteurised and filled into very large tanks in rooms maintained at about −28°F. Some use of ultra-violet irradiation of the liquid surface is still made in some installations, in others a thick ice-cover is allowed to form. In one factory, trouble had only been encountered where preliminary heat treatment had been insufficient, in another a very close watch was maintained to ensure that there was no incipient fermentation and, in case of doubt the juice was re-pasteurised. Past work at the Geneva Station suggests that in the course of time populations of non-fermenting low temperature resistant yeasts can build up and cause quality deterioration. Large volumes of grape and berry juices are, however, stored in this manner and the success of the method would seem to be the result of long experience in the factories.

Work now in progress (at Summerland) has emphasised the importance of low temperature storage of high density apple concentrates. If 6-8 fold concentrates are stored at temperatures as high as 0°C. it is considered that quality deterioration is excessive. At the Vineland Station (Ontario) tests are proceeding on the sterile storage of juice at 0°C as the better alternative, as it is thought that diluted concentrates give an inferior product.

The general impression gained in Canada was that there was no future in the manufacture of the older type of concentrate, that is, high density concentrate stored without refrigeration. Even considered as a salvage operation the product meets severe competition from other countries operating on a lower cost level: it was stated that European concentrate has been imported into Canada. Such salvage operations bring little return to the grower.

The manufacture of high quality concentrate for dilution to juice is a different proposition but here quality is the main consideration. The research work in progress at Vineland, Ontario, and at Summerland, British Columbia, is leading to the opinion that much lower storage temperatures than those considered in the past are needed for high density apple concentrate if quality is to be maintained. At Vineland it was stated that no such concentrate diluted is equal to fresh juice; at Summerland the opinion seemed to be that a good quality product could be diluted and blended with fresh juice.

6. *The Supply of Apples for Juice Manufacture*

AN ENQUIRY AMONG GROWERS AND CO-OPERATIVES

Section I—The Sample

The object of this enquiry was to find out from a sample of growers and co-operative managers, something of their attitudes towards the supply of low grade apples for juice manufacture. The questions dealt with prices, quantities and readiness to contract. For the purposes of the questionnaire a tentative processing grade for apples was defined with the following minimum characteristics:

(i) minimum size 1¾" with a small tolerance down to 1½";
(ii) free from progressive defects ;
(iii) not over mature.

Quality lower than this would not be suitable for production of a good quality apple juice.

Eleven growers or co-operative managers were interviewed using a standard questionnaire. Four growers were interviewed in Wisbech, three co-operatives in Kent, two growers and two co-operatives in Essex. Figures were taken for the seasons 1960/61 and 1961/62, representing two extreme marketing situations. Although the number in the sample was small it covered very large production with a considerable range of size (1961/62, smallest respondent 15,000 bushels, largest respondent 200,000 bushels).

(i) The total crops represented were as follows:

'000 bushels

	CROP 1960/61			CROP 1961/62		
	†D.	‡C.	Total	D.	C.	Total
Wisbech	33	141	174	45	46	91
Kent	*	*	750	*	*	383
Essex	594	29	621	274	14	288
			1,545			762

*Note: incomplete returns.
†D=Dessert.
‡C=Culinary.

(ii) Sales to processors were as follows:

	Sold to Processors '000 bushels.	
	1960/61	1961/62
Wisbech	22	7
Kent	42 (incomplete)	13 (incomplete)
Essex	41	10

The figures obtained create a reasonable pattern in which large surpluses appear to have been "dumped" in 1960/61, whereas in 1961/62 the "fresh marketings" together with "sales to processors" relate closely to the total crops. The Wisbech figure contains a preponderance of culinary apples, Kent a balance of dessert and culinary, and Essex a preponderance of dessert.

Section II—Results

Enquiries were made as to the grading of sales to processors, and the prices realised. Some correlation appears:

	1960/61	1961/62
"Bag apples" (presumably true culls mainly for cider making)	£5 to £8 per ton	£7 to £9 per ton

(*It is understood that at least in some cases these low prices are due to long term arrangements with cider manufacturers.*)

Apples for canning, mincemeat. (Some grading of indefinite specification)	£9 to £10 per ton	£20 - £26 - £40 per ton
One school contract quoted (Domestic R. Grade)	—	£20 per ton

A question was asked as to the proportion of crop falling into H.M.C. "processing grade". The general opinion ranged between 5% and 13%, but in one case the respondent thought 25%-40% and in another 20%: it may be that the question was not clear, but it is noted that in both cases the respondents (in Essex) grow dessert fruit preponderantly. Fruit of the "processing grade" was stated by four respondents to fetch, per ton:

1960/61 Fresh, £20, £12 10 0.
1961/62 Fresh, £50, £74, £80.
Cider, £5-7.

Questions were asked as to readiness to enter into long term contracts for "processing grade" fruit from 2 to 5 years, and the prices which would be required ex farm in bulk. There was a general readiness to enter contracts, with reservations: the most important were:

(a) the grower was willing to contract for a quantity over 3 years, but he would not want to commit himself to equal deliveries in each year;

(b) another grower would commit himself to equal deliveries each year but would wish to negotiate a price each year.

(Both of these, of course, amount to a desire to enjoy the benefit of high prices for low grade fruit in the fresh markets in years of short crops.) Five respondents said they were willing to enter 5 year contracts (3 Wisbech, 1 Kent, 1 Essex). Six respondents opted for 3-year contracts (1 Wisbech, 2 Kent, 3 Essex). Suggested price minima for period contracts ranged from £10-£20 per ton. In Wisbech, with its preponderance of culinary apples, the range was £10-£15. In Kent and Essex, contract supplies of dessert varieties would be prices at £15-£20, but one respondent would contract Bramleys at £10.

Quantities suggested for contracts ranged from 1,000 bushels to 50,000 bushels, but it should be emphasised that in some cases the suggested quantity was greatly in excess of the respondent's estimate of the "processing grade" fruit he had available (an earlier question had established this). This suggests that respondents had not clearly in mind the fruit which was specified: emphasis was given, however, to the exclusion of over-ripe and rotten fruit. Probably respondents thought in terms of their smallest "fresh" fruit and had in mind diverting some of this from the fresh markets if they could get the right price. This suggests that the contract price indications should be considered as maxima and on the high side for "processing" fruit.

As a check question, respondents were asked what prices would have been expected in negotiation at the beginning of the two seasons, for "processing grade" fruit, in the absence of contracts. The answers from seven respondents relate reasonably well to their "contract readiness" answers:

For 1960/61 the range was £8-£20 per ton, average £11.

For 1961/62 the range was £9-£30 per ton, average £18.

This implies an average return of about £15 per ton over the seasons, without differentiation between culinary and dessert varieties.

A large grower/merchant/importer in Kent was separately interviewed. He thought that he could obtain and handle up to 200,000 bushels a year (75% Bramley, 25% Laxton and Worcester) at a return to the grower ex farm of £11 per ton. This correlates with the other data as regards Bramley supply.

Section III—Conclusions

A brief summary of conclusions. Perhaps 10% of the total crop falls within the "processing grade": it would generally be available on period contracts at £10-£15 per ton for Bramleys and £15-£20 per ton for dessert varieties, ex farm in bulk. Many respondents emphasise the importance of variety: obviously Cox's O.P. will be more difficult to obtain and would tend to be priced at the top of the price range. The "juice" demand for the fruit would compete with other processing demands and with the fresh market in short seasons, and a large scale "juice" demand might raise these price ranges. The importance of concentration and storage is obvious. At least two respondents were interested in the possibilities of setting up a concentration plant.

It should be emphasised that these conclusions are tentative, being based on such a small sample. However, the conclusion that about 10% of the total crop, say 50,000 tons, would be suitable and available, for processing agrees with the estimate made separately and mentioned in Chapter 2, and also with enquiries made elsewhere. The indicated price ranges, it has been said, should be regarded as maxima and on the high side. It is, therefore, worth noting that prices in Switzerland are said to be for "processing" or "cider" varieties approximately £8 8s. 0d. to £10 10s. 0d. per ton, and for surplus "fresh" varieties £6 14s. 0d. to £8 8s. 0d. in glut years. In years of small crops very little of the "fresh" varieties is used for juice making in Switzerland and that of marginal quality: juice producers appear unable to pay very much over £10. In Canada, where juice manufacture has been regarded primarily as a salvage operation, juice apples command generally about £8 per ton and in Ontario and Nova Scotia sometimes as little as £4-£6 per ton (see Chapter 5.) These comparisons should not be taken too literally since other manufacturing costs like transport can vary substantially, and since the ultimate product price is the controlling factor. But they suggest that the price ranges in the previous paragraph are certainly pitched on the high side if a similar grade of fruit is used in Switzerland and Canada.

The supply position might be summed up like this. So long as processing outlets like apple juice are regarded merely as salvage outlets for low grade and surplus fruit and while an apple juice industry is small, it may be economical and convenient for both grower and processor to contract seasonally at prices fluctuating from season to season. The processor will, if the potential apple juice market justifies it, invest in concentration and storage equipment to provide buffer stocks and to take full advantage of low prices in the surplus season. This is not necessarily to the grower's disadvantage since his costs of production do not vary directly with the size of his crop: the sales in surplus seasons at low prices would still be likely to produce net income to him. (What would be to the grower's disadvantage is if high prices of processing apples in "short" seasons persuaded processors not to concentrate and store from surplus seasons, but to import concentrates.) It might well be in the long term interests of growers, however, in relation to a developing apple juice industry to accept period contracts at modest prices, giving them security of outlet, at least for part of the juice demand. They would earn rather more in the surplus season and rather less in the short season when they might have to divert fruit from the fresh markets to fulfil their contracts. The enquiry suggests that some growers and co-operatives at least would be prepared to accept period contracts: it also suggests that the nominated prices may be a little too high to be economical. There are various possibilities, of course, in contracting and no doubt, as development occurs, negotiation between growers and processors will produce arrangements satisfactory to both parties.

It appears to the Council that economic price ranges for apples of the "processing" grade would be about £10-15 per ton for dessert varieties and £8-12 for culinary varieties. Although these are less than the ranges mentioned in the results of the enquiry, past experience suggests that they would be attractive enough to growers. Growers, it is thought, would probably be prepared to enter contracts for say 50% of their estimated processing fruit in a "normal" season; the remaining 50% would perhaps have to be negotiated from year to year.

7. *Technical Considerations*

Section I—The Storage of Apple Juice

Apple juice can be stored in the form of fruit, as single strength juice, or as concentrate. If apples are taken from store late in the season, this is in effect equivalent to juice storage. There will be some fall-off in the quality of late pressed juice, the extent varying according to storage conditions and fruit variety. A fall in the acidity of culinary varieties may, on the other hand, be an advantage. It is considered, however, that the highest quality juices are pressed soon after harvest, and in some factories late pressed juices are used in blended products or for those where some fall-off in apple juice quality is tolerable.

Storage of products

Taking an average yield of 160 gallons per ton, the space occupied by this volume as canned juice in cases each containing 2 doz. 12 oz. cans would be about 47 cu. ft. As bulk juice, and excluding the volume of the tank and fitments, the volume would be 26 cu. ft. As concentrate (7-fold) the volume, excluding tank, etc., would be 3.7 cu. ft. A concentrate would then take up about one-tenth the space of canned juice.

Before discussing juice storage some general aspects of processing will be re-capitulated.

Types of juice

To make clear juice the fruit is washed, milled and pressed as for cider. The juice is turbid, and oxidation soon changes the colour from yellow to brown. It is clarified by adding a commercial enzyme that breaks down pectin and causes the flocculation of suspended solids and colloidal material with a lightening of colour. Gelatin is often also added to assist clearing and improve later stability. An alternative method of clarification is to add tannic acid, followed by gelatin: this removes suspended material without removing pectin. After either method of clarification the juice is separated from the sludge and filtered. In Europe it is usually stored in bulk at this stage; in the U.S.A. and in Canada direct bottling or canning is more general.

For opalescent juice the fruit is rapidly milled and pressed, and the juice screened. It is at once treated with ascorbic acid to arrest oxidation and sedimentation of the colloids. Immediate flash-pasteurisation then stabilises the juice, preventing pectin changes and darkening. It is filled hot into can and rapidly cooled. In the Canadian factories where this method was developed the whole operation from fruit to can takes less than half an hour.

Whereas the clear depectinised juice can be concentrated 7 or 8-fold to a specific gravity high enough to prevent fermentation (about 70% total solids), the opalescent juice cannot be concentrated more than about 3 to 4-fold, for the pectin still present would form a gel. Such concentrates are described later.

Juice storage

The classical method of juice storage, widely used in Europe, is the Boehi procedure. The juice, freed from the bulk of micro-organisms by the centrifuge or filter, is impregnated with carbon dioxide (1.5% CO_2 wt./vol.) and stored in high pressure tanks. At 15°C. this corresponds to 7 atm. above atmospheric pressure. This inhibits yeast action but it does not stop bacterial growth, and there has been a general move to storage at 0-2°C. with a corresponding pressure of 3-4 atm. Under these conditions deterioration is prevented.

This method is expensive and a cheaper alternative in smaller concerns is to fill tanks or glass containers with hot juice and thus store the juice sterile. The containers may be cooled by water spray but even so, the technique is liable to give a cooked flavour to the juice. An alternative is to flash-heat and cool juice and fill into sterilised tanks, kept preferably at low temperature (about 0°C.). A low pressure of carbon dioxide is advisable to prevent growth of accidental infection by heat resistant moulds.

As described later, in the U.S.A. large volumes of grape and other juices are stored in large tanks with refrigeration. The juices after flash-pasteurisation are chilled and stored at temperatures just below 0°C., where the growth of micro-organisms is greatly retarded. More recently, a method has been adopted in France for the commercial storage of flash-pasteurised grape and apple juices, apparently without refrigeration, where a gas blanket of nitrogen is used to inhibit mould growth. Nitrogen has the advantage of a low solubility in juice as compared with carbon dioxide, but it does not have the inhibitory action against moulds shown by the latter. Mixtures of nitrogen and carbon dioxide have been used satisfactorily in recent tests at Long Ashton for the storage of flash-pasteurised juice in metal containers at 1°C.

While these later methods call for less expensive plant than does the Boehi method, their effectiveness is dependent upon the maintenance of effective sterility in the juice and storage vessels or upon the inhibition of chance contamination by anaerobic conditions and/or temperatures near 0°C. In the course of time there is a danger that a population of

organisms capable of growing under these conditions will build up in a factory, as for example, psychrophilic yeasts or heat-resistant moulds: constant vigilance is, therefore, necessary. As described below, the storage of juice as concentrate is in many ways simpler and has other advantages.

Types of concentrate

Much concentrate made in the past and some still in production is prepared by simple concentration of apple juice 7-8 fold in vacuo at temperatures around 40°C. In this process the volatile apple aromas are lost, so that the product obtained on re-dilution has little apple character. Furthermore, if such concentrates are stored at ambient temperature they undergo chemical changes and the flavour deteriorates.

If a concentrate is to be re-constituted for juice it is essential to retain the volatile aromas. This has been possible with the Kestner Evaporator for over 20 years but improvements in technique have since gone forward in the U.S.A. and elsewhere, and most modern evaporators are now designed for the recovery of volatile fruit aromas. The first 10 to 15% of vapour, which usually contains the bulk of the volatile aroma, is first stripped off and condensed, and then fractionated to concentrate the material into a small volume. The stripped juice passes on for concentration in the usual manner at reduced pressure. The aroma fraction is stable on storage but it is kept separate from the concentrate and only returned to it when the concentrate is diluted. A re-constituted juice containing volatiles should closely resemble the original.

High density apple concentrates are in extensive commercial production and, being relatively immune from microbiological spoilage, they are readily transportable: their total solids content (about 70%) inhibits the growth of many micro-organisms at ordinary temperature. They are used for dilution to juice, for fermentation to cider, for the formulation of apple drinks and for a variety of subsidiary purposes. If diluted back to juice the quality of the product will be dependent upon the quality of the concentrate itself quite apart from the question of volatile aroma addition.

Such concentrates can only be made from depectinised juices, for the presence of appreciable amounts of pectin would set the product to a gel. Freshly pressed juices or those of opalescent type can only be partially concentrated, some 3-4 times, if they are to remain liquid. Half-concentrates of this type have, however, certain advantages. In their preparation the juice undergoes less heat treatment and there is thus less alteration of flavour. Less concentration capacity is needed, but this is offset by the need for greater storage space for the final product. Although the half-concentrates are less stable microbiologically than those of high density, they are more stable than the original juice.

Storage of concentrate

The rate of deterioration of juice concentrates on storage will depend upon the type of fruit juice and upon the temperature: there will be variations in stability according to apple variety due to differences in chemical composition. Flash-pasteurisation before concentration is desirable for the inactivation of juice enzymes that can take part in oxidative and other changes, and is commonly combined with volatile stripping. Although changes in quality can be effectively delayed by storage at deep-freeze temperatures, in practice the advantages of low temperature storage must be considered in relation to the cost of refrigeration. For high-density concentrates the temperature of storage should be low enough to prevent appreciable loss of quality during the required period of storage. This point is discussed further later in relation to tests in progress at Long Ashton.

For half-concentrates the storage temperature must be such that microbiological deterioration is prevented in addition to chemical change. It has been found in practice that sterility may be safeguarded by an atmosphere of carbon dioxide with storage at 0°C. and that quality is maintained adequately under these conditions.

Current developments

It was noted that in Canada the optimum conditions for the bulk storage of apple juice and of concentrates were still under active discussion. The question has now been taken much further in Switzerland, for it appears that the work initiated at the Wädenswil Research Station has proved so promising that the juice industry is now going over extensively to the storage of juice as half concentrates. The rate of deterioration of 3-4 fold concentrates is much slower than that of full concentrates and after storage at about 0°C. the product given on dilution is scarcely distinguishable from fresh juice. Moreover, under a gas blanket of carbon dioxide, the half-concentrates remain free from microbiological spoilage.

The Swiss procedure for clear apple juice using this method is now as follows. Freshly pressed juice, centrifuged if necessary, is flash-heated to pasteurise the juice and to strip the volatile aroma which is separately fractionated and stored. The juice then passes to the concentrator. The 3-4 fold concentrate is cooled and filled into containers that have been effectively sterilised chemically or by heat. After storage (0°C.) the concentrate is diluted, enzyme clarified and filtered and bottled in the usual manner.

This method of operation has several advantages. There is a saving of storage space, and the method of storage is less expensive than the Böhi process. Juices can be blended as required and the final juice can be clarified for clear juice or put up as a cloudy product.

Section II—Apple Juice Storage—Long Ashton Tests 1962

Since a Memorandum on the storage of apple juice was prepared for the Council in 1961 it has become evident that a wider use of concentrate for dilution to juice is now being made commercially, and that the subject is taking on an increasing interest. Earlier tests made at Long Ashton had shown that at deep-freeze temperatures deterioration in concentrated fruit juices was slow, but that further information was required as to the rate of change at temperatures in the neighbourhood of 0°C. Later tests begun at Long Ashton in 1961 on the storage of apple juices and concentrates are still incomplete, but the results to date will be summarised here. A fuller account will be published later.

The main purpose of the tests was to assess the quality of English apple juices, stored as such, with those diluted from concentrate at intervals throughout the year. The juices were intentionally prepared from fruit of no more than average quality, the apples had been out-graded for size or lack of colour but they were free from other than superficial damage.

Clear apple juice

Juice was pressed from a mixture of Bramley Seedling, Cox's Orange Pippin and Laxton's Superb, enzymed, filtered and flash-pasteurised. A portion of this juice was collected under sterile conditions in sterile stainless steel drums of 4 gallon capacity and stored at 1°C. The juice was partially saturated with carbon dioxide and the head space of each drum then filled with a mixture of 95% nitrogen and 5% carbon dioxide. A further portion of the flash-pasteurised juice was re-filtered, carbonated and pasteurised in bottle: the bottled juice was stored in a cool cellar.

The bulk of the juice was stripped of volatiles and concentrated 7 times by volume in a Kestner Climbing Film Evaporator. The volatile fraction was further rectified and stored at deep-freeze temperature until required. Batches of concentrate were stored in full jars at 1°C., 5°C. and cellar temperature. The temperature of the cellar varied from a daily average of about 10°C. in the winter months to about 18°C. in the summer: it was below 15°C. for most of the year.

Samples of concentrate were diluted to juice strength at intervals, the liquids were then filtered, ascorbic acid and volatiles added, carbonated and pasteurised in bottle. The concentrate stored at cellar temperature was reconstituted after 2, 6 and 9 months' storage, those stored at 1°C. and 5° C. after 6 and 9 months. The bottled products were all stored at cellar temperature.

At the end of the 9 months' storage period juice was taken from a stainless steel drum, filtered and bottled as above. All bottled samples were then taken for quality assessment.

Aroma and flavour

Samples were coded and assessed for aroma and flavour by seven experienced judges using a plan of random sampling that allowed statistical treatment of the results. Scores were awarded according to the following scheme.

5 fresh apple.
4 average, fruity.
3 weak or slightly cooked.
2 cooked or slightly foreign.
1 definite off-character.
0 undrinkable.

Comparing juices stored in bottle or drum with those prepared by diluting concentrate stored at cellar temperature for increasing periods, the range of scores for aroma was from 2.68 to 3.57. The difference required for significance at the 5% level was 0.67, and at 1% was 0.91. The juice stored throughout in a drum at 1°C. and that freshly prepared from concentrate stored for 9 months at cellar temperature were significantly better in aroma than all other samples.

Flavour scores varied from 2.80 to 3.25; the differences were not significant (at 5%), but the order of score corresponded to that found for aroma.

Further assessments were made to determine the effect of temperature of storage on the concentrate: dilutions of each sample of concentrate being compared one with another. Aroma scores ranged from 2.68 to 3.70 and some differences were highly significant. It could be concluded that concentrate stored at 5°C. or 1°C. was better than that stored at cellar temperature. At the lower temperatures concentrate diluted to juice after 9 months gave a better product than that diluted after 6 months and stored 3 months as juice in bottle.

Flavour scores ranged from 3.10 to 3.49 and no significant differences between treatments were found.

Colour

The colours of the bottled samples were measured over a range of wave-lengths in the visible spectrum. The main point of interest was a deepening of colour in certain samples. After storage of the concentrate for 9 months, the freshly bottled juices from 1°C. and 5°C. storage were paler than that from cellar storage. After 6 months' storage as concentrate and 3 months in bottle the 1°C. sample was paler than the other two. The deepest colour was found in the sample bottled after 2 months' storage in the cellar and 7 months in bottle. The differences in colour were not great: the main effect appeared to be that storage at cellar temperature, whether as juice or concentrate, gave a deepening of colour.

Opalescent apple juice

Fruit as used for the clear juice was milled and pressed, and the juice treated with ascorbic acid and immediately flash-pasteurised. One portion was filled

hot into bottles, another portion filled cold into sterile stainless steel drums as before, and the remainder was collected cold in a large drum for concentration and collection of the volatiles next day. Concentration was taken slightly too far (4.3 fold by volume) and gel formation occurred. After homogenisation, the concentrate was stored at 1°C. in glass gallon jars under a gas blanket of carbon dioxide and nitrogen as used for the drums. Samples were reconstituted for quality assessment after 2, 6 and 9 months' storage at 1°C.

Aroma and flavour

Mean scores for aroma all fell between 2.88 and 3.54 out of a total of 5: the difference needed for significance at the 5% level was 0.69. Thus the juice samples from the different treatments did not show significant differences in aroma, the highest score was, however, given to the juice that had been stored at 1°C. in a stainless drum.

Flavour scores all fell between 2.64 and 3.54, the difference needed for significance being 0.74 at the 5% level. The juice from the drum was significantly better than that which had been stored for the longest period as concentrate. Juice prepared from concentrate stored for intermediate periods differed little in score from juice bottled at the time of making.

Colour

The juices prepared from concentrate were all slightly darker than those stored as juice, irrespective of time of storage. Before these samples were assessed for quality their colours were adjusted to uniformity by the addition of permitted food colour.

Conclusions

Although the tests described are incomplete and do not cover all possible variations of treatment, or storage in can as compared with storage in bottle, certain general conclusions may be drawn. Juices stored in bulk at 1°C. were better than those stored as concentrate but the differences in quality were not great. Juices stored as concentrate were little different in quality from those stored in bottle at the same temperature, in some instances they were slightly better. In general, quality was maintained better at 0° or 5°C. than at temperatures between 10 and 15°C.

Work on the storage of juice, concentrates and half-concentrates will continue at Long Ashton Research Station.

8. *The Economics of Concentration and Storage of Apple Juice*

This study was commissioned from the E.I.U. Ltd. to obtain up-to-date capital and operating costs of concentration and concentrate storage plant, to examine costs in relation to size of plant and to consider the main problems of economic production.

Section I—The Economic Problem of Apple Juice Concentration

Concentrate and its manufacture should be regarded solely as inseparable adjuncts of apple juice manufacture. The setting up and operation of apple juice concentration plant is essentially an internal problem of the manufacturer of apple juice. Concentrate is a buffer stock of juice, its manufacture an aspect of the production and marketing of apple juice itself.

In the opinion of the E.I.U. it would be uneconomical and impracticable for a co-operative of growers to operate an apple juice concentration plant, small or large, with a view to selling concentrate to manufacturers of apple juice, except in very special circumstances. Such circumstances would arise if the growers were in a monopoly or near-monopoly position as suppliers of apples and concentrate to apple juice manufacturers. Only then—by controlling the price of apples and of concentrate—would they be in a position to ensure a remunerative operation of an apple juice concentration plant.

Apple juice concentration and storage plant is expensive. This much is clearly shown by the information gathered. It would be important, therefore, that the concentration plant should be operated on an even keel from season to season. It is necessarily cheaper to manufacture apple juice from fresh apples harvested in the season than to manufacture it entirely or in part from concentrate. A co-operative of growers with no direct interest in apple juice manufacture and with no control over the supplies and price of apples, including apples suitable for direct processing into juice, could not ensure a full utilisation of a concentration plant from season to season. For in periods when there is a surplus of apples, and in a free market, manufacturers of apple juice would substitute apple juice made from the season's apples for concentrate. The demand for concentrate and the price which manufacturers of apple juice would be prepared to pay for concentrate would fall; unit cost of production of concentrate would rise. If manufacturers of apple juice could also rely on imported supplies of concentrate, the position of the commercial operators of a concentration plant would be further weakened.

In view of the uncertainty of supplies of apples a substantial market for, and manufacture of, apple juice cannot be contemplated without making provision for the manufacture of concentrate. Concentration plant is costly ; the cost of the insurance, as it

were, against the uncertainty of supplies is high. For this reason the E.I.U. is of the opinion that the manufacture of apple juice can be undertaken either without concentration plant for a limited market and on a limited scale, or with a concentration plant on a substantial scale and by a substantial producer. The producer should preferably also be the producer of other juices and concentrates and in general immune to the danger of being undercut in certain areas of the market in periods of surplus of apples by marginal producers who do not operate and do not have to bear the cost of concentration plant.

Even such a substantial producer should initially think in terms of a small concentration plant and in terms of a product which would contain a small, variable proportion of concentrate.

Section II—Size of Plant

The following Sections set out details of costs and the main problems to be considered in setting up apple juice concentration and concentrate storage plant. Information was gathered from the leading manufacturers of the necessary machinery. It was found that none of these manufacturers has done any actual or hypothetical costing studies to determine the smallest size of plant which would be economical, or to show how the cost of a plant would change with changes in technical and economic circumstances. The only general proposition that can be established, as a rough guide, is that the cost of concentration plant is related to the size of plant by a factor of 1.6. For example, if a plant processing 10 tons of apples cost £100, the cost of a plant to process 20 tons of apples would be £160 and not £200.

As far as the manufacturers' actual production and sales experience is concerned, individual installations are almost invariably tailor made to fit the requirements of customers. Evaporators and storage tanks are good examples of equipment which has to be designed to deal with specific throughputs of juice or residential space. The location of the plant and the commodity to be processed have also important technical and economic repercussions, and manufacturers have had only limited experience with apple juice.

Individual estimates of the smallest economic unit varied from a quantity of 300 tons of apples a season, to a juice throughput between 200-300 gallons/hour. (This last estimate is equivalent to 550-800 tons of apples in a ten week processing season, assuming that the plant is operated eight hours a day for a five-day week.)

All the manufacturers were helpful and their production and sales experience, fragmentary and limited as it is, under analysis throws a great deal of light on the problem.

For the purpose of comparing the cost of different types and sizes of concentration plant, there has been assumed three hypothetical throughputs of juice 300, 800 and 1,500 gallons/hour. The upper limit was fixed at 1,500 gallons/hour since this is believed to be the size of the largest juice processing plant in the country.

The tonnage of apples which could be processed using juice throughputs of 300, 800 and 1,500 gallons/hour would vary with the length of the processing season. The following table shows the quantities of apples involved assuming a 10-week processing season (using freshly harvested apples and no cool storage) and an average juice yield of 150 gallons of juice from one ton of apples.

Quantities of Apples Required for Varying Juice Throughputs in a 10-week Processing Season

Juice Throughput (gallons/hour)	5 Day Week 8 Hour Day (tons)	6 Day Week 24 Hour Day (tons)
300	800	2,880
800	2,130	7,680
1,500	4,000	14,400

The length of the processing season could be doubled to 20 weeks if apples were kept in cool storage. This would double the quantities of apples processed as given in the above table. Therefore, the selection of the arbitrary throughputs of 300, 800 and 1,500 gallons/hour makes it possible to cover a quantity range of apples from 800-29,000 tons.

With a concentration ratio of 1:7 the volume of concentrated juice which corresponds to the quantities of apples given in the table above are:

Volume of Concentrated Apple Juice for Varying Juice Throughputs in a 10 Week Processing Season

Juice Throughput (gallons/hour)	5 Day Week 8 Hour Day ('000 galls.)	6 Day Week 24 Hour Day ('000 galls.)
300	17	62
800	46	165
1,500	86	309

Similarly, if the processing season were extended to 20 weeks the volume of concentrated juice to be stored would range from 17,000 gallons to 618,000 gallons. In this case the assumption is made that all the concentrate produced is to be stored and none is to be marketed immediately.

Section III—Plant and Capital

For the purpose of comparing the costs of different types and sizes of concentration plant, E.I.U. assumed three hypothetical throughputs of juice, 300, 800 and 1,500 gallons per hour, as stated above.

Processes in the Production and Storage of Concentrates of Apple Juice

All apples must go through the following initial processes to obtain apple pulp:

Fruit reception and weighing.
Storage in silos under cover.
Conveyor (water).
Washing and sorting.
Milling.
Pressing.

The methods of dealing with the apple pulp to produce concentrated juice vary slightly. For the production of clear concentrate the processes are:

Depectinising.
Centrifuging or filtering.
Flash Pasteurising.
Volatile stripping and rectification.
Concentration.
*Cooling.
*Cool storage in tank.

For cloudy concentrate the processes are:

Juice pressed from chilled fruit.
Addition of ascorbic acid.
Screening (to remove particles).
Flash pasteurising.
Volatile stripping and rectification.
Concentration.
*Cooling.
*Cool storage in tank with exclusion of air.

Milling and pressing machinery

A volume of 300, 800, and 1,500 gallons of apple juice an hour represents roughly a tonnage of 2 tons, 5 tons and 10 tons of apples an hour respectively.

In a specification by H. Beare and Sons:

(a) 2 tons of apples an hour can be handled by two 100-ton presses and one 'cheese' building station equipped with such ancillaries as press trucks, grinding mill, hydraulic truck lift, racks and pulp tank.

The maximum capacity of two 100-ton presses is in the region of 3 tons of apples an hour, assuming that each pulp cheese weighs approximately 9/10 cwts.

The ex-works cost of this equipment, complete with ancillaries, would be around £3,000.

(b) An output of 5 tons of apples an hour represents 10/11 pulp cheeses. This quantity can still be dealt with by one 'cheese' building station, but would require three 100-ton presses operating at full capacity.

The same size fruit grinding mill used for a capacity of 2 tons of apples an hour is sufficient for 5 tons of apples an hour.

Therefore the major additional machinery cost in increasing the juice throughput of a plant from 300 to 800 gallons/hour would be for one 100-ton press.

(c) A throughput of 10 tons of apples an hour, roughly 200 'cheeses' an hour, would require two 'cheese' building stations and six 100-ton presses. It would also be necessary to have two fruit grinding mills.

H. Beare and Sons recommend the 100-ton press since it is easier to handle, the trucks are smaller and lighter than those required for the older 200-ton and 300-ton presses, the 'cheeses' are easier to build, and a better yield is obtained from the fruit.

Tanks for depectinising or storage

Two main types of steel tanks are available. The cheapest are those made from mild steel with a prodorite lining.

Stainless steel tanks cost an additional half or three-quarters the price of the mild steel tanks, depending on the grade of stainless steel used.

Centrifuges

The capacity of a centrifuge to separate solid particles from pressed fruit juice depends on the density of the juice and the requirements of the finished product. In the case of apples, the density of the juice will depend on the type of apple used, the maturity of the fruit, the methods of pressing, and whether depectinising takes place before or after the essence recovery.

Two types of centrifuge are manufactured. The first cannot be operated continuously since the machine must be stopped while the sludge which collects in the bowl is removed. In a model made by Alfa Laval the bowl can hold up to 65 litres of sludge. The time required for cleaning is about half an hour (but this need not be wasted if a spare machine is available to take over when the other one is stopped). With a capacity of 300-500 gallons of apple juice an hour this machine costs around £2,500 ex-factory.

The second type of centrifuge is self cleaning. Production is not interrupted as the cleaning only takes a fraction of a second. Therefore, this type of centrifuge is more suitable for large juice throughputs. The D.H.2 continuous solids discharge model made by Sharples has sufficient capacity for throughputs of 800 and 1,500 gallons/hour. It costs £5,500.

Alfa Laval manufactures three models of self-cleaning centrifuge. It is not certain whether the cheapest (£3,000) would be able to deal with a 300 gallon/hour throughput. The second size costing £4,500 would be big enough for 300 gallon/hour but not for 800 gallon/hour.

For 800 and 1,500 gallon/hour the largest model at £7,000 would be needed. It is likely that two of these machines would be required for a throughput of 1,500 gallons/hour.

Essence recovery plant and evaporators

A.P.V. and Kestners are the only companies which manufacture essence recovery plant and evaporators. The Alfa Laval Company, treated in the next section, only manufacture evaporators.

A.P.V.

The A.P.V. evaporation plant is in the form of a plate heat-exchanger similar to a flash pasteuriser. A separate unit is required for recovery of the esters.

The height of the evaporator is only 9 feet, but the floor space requirements are 18 feet by 27 feet. The accompanying essence recovery plant is 16 feet 6 inches in height and occupies a floor space of 16 feet by 14 feet.

*N.B. : See Chapter 7 for further discussion of storage temperatures.

Kestner

The dimensions and cost of Kestner equipment vary with the type used. Single effect evaporators are taller and require a higher steam and water consumption than multiple effect evaporators. In the multiple effect evaporators steam and water consumption is lower since vapour is re-circulated as an evaporating agent.

One advantage of Kestner equipment compared with A.P.V. equipment is that it requires less floor space. This is partly because the evaporator and essence recovery plant form one unit instead of two. The floor space needed is only 10 feet by 10 feet for a plant with a capacity of 800 gallons/hour compared with 35 feet by 40 feet for an A.P.V. plant.

A major problem is the greater height of the Kestner equipment. For a single effect evaporator the height is 40-45 feet, for a multiple effect is 30 feet. In both cases the height requirements can be reduced slightly, but two or three extra pumps would have to be installed to make up for the loss in height.

Evaporators

Alfa Laval Company

The De Laval Group has recently brought a new type of evaporator, known as a centri-therm, on to the United Kingdom market. The company claims that the juice produced is of higher quality than juice from other types of evaporator. This is due to a very high heat transfer with the result that the liquid to be treated is concentrated to the desired degree in only one second.

A complete centri-therm evaporating plant costs £10,500 and consists of:

Stand (8 ft. 6 in. by 6 ft. 3 in.).
Twin strainers for eliminating coarse particles.
Balance tank.
Feed meter.
Evaporator.
Entrainment separator.
Extraction pump for the concentrate.
Concentrate cooler.
Barometric condenser and vacuum pump.
Steamvalves including automatic regulation and safety valves.
Panel including manometers, thermometers, indicators for concentration regulator, starters, etc.

All this equipment is housed on the stand with dimensions 8 ft. 6 in. by 6 ft. 3 in. The height of the evaporator is about 12 feet (this includes the depth of the stand).

There are two drawbacks to the centri-therm evaporator. First is its high cost of £10,500 for the relatively small juice capacity of 200 gallons/hour. Second, Alfa Laval do not yet manufacture their own ester recovery equipment.

Refrigeration for storage

It has been difficult to obtain precise information about the capital cost of cool storage for apple-juice concentrate. This is because the equipment required to maintain a specific temperature depends on several variables.

For the concentrate it is necessary to know:

(a) The quantity to be cooled at a particular time.
(b) The temperature and density at which it enters the storage tank.

For the tanks:

(a) Size of tank.
(b) Type of tank.
(c) Hygienic requirements.

For the refrigeration:

(a) Whether air or water condensing unit is required.
(b) Maximum ambient temperature.
(c) Whether the tank will be steam sterilised.
(d) Electrical supply available.
(e) Size of the store.

The costings have been made on the assumption that the concentrate enters the storage tanks at a temperature of 60°F. and is cooled to and held at 35°F. The type of tank which is in general use for fruit juice is a horizontal, mild steel tank with a prodor glass lining, and has a capacity of 5,000 gallons. The dimensions of such a tank are approximately 9 feet by 14 feet.

There are two methods of keeping concentrate cool.

(a) Lagging.
(b) Refrigeration.

Lagging

The system is essentially a temperature control system and can be applied to either raise or lower temperature as desired. The method by which heat control is implemented is to attach evaporator plates to any tank or vessel in which the contents are to be cooled or heated and by passing a refrigerant or heating medium through the plates thereby obtain any required temperature.

Superimposed on the plates is a layer of insulation, suitably surfaced to exclude moisture. Layers of medium and light density insulations, each averaging two inch thickness form an efficient lagging and prevent undue heat losses.

An approximate cost from the Lancastrian Evaporator Company for 5,000 gallon tank complete with normal standard fittings and the above equipment is £2,750. This would mean a capital outlay of:

	£
Store with 5 tanks	13,350
Store with 10 tanks	27,500
Store with 20 tanks	55,000

However, it must be noted that these costs include the cost of the storage tanks as well as the refrigeration equipment.

Refrigeration

With the dimensions given above of 9 feet by 14 feet for a 5,000 tank the following size of storage room would be necessary:

Number of Tanks	Approx. dimensions of store	Capacity of store (cu. ft.)	Estimated cost £
5	15ft. x 60ft. x 12ft.	10,800	7,500
10	30ft. x 60ft. x 12ft.	21,600	11,000
20	75ft. x 48ft. x 12ft.	43,200	22,000

Capital Costs of Plant and Buildings

TABLE I

Various Capital Costs of Concentration and Storage Machinery

	300 g.p.h.	800 g.p.h.	1,500 g.p.h.
	(£)		
Clarification tanks			
A.P.V.			
Mild steel, prodorite lined	3,000 (5 x 300 galls.)	3,600 (5 x 800 galls.)	7,200 (10 x 800 galls.)
Centrifuges			
Alfa Laval			
Non-continuous	2,500	5,000	10,000
Self cleaning	3,000 or 4,500	4,500 or 7,000	7,000 or 14,000
A.P.V. (Sharples)			
Non-continuous	2,000	—	—
Self cleaning	—	6,500	7,000
Essence recovery Plant and evaporators			
A.P.V.	18,000	21,500	26,000
Kestner			
Single effect	12,000	18,000	25,000
Double effect	15,000	20,000	30,000
Essence recovery plant only			
A.P.V.	6,600	8,400	10,150
Evaporators only			
Alfa Laval	21,000	42,000	75,000
A.P.V.	11,000	13,000	15,750
Pasteurisers			
Alfa Laval	1,300	1,680	2,330
A.P.V.	1,050	1,100	1,500
Storage tanks	5,000 gallon capacity		
A.P.V.			
Mild steel lined in prodor glass		1,150 each	
Stainless steel		1,700 each	
Burnett and Rolfe			
Stainless steel		2,600 each	
Enamelled Metal Products			
Mild steel lines in prodor glass		1,600 each	
Stainless steel		2,600 each	
Refrigeration	8 tanks 10,000	20 tanks 22,000	40 tanks 40,000

TABLE II

Range of Capital Costs of Machinery

(£)

	300 gph	800 gph	1,500 gph
Pressing and milling	3,000	3,500	7,000
Clarification tanks	3,000	3,600	7,200
Centrifuge	2,000— 4,500	4,500—7,000	7,000—14,000
Essence recovery and evaporators	12,000—18,000	18,000—21,500	25,000—30,000
Pasteurisers	1,050— 1,300	1,100—1,700	1,500— 2,350
*Storage tanks (8, 20, 40 respectively)	9,200—12,000	23,000—30,000	46,000—60,000
Buffer tanks and pumps	350	350	550
Interconnecting piping	1,800	2,500	4,000
Erection and delivery	2,000	2,500	4,000
*Refrigeration (for 8, 20, 40 tanks respectively)	10,000	22,000	40,000
	44,400—55,950	81,050—94.650	138,250—169,100

* Assuming storage is required for the entire output.

Capital Allowances

Capital allowances are designed to allow as a deduction from taxable income the cost of certain classes of capital expenditure over the lifetime of the asset.

They are:—

(i) Initial allowance made when the asset is purchased.

(ii) Annual allowance given at a fixed rate over the lifetime of the asset.

(iii) Investment allowance given only on the purchase of new assets.

Rates of Allowances

(under new arrangements announced November, 1962)

	Investment Allowance (per cent)	Initial Allowance (per cent)
New machinery and plant	30	10
Used machinery and plant	—	30
Industrial buildings	15	5

The annual allowance for industrial buildings is 2 per cent of the expenditure. For machinery and plant, new or unused, the basic annual allowance will be from 1962/63, a minimum of 15 per cent.

Higher annual allowances are normally made for machinery which is used for double shift or continual shift work. However, this only applies if the machinery is used throughout the year.

The following example is worked out to show how these allowances would apply to machinery for a 300 gallon/hour plant. Table II shows that the minimum cost of this plant would be £45,000. A basic rate of 15 per cent is assumed for the calculation of the annual allowance.

Capital allowances for New Fruit Juice Machinery
(300 *gallons/hour plant*)

		£	£
	Cost		45,000
1962/63	Investment allowance 30 per cent of cost ...	13,500	
	Initial allowance 10 per cent of cost ...	4,500	
	Annual allowance, say 15 per cent of cost	6,750	
			11,250
	Written down value ...		33,750
1963/64	Annual allowance, say 15 per cent of £33,750		5,062
	Written down value ...		28,688
1964/65	Annual allowance, say 15 per cent of £28,688		4,303
	Written down value ...		24,385
1965/66	and later years, annual and/or balancing allowances		24,385

Thus for fruit juice processing machinery costing £45,000, the total allowances which can be deducted from taxable income will be:—

	£
Investment allowances	13,500
Initial allowances	4,500
Annual allowances	40,500
	58,500

Capital cost of buildings

The following are approximate areas of buildings required for the processing machinery and storage tanks.

Approximate Floor Space of Buildings

Throughout (gph)	Processing Plant (square feet)	Storage
300	2,000	1,500
800	2,250	3,750
1,500	3,000	7,500

It is difficult to give accurate estimates of the cost of buildings since costs vary widely with locality and type of construction. The cheapest factory buildings are steel framed with corrugated asbestos roofs. In these materials a 100ft. x 40ft. building costs around £7,000. To double the length to 200ft. x 40ft. would double the cost. However, the cost would be more than doubled if the width were increased to 100ft. x 80ft.

Capital Costs of Manufacture and Storage of Half-concentrates

Half-concentrates are not yet produced by fruit juice manufacturers in the United Kingdom.

The capital cost of equipment for a plant producing half-concentrates will vary from the cost of one producing full concentrates. There are three main differences in producing and storing half-concentrates:—

(i) Smaller evaporating plant is required.

(ii) The refrigeration needs will be greater.

(iii) Larger storage requirements.

Thus, in Table II, the evaporating plant required for producing full concentrate at a juice throughout of 800 gallons an hour is capable of dealing with a throughput of 1,500 gallons an hour for the production of half-concentrates. Similarly, the smaller evaporating plant for full concentrate at a throughput of 300 gallons an hour could be used for half-concentrates at a throughput of 800 gallons an hour. In each case this would mean a capital saving of around £5,000.

Costs of refrigeration equipment for storing full concentrates are £10,000, £22,000, and £40,000 respectively for the three hypothetical sizes of plant. These costs are based on the assumption that the full concentrate enters the tank at 60°F. and is cooled to and held at 35°F. It is difficult to obtain precise information about the normal temperature at which half-concentrates are held, but it should be assumed that 0°C. is desirable. In this case the refrigeration costs will be similar per unit to those for full concentrate, but of course, the number of storage units is doubled.

The Capital savings for evaporation plant would thus be much more than offset by the increased cost of doubled storage capacity and refrigeration, together with larger buildings.

Section IV—Operating Requirements and Costs

TABLE III

Summary Table of Service Requirements

	Electric Power (H.P.)	Water (gph)	Steam (lbs./hr.)
Milling and pressing (including fruit elevator) H. Beare & Sons			
300 gph	16	—	—
800 gph	20	—	—
1,500 gph	40	—	—
Centrifuging Alfa-Laval Company			
300 gph	10—15	—	—
800 gph	15—25	—	—
1,500 gph	25—50	—	—
Essence recovery and evaporators APV			
300 gph	18	3,200	1,550—1,700
800 gph	21	8,400	3,700—4,100
1,500 gph	27	16,000	7,200—7,900
Kestner (double effect)			
300 gph	12	6,000	2,500
800 gph	18	10,000	4,500
1,500 gph	25	20,000	8,000
Kestner (single effect)			
300 gph	...	10,000	4,000
800 gph	...	18,000	7,000
1,500 gph	...	30,000	12,000
Pasteurisers Alfa Laval			
300	5	600	80
800	5	1,600	200
1,500	7½	3,000	400
Refrigeration			
300	20	—	—
800	40	—	—
1,500	60—70	—	—

TABLE IV

Range of Servicing Requirements

	300 gph			800 gph			1,500 gph		
	Electricity (H.P.)	Water (gph)	Steam (lb.-hr.)	Electricity (H.P.)	Water (gph)	Steam (lb.-hr.)	Electricity (H.P.)	Water (gph)	Steam (lb.-hr.)
Milling and Pressing	16	—	—	20	—	—	40	—	—
Centrifuging	10—15	—	—	15—25	—	—	25—50	—	—
Essence recovery and evaporation	12—18	3,200—10,000	1,550—4,000	18—21	8,400—18,000	3,700—7,000	25—27	16,000—30,000	7,200—12,000
Pasteurisers	5	600	80	5	1,600	200	7½	3,000	400
Refrigeration	20			40			60—70		
	63—74	3,800—10,600	1,630—4,080	98—111	10,000—19,600	3,900—7,200	157½—194½	19,000—33,000	7,600—12,400

The following table gives approximate costs of the amounts of electricity, water and steam given in Table IV.

TABLE V

Range of Cost of Service Requirements in a 10-Week Processing Season

	5-day week 8 hours a day (£)	6-day week 24 hours a day (£)
Electricity		
300 gph	215—305	460— 540
800 gph	455—560	690— 780
1,500 gph	445—560	930—1,160
Water		
300 gph	105—265	320— 890
800 gph	320—355	690— 780
1,500 gph	455—560	930—1,160
Steam		
300 gph	245—610	760—1,910
800 gph	585—1,080	1,825—3,370
1,500 gph	1,140—1,860	3,555—5,800

Electricity

The following assumptions are made:—

(a) The full installed capacity is being used during the whole time the plant is in operation.

(b) All electricity is supplied at the winter tariff rate.

(c) An approximate conversion factor is that 1 horse power = 1 kVA or kW.

The maximum demand tariff of the Eastern Electricity Board has been used to calculate the costs. This is not the only tariff available, nor does this breakdown of charges necessarily apply to other electricity boards.

It should be noted that these figures do not include lighting or power for accessory apparatus such as conveyor belts.

Water

Costs of water have been calculated according to the supplies by measure tariff of the Metropolitan Water Board. The scale of charges operating is as follows:—

Consumption per Quarter (per 1,000 gallons)	s.	d.
Not exceeding 50,000 gallons	1	8
50,000—100,000 gallons	1	6¾
100,000—200,000 gallons	1	6
200,000—500,000 gallons	1	5½
500,000—1,000,000 gallons	1	4¾
1,000,000—3,000,000 gallons	1	4¼
3,000,000—5,000,000 gallons	1	3
Exceeding 5,000,000 gallons	1	2

Steam

The cost of steam required has been calculated from the average cost per 1,000 lb. of steam obtained in a recent sample by the National Industrial Fuel Efficiency Service. For plant using solid fuel this average was:—

82d.—94d. per 1,000 lb of steam in a single shift.

76d.—81d. per 1,000 lb. of steam for more than one shift

Direct Labour Costs

No specific agreement on wages and hours of labour in the fruit juice processing industry have been registered with the Wages Inspectorate of the Ministry of Labour.

However, there is a Wages Regulation Order setting out minimum wage rates for the manufacture of aerated waters. For this purpose aerated waters are defined as "mineral or aerated waters, cordials, syrups, unfermented sweet drinks and other similar beverages". The minimum agreed wage rates in this industry which became operative from April 29th, 1960 are as follows:—

Average Hourly Earnings in the Second Pay Week in October 1961

	General Minimum Time Rates (per week)	Piece Work Basis Time Rates (per hour)
	s. d.	s. d.
Workers, other than driver-salesmen, delivery workers, and mates:		
Men, 21 years and over	157 0	4 2½
Women, 19 years and over	111 0	2 11½

Minimum Agreed Wage Rates for Aerated Water Manufacture

It must be emphasised that these are only minimum rates, and that wages actually paid are often substantially higher. The results of the latest six monthly survey (October 1961) made by the Ministry of Labour give the following average hourly earnings in the food, drink and tobacco industries:

Food, drink and tobacco

Men (21 years and over)	Youths Boys (under 21)	Women (over 18) Full time/ Part time		Girls (under 18)
s. d.	s. d.	s. d.	s. d.	s. d.
5 11¾	3 2¾	3 8	3 6½	2 6¼
	*	*	*	

The operation of the plant after pressing the apples can be done by one person. His main function is supervisory once the machine is switched on.

A small plant, with a juice throughput of 300 gallons/hour, would require a minimum labour force of 10 or 11 people. This would allow three men for the more skilled operations and for supervision, four women for washing and sorting the apples and four labourers for unskilled labour. On this basis, the weekly wage bill based on the rates given above would be approximately £100 if the plant was operated for one 8-hour shift a day. Thus in a 10-week season the labour cost would be £1,000. If two or three shifts were worked the seasonal labour cost would be doubled or trebled accordingly.

Labour costs would not rise proportionately with the size of the processing plant. This is because most of the juice processing equipment only requires supervision. For juice throughputs greater than 300 gallons/hour additional labour is required mainly for the unskilled jobs in the preparation of the fruit for processing.

Half-Concentrates

Operating costs

It is estimated that operating costs for electricity, water and steam in a plant producing half-concentrates would probably be between 20% and 30% lower than the operating costs for a plant producing full concentrates. The bigger savings would be made on the smaller-sized plants since they do not benefit from the lower tariffs charged to larger plants. Therefore, any reductions in charges for service requirements will be made at a higher rate for a small plant than for a large one.

The differences between plant needed for half-concentrates and full-concentrates have been referred to in the section on capital costs. Less electricity, water and steam would be needed for producing half-concentrates since the evaporation plant for the same juice throughput would be smaller.

Section V—Summary

Making and storing concentrates or half concentrates requires a considerable capital outlay. But it is considerably less than the investment required if the pure juice itself is stored: in the case of full concentrates, eight times less storage and refrigeration is required, and in the case of half concentrates, four times. The Boehi (high pressure) process for juice storage is expensive and the extra costs of this process can be set against the concentration process costs.

Whether or not a juice manufacturer is prepared to stock concentrates from season to season to cover short crops, he will certainly require buffer stocks to give him continuous supplies of his product throughout the year sufficient to fill the distributive pipeline. A failure to keep the pipeline full will frustrate the best of marketing and promotional efforts.

These buffer stocks can be of juice, concentrate, half concentrate, or some of each. It may be necessary to hold some juice stock to maintain product quality. The extent to which diluted concentrate alone will provide a stable, high quality product depends on the quality of the original juice and the efficiency of the concentration and storage plant. Clearly, it will be least costly to hold as much of the buffer stock in the form of concentrate or half concentrate as possible: half concentrate is likely to reduce the problem of quality maintenance.

For these reasons, as well as the possibility of smoothing supplies from year to year, the Council decided that a detailed study of concentration and storage was necessary.

9. Conclusions

The Council's investigations as recorded in this report suggest the following conclusions:—

(i) Apple juice and blends of apple juice are *prima facie* acceptable in U.K. in comparison with existing fruit juices. No work has been done by the Council on costs of production, selling prices, and the relationship of demand to selling prices: experience abroad, however, does not suggest that there is any inherent economic problem in this respect.

(ii) The pure fruit juice market in U.K. is relatively small and is not growing at a notably high rate, although rising standards of living are likely to accelerate this in the future.

(iii) There are no unusual natural or political factors in the U.K. fruit juice market which particularly favour the development of apple juice. Although the Council's enquiries have not covered the development of an apple based soft drink (as distinct from pure juice) it is worth noting that the soft drink industry is very highly competitive even though its market is very much greater than that for pure juices.

(iv) It follows that the development of apple drinks will require large scale marketing efforts whether these are directed to the creation of a new pure juice market or to breaking into the soft drink market.

(v) For this reason it does not appear likely to the Council that the development of apple juice products could successfully be undertaken by a new and separate enterprise. It appears that the products could best be developed by businesses which already have established production and distribution facilities, and the resources to promote the products.

(vi) The Council, therefore, finds it difficult to recommend that growers or their present organisations should consider the investment of very large amounts of capital in an apple juice enterprise. Their efforts would probably be better directed to organising the supply of apples in ways appropriate to the needs of the processing industry. It is possible, of course, that growers' organisations could undertake the production of bulk juice supported by buffer stocks of concentrates, for soft drink manufacturers who would undertake marketing and promotion. The capital investment would still be considerable, however, and such an undertaking would be vulnerable since it would have no command over the ultimate market for the finished product.

(vii) The Council is satisfied that sufficient fruit of suitable varieties and quality is available in total for the production of all the output that is likely to be required during the next few years of apple juice development. However, it recommends that appropriate growers' bodies, both national and local, should carefully consider the possibilities of organised supply of apples (or juice or concentrate), and should be prepared to consult with processors on behalf of their members. Such consultation should, of course, have regard to the provisions of the Restrictive Practices legislation. The importance of supplying fruit above a minimum quality is emphasised: culls will not be suitable and the specification at the beginning of Chapter 6 should be regarded as an indication of the minimum quality required.

(viii) In examining experience abroad, and the supply position, the Council noted that a fully developed large scale apple juice industry could probably not be sustained merely on varying surpluses of dessert and cooking variety apples, and that the cultivation on contract of special varieties might be necessary. This is a longer term consideration which would become increasingly important with the growth of the apple juice market.

(ix) Seasonal supply fluctuations could be dealt with in several ways, but most obviously by the installation of concentration and storage plant by processors, or by the import of concentrates by processors. The latter will be discouraged if growers and their organisations are prepared to contract for at least basic supplies at reasonable prices, covering seasons of short production as well as over production. While it can be expected that processors may be prepared to install sufficient concentration and storage plant to provide buffer stocks, it is unlikely that they will invest in extra capacity solely in order that growers can enjoy the additional demand from an additional outlet in years of over production, while they themselves go short in other years. The temptation to processors will be rather to import concentrates and aromas.

The Council considers that the prospects of a growing apple juice industry are bright in the longer run. But it would be misleading to suppose that sudden development of apple juice will overnight transform the marketing of apples by removing surpluses with profit to the grower. Growth will take place if the marketing effort is made, and benefit will accrue to growers if they are prepared to match the needs of the manufacturer and thus the consumer. The dominant factor is the demand for apple juice and its responsiveness to promotion and marketing, and not the simple existence of surplus apples.

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STRUCTURE OF ORIGINALLY CONTACTED SAMPLE

Base: All in survey

	TOTAL
Base:	(1435)
	%
AGE OF HOUSEWIFE:	
16-34 years	31
35-44 years	38
45+	31
	100
FAMILY COMPOSITION:	
With children under 16	66
No children	34
	100
SOCIAL GRADE:	
AB	5
C1	22
C2	73
	100
AREA:	
London	30
Birmingham	35
Manchester	35
REFRIGERATOR:	
With refrigerator	27
Without refrigerator	73
	100
PRODUCT(S) PLACED:	
Apricot	15
Raspberry	15
Pineapple	15
Carbonated apple	15
*Opalescent apple	10
Council Orange/Trout Hall Orange	14
Apple and Orange/Trout Hall Orange	16
	100

*The number of placements of Opalescent Apple was fewer than that of other blends. This was due to the fact that a number of questionnaires had to be withdrawn at a later stage due to unsatisfactory interviewing.

STRUCTURE OF SUCCESSFULLY RE-CONTACTED SAMPLE

Base: All households where fruit juices tried

	TOTAL
Base:	(1320)
	%
AGE OF HOUSEWIFE:	
16-34 years	32
35-44 years	37
45+	31
	100
FAMILY COMPOSITION:	
With children under 16	67
No children	33
	100
SOCIAL GRADE:	
AB	4
C1	22
C2	74
	100
AREA:	
London	30
Birmingham	35
Manchester	35
	100
REFRIGERATOR:	
With refrigerator	27
Without refrigerator	73
	100
PRODUCT(S) PLACED:	
Apricot	15
Raspberry	15
Pineapple	15
Carbonated apple	16
Opalescent apple	10
Company Orange/Trout Hall Orange	13
Apple and Orange/Trout Hall Orange	16
	100

ACCEPTABILITY RATING OF FRUIT JUICES

Table A

A.Q.5. These boxes are a scale. This box means that you think it is the best possible, and this
B.Q.6. one that you think it is the worst possible. Would you tell me how you would rate (....) by putting a tick in one of the boxes?

Base: All households where fruit juice(s) tried

BY FRUIT JUICE TRIED

Base:		Arbitrary Numerical Value	Apricot (202) %	Raspberry (191) %	Pineapple (200) %	Carbonated Apple (212) %	Opalescent Apple (133) %	Council Orange (194) %	Apple and Orange (187) %	Trout Hall Orange (381) %
The best possible	[ ]	+ 4	38	19	32	34	22	27	32	22
	[ ]	+ 3	16	19	17	16	12	9	16	16
	[ ]	+ 2	18	21	17	17	21	11	13	12
	[ ]	+ 1	8	9	8	6	8	8	10	8
Neither good nor bad	[ ]	0	12	12	15	19	28	26	16	19
	[ ]	− 1	5	6	5	2	5	4	3	7
	[ ]	− 2	2	6	2	1	3	4	4	3
	[ ]	− 3	1	5	2	2	1	3	1	2
The worst possible	[ ]	− 4	*	3	2	2	—	6	1	8
Don't know	[ ]	0	—	—	—	1	—	2	4	3
			100	100	100	100	100	100	100	100
Mean acceptability rating:			+ 2.27	+ 1.4	+ 2.02	+ 2.04	+ 1.6	+ 1.24	+ 2.04	+ 1.18

* Denotes less than 0.5%

SCALE RATING OF FRUIT JUICES

Table B

A.Q.5. These boxes are a scale. This box means that you think it is the best possible, and this
B.Q.6. one that you think it is the worst possible. And here's the middle point. Would you tell me how you would rate (.....) by putting a tick in one of the boxes?

Base: All households where fruit juice(s) tried

BY FRUIT JUICE TRIED

Base:	Apricot (202)	Raspberry (191)	Pineapple (200)	Carbonated Apple (212)	Opalescent Apple (133)	Council Orange (194)	Apple and Orange (187)	Trout Hall Orange (381)
				MEAN RATINGS				
Total mean acceptability rating	+2.27	+1.4	+2.02	+2.04	+1.6	+1.24	+2.04	+1.18
CHILLING								
Those chilling fruit juice	+2.19	+1.98	+2.32	+1.9	+1.36	+1.77	+1.97	+1.22
Those *not* chilling fruit juice	+2.29	+1.2	+1.93	+2.1	+1.72	+1.14	+2.14	+1.17
AGE OF INFORMANT								
16-34 years	+2.46	+0.98	+2.07	+2.19	+1.43	+1.55	+1.92	+1.17
35-44 years	+2.11	+1.65	+2.08	+1.82	+1.87	+1.42	+2.04	+1.05
45 years and over	+2.25	+1.45	+1.85	+2.16	+1.77	+0.67	+2.14	+1.36
FAMILY COMPOSITION								
Households with children	+2.44	+1.5	+2.01	+2.03	+1.74	+1.6	+1.91	+1.05
Households without children	+1.89	+1.22	+2.02	+2.07	+1.3	+0.48	+2.31	+1.47
SOCIAL GRADE								
ABC1	+2.14	+1.58	+1.9	+2.01	+1.18	+0.95	+2.26	+1.57
C2	+2.32	+1.33	+2.05	+2.06	+1.75	+1.31	+1.99	+1.11

REASONS FOR CLAIMED COMPARISON WITH SOFT DRINK LAST BOUGHT

Table C

A.Q.4. How did this fruit juice compare with (soft drink last bought)?
B.Q.7. How did Orange I/Apple and Orange compare with (soft drink last bought)?
Base: All households where fruit juice(s) tried

BY FRUIT JUICE TRIED

Base:	Apricot (202) %	Raspberry (191) %	Pineapple (200) %	Carbonated Apple (212) %	Opalescent Apple (133) %	Council Orange (194) %	Apple and Orange (187) %
FAVOURABLE:							
Fruitier/real fruit flavour	7	11	4	5	6	4	4
More flavour/tastier/richer	6	6	5	5	3	2	2
Refreshing/thirst quenching	4	—	3	6	2	1	3
Better taste, flavour (unspec.)	3	3	3	2	1	3	—
Different, unusual taste	1	2	6	1	1	—	1
Not so fizzy, gassy	2	—	1	4	2	5	2
Not so sharp/sweeter	3	2	2	1	2	4	2
Sharper/not so sweet	2	2	1	2	—	1	1
Better/prefer (unspec.)	11	11	22	23	17	15	32
Miscellaneous favourable reasons	2	4	3	2	2	1	1
Sub-total: Those comparing fruit juice favourably	41	38	47	47	33	34	46
UNFAVOURABLE:							
Prefer Orange flavour	4	3	2	9	8	—	—
Not so refreshing, thirst-quenching	8	6	2	—	4	1	1
Too sweet/sickly	5	6	2	1	3	1	—
Not so sweet/not sweet enough	3	1	1	5	4	3	2
Less taste, flavour/watery	*	3	2	—	8	2	1
Worse flavour (unspec.)	2	3	1	2	—	2	—
Not so fizzy/not gassy	*	3	—	*	3	1	1
Not as good as (unspec.)	9	12	15	15	17	26	21
Miscellaneous unfavourable reasons	8	2	3	4	3	6	2
Sub-total: Those comparing fruit juice unfavourably	34	38	26	33	48	37	25
About the same	14	22	18	14	14	15	16
Don't know/no information	11	2	9	6	5	14	13
	100	100	100	100	100	100	100

* Denotes less than 0.5%

THINGS SPECIALLY LIKED ABOUT FRUIT JUICES

Table D

A.Q.3a. What, if anything, was specially liked about the fruit juice?
B.Q.4a. Was there anything specially liked about Orange I/Apple and Orange?
B.Q.4b. Was there anything specially liked about Orange II?
Base: All households where fruit juice(s) tried

BY FRUIT JUICE TRIED

Base:	Apricot (202) %	Raspberry (191) %	Pineapple (200) %	Carbonated Apple (212) %	Opalescent Apple (133) %	Council Orange (194) %	Apple and Orange (187) %	Trout Hall Orange (381) %
Refreshing/thirst quenching	14	6	15	22	11	5	10	6
Fruity taste/real fruit flavour	12	20	9	3	8	3	3	3
Tasted of apples	2	—	1	23	21	1	7	—
Tasted of apricot	28	—	—	—	—	—	—	—
Real orange taste	—	—	—	—	—	11	1	14
Tart/sharp/tangy	4	2	9	6	6	4	3	5
Not sickly/not too sweet	10	4	8	2	2	2	—	2
Sweet	6	4	4	6	4	12	6	2
Tasted of pineapple, grapefruit	1	—	18	*	—	4	2	—
Not too sweet and not too sour	3	2	3	4	2	—	—	—
Tasted like cider, Babycham	—	—	1	10	2	—	—	—
Strong flavour	3	5	3	*	—	1	1	3
Not gassy/not too fizzy	2	1	2	3	2	—	—	—
Unusual, new flavour	4	2	1	1	2	1	7	—
Not acid, sharp, bitter	1	1	3	3	1	2	2	*
Tasted of raspberry	—	7	—	—	—	—	—	—
Fizzy/sparkling	—	—	—	3	1	—	—	—
Liked taste, flavour (unspec.)	10	19	19	13	9	7	18	10
Miscellaneous likes	14	9	7	7	6	6	7	4
Sub-total: Those mentioning something liked	86	74	78	79	63	52	59	46
Not mentioning anything specially liked	14	26	22	21	37	48	41	54
	100	100	100	100	100	100	100	100

* Denotes less than 0.5%

THINGS SPECIALLY DISLIKED ABOUT FRUIT JUICES

Table E

A.Q.3b. And what, if anything, was specially *disliked* about the fruit juice?
B.Q.5a. Was there anything specially *disliked* about Orange I/Apple and Orange?
B.Q.5b. Was there anything specially *disliked* about Orange II?
Base: All households where fruit juice(s) tried

BY FRUIT JUICE TRIED

Base:	Apricot (202) %	Raspberry (191) %	Pineapple (200) %	Carbonated Apple (212) %	Opalescent Apple (133) %	Council Orange (194) %	Apple and Orange (187) %	Trout Hall Orange (381) %
Too sweet/sickly	10	18	7	6	10	6	5	4
Too acid, sour, bitter	7	5	9	12	13	6	9	22
Not sweet enough	6	3	2	8	5	2	3	3
Weak/insipid/tasteless	*	9	4	1	13	16	1	2
Too thick, rich, syrupy	6	5	6	1	5	—	—	2
Tasted of apples	—	—	6	1	5	—	—	—
Tasted like cider	—	—	—	8	1	—	—	—
Tinny taste	1	3	4	*	2	3	2	3
Grapefruit taste	—	—	—	—	—	6	2	3
Not refreshing, thirst quenching	2	1	2	1	1	—	—	—
Dislike apricot/raspberry/pineapple	4	1	1	—	—	—	—	—
Leaves after taste	*	1	2	1	2	1	1	1
Not fizzy/too flat	1	1	1	1	3	—	—	—
Too fizzy	—	—	—	5	—	—	—	—
Don't like canned drinks	1	1	—	2	1	—	—	—
Too strong	1	2	1	1	—	1	3	7
Can't drink much of it	1	1	1	1	1	—	—	—
Dislike mixture/blend	—	—	—	—	—	—	4	—
Not a real orange taste	—	—	—	—	—	4	—	*
Miscellaneous dislikes	2	7	3	10	8	11	6	9
	—	—	—	—	—	—	—	—
Sub-total: Those mentioning something specially disliked	39	51	39	52	59	45	34	47
Not mentioning anything specially disliked	61	49	61	48	41	55	66	53
	100	100	100	100	100	100	100	100

* Denotes less than 0.5%

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