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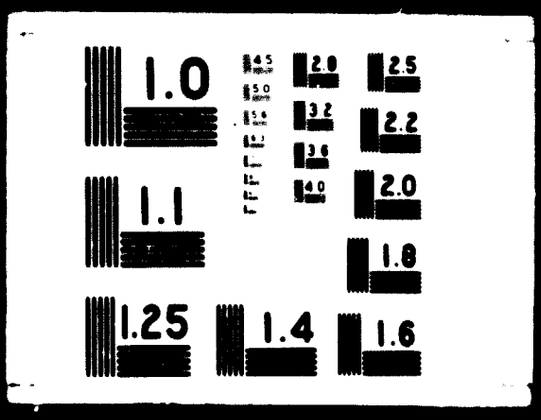

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Expert group meeting on processing
selected tropical fruits and vegetables
for export to premium markets

Salvador, Bahia, Brasil, 25 - 29 October 1971

INDUSTRIAL AND MARKETING ORGANIZATION STANDARDS [1] AND QUALITY CONTROL OF CITRUS FRUIT

by

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Technion - Israel Institute of Technology
Haifa, Israel

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SUMMARY

INDUSTRIAL AND MARKETING ORGANIZATION STANDARDS AND QUALITY CONTROL OF CITRUS FRUIT

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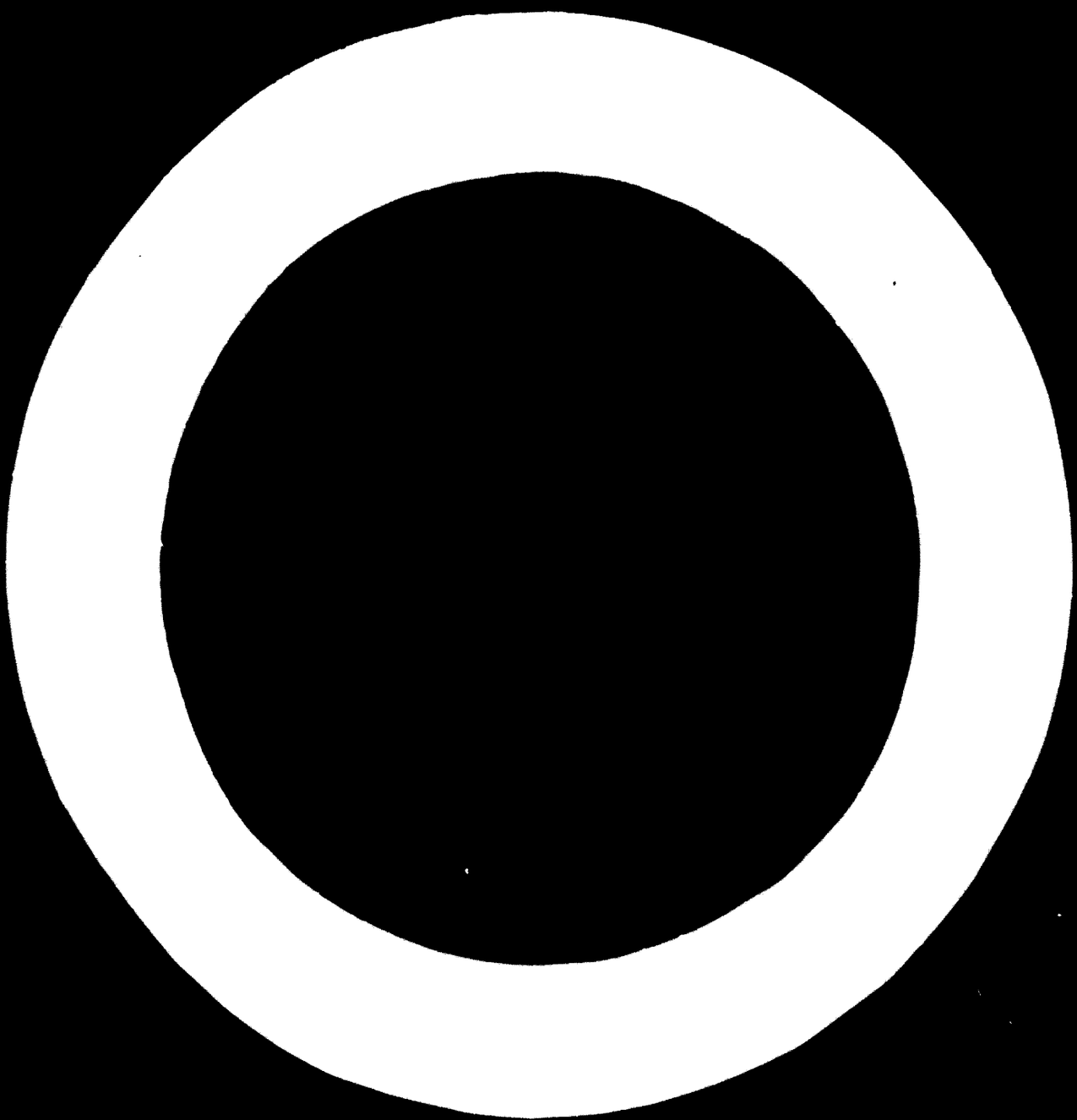
Citrus fruit and industrial citrus products could become one of the principal sources of income in many developing countries of the subtropical regions. The advantages of citrus over other fruit varieties are: adaptability to a wide range of climatic and soil conditions, a steadily increasing world demand for fresh fruit and for by-products, the existence of an advanced technology and the availability of a usually stable local market. The main problems are the need for relatively high capital investment and high level of organization.

Citrus marketing operations may be based on the sale of fresh fruit alone, on industrial processing of the entire crop or on a combination of these two approaches. The last system offers the highest flexibility and in many cases the highest return to the grower.

In planning a commercial citrus processing operation, the most important step is the establishment of a system (contracts, partnership with growers, collective bargaining, etc.) which will secure a reliable supply of raw-materials. The next stage is the development of a production schedule and marketing policy. Citrus products may be intended for direct consumer use or for industrial reprocessing. The two outlets differ in their demands. Each offer specific advantages and present specific problems. Uniformity of product is a prerequisite in both cases. It can be secured by adapting the production schedule to the seasonal variations in fruit composition and be regorous quality control. The governments should take an active part in the maintenance of standards in exports.

The development of a new citrus processing industry should be a gradual process, starting with "pilot" plantations for the selection of the varieties, in view of their adaptability to the local conditions and their suitability for processing. The initial outlet for the fruit should be the local fresh market. The stage of industrial processing should start only when the agricultural results are fully satisfactory.

Co-operation between citrus processing industries both at the national and international levels is highly desirable.



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INTRODUCTION

A... is a charming little town in tropical South America, situated in the centre of a region known for the good quality of its oranges. There are no established statistics on the cultivated area, the number of trees, or tonnage produced, but a short visit to the town plaza on a market day is sufficient to give an idea of the region's agricultural wealth, especially in citrus fruit. The growers, most of whom possess not more than a few hundred trees, bring in the crop to the market, packed in huge burlap bags, laden on mules. Traders and middlemen from the nearby capital are also there with their trucks, ready to buy. Since there is no co-operative system, each grower bargains individually. In the season, one bag weighing 60 kilos would fetch US$ 1 in the morning of the market day, but towards noon, as more fruit is brought to the market and demand declines, any offer above 50 cents is considered a personal favour.

On the fruit stands and in the supermarkets of the modern capital only 50 km. away, the situation is quite different. The effect of bad handling and poor storage conditions are evident from the appearance of the bruised, partially rotten fruit. The price tag indicates a twentyfold market price "margin".

In A..., the growers are unhappy. During the high season, their income does not cover the cost of picking and transportation of the fruit to the market. So half the crop is left on the trees. The lack of interest in expansion or improvement is understandable. The fact that citriculture still survives in A... at all is merely due to the traditional inertia of the farmers and especially to the favourable natural conditions. In many other regions the trees have been cut down or abandoned.

Yet, citriculture has several characteristic advantages which could make this industry one of the most important economic factors in many developing countries:

(a) It is customary to consider as the natural habitat of citrus species the so-called "citrus belt", extending from latitude 35° north to latitude 35° south. Given adequate conditions of moisture and soil, commercial species of citrus can be cultivated everywhere within these wide limits. It so happens that almost all of the world's "developing" areas are also situated within the same limits;

(b) Unlike many "exotic" tropical fruits, citrus is well-known and well accepted in the world markets. According to Chorin (1966) if the per capita consumption of citrus in 1930 is taken as 100, the index in 1963 was as follows:

U.S.A.	380
Mediterranean Area	150
Great Britain	150
Common Market Countries	300
Scandinavia	550

Between 1960 and 1964 the import of citrus juices to western continental Europe increased from 120,000 to 175,000 tons.

(c) A sound and advanced technology exists for the conversion of citrus fruit to accepted industrial products of high quality. In this respect, citrus fruit occupies a privileged position denied to many other tropical and sub-tropical fruits such as the banana and avocado.

(d) In the citrus-growing countries themselves there is a good local market which provides the back-bone for any large-scale operation. This market is based on the extensive use of citrus fruit in the local diet, either as fresh eating fruit or as juices, drinks and preserves. It should be pointed out that some fruits, such as the sweet banana, do not always enjoy a good "image" as foods among the population of their natural habitat.

It appears from the aforesaid that a serious gap exists between the actual level of exploitation of citriculture and the potential resources which could be offered by this industry to the economics of many countries. We shall devote the rest of our discussion to the analysis of the factors which are essential to close this gap.

I. MARKETING STRATEGY

For all practical purposes it is convenient to classify the citrus marketing systems into three categories: those based on the sale of fruit for fresh, table use; those depending on industrial processing of the fruit; and those making use of both outlets. The selection of a marketing system affects all the aspects of production, from agriculture to technology and quality control.

1. Fresh market oriented systems

In most cases the fresh market provides the highest income per ton of fruit, at the lowest level of capital investment. Fresh market oriented systems are mainly limited to countries where the fruit is intended for local consumption. The system can be successful only as long as the demand is very large and not too discriminating with regard to quality. The grower has no protection against fluctuations in the supply-demand balance, no guaranteed minimum income, no alternative outlet for the fruit which cannot be absorbed by the market at a given time for one reason or another.

Obviously, this system becomes even less adequate when export of fresh fruit is contemplated. The strict quality standards for exported fruit can be met only by means of rigorous selection. Thus, considerable quantities of fruit are rejected, not being of exportable quality. The lack of a reliable outlet for the fruit rejected strongly affects the profitability of the operation.

When considering the export of fresh fruit, one should bear in mind that citrus fruit is seldom sold profitably on an FOB basis. Not only selection and packaging, but also proper transportation to the importing country and pre-sales storage are often under the responsibility of the seller. Under such conditions the marketing of fresh citrus fruit becomes an operation no less organization-sensitive and investment-demanding than the other systems described below.

2. Industry oriented

The most successful representation of this system is the citrus industry of Florida. The entire crop produced is sold to factories for processing. This

method is also applied in Australia, Brazil, Cuba, Panama, South Africa and the West Indies.

The advantages of the system are considerable. The industry enjoys the convenience of reliable raw-material supplies, preditable quality and stable prices. The grower is relieved of the worries associated with marketing. The cost of growing, picking and handling of industrial grade fruit is lower. Often higher yielding varieties can be planted.

However, this rigid partnership between industry and agriculture does not necessarily lead to maximum profitability. The industry cannot afford to pay the premium price offered for good fruit on the fresh market. The system is successful in Florida, only because a protected internal market for frozen concentrated juice exists in the USA. Obviously, the system can also succeed where the cost of fruit production is unusually low, as a result of high yields, favourable natural conditions and availability of low-cost labour.

3. Mixed systems

Citrus marketing operations serving, at the same time, the fresh market and the processing industry are the most flexible ones. Obviously, many variations of this system are possible, depending on the relative importance of the two outlets. For example, in Israel, emphasis is put on marketing as much of the crop as possible as fresh fruit, and processing only the rejects. Obviously, this system has some disadvantages. The varieties of citrus most suitable for the fresh market are not necessarily the best fruit for processing. For example, the Jaffa or Shamuti orange of Israel, while enjoying an excellent reputation as a table fruit, has some disadvantage as a raw material for the juice industry. The yield of juice is lower and the colour of its juice is too pale. Furthermore, the proportion of rejects in the process of selection fluctuates within wide limits, following climatic conditions and marketing strategy.

Putting more emphasis on the fresh market and considering the industry as "insurance" is perhaps sound policy. But the industry should also be "insured" against failure, by establishing minimum and maximum limits of supply and reserving some of the plantations for industrial varieties capable of correcting the shortcomings of the harvests, by blending. An optimal point of operation can surely be found under such a system.

II. SPECIFIC PRODUCTS

In this section the marketing characteristics of the principal citrus products will be discussed.

A. Single strength juices

In the international market, this commodity is usually sold as "hot pack" (pasteurized) juice, packed in cans for direct consumer use. Smaller quantities of bottled juice are also traded. Orange juice is the main representative of the group and until three years ago its share in the market had been increasing steadily. However, recently, demand for grapefruit juice has increased at a faster rate. Most exporting countries build up their sales around orange juice. A few countries specialize in other juices. Thus, Trinidad exports mainly grapefruit juice, while lemon juice constitutes a major part of Italy's juice exports. The bulk of single strength citrus juices are sold unsweetened. There is some demand for grapefruit or orange juice, sweetened with sugar to 13 - 14°Bx. Although the product has only limited demand, its importance to the juice manufacturer in many countries is significant. Early season fruit, which is not yet sufficiently mature for natural juice may be quite suitable for the production of sweetered juice. Thus, substantial orders for sweetened juice enable the industry to extend the season by a few weeks.

Technologically, single strength juices are the simplest industrial citrus products. Their production does not require much skill or high capital investment. Production lends itself to small scale, localized operations. Where labour is very inexpensive, the automatic juice extractor can be replaced by hand reaming, thus reducing further the requirements for capital investment. In many cases, plants with inputs as low as 2 - 4,000 tons of fruit per year have proved profitable. However, the smallest automatic line would require an input of 4 - 5 tons per hour.

On the other hand, the production of good single strength juice is extremely sensitive to the characteristics of the raw material. Since the product is "natural" it reflects exactly the composition of the fruit. The soluble solids content must be at least 11°Bx both for orange and grapefruit. In the case of orange, the Brix/Acidity ratio should be between 14 and 18. Many "native" varieties of oranges and grapefruit grown as fresh fruit in Tropical South America would not be suitable as raw materials for the production of single strength juice on account of too low soluble solids content at all stages of maturity.

Deep colour is desirable but not essential. Sedimentation is objectionable in bottled juices but not so much in canned products, as long as a stable cloudiness is retained.

The most important quality factor in single strength juices is taste. The taste should be "clean" i.e. free of cooked taste, excessive bitterness and too much peel oil. Bitterness is a serious defect in orange juice. Some fruit varieties such as Navel oranges are excluded on account of juice bitterness. Obviously, the use of damaged oranges, including fruit which has suffered from frost, should be avoided, to prevent bitterness. Bitterness is of course a natural component of grapefruit juice, caused by the presence of the bioflavonoid naringin. However, too much of it is undesirable. The possibility of debittering grapefruit juice by means of the enzyme naringinase has been investigated.

For the local market, citrus juice can be packed in plastic lined carton boxes similar to those used for milk. Usually these products are preserved with sodium benzoate (500 - 1000 parts per million, where permissable) and marketed under refrigeration. Given a well-organized marketing chain (usually superimposed on dairy distribution systems), this product can be extremely successful. This outlet can constitute a logical start for many citrus processing operations envisaging export at a later stage.

B. **Concentrated juices**

Frozen, concentrated juice is by far the most important citrus product in the USA. In Europe, the major part of all processed juice is traded in concentrated form. The rate of growth has been more rapid for concentrated juices than for single strength products. The reasons for this trend are various:

(a) The costs of packaging, transportation and storage are extremely high in the case of single strength juices. In fact, less than 30 per cent of the price paid by the consumer in Europe may present the actual value of the juice. These cost items are reduced considerably in the case of "hot-pack" concentrates. The difference in transportation cost is especially significant in the case of producing countries situated far away from the markets and in those where internal transportation is a problem (long distances or bad roads).

(b) Despite strong promotional activities towards the increased consumption of "natural" juices, the shift from natural juices to "soft drinks" is continuing. Natural citrus juice is not only expensive, but its value as a thirst quenching

drink is limited as compared to other carbonated or non-carbonated soft beverages. The tremendous commercial success of "flavoured water" has created a demand for concentrates, which can be used in order to impart to such diluted drinks the flavour and appearance of citrus juice.

(c) In many cases, fruit which would be suitable for the production of single strength juice (see previous paragraph) may yield acceptable or even superior concentrates.

The technology of concentrate production is, of course, more complicated. The heart of the process is the step of concentration, but each one of the processing operations affects the quality of the product considerably. For example, the pressure applied to the fruit during juice extraction has a strong effect on the viscosity of the product. The control of pulp particle size and pulp volume is extremely important. This is carried out by means of sophisticated screening and centrifugal techniques. The importance of the pasteurization step in connection with cloudiness, cloud stability and resistance to gelification is well known.

Concentration is still carried out by vacuum evaporation. The industrial implementation of alternative methods of concentration (freeze concentration, reverse osmosis etc.) has been very slow. On the other hand, development in the field of evaporative concentration has been extremely active. The evaporator itself has undergone important changes. The centrifugal evaporator, permitting ultra-short retention time is finding increasing application in the field of citrus juices. Essence recovery systems which have been applied to many other fruits with considerable success, have not been altogether satisfactory for citrus juices. However, remarkable progress has been achieved in the last few years and a technical breakthrough may be expected soon. In fact a number of well-known evaporator manufacturers now offer complete evaporator systems which also include essence recovery.

From the point of view of marketing targets the concentrates may be divided into two groups:

(i) <u>"Juice concentrates"</u>

These are simply juices which have been concentrated by evaporation. They may be flavoured with a small amount of unconcentrated juice (cutback), with recovered citrus essence or with a limited amount of citrus peel oil. When diluted with the proper amount of water, these products are supposed to yield a beverage presenting the characteristics of the original juice.

The concentrates may be preserved by freezing, pasteurization or with chemical additives. Chemically preserved concentrates have almost disappeared from the international market. Frozen concentrates may be packed in small cans for retailing or in 200 kg barrels for industrial use. The quantity of frozen concentrates in retail packages sold on the international market is very small, due to the reluctance of customers outside the USA and Canada to use this commodity. Frozen concentrates in barrels are used for institutional consumption or in industry, for the manufacture of reconstituted juice. Considerable quantities of frozen concentrates are packed also in polyethylene bags. This product is intended mainly for industrial use in internal markets.

Pasteurized concentrates are packed in large cans containing 3 - 5 kg each. With the development of aseptic filling methods for large containers, we may expect to see soon on the market, non-frozen, pasteurized concentrate in barrels. To prevent browning, heat-treated concentrates should be stored and transported under refrigeration.

(ii) "Special concentrates":

This is a trade name recently coined to products that were called "bases" until a few years ago. These are custom-made mixtures for the manufacture of soft drinks. They contain concentrated juice, finely comminuted fruit or special fractions of fruit, sugar and citric acid. They are heavily flavoured with natural or artificial aromas. They may also contain natural or artificial colorants. Generally these products are stabilized in order to improve cloud stability and prevent sedimentation in the concentrate as well as in the diluted drink. There is no legal definition for these products, which are developed according to the customer's specifications. Obviously, these products rely on high level technology more than the quality of the raw materials.

C. Fruit segments

Canned segments of grapefruit and mandarin oranges are well-known products. Grapefruit segments are consumed as a fruit compote and compete directly with other canned fruit such as pineapple and peaches. Mandarin segments are mainly used for decoration and as a component of fruit salads.

The manufacture of both products involves the process of peeling, which is extremely labour-consuming. Many developing countries, anxious to engage in labour-intensive industries, have been attracted by this feature. The market is good and

can be expanded by the introduction of chilled and frozen segments and diversified products such as combinations of two or more varieties. The international trade of canned mandarin segments is dominated by Japan, which exports over 80,000 tons of this product annually. However, other countries in the Mediterranean area and in South America have now started to grow mandarin varieties suitable for canning. The presence of these newcomers may be felt in the market in the near future.

Part of the work involved in peeling, segmentation and removal of the membranes may be done by automatic machines. Recently a number of equipment manufacturing companies have developed automatic machines to cover the entire operation. It may be expected that this development, if successful, will have a profound influence on the economics of the canned citrus segments industry.

D. Utilization of citrus peels

Most prospective citrus processors include in their projects ambitious plans for the utilization of citrus waste. However, economic studies often reveal, that, for plants having an input of less than 20,000 tons per year, the best solution is to sell the peels as fresh animal feed without further processing. Conversion of the peels to dry feed is justifiable only for larger plants or when the disposal of fresh peels is difficult.

The quantity of citrus peels absorbed by the pectin industry is insignificant. At present there is excess production capacity for pectin. An interesting development is the discovery of artificial sweeteners based on specific citrus flavonoids. If these sweeteners are approved for use in foods, new markets may be created for citrus flavonoids, by-products isolated from citrus peels.

At any rate, the profitable utilization, or at least the costless disposal of peels, is an important economic factor in the citrus processing industry. In the case of most citrus varieties, the peels constitute at least 50 per cent of the weight of the fruit.

III SPECIAL PROBLEMS IN THE EXPORTATION OF CITRUS PRODUCTS

A. Consumer goods U.S. industrial products

The problems connected with the exportation of citrus products vary according to the type of market envisaged. The technology itself is also affected by the type of market. Some citrus products, such as single strength juices, canned segments and some frozen concentrates, reach the consumer without further processing. Although the wholesale importer has specified the quality standards, the package and the label, the future of the product on that particular market is determined ultimately by the consumers themselves. Since the label generally identifies the producer or at least the country of origin, the performance of one product affects considerably the success of others from the same source. Generally, the volume of sales is not sufficiently large to permit expensive promotional operations. The product must "sell itself". For the same reasons, it is almost impossible for a single exporter to introduce into a foreign market a new product for direct consumer consumption.

The same difficulties exist, although to a much lesser extent, in products sold in large units, for institutional use (schools, hotels, hospitals).

At first sight the case of products for industrial use seems to be less problematic. The product is reprocessed, diluted, or mixed with other substances, before it reaches the consumers. It may gain or lose in the process of reconditioning and re-packaging, but the source can no longer be recognized by the consumer. One has to deal with a small number of buyers who can express their requests in terms of precise specifications. However, the industrial market requires a special kind of salesmanship. In order to maintain the uniformity of their products, the industrial buyers set their standards within very narrow tolerance limits. The products are usually more sophisticated. They are supposed to perform well in the reprocessed beverage or food. Competition is difficult. In short, an agressive marketing organisation and much experience are needed in order to succeed in the field.

B. Uniformity

Citrus products are sensitive to variations in raw material and processing conditions more than most processed agricultural commodities. Yet uniformity of quality is an essential requisite in any export. How can the variability of raw

materials be reconciliated with the condition of product uniformity? First of all, a rigorous system of quality control is required. This will be discussed later. Another solution to the problem is to establish and maintain a production program covering a wide spectrum of different products.

C. Quality control

Quality control starts with a well-planned survey of the condition of the fruit. Several methods have been developed for sampling the fruit at the entrance to the storage bins. Acidity and soluble solids determinations as well as measurements of the juice yield are usually reliable and sufficient tests for evaluating the suitability of the fruit for the manufacture of juices and concentrates. It is more difficult to predict the performance of fruit for canned segments.

In-production quality control and process control are interconnected. The operation of the juice extractors should be tested frequently through determination of factors such as juice yield, pulp content and bitterness. All the steps involving heat treatment should be equipped with automatic temperature controller-recorders. Maintenance of the highest sanitary standards is essential. Sanitary control is not limited to the overall visible cleanliness of the plant, equipment and workers, but includes frequent bacteriological checks on the fruit, different product streams, contact surfaces and effluents.

Packaging materials and especially cans should be tested as to their suitability to the task assigned to them. The tests are quite specific and require considerable skill. This point will be discussed in more detail.

The operation of filling machines should be tested frequently, as the net weight of contents is one of the important factors of acceptance or rejection. As in all canning operations, the seaming machines should be kept under constant check by the laboratory.

Finally, special attention should be paid to the labelling operation to ensure that the labels are properly positioned and firmly glued.

The third and probably most important step in quality control is the examination of the finished product. For the purpose of inspection, it is customary to divide the production into lots of convenient sizes. If the plant output is not very big and variations in raw materials are not too frequent, the production of

one day may be considered as a lot. A sample, the size of which depends on the size of the lot and nature of the product, is taken at random. The containers are inspected as to their external appearance, labelling, presence of rust, scale or dirt. Next, the net weight and the pressure inside the containers are determined. Then the containers are opened and the appropriate physico-chemical tests are carried out on the contents. The empty cans are inspected for corrosion, stains or extensive feathering. It is important to train a number of individuals as an organoleptic test panel and to submit the products for their evaluation.

The inspection of canned segments is especially difficult, for two reasons. Because of the extensive hand labour involved, each container is a production entity by itself, while a can of juice can be considered as a portion of a much larger homogenous sample, say a tankful of the same juice. Therefore much wider variability in quality parameters may be expected in the case of segments. For the same reason a larger number of containers have to be inspected in order to determine the acceptability of a given lot. The second source of difficulty is connected with the tests themselves. Many of the quality factors in processed citrus segments cannot be determined satisfactorily by means of objective tests. Thus the examination of this product requires much stronger emphasis on organoleptic evaluations.

The basis for acceptance or rejection may be an official standard of quality or a specification sheet provided by the buyer. Official standards exist for most conventional citrus products. Sometimes these standards also permit the grading of the products according to their quality. Buyer's specifications are extremely useful in the case of citrus products for industrial reprocessing while commodities for direct retail marketing rely mostly on official standards of quality and/or identification.

D. The problem of adulteration

The chemical complexity and variability of citrus fruit on one hand, and the high cost of raw materials on the other hand may encourage some producers to practice adulteration. The fact that quality control laboratories both in the exporting and the importing countries are engaged more in the detection of adulteration than in organoleptic evaluation is not a secret. The basic assumption is that citrus juice can be diluted with water to some extent and that this dilution cannot be detected, provided that it is also counter-balanced by

the judicious correction of composition through admixture of sugars, citric acid, mineral salts, etc. Unfortunately, this assumption is still true, although recent analytical techniques and better knowledge of the chemistry of citrus fruit, have lowered the "safe" limit of dilution considerably.

Today, against the competition of inexpensive soft drinks, fruit juices have only their "purity" to rely upon. An "orangeade" may be more refreshing or even tastier than pure orange juice. It is certainly less expensive. The consumer who still prefers to buy juice does so simply because he wants a "pure natural product". He will lose interest in the more expensive product, if he realizes that this later may also be a "fabricated drink". Thus, adulteration, be it subtle or coarse, is not only dishonest but dangerous for the future of citrus products and should be combatted.

E. Packaging

Tin cans are the principal packaging material for citrus products. Because of their high acidity and their tendency to undergo non-enzymatic browning, citrus products present some special packaging problems. These problems are rendered even more difficult in the case of export, where a shelf-life of one or two years has to be envisaged.

The problem may be stated in general terms, as follows: due to their high acidity, citrus products tend to attack tinplate, causing rapid detinning and subsequent corrosion. This might be counteracted by coating the cans internally with protective laquers. However, the contact with tin is beneficial to the product, as it creates reducing conditions which prevent or retard non-enzymatic browning. Thus, the selection of a can for citrus products is always a matter of compromise.

The compromise consists of using plain tinplate for the less acid products such as orange juice, canned segments, etc., plain bodies and laquered ends for grapefruit juice and fully laquered cans for concentrates and all lemon products. In this latter case, browning must be retarded by means of refrigerated storage.

The inconvenience involved in the use of glass containers for export of citrus products is obvious. Yet there is some demand for bottled juices as explained before.

To summarize, the actual practice of packaging citrus products is far from being ideal. Alternative packaging materials are urgently needed.

IV. STARTING A CITRUS PROCESSING INDUSTRY

1. Organization of citriculture

It takes five years and an investment of 20 dollars per tree to bring a newly planted orchard to production. This figure does not include the cost of land, the creation of the complex infrastructure and other expenses associated with starting any agricultural operation. In short, large scale citriculture requires considerable capital investment. Our present knowledge of the biological and ecological factors is not sufficient for the prediction of the success of citriculture in a given area, even if we possess extensive information on the soil and the climate. One should be prepared for suprises, which may often mean the loss of huge amounts of capital. When planning production of citrus in a new area, it is advisable to start with a small acreage and to increase the plantation gradually.

In many developing countries the agrarian systems as well as the topographical structure of the land favour the creation of small orchards owned by individual farmers, rather than large plantations. Organization of the growers in some sort of co-operative is imperative. The function of this organization should cover co-operation in agrotechnical matters, (pest control, fertilization, organized procurement of suppliers, etc.) as well as marketing of the product.

Frequently the growers also own and operate at least the first stage of industrial processing i.e. the packing-houses.

Regardless of the proprietory status of the different sectors, the establishment of binding agreements between the growers and the industry is essential.

2. Timetable for industrialization

As in any project, the optimal schedule for the implementation of an industrial citrus processing scheme depends on the local conditions. However, a number of observations can be made, which are generally applicable to most developing countries.

The industrialization of agricultural products in developing countries is one of the best known cases of economical "vicious circles". In the absence of an industry capable of absorbing the fruit, the growers are reluctant to start large-scale production. On the other hand, no industry is erected until the availability of raw materials in sufficient quantities and at reasonable prices

can be guaranteed. So, agriculture and industry wait for each other to make the first step.

At which point should the vicious circle be broken? In the case of fast-growin · crops of limited use such as fresh foods (passion fruit, pineapple, some vegetables) the logical start would be the erection of a processing plant. The loss connected with the fact that the plant would not enter into full-scale production for some time is less serious than the danger of lack of outlets for the agricultural production even for one season.

In the case of citrus, the optimal schedule of implementation may be, and generally is, different.

It has been stated above, that new development of citriculture should be gradual. Usually there should be no difficulty in providing a profitable outlet for the crop, at the beginning of the operation, in the form of freshfruit for the local market. Obviously, as production increases it becomes necessary to organize this outlet and to utilize it more fully. This requires the establishment of packing houses, better selection of the fruit, promotional operations, etc.

At this point when the agricultural success has been firmly established and some experience gained, processing industry may be started. In the beginning, the main outlet for the products of this industry would probably be the local market, but exports should soon become the main target. Given favourable conditions, export of fresh fruit may become feasible but in our opinion, this is a step which should be tried only when all the other parts of the system have been established and sufficiently tested.

3. Selection of a technology

The art involved in the industrial processing of citrus fruit is an "open technology". The basic principles of production are well-known. As to specific know-how, it should not be too difficult to establish relations on a commercial basis with most processors.

As in any other food processing industry, the availability of properly trained food technologists is essential. In the absence of such personnel, the benefit which could be derived from foreign know-how would be wasted.

The selection of a technology involves several difficult decisions which require a detailed and careful feasibility study. The following are a few of the

questions to be answered:

- What is the optimal size of the plant? Should the industry be planned on the basis of few but large plants or a large number of smaller factories?
- Should the industry (or plant) specialize in one class of products or should it diversify its spectrum of production?
- Should the industrial utilization of wastes be undertaken?
- Should the plant engage mainly in the production of consumer goods or in industrial products?
- Even in the tropics, citrus processing has to be a seasonal operation. How would the plant be utilized outside the season? This decision has a strong influence on the selection of equipment. For example, if it is decided to process tomatoes in the off-season (as it is often done in the Mediterranean area), one may select an evaporation system which can be suitable both for citrus and tomatoes.
- What should be the degree of automation? Very often labour-intensive industries are granted considerable governmental support. Under given conditions the most advanced technology may not be the most profitable.

4. Organization of the industry

It is often more difficult to organize industrialists than farmers. Yet co-operation is as important at the industrial level as in agricultural production especially in the case of exports. The following are a few points on which such co-operation is essential and possible even under the hardest conditions of competition:

- Development of quality control methods;
- Compilation of data on the composition of fruit;
- Co-ordinated action against discrimination regulations at home or abroad;
- Co-ordinated promotion of products abroad;
- Collective bargaining with growers;
- Co-ordinated action in the selection and control of packing materials;
- Joint action in the establishment of quality standards;
- Research or support of research;
- Training of technical staff.

The present needs have induced the processors to seek co-operation not only at the national but even at the international level. These international organizations are active mainly in research, dissemination of information, joint action towards adulteration, international legislation (Codex Alimentarius), co-ordination in problems of general interest such as pesticide residues, additives etc. Co-operation with these organizations and creation of new associations on a geographical basis should prove beneficial, especially to newcomers to the field of citrus products marketing.

LITERATURE REFERENCES

Berk, Z. (1969) "Industrial Processing of Citrus Fruit"
Food Industry Studies No. 2, UNIDO, New York.

Braverman, J.B.S. (1943) "Citrus Products"
Interscience Publishers, New York.

Chorin, Y. (1966) "Citrus in Israel"
Israel Periodicals, Tel-Aviv.

Commonwealth Secretariat (1968) "Fruit, a Review"
Commonwealth Secretariat, London.

FAO, (1970) "Trade Yearbook Vol. 23
FAO, Rome.

GATT Industrial Trade Centre (1966)
The European Market for Citrus Juices, GATT, Geneva.

Tyseer, H.F. editor (1970) "The Fruit" Annual 1969-70
British-Continental Trade Press Ltd., London.

U.S.D.A. (1970) "European Citrus Imports and U.S. Trade"
U.S.D.A., Foreign Agricultural Circular FCP 3-70, Washington.

A P P E N D I X

TRADE STATISTICS - CITRUS PRODUCTS

(From the United States Department of Agriculture,
Foreign Agriculture Circular FCP 3-70, November 1970)

Austria: Imports of citrus juices, by countries of origin, 1963-64 to 1968-69.

Item and Country of Origin	Year beginning October 1					
	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
Orange Juice, Concentrated 1/						
United States	25.4	4.3	30.2	58.0	189.2	71.2
Germany, West	34.0	23.8	25.4	59.4	5.7	28.0
Israel	57.6	195.8	120.8	44.1	140.6	75.7
Italy	141.2	158.6	93.0	77.1	18.9	24.9
South Africa	6.4	30.2	4.5	33.0	4.0	90.6
Spain	75.0	47.7	77.8	60.7	64.5	56.4
Other	63.4	19.6	60.3	102.5	48.9	75.3
TOTAL	403.0	480.0	412.0	434.8	471.8	422.1
ORANGE JUICE, SINGLE-STRENGTH 1/						
United States	74.8	90.5	112.3	361.8	941.3	584.5
Brazil	24.5	67.4	72.5	69.4	42.2	38.9
Germany, West	254.0	267.3	436.8	213.8	227.2	190.1
Greece	42.7	229.5	162.3	163.1	177.3	67.7
Israel	910.5	1,061.1	1,087.9	1,276.7	1,914.1	1,674.9
Italy	201.2	205.3	255.0	261.3	1,319.0	404.4
South Africa	36.6	112.7	114.3	27.1	117.0	307.8
Spain	57.5	82.6	70.4	86.4	53.1	40.4
Other	120.3	58.5	47.0	190.4	691.9	389.2
TOTAL	1,722.1	2,192.9	2,358.5	2,650.0	5,483.1	3,697.9

1/ Includes an unknown quantity of lemon juice.

Belgium: Imports of citrus juices, by countries of origin, 1964 to 1968.

Item and Country of Origin	Calendar Year					
	1964	1965	1966	1967	1968	1969
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
CITRUS JUICES (All)						
United States.....	513	544	591	1,610	3,009	1,960
Germany, West.....	58	—	17	123	140	522
Greece.....	514	546	389	389	523	704
Israel.....	886	800	845	987	1,448	2,314
Morocco.....	1/	49	152	129	1/	160
Italy.....	28	64	30	75	100	366
South Africa.....	323	83	259	1/	422	636
Spain.....	343	264	227	1/	167	222
Other.....	659	394	2/1,211	3/1,431	1,702	1,614
TOTAL.....	3,324	2,744	3,721	4,744	7,511	8,498

1/ If any, included under "other".

2/ Includes 203 metric tons from Argentina and 231 metric tons from Brazil.

3/ Includes 121 metric tons from Argentina and 271 metric tons from Brazil.

Denmark: Imports of citrus juice, by countries of origin, 1964 to 1969.

Item and Country of Origin	Calendar Year					
	1964	1965	1966	1967	1968	1969
CITRUS JUICES (All)	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
United States.....	235	387	816	3,542	2,172	944
Brazil.....	1/	1/	396	181	555	470
Greece.....	918	1,357	1,694	668	906	510
Israel.....	742	784	892	970	1,147	2,384
Italy.....	336	280	335	388	151	382
Spain.....	638	437	490	392	389	487
Sweden.....	26	85	74	348	1/	98
United Kingdom.....	202	310	150	70	59	86
Other.....	93	194	336	423	209	493
TOTAL.....	3,190	3,754	5,085	6,922	5,128	6,084

1/ If any, included under "other".

France: Imports of citrus juices, by countries of origin, 1964 to 1969.

Item and Country of Origin	Calendar Year					
	1964	1965	1966	1967	1968	1969
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
ORANGE JUICE (All)						
United States.....	1/	1/	409	3,862	5,764	2,890
Algeria.....	1,539	362	1,889	3,203	1,259	135
Greece.....	128	1,208	808	190	305	564
Israel.....	169	419	776	1,955	2,463	3,525
Italy.....	85	35	196	140	140	355
Morocco.....	4,746	4,234	4,740	3,999	7,061	7,211
Spain.....	1/	25	31	45	129	652
Other.....	103	123	75	32	383	102
TOTAL....	6,770	6,406	8,724	13,426	17,502	15,434
LEMON JUICE (ALL)						
Algeria.....	11	1/	76	43	1/	1/
Italy.....	242	348	255	518	409	132
Other.....	128	186	139	131	188	2/ 387
TOTAL....	381	534	470	692	597	519
GRAPEFRUIT JUICE (ALL)						
United States.....	1,395	3,713	1,941	5,740	3,593	2,518
Algeria.....	517	16	771	1,205	392	399
Israel.....	749	2,224	2,718	3,507	3,705	2,593
Morocco.....	3,300	2,929	2,953	2,610	4,183	2,932
South Africa.....	69	1/	1/	46	1/	421
Other.....	174	56	18	45	45	3/ 1,297
TOTAL.....	6,204	8,938	8,601	13,153	11,918	10,160

1/ If any, included under "other".
2/ Includes 299 metric tons from the Netherlands.
3/ Includes 822 metric tons from Greece and 333 metric tons from the Netherlands.

Netherlands: Imports of citrus juices, by countries of origin, 1964 to 1969.

Item and Country of Origin	Calendar Year					
	1964	1965	1966	1967	1968	1969
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
CITRUS JUICES(All)						
United States.....	695	497	778	2,194	2,309	1,854
Argentina.....	41	45	148	202	185	1/
Belgium-Luxembourg....	167	243	546	695	1,012	1,091
Brazil.....	1/	17	391	1,176	2,111	3,438
Germany, West.....	83	100	1,255	1,559	1,444	1,515
Greece.....	202	200	98	225	144	168
Israel.....	1,350	2,035	2,462	3,205	2,859	2,388
Italy.....	490	484	712	998	1,118	1,253
Jamaica.....	96	223	185	60	68	32
Kenya.....	20	20	20	1/	1/	1/
Morocco.....	202	447	230	200	328	196
Mozambique.....	62	118	166	48	202	304
South Africa.....	482	487	549	528	307	192
Spain.....	699	709	777	1,305	995	485
Other.....	101	230	159	254	225	305
TOTAL.....	4,950	5,918	8,024	12,753	13,652	14,179

1/ Nil or, included under "other".

Sweden: Imports of citrus products, by country of origin, 1964 to 1969.

Item and Country of Origin	Calendar Year					
	1964	1965	1966	1967	1968	1969
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
CITRUS JUICES (All)						
United States........	1,015	1,232	1,733	4,252	12,918	9,951
Brazil..............	—	13	150	226	428	880
Greece..............	402	420	360	269	72	107
Israel..............	3,120	3,632	3,756	3,400	4,572	7,173
Italy...............	416	396	216	285	241	534
South Africa.........	312	175	175	137	91	127
Spain...............	555	200	540	578	894	737
United Kingdom.......	66	109	214	276	1,308	955
Other...............	195	204	525	488	460	186
TOTAL......	[illegible]	[illegible]	[illegible]	9,911	19,9[illegible]	[illegible]
CITRUS JUICES (All)						
United States........	66	70	50	46	44	49
Israel..............	17	21	25	11	1/	1/
Other...............	50	31	30	24	27	60
TOTAL......	133	122	105	81	71	109
CANNED CITRUS						
United States........	15	20	19	20	16	14
Mainland China.......	74	111	142	37	81	27
Israel..............	12	14	96	97	135	160
Japan...............	932	1,270	1,202	1,058	818	1,118
Spain...............	1/	30	140	19	59	162
Taiwan..............	140	32	1/	5	1/	91
Other...............	7	11	73	79	27	21
TOTAL......	1,180	1,498	1,672	1,295	1,136	1,593

1/ If any, included in "other".

United Kingdom: Imports of citrus products by countries of origin, 1963-64 to 1968-69.

Item and Country of Origin	Year beginning November 1					
	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons
ORANGE JUICE,						
CONCENTRATED, UNSWEETENED						
United States.....	1/	64	181	448	437	370
British Honduras.....	95	161	226	291	325	324
Israel.....	348	605	549	1,031	814	726
Italy.....	122	50	90	96	25	41
Jamaica.....	183	249	228	229	207	181
South Africa.....	279	174	287	345	292	131
Spain.....	192	209	177	248	180	150
Other.....	201	204	192	224	154	139
TOTAL.....	1,420	1,716	1,990	2,908	2,430	2,062
ORANGE JUICE,						
NOT CONCENTRATED 2/						
United States.....	1/	17	11	192	20	13
British Honduras.....	630	538	554	344	430	333
Israel.....	3,548	3,284	3,153	3,783	4,504	5,407
Italy.....	15	33	280	50	21	6
Jamaica.....	26	67	486	21	51	14
South Africa.....	453	521	408	275	483	388
Spain.....	674	415	500	898	507	234
Trinidad.....	535	503	34	589	454	244
Other.....	395	281	130	191	130	80
TOTAL.....	6,276	5,659	5,556	6,343	6,600	6,659
GRAPEFRUIT JUICE,						
CONCENTRATED, UNSWEETENED						
British Honduras.....	9	19	2	11	4	5
Israel.....	43	39	29	52	156	92
Jamaica.....	46	67	79	49	46	59
South Africa.....	36	41	72	7	6	18
Other.....	3	9	15	52	55	45
TOTAL.....	137	175	197	171	267	219

Continued. . .

United Kingdom: Imports of citrus products, by countries of origin, 1963-64 to 1968-69. (Contd.)

Item and Country of Origin	Year beginning November 1					
	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons	1,000 U.S. gallons
GRAPEFRUIT JUICE, SINGLE-STRENGTH 2/						
United States.....	107	240	26	224	8	3
British Honduras....	135	79	119	273	106	197
Israel.....	1,333	1,942	1,616	1,992	2,779	3,350
Jamaica.....	284	458	422	287	323	264
South Africa.....	195	116	142	97	180	160
Trinidad.....	987	1,313	1,183	706	590	480
Other.....	9	13	25	39	48	46
TOTAL.....	3,050	4,161	3,533	3,618	4,034	4,500
OTHER CITRUS JUICES CONCENTRATED, UNSWEETENED						
United States.....	1/	1	1/	6	17	17
Greece.....	72	251	181	208	191	70
Israel.....	55	46	96	198	66	85
Italy.....	530	507	687	519	518	645
South Africa.....	38	18	23	33	20	8
Windward Islands....	53	41	91	48	51	78
Other.....	13	74	62	197	158	453
TOTAL.....	761	938	1,140	1,209	1,021	1,356
OTHER CITRUS JUICES SINGLE-STRENGTH, UNSWEETENED						
United States.....	13	197	20	15	13	6
Ghana.....	681	1,635	1,172	1,518	878	435
Israel.....	390	351	199	115	69	128
Italy.....	904	965	525	629	602	521
Jamaica.....	396	590	449	378	459	431
Mexico.....	1/	245	416	353	26	1/
South Africa.....	137	103	76	77	24	1/
Trinidad.....	72	96	58	81	75	48
Windward Islands....	118	307	207	132	133	59
Other.....	32	86	39	116	93	53
	2,743	4,575	3,161	3,414	2,372	1,681

Continued. . .

United Kingdom: Imports of citrus products, by countries of origin, 1963-64 to 1968-69. (Contd.)

Item and Country of Origin	Year beginning November 1					
	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
	1,000 cases 24/2's	1,000 cases 24/2's	1,000 cases 24/2's	1,000 cases 24/2's	1,000 cases 24/2's	1,000 cases 24/2's
GRAPEFRUIT, TINNED OR BOTTLED, IN SYRUP						
United States.....	22	27	29	19	7	1/
British Honduras.....	135	67	180	218	220	269
Cyprus.....	62	42	51	97	84	150
Israel.....	507	485	626	730	686	1,015
Jamaica.....	564	633	578	904	539	458
South Africa.....	266	199	320	335	454	491
Trinidad.....	97	93	139	180	111	184
Other.....	18	5	12	48	60	104
TOTAL.....	1,671	1,551	1,934	2,189	2,361	2,691
ORANGES, TINNED OR BOTTLED, IN SYRUP						
China.....	33	49	131	120	206	72
Cyprus.....	15	18	15	19	25	24
Israel.....	10	7	8	4	9	7
Japan.....	1,692	1,337	1,648	1,561	1,258	1,588
South Africa.....	13	5	25	6	14	7
Spain.....	2	4	9	30	33	59
Taiwan.....	1/	26	34	37	28	41
Other.....	35	5	14	18	22	19
TOTAL.....	1,820	1,451	1,882	1,785	1,978	1,817

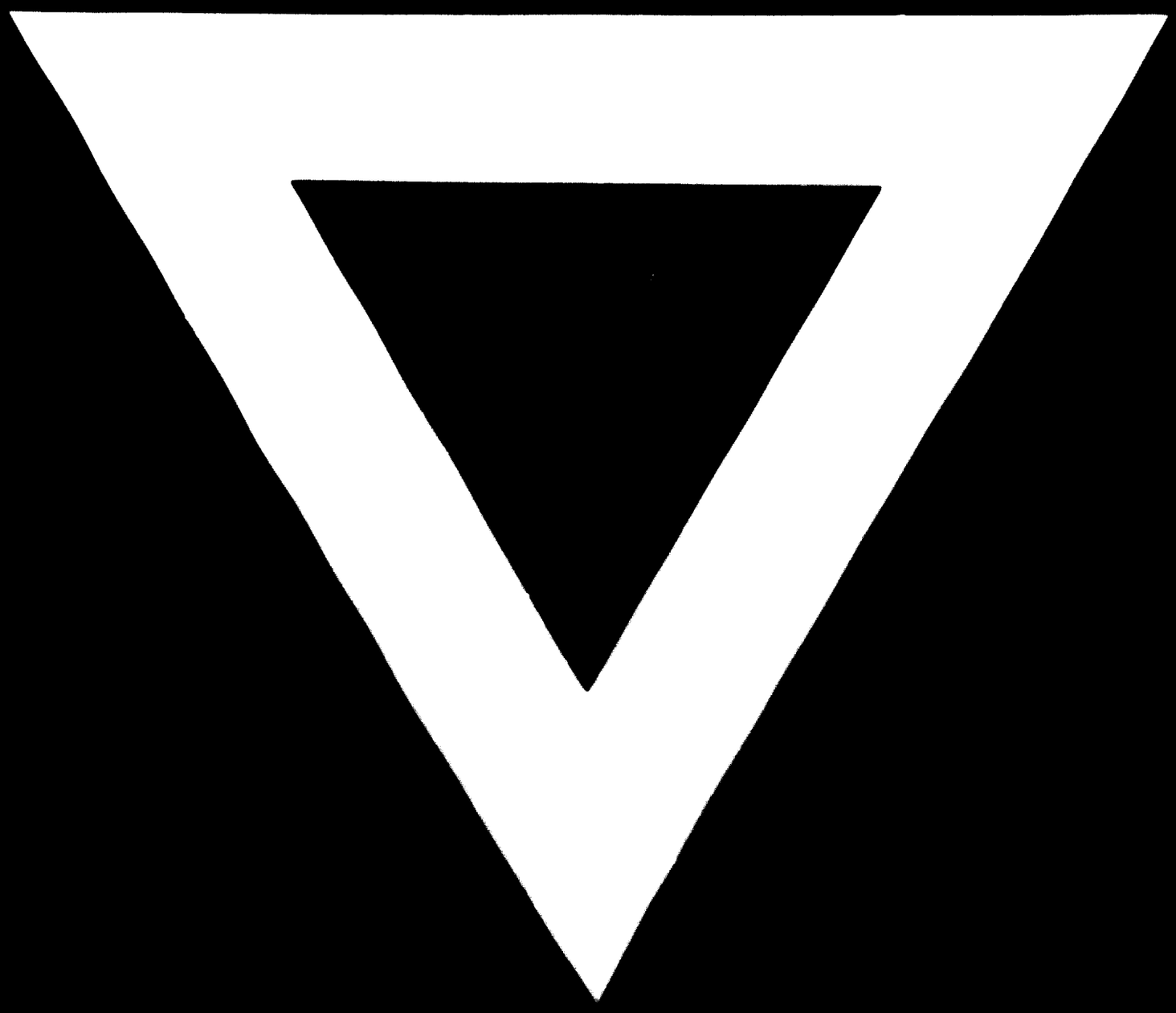
1/ If any, included under "other".

2/ Includes both sweetened and unsweetened juices.

West Germany: Imports of citrus juice by countries of origin, 1968 and 1969.

Item and Country of Origin	1968			1969		
	Sweetened	Not sweetened	Total	Sweetened	Not sweetened	Total
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
ORANGE JUICE 1/						
United States	44	8,076	8,120	53	4,426	4,479
Argentina	2/	495	495	2/	413	413
Brazil	2/	6,822	6,822	20	7,904	7,924
France	2/	404	404	2/	81	81
Greece	2/	6,582	6,582	2/	5,131	5,131
Israel	3,057	3,556	6,593	3,114	5,454	8,568
Italy	179	3,774	3,953	58	2,942	3,000
Jamaica	2/	53	53	2/	2/	2/
Morocco	2/	3,785	3,785	2/	5,877	5,877
Netherlands	7,072	1,426	8,498	4,228	4,930	9,158
South Africa	105	2,300	2,405	65	3,865	3,930
Spain	2/	3,394	3,394	2/	3,591	3,591
United Kingdom	49	21	70	45	2/	45
Other	20	105	125	54	374	428
TOTAL	10,504	40,791	51,295	7,637	44,988	52,625
GRAPEFRUIT JUICE 1/						
United States	—	—	655	—	—	1,057
China	—	—	104	—	—	163
Greece	—	—	179	—	—	1,509
Israel	—	—	4,298	—	—	3,400
Morocco	—	—	157	—	—	204
South Africa	—	—	268	—	—	33
Other	—	—	204	—	—	742
TOTAL	—	—	5,865	—	—	7,108
OTHER CITRUS JUICE 1/						
United States	—	—	518	—	—	363
Brazil	—	—	541	—	—	145
Greece	—	—	557	—	—	2/
Israel	—	—	417	—	—	432
Italy	—	—	3,403	—	—	2,971
Netherlands	—	—	7,498	—	—	5,532
South Africa	—	—	89	—	—	41
Spain	—	—	186	—	—	99
United Kingdom	—	—	205	—	—	257
Other	—	—	27	—	—	177
TOTAL	—	—	13,378	—	—	3/ 9,950

1/ Of a density of 1.33 (specific gravity) or less.
2/ If any, included under "other".
3/ Includes 6,611 Metric Tons of Lemon Juice.



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