**FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS**

AMAZON COOPERATION TREATY

**MINISTRY OF TECHNICAL COOPERATION OF THE
GOVERNMENT OF THE NETHERLANDS**

TECHNICAL MANUAL

SMALL-SCALE PROCESSING OF NATIVE AND INTRODUCED AMAZONIAN FRUITS AND VEGETABLES

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Caracas, Venezuela

FAO REGIONAL OFFICE FOR LATIN AMERICA
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PRESENTATION

Latin America and, especially, the Amazon Region, has immense potential wealth which, if properly used, may become an important factor in improving the quality and level of life of its inhabitants. The countries with sovereignty over this region, are joining efforts, with the support of the international community, to achieve its sustainable development.

The Pro Tempore Secretariat of the Amazon Cooperation Treaty (TCA), with the collaboration of Project GCP/RLA/128/NET , "Support to the TCA Pro Tempore Secretariat" and the FAO Regional Office for Latin America and the Caribbean, is participating in a joint training programme which, in the short and medium term, will lead to the creation of agroindustrial microenterprises for the efficient use and processing of its biodiversity, particularly with regard to fruits and vegetables.

A practical way has been sought through this effort to approach and train Amazon communities in the rational utilization of their resources within a framework of absolute respect for the conservation of the Region´s biodiversity, considered as one of Earth´s most valuable resources.

As a result, the development of the process for the formation of agroindustrial microenterprises to process Amazon fruit and vegetable resources may represent an important step in the sustainable development of the Region, where it is increasingly urgent to incorporate a large population to adequate development levels. In this respect, such training has had a multiplying effect since, when returning to their communities, participants disseminate the knowledge obtained.

This level of training requires adequate material whose didactic nature is aimed at obtaining efficient results, through an objective transmission of theoretical and practical knowledge. In this case, the purpose of training is the formation of agroindustrial microenterprises for processing fruits and vegetables of Amazon origin; and the targets are the specialized technicians and final users of Amazon communities, as potential microentrepreneurs.

This Technical Manual also represents a continuing effort in relation with the "Manual on Fruit and Vegetable Processing through Artisanal and Small-Scale Methods" published by the FAO Regional Office for Latin America and the Caribbean, in Spanish (in 1993) Portuguese (in 1995), and English (in 1997).

GUSTAVO GORDILLO DE ANDA	*VICTOR E. CARAZO*
Assistant Director General	*Ambassador*
FAO Regional Representative for	*Pro Tempore Secretary*
Latin America and the Caribbean	*Amazon Cooperation Treaty*

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The contributions of the Peruvian Amazon Research Institute and of the National Agrarian University of "La Selva" , Faculty of Food Industries Engineering, of Peru; of the National Agro-Industries Department of the National Agriculture Secretariat of the Ministry of Economic and Livestock Development, of the Foundation for the Development of the Province of Vaca Diez, of the Technical University of Beni, of the Forestry Engineering School, and of the Illustrious Municipality of Riberalta, of Bolivia; of the Faculty of Chemical Science of the University of Cuenca, of Ecuador; and of the Amazon Scientific Research Institute and the Colombian Institute of Agricultural Technology, of Colombia, were useful in implementing the training courses which allowed the authors to structure this Manual.

We express our gratitude to all who were always willing to make their best efforts in every activity carried out. To the authorities, professional and technical staff and support personnel of the institutions who always played a very important role in the development of the entire programme.

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INTRODUCTION

Whenever a training programme is being conceived, it is always necessary to have didactic material which will allow the objective transmission of theoretical and practical knowledge to the trainees. In the present case, the purpose of training is to form agroindustrial microenterprises for processing Amazon fruits and vegetables; the programme is aimed at specialized technicians and final users of the Amazon communities, who are potential microentrepreneurs.

This Technical Manual is the result of a joint effort of the *Pro Tempore* Secretariat of the Amazon Cooperation Treaty, with the support of Project GCP/RLA/128/NET "Support to the *Pro Tempore* Secretariat of the Amazon Cooperation Treaty" and the FAO Regional Office for Latin America and the Caribbean, with the sponsorship of the Technical Cooperation Network on Fruit and Vegetable Processing which the Regional Office has developed in Latin America over the last ten years.

The result of the effort of these institutions, is a document structurally similar to the Manual published by FAO, in 1993, on Small Scale Fruit and Vegetable Processing. However, it differs in two fundamental aspects; the nature of some of the raw materials used in this case and, the focus of both manuals. While in the first the focus is merely technological in regard to processing, the focus of the present manual is placed on a training methodology and on microentrepreneurial organization.

The didactic structure of this Technical Manual is such that the person responsible for training and extension may follow a similar procedure in every case that it is applied. It is an effort to provide aspects of entrepreneurial organization, rational resource management, efficient use of time, with permanent control of the processes (be they complex or simple); all of them managed in keeping with the environment. All these aspects pertain to the implementation of a total quality programme.

In the present case it is assumed that human resources available in the Region are sufficiently autonomous to deliver the purely technical aspects of Amazon fruit and vegetable processing. Differences normally lie in organizational aspects and, it is on these aspects that emphasis will be placed in the different chapters of this Manual.

Whether the organization of an enterprise is simple or complex, depending on its nature, it must be oriented towards continuous improvement, as a factor for permanent growth.

The contents of this Manual is divided into two large parts, one on general basic aspects, small scale technical processing aspects and basic aspects to be developed when training small, present and potential, entrepreneurs. The second part refers to formulations, that is, to specific technical aspects of industrial processing and, because of its qualitative incidence, includes the subject of raw materials in a brief graphic presentation of the fruits and vegetables included in the training programme developed in relation with the project, which supports the activities of the Amazon Cooperation Treaty in collaboration with FAO in the Amazon Region.
This work was carried out with the professional contribution of an outstanding group of the Region's specialists, both as regards joint work as well as in specific activities. These professionals are listed below:

Bolivia

- Dr. Ing. Gonzalo Villalobos S.
  Director Nacional de Agroindustrias
  Secretaría de Agricultura y Ganadería

- Ing. F.J. Armando Perez-Cueto E.
  Escuela Militar de Ingeniería

Brazil :

- Ing. Wilson Carvalho Barbosa
  Investigador en Frutas y Hortalizas
  EMBRAPA-CPATU

- Ing. Herbert Cavalcante de Lima
  Investigador
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Guyana:

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- Ing. Enrique Conrado Chávez P.
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- Ing. Jaswant Sathoe
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  Ministry of Agriculture

Venezuela:

- Ing. Julio M. Olivar
  Coordinador Departamento de Producción
  de la UEDA-Delta
  Amacuro
  Ministerio de Agricultura y Cría

It is also necessary to recognize the efforts of the various groups of persons who were involved in the training courses and who contributed their work for this Manual to become a reality in terms of its processes and of the products obtained.

All the processes and products shown further on are the result of the activities carried out in five training courses.

Development of the training courses

The structure of the training courses implemented both within the framework of the joint programme of the *Pro Tempore* Secretariat of the Amazon Cooperation Treaty, within the scope of the "Comisión Especial de Ciencia y Tecnología" (CECTA) and the FAO Regional Office for Latin America and the Caribbean, as well as of the courses that the latter has been carrying out for some years throughout Latin America, makes it possible to provide the participants with basic and applied information in a term of 5 to 10 days, jointly with practical training, which, with the support of a manual such as this and an audiovisual package, will allow them to develop their own actions autonomously.

The structure of the programme of the courses is the following:

Theoretical component

Includes the following chapters:

- Description of the basic characteristics of the premises to be used for small scale processing of fruits and vegetables.
- Information on the necessary equipment and implements.
- Design of the processing room and location of the equipment.
- Assistance in the installation and initiation of the system's operation.
- Basic principles, personal hygiene and sanitation of the processing premises and measures applied.
- Microbiologic principles of foods.
- Theoretical and practical training of the staff.
- Appropriate management of raw material.
- Cost structure to be considered.

Practical Component

This component consists of the implementation of several processing exercises for the manufacture of various products and includes the following chapters:

- Presentation of the equipment and materials to be used and description of their operation.
- Explanation regarding processing technologies for products such as marmalades, fruits in syrup, nectars and others.
- Practical demonstration of the processing methods described above, using from 10 to 100 kg. of raw material, with the active participation of each of the participants in the course.
- Preparation of specific products according to recipes provided by the participants, using the methodology and principles being taught. This makes it possible to evaluate the knowledge obtained.

Audiovisual Component

The theoretical and practical components are complemented in these courses with audiovisual material especially prepared for this purpose.

In the case of the programme which gave raise to the preparation of this Manual, in two of the courses carried out - Pucallpa, Perú and Cuenca, Ecuador - audiovisual material was prepared which, in turn, resulted in the making of several videos for practical application in small scale processing of Amazon native and introduced fruits and vegetables. It is recommended, therefore, that theoretical and practical training activities be complemented with the presentation of the respective video tapes.

Courses Given in the Joint Programme of the *Pro Tempore* Secretariat of the Amazon Cooperation Treaty/FAO Regional Office for Latin America and the Caribbean

The first international training and validation course on processes and products was carried out in Pucallpa, Peru, between 17 and 21 June, 1996, and was aimed at professionals and technicians from the Amazon Region in which 32 persons participated: 12 from the different countries of the Amazon Cooperation Treaty and 20 from Peru.

The products made in this international course were:

- Sweet peppers in aromatic vinegar
- Chili peppers in aromatic vinegar
- Crystallized watermelon rind, preserved in syrup at 80%.
- Passion fruit syrup
- Pasteurized tomato juice
- Fruit leathers
- Brazil nut marzipan
- Copuazu marmalade
- Papaya marmalade in chunks
- Pulped papaya marmalade
- Araza nectar
- Copuazu nectar
- Granadilla nectar
- Passion fruit nectar
- Brazil nut in syrup
- Palm heart in brine with citric acid
- Palm heart in aromatic vinegar at 5%
- Palm heart in vinegar at 5%
- Aguaje pulp for nectar
- Pickled watermelon pulp
- Breadfruit seed in syrup
- Aromatic vinegar

The **second national training course** was carried out in Cuenca, Ecuador, between 15 and 19 July, 1996, with the participation of 35 persons: 14 women and 21 men. The products processed in this course were the following:

- Pineapple nectar
- Pineapple cubes in syrup
- Sliced papaya in syrup
- Carrot and lemon marmalade
- Carrot and orange marmalade
- Tree tomato marmalade
- Tree tomatoes in syrup
- Carambola nectar
- Carambolas in syrup
- Naranjilla marmalade
- Naranjilla nectar
- Granadilla nectar
- Passion fruit nectar
- Tomato sauce with basil
- Mandarin segments in syrup
- Guava marmalade
- Guava segments in syrup
- Quila nectar
- Ungurahui nectar
- Amazon pickles
- Marinated vegetables
- Chili peppers in vinegar
- Vegetables in vinegar
- Small onions in vinegar
- Garlic in vinegar

The **third national training course**, was carried out in Riberalta, Bolivia, between 12 and 16 August, 1996, with the participation of 34 persons: 11 women and 23 men. The products prepared in this course were the following:

- Orange marmalade
- Guava segments in syrup
- Small onions in vinegar
- Green tomatoes in vinegar
- Mixed vegetables in aromatic vinegar
- Mixed vegatables in pure vinegar at 5% acetic acid
- Cashew “apple” nectar
- Fruit leathers
- Italian style tomato sauce
- Pineapple and papaya nectar
- Mandarin in syrup
- Pineapple in syrup
- Passion fruit nectar
- Brazil nut in syrup
- Brazil nut marzipan
- Carambola in thick syrup

- Cashew “apple” in thick syrup
- Tamarind syrup
- Tamarind marmalade
- Cashew “apple” in syrup
- Carambola marmalade
- String beans in acidified brine
- Whole preserved tomatoes
- Palm heart in acidified brine

The **fourth national training course** was carried out in Tingo María, Peru, between 23 and 27 September, 1996, with the participation of 28 persons: 11 women and 17 men. The products prepared in this course were the following:

- Papaya marmalade in chunks
- Pineapple marmalade in chunks
- Cocona marmalade
- Carrot and lemon marmalade
- Carambola preserve
- Cashew “apple” preserve
- Papaya in syrup
- Carambola in syrup
- Pineapple chunks in syrup
- Tangerine in syrup
- Guaba in syrup (with seeds)
- Guaba in syrup (without seeds)
- Uvilla in natural syrup (with seeds)
- Uvilla in coloured syrup (with seeds)
- Uvilla in natural syrup (without seeds)
- Uvilla in coloured syrup (without seeds)
- Banana in syrup
- Carambola nectar
- Cashew” apple” nectar
- Aguaje nectar
- Guaba nectar
- Uvilla nectar
- Ungurahui nectar
- Pineapple nectar
- Apple nectar
- Apple purée
- Aguaje pulp
- Tomato juice
- Italian style tomato sauce
- Tomato purée
- Whole palm heart with acidified brine
- Palm heart pieces in acidified brine
- Aromatic vinegar
- Banana in aromatic vinegar
- Mixed vegetables in aromatic vinegar
- Red and yellow peppers in aromatic vinegar
- Sweet and hot peppers in oil

The **fifth national training course** was carried out in Bogotá, Colombia, between 25 and 29 November, 1996, with the participation of 25 persons: 6 women and 19 men. The products prepared in this course were the following:

- Pineapple marmalade in chunks
- Papaya marmalade in chunks
- Pineapple nectar
- Pineapple in syrup
- Papaya in syrup
- Guava marmalade
- Guava nectar
- Guava segments in syrup
- Cocona marmalade
- Cocona nectar
- Araza marmalade
- Araza nectar
- Pure copuazu pulp marmalade
- Copuazu syrup with lemon juice
- Whole bananas in copuazu syrup
- Copuazu syrup without lemon juice
- Tree tomato marmalade
- Carambola in syrup
- Maraco nectar *(Theobroma bicolor)*
- Araza and maraco marmalade
- Maraco sauce
- Maraco marmalade
- Washed copuazu pulp marmalade
- Aguaje nectar
- Aguaje marmalade
- Passion fruit nectar
- Copuazu and papaya marmalade
- Mixed vegetables in vinegar
- Tomato sauce with basil
- Palm heart in acidified brine
- Cassava flour
- Palm heart flour
- Copuazu tidbits
- Aromatic vinegar

P A R T I

This First Part of the Manual is devoted to the basic principles, the elements on which the technology of fruit and vegetables processing is based, as well as to the procedures to be implemented for the creation and development of small enterprises for the rational and efficient exploitation of the Amazon region's fruit resources.

It is not intended to turn this first part of the Manual into a text to be followed, but rather into a guideline for specialists to develop their own methodology. It is therefore, a guideline to standardize training in the different TCA countries and at the same time within their different regions.

The principles presented herein are the result of the experience of the authors over 20 years. Rather than an account or compilation of knowledge developed by other authors, they constitute a simplified presentation of various subjects which have been assumed and validated by experience in different parts of the world, under different realities and particular conditions. This Manual must, therefore, be validated under Amazon conditions and all necessary modifications will be introduced for optimum use by all communities requiring technical assistance to support their development.

Analyzed in this way, this Manual is the result of a basic structure proposed by the authors and the valuable contribution of many specialists of the Amazon region who, most willingly and with great effort, contributed their experience to this small work which will serve as the starting point for a long term programme.

1. GENERAL BACKGROUND

In this chapter some basic organizational concepts regarding the so called microenterprises and some special considerations concerning agroindustrial enterprises will be discussed. For the purposes of this Manual and subsequent training, no separation will be made between micro agroindustrial urban and rural or semi-urban enterprises, mainly because of the nature of the Amazon region in this respect, where sometimes such separation is not applicable. The so called urban centers, or having urban characteristics, constitute a continuity of rural life and their interrelation is very close, with the exception of large industrialized urban centers, such as those in Brazil.

1.1 Microenterprise

There are many ways to define a microenterprise, so that what will be sought on this opportunity is a simple definition which may be applicable to the different cases of microenterprises known to the recipients of this Manual.

In the first place a microenterprise must always be considered as an enterprise, that is, its structure and organization are those of an enterprise. In this respect there must be a clear definition between a microenterprise and an informal artisanal type activity, which does not have an entrepreneurial structure.

The present definition of the levels at which an enterprise can be classified is confusing and insufficient in many cases. Since a long time enterprises have been classified by size, in relation with the number of workers they have. At preset, however, this does not apply. To illustrate this, mention may be made of a microenterprise, considered as such because of the number of persons working in it, which sells over five million dollars a year. This converts it into at least a small and sometimes a medium enterprise. The so-called high technology enterprises, have changed the concept of enterprise classification and, therefore, it is necessary to clearly define what, from the viewpoint of each country and, hopefully, from the viewpoint of a group of countries (as the TCA), must be considered a microenterprise, for purposes of development, tax supports, subsidized support for training and others.

When speaking of microenterprises, most specialists and economists know what it is about; however, there is no definition common to all of them, nor to all governments, nor all official national and international agencies.

They are organized enterprises with less than ten workers, the limitation of this definition has already been understood; enterprises with gross yearly sales of less than 1 million dollars; enterprises producing goods and services at a low technological level and with an important labour component.

In any event, these enterprises are affected by deficiencies in marketing their products, in other words, in the action of placing their products in the markets, even in the case of well accepted products for which there is a high demand. On the other hand, these enterprises, generally, are of a family nature or community organization, involving small production volumes, due to which their access to normal marketing outlets is limited.

In accordance with the above, a definition for MICROENTERPRISE may be proposed and described as follows:

a microenterprise is one which operates with a very simple organization, low investment levels and is usually constituted by persons related to one another in some special way and not by a labour contract, who have special motivations, aspirations and a common view of the future and a special link with the medium in which it is inserted.

Normally, when forming a microenterprise, consideration must be given to some especially relevant aspects, such as:

- The organization of the enterprise in the context of a particular milieu.
- The economic feasibility of the chosen activity.
- The influence of the participation of women and youth in the development of the enterprise.
- A technical implementation which will allow the microenterprise to compete with similar enterprises in its field.

1.2 Agroindustrial microenterprise

This is a very special type of microenterprise, inserted in a very special reality, normally of a rural nature, although not necessarily so. As the name implies, this group includes all microenterprises making products or providing services related with agricultural production, or agricultural and livestock production of a primary type. Examples of agroindustrial enterprises are the collection, selection and packing centers of agricultural or wild products; food processing enterprises using primary agricultural or wild products; artisanal textiles or furniture and utensils made of wood without a high degree of manufacture; enterprises dealing in medicinal and aromatic herbs; in other words, enterprises using wild and cultivated products of the rural agricultural milieu as raw materials.

In this case, the agroindustrial microenterprise being analyzed, is inserted in a special medium, the Amazon watershed, the tropical forest environment with the greatest biodiversity on the entire planet. This causes the development policy of productive activities to have a component of special care in approaching future tasks with a conservationist criterion. It is not a matter of maintaining natural unused resources at any cost, but to use them rationally to the benefit of the most needy communities of the Amazon region.

The agroindustrial microenterprise has two simultaneous advantages, first, the small size and low technification level of such enterprises make rational resource management possible, avoiding over exploitation; and secondly, the degree of simplicity and small investment needs, allow for the multiplication of development nuclei in small organized communities.

The purpose therefore, is to create an Amazon system of agroindustrial microenterprises for the production of first quality goods on the basis of raw materials from the forest, wild or domesticated, having real marketing possibilities in highly demanding markets with a high purchasing power. For these markets the product must be outstanding, because they have a high discriminating power over the product's quality. This includes aspects relating to their intrinsic nature, that is, to the particular nature of Amazon products; and also, to the natural characteristics of the processed product, favouring a process exempt from preservatives and additives, permitting the enhancement of the product's properties.

To meet this objective it must be kept in mind that the enterprise to be established must meet a series of requisites, including total quality management, or what is currently known as total quality in management, must be a fundamental factor. Only total quality in the process, from the raw material to the final product, the management of the process and interpersonal relationships, will result in a satisfactory productive cycle, which always ends when the final consumer expresses his acceptance of the product, consuming it or demanding more of the same.

1.3 Reasons for training

Although most products made in an agroindustrial enterprise, especially on the basis of fruits and vegetables, which is the case of this analysis are generally known, that is, they are generally managed at the household level, it is not less true that to achieve a controlled, assessable productive process, and above all of acceptable profitability, requires careful technical and economic management of the entire system.

Thus, training is an indispensable process to ensure the adequate functioning of microenterprises in a highly competitive world. This is also true in the case of agroindustrial enterprises producing goods and services for community, regional or national consumption, because in all cases there are other enterprises competing in the same fields.

It will never be possible to be the only one in a field; therefore, it must always be endeavored to be the best in every sense, in costs, presentation, diversity, economic stability, positioning in constantly developing markets.

1.3.1 Training as a permanent necessity

This means that training, learning never ends. There will always be new knowledge to be acquired and incorporated in the enterprise's productive process. The development process begins with the microenterprise, it is never an end in itself, that is, the target will never be restricted to the sole creation of a microenterprise, it will have to be the beginning of a development process.

In the case of the Amazon region, it has already been stated that creating microenterprises may be much more beneficial than creating medium or large enterprises, but if there is awareness that the environment must be respected and rationally exploited, if an entire system, technologically balanced with the environment, is created, the theory that the microenterprise is only the beginning may be absolutely valid also in the Amazon Region.

1.3.2 Training as a mechanism to help create capacities at the executive level of any project

This means that any activity, however trivial, requires some training and learning process. It has already been said that the products resulting from an agroindustrial process applied to fruits and vegetables, will often be recognized by the executors. Everyone has had some culinary experience which has permitted them some contact with the products proposed in this Manual, and it is for this reason that many people think that making marmalades or sweets, fruit preserves and other simple food products, is a simple and easy process. However, the proposal put forth here consists in producing these products commercially and profitably, in other words, with clearly established and controlled costs and benefits.

This leads to the development of an industrial process for which resources are always limited or scarce, where time must be strictly controlled and where the quality of the products, especially as regards uniformity is a key point.

Thus, it is no longer a matter of producing small quantities for self-consumption; it is a matter of producing volumes marketable in demanding markets and this requires special capacities. It will not always be possible for a microenterprise to have professionals available to provide advice, but it will always have to answer for the quality and uniformity of its products.

The products must meet the needs of consumers who are not necessarily part of the producer’s group, who possibly do not even speak the same language, but may be in another hemisphere, living under different conditions and with very different cultures. These new clients will be more demanding than the family members or the local community group; they will be very demanding because they will be paying for the product, often at very high prices.

These clients, for whom the effort of creating capacities is being made, must be provided with the best, a quality to which they are used to, and this requires technical capacity, an adequate level of ability to manage the business, to negotiate, incorporate new technologies, new developments, to adapt the variables arising from the milieu, especially from one as diverse as that of the Amazon region.

The capacity to plan, to create an efficient process, to improve it continually, and adapt it to changes which are the only certainty of present reality; this capacity to respond to the stimuli of the medium is what is created through training programmes such as that proposed in this Manual. The target will be to do things right the first time around, without loss of time, without loss of resources, with a rational utilization of all the elements determining the efficiency of the industrial productive processes. That which is the natural way of carrying out productive activities in medium and large enterprises, is not common in small enterprises and is far from being the manner in which microenterprises act. However, this is the only way to success in management. The success of some model microenterprises, will be the basis on which to develop the series of enterprises capable of making significant contributions towards the incorporation of Amazon communities in great need of a better level of living.

1.3.3 Continuous improvement

One of the most significant aspects of entrepreneurial growth and development is that the training process must be permanent. In the case of microenterprises, rather than a re-engineering process, or periodically redoing everything, a continuous process of gradual changes must be promoted. Such improvement will bring about the evolution and growth required to provide any enterprise with stability over time.

1.3.4. Types and levels of training

In this training process different levels and forms of training may come about. In fact, it is advisable to begin formal training, when there are deficiencies in relation with subjects required for adequate management of this type of enterprise. This formal training process includes courses, practical workshops and in-service-training. All these different steps regarding personnel training for industrial processing must be supported with material such as manuals, audiovisual material and practical sessions, in which the trainee will acquire the necessary capacity to tackle the problems of industrial production.

The training process must include all aspects relating to the management of an industry, both as regards the production line, as well as aspects of administration and labour management. It must not be forgotten that a microenterprise will often require the persons comprising it to perform multiple activities, in other words, each person will need to have various abilities so as to take over different functions, either in the production process or in administration and marketing. It is not possible for a microenterprise to have a highly specialized staffing structure, rather the entire staff must have a high degree of versatility. More than in any other activity, complementary action in a microenterprise will provide the strength which will promote success.

A point to which special consideration must be given in any training process relating to agroindustrial microenterprises of fruits and vegetables, is the perishable nature of most of their raw materials and the need for special preservation during post-harvest. This aspect, coupled with the sanitary conditions to be met by processes and products, must always be taken into account in training efforts.

1.4 General context of the analysis

The Amazon basin has approximately 6 million square kilometers of tropical forest, with the greatest biodiversity existing on Earth and an enormous wealth of natural resources available for rational management.

As a result of the “Round Table on Agroindustrial Microenterprises as a Factor for Sustainable Development of the Amazon Region”, carried out in Iquitos, Peru, in November 1994, it was determined that serious consideration must be given to the establishment of agroindustrial microenterprises in the Region, to promote sustainable development of the poorest communities. Poor communities in the midst of the immense natural wealth of the Amazon region, is part of the dichotomy which it is desired to overcome with the implementation of this programme.

It is therefore intended to provide the poorest communities, the undernourished, with access to the resources which will allow them to increase their level of living. It is not the idea that fruit and vegetable resources alone will be enough to balance the level of malnutrition of some communities, but rather to promote activities that will allow them access to other resources through an increase in their purchasing power and their management capacity.

It is worth while keeping in mind that promotion of development must always be carried out on the basis of the possibility of implementing concrete productive solutions, that is, of providing communities with the possibility of being the managers of their own development. A microenterprise needs to have people who are committed, who have a mystique for joint work, with a spirit for improvement surpassing ever present differences which hinder human activities.

Another vital aspect to achieve success in this type of enterprise is the participation, at an equal level, of all the community members making up the microenterprise. That some will have greater responsibilities than others with similar benefits from the business, is the cause of a large part of the problems which have caused cooperative organization to be clearly withdrawing from Latin American communities. With a type of equal participation, in which responsibilities are shared by all, with similar efforts, where decisions are taken on the basis of sound reasoning, and as a community, in summary, with healthy relationships among the protagonists of the action, great part of the way will be ensured and a great part of the difficulties will have been solved. The special nature of the Amazon Region, may favour personal relationships and therefore, promote the necessary complementation for the implementation of strong microenterprises with a great future.

An especially important element for the success of development programmes based on the possibilities for agroindustrial utilization of Amazon resources, is the uniformity of the Region throughout the different countries comprising it. Multilateral cooperation between the countries holding parts of the Amazon region is an aspect which must be assigned priority to the benefit of the Region's most needy communities. Each of these countries have their own experiences which may be very useful to those less developed. Obviously, all of them are not at the same level, and therefore, exchange may be a very important factor for achieving the objectives of growth and the rational and sustainable use of available resources.

In general, development policies must consider the contributions that may be made by the different countries of the Region and, their regional and local experiences, which may be generally applied. It is always better to begin by implementing solutions inherent to the native idiosyncrasy, rather than to incorporate foreign solutions. For these reasons, in this case, it is necessary for multilateral cooperation policies to be considered within development mechanisms, in the TCA countries. These policies refer specifically to the exchange of technologies, training, and preparation of professionals and technicians.

In addition, great importance should be assigned to commercial exchange of inputs pertaining to this activity. The supply of containers and packaging, of certain ingredients and adequate transportation means, may be a relevant aspect regarding the possibilities for these microenterprises to be successful, some of which may be located in very isolated places.

1.5 Integral training: a didactic package

When considering training mechanisms, there always are various models for their practical implementation with the final users of the process. In this case the final users of the process are the potential microentrepreneurs who have not had formal training in the subject of food processing microenterprises; in this case, fruit and vegetable processing plants.

This special clarification about the final users, is made because within the implementation process of development programmes, the initial stages are aimed at the formation of monitors to fulfill the functions of multipliers to become the point of contact between the trainee and the subjects. However, it must be kept in mind that this type of programme is not an academic improvement mechanism for professionals and technicians participating in the programmes, it is a promotional mechanism to bring about the development of the final users of the technology provided during training.

Thus, the ideal would be to put the final users into direct contact with the technology and that - through a self learning process - it could be transferred without any type of interference, after having been rationally validated.

This Manual is part of a technological package with such an aim. It is the basis for direct practical training, between the principles and the final users, validated by a number of experiences in this field, under varying conditions and with people of different cultures and educational level. What is required from the users of this Manual is that they use it as a basis for their own development; it is not a rigid scheme to be followed, but a reference framework, which is expected to be as flexible as possible so that it will allow for the always valuable contributions of the users. In summary, a series of elements are placed at the disposal of the trainee, which will have to be managed and adapted to each particular reality; making it possible, furthermore, to motivate creativity within reasonable limits of efficiency, the profitability and stability of the business, always keeping in mind that when preparing food for humans there are certain inevitable rules established by each community, region or particular country, and above all, by common sense and the population's general well-being.

This manual therefore, is part of a didactic package which is susceptible of being perfected, but which at present has a technical and practical training programme directly aimed at the final user, consisting of theoretical classes (20%) and practical work sessions (80%) in which all the concepts and principles governing small scale fruit and vegetable processing are reviewed and then, a line of products representative of the processes applicable to the microenterprises are actually processed.

In this practical training process, the trainees participate actively in the various ways for processing raw materials and, at the same time, they are made aware of other subjects, such as personnel management, calculation of technical and economic efficiency, evaluation of the processes in terms of cost and benefit.

In the theoretical or practical sessions training through audiovisual methods has been introduced. This element is in the process of being perfected. These materials, videos for practical application, are useful in providing a clear and accurate idea regarding the manner in which to implement the various operations. These videos have been prepared on the basis of the practical sessions of the courses themselves, in other words, they have not been produced on the basis of artificial material, but on the basis of actual experiences in courses carried out under various conditions, environments and with people of different origin.

This set which now forms a package of complementary units, could be extended to other dissemination and training means that are being studied.

For the time being, each unit can be used independently, but the full benefit is obtained precisely from complementation of the various components. The theoretical classes contribute the basic knowledge which creates capacity, and is strengthened by the use of videos on actual processing and validated by experience acquired when actually carrying out the work.

An engineer who builds tunnels, will be an expert in tunnels after having built several, before that he will be a specialist.

An entrepreneur will be an expert in preserves, marmalades, nectars or pickles, after he has produced hundreds of thousands of jars of preserves, marmalades, nectars or pickles, before that he will only be an entrepreneur with knowledge regarding the subject with a beautiful vision of the future.

The importance of an expert does not lie in the image he presents, although in some cases it helps motivate others; but rather on his capacity to transfer knowledge, to teach others, on the basis of his direct knowledge.

2 SMALL-SCALE PROCESSING

In this chapter some bases will be provided for small scale fruit and vegetable processing, which must be understood as the beginning of a microentrepreneurial activity.

Small scale processing must be capable of manufacturing products of the same or superior quality than those produced by the medium or large scale industry. It is not a matter of promoting unit production, but to establish a processing line as continuous as possible; however, practically every unit being processed is controlled, and this is what ensures quality more accurately, as a result of the smaller volumes being processed.

2.1 General aspects

Fruit and vegetable processing in small volumes, must be aimed at specialty products. This is a basic management principle of a microenterprise. It is very difficult to compete when entering the business of mass produced products, which are easily processed by the large companies, that is, when processing by large companies is highly mechanized, with a very low labour input, and with large volumes of raw materials and movement of products.
It is the processing of scarce specialty products, with small volumes of raw material available for a given process, which gives raise to satisfactory business at the microenterprise level. It is for this reason that the decision regarding the products to be processed is an aspect of great importance when implementing or undertaking a microentrepreneurial project.

Some examples may illustrate the above, such as the case of tomato paste, which is highly applicable in this case. The processing of tomato paste in the present world is highly technified, including the aseptic packing process which is relatively new and involves high level technology, within food production processes. Tomato paste constitutes a commodity, meaning that it is a mass production product, with large volumes. Therefore, it is not economically advantageous to process tomato paste on a small scale, when quality is determined by a vacuum evaporation system, an aseptic flow system and by highly sophisticated packing with the use of high technology flexible containers. The smallest systems of acceptable efficiency use equipment with a daily processing capacity of several hundreds of tons of raw material.

Another case in which the approach is different but the result is the same is that of frozen fruits, vegetables or pulps from the same raw materials. In general, there is no equipment nor processing line which, under acceptable conditions of economic and technical feasibility, will permit processing small volumes for the proposed ends. Thus, it is impossible to compete with the companies or enterprises which have very costly installations and enter the market with important volumes.

These two examples provide an idea of the choice to be made of processes and products in order to develop the microentrepreneurial activity. They will necessarily be simple processes adapted to the financial capacity of the entrepreneurs, with technology levels adapted to training the personnel who will be in charge of the undertaking, with manageable production volumes, operating with limited mechanization and a high labour component.

Neither is it advisable to begin an activity of this nature with the preconceived idea that this will be the end of the entire effort, or that the purpose of this business is to remain at the microentrepreneur level. It is always advisable to have a more ambitious outlook which should be the motor of all actions. In this respect, it is advisable to understand that a microentrepreneurial project must not be an end in itself, but a means to set forth on the road toward progress; a road whose end will always be determined by the effort and conviction of the executors of the action.

2.2 Organization

When thinking about a microenterprise, the tendency is to assume that activities may take place in a relatively informal environment, where decisions are taken by all and procedures are very similar to those used within a family or group of friends.

It is advisable to understand that this approach may be very harmful to the stability of this business. Yes indeed, this is a business and as such must have a degree of organization to permit its orderly management, with knowledge of the information required to make plans, make decisions and adapt production programmes to a reality.

The above implies the formation of a simple organizational chart, clearly assigning the responsibilities of every member of the working group making up the microenterprise. This organizational chart must be very simple, because as was explained earlier, responsibilities for a given activity are often shared by several persons and one person may have multiple activities.

In a microenterprise decisions are often taken collectively, but there always must be a person in charge of making final decisions regarding aspects which are the cause of indecision, conflicting aspects, and this person must be trusted by everyone, be accepted by all. The pyramid of authority in a microenterprise is very level, in other words, the organizational chart has a small number of hierarchical levels, where very few persons give orders and many work together at the same level.

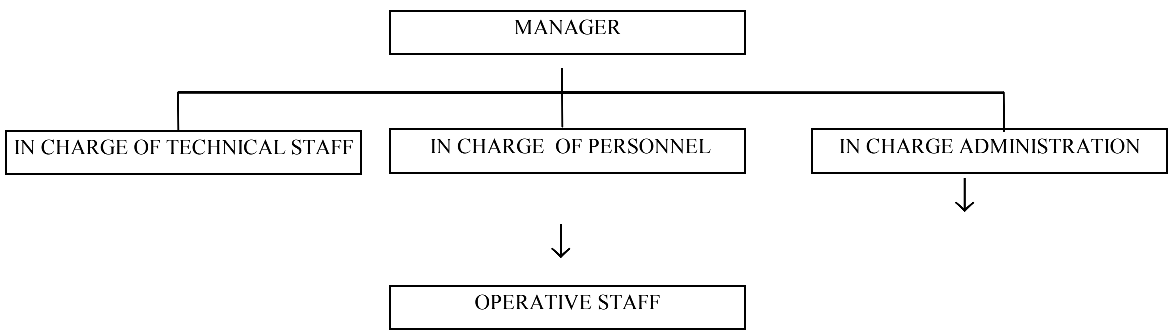
The organization must involve two fundamental aspects: the technical management of the enterprise and its administrative/accounting management. Both tasks may be carried out by the same person, taking care to make use of comparative advantages of training and aptitudes of the members of the microenterprise. This division between technical and administrative aspects is fictitious as it only serves to make resource balances to permit a continuous evaluation of the enterprise's economic and financial behaviour; it is not a real division, as the effective separation between persons of one section and another does not exist, everyone must carry out tasks in both aspects.

Formality in establishing a microenterprise, in terms of a person with legal authority, nearly always is indispensable mostly due to the fact that it must have a representation vis á vis financial agencies, both public and private; it must be represented vis-á vis technical controlling agents , such as health services, taxes and others; and above all because they must have a representation vis-á-vis those who will be their suppliers of raw material, inputs, services, etc.. The microenterprise will not always be formed by raw material or input producers. This must be clear. The proposal does not consider the transformation of peasants into agroindustrialists developing mixed activities, but the insertion of a new type of enterprise which, even consisting of former peasants, will be an independent agency, which will relate to raw material producers or suppliers horizontally and not vertically.

A simple organizational chart may be as that shown below, in which the manager is the only formal representative of the enterprise; the remaining positions may be attended by any of the members of the enterprise, even with a rotary programme of responsibilities.

It is proposed that the manager should be the only person formally recognizable as he is the person legally responsible for the enterprise. Even a microenterprise must have a legal representative, that is, someone to answer legally for the entire functioning of the enterprise.

The other three posts proposed in this scheme, must be in charge of persons with certain abilities for the enterprise to operate efficiently.



Whoever is in charge of the technical aspects must meet certain requisites in technical matters, as for example, have training in hygiene and sanitation and technical management of the processes to be undertaken. Also, he will require certain abilities in staff management, in other words, to be able to obtain the best from every person, to achieve the highest unit productivity and therefore the highest global productivity. The profitability of the business and the permanence of the microenterprise in operation will depend on productivity. The important thing is to achieve the highest possible productivity and quality, in other words, both factors combined will determine the level of success of the microenterprise. Whoever is in charge of production is responsible for this task.

The person in charge of personnel, generally, should act independently of the general administrative aspect of the enterprise. The reason for this is that this special resource, manpower, presents special problems. The specific tasks of the person in charge of personnel are to look after the quality of life of staff during work. This is a type of enterprise in which personal relations are normally closer than relationships in a larger enterprise, and it is therefore, very important to maintain harmony during work, jointly with a high productivity level. This is determined by a series of small factors pertaining to daily activities. Therefore, it is important to have answers for problems, to respect everyone's opinions, without this meaning that it will be necessary to continuously change the operation of the enterprise. To explain to the staff why it is impossible to make a change that they deem to be necessary, is as important as taking into account their ideas regarding concrete changes.

In this respect, although the number of persons may be very small, it is good to have a person to act as a link between the enterprise as a body and each of the members in particular. This post is often the responsibility of the general manager himself, in which case this person must have special characteristics, great ascendancy over the rest of the members, because to compatibilize the particular interests of everyone with the protection of the general interests of the enterprise, which is his main function, is not always easy or possible.

The task of the person in charge of personnel, is of particular importance when the microenterprise has staff under contract, who are not part of the owners' group, in other words, when there are persons linked to the enterprise by a salary and not by its profits and, therefore, are not clearly aware of the entrepreneurs' outlook towards the future.

The person in charge of administration on his part, must be the most orderly person of the entire enterprise. His responsibility is to consign in a register all events occurring in the enterprise, however small and insignificant that they may appear. An example which may illustrate this situation is the case of small "filtrations" occurring in enterprises of this type. As the workers of the enterprise are the owners themselves it is quite common for small quantities of different types of material, to be taken out of the enterprise or consumed in the act of production by the staff itself.

It must never be forgotten that one ton is nothing but the sum of many grams. In other words, to consume 10, 15, 50 or 100 grams a day may result in tons of losses a year.

This is very important, as it must be kept in mind that when forming a microenterprise, however small it may be, the private assets contributed to it, acquire a collective nature and, therefore, no longer belong to each individual but become the property of the enterprise, and therefore, cannot be disposed of freely.

But this situation which is voluntary, has an involuntary counterpart, in losses resulting from failures or carelessness in the process, unsatisfactory quality of raw materials or inputs and fortuitous situations unrelated to personal action.

All these cases must be recorded, as any of them will seriously affect the efficiency of the enterprise. Industrial yield of a given raw material, the quality of the glass containers used, failures in drinking water supplies are classical examples of the foregoing.

Many of these problems may be solved by adequate management, but to solve them, there must be data available, and such data must be gathered, put in order and maintained in a register in order to be able to evaluate the magnitude of the problem and accurately establish the causes-roots of such problems. This function is the responsibility of the person in charge of administration. The decisions regarding solutions are the responsibility of management and the staff in charge of the technical management of the enterprise.

The most relevant aspect in charge of the person responsible for administration is to record the expenses and income of the enterprise and manage the accounts, for the purpose of collaborating with the general administration in charge of the manager.

The microenterprise may obtain the advice of external services for accounting purposes, so that what is important is to have the adequate information available, and this, indeed is an internal responsibility of the enterprise.

An aspect which is worth emphasizing is the importance of having available data regarding the productive process of the enterprise, as this will make it possible to avoid the recurrence of mistakes, to evaluate processes and to implement improvements which will contribute to the development of the enterprise. Continuous improvement and implementation of complete total quality plans, will be possible only when a record of events is available in order to prepare a manual on quality in accordance with the needs of the productive system.

As proposed at the beginning of this section, the responsibility for the tasks of the technical and staff management posts and for administration, may be shared by different persons among the members of the microenterprise, but it must be pointed out that, to the extent that persons acquire a certain ability to lead others or to direct certain actions, the result of such actions will be more satisfactory, due to which excess rotation in posts of responsibility is highly unadvisable. The degree of complexity of the organization of the enterprise will depend on its nature and on how its members decide to organize its operations. There may be cases in which there is a natural leader in the enterprise, who will be the one to assume all responsibilities and thus the pyramid will become even lower, resulting in an organizational scheme with only two levels, one chief and an operational group. In many cases this has turned out to be of great benefit in decision making and business results.

2.3 Infrastructure

As a result of the size of operations and the form of financing, the investment level of a microenterprise generally is highly restricted. This leads the enterprise to assign priority to aspects relating to direct production, such as, the need for capital goods directly involved in the production and productivity of the enterprise. Even so, it is necessary to be very careful as to how funds are committed in order to serve fixed term loans, since the commercial process of a microenterprise may undergo important variations, which may signify moments of financial straights which would have a serious effect on the stability of the enterprise.

Because of the foregoing the possible infrastructure of an agroindustrial microenterprise for fruits and vegetables processing must be very simple, taking care to meet basic requirements in order to maintain the necessary level of hygiene and sanitation of a process involving, via consumption, human beings at different destinations.

For the purpose of analysis, the infrastructure of a fruits and vegetables processing plant may be divided into two aspects: civil works requirements and available utilities, and availability of equipment.

2.3.1 Civil works and utilities

The premises of a processing plant must meet certain specifications for its operation which, normally, are clearly defined in the internal regulations of every country regarding the installation of food processing establishments. This is due to the duty health authorities in every country have regarding public protection. Therefore, the mentioned regulations may be a good starting point to define the infrastructure in civil works and utilities.

On the basis of the instructions set out in the official regulations, it is possible to design an adequate implementation in line with the funds available to the enterprise. There are certain basic principles which must be considered in every case if they are not already included in the official regulations.

Some of these principles are:

- The materials used in the installations must be of a permanent nature, which will make it possible to work under acceptable safety conditions.
- Material used must be easy to clean, so as to keep the premises in adequate sanitary and hygienic conditions. An example of this is that the floor cannot be earthen, but must be of a material that may be wet for cleaning and permit sanitary treatment.
- The industrial installations must have an adequate supply of drinking water, or water of such quality that it could be treated at the plant, to ensure the permanent operation of the enterprise.
- As far as possible, the installations should permit work with natural light, if this were not so, artificial light should be adequate to make work safe and to maintain acceptable levels of quality in the processes and products.
- The surroundings of the processing room must be adequate for a food producing enterprise. This means that there are at least two aspects that must be considered as vital when planning an installation such as this, the effect that the environment will have on the plant's operation and the effect of the plant and its activities on the environment. The first considers the hostile effect that the environment could have on the plant and the second considers the impact that the plant's processes may have on the environment.
- According to the above, the location of the plant is of primary importance among the decisions that must be made when implementing a project of this nature.
- The location will also depend on conditions for the supply of raw material, access of inputs and outlet of products towards the markets.

Obviously, there are a series of details that must be taken into account when adapting or constructing premises for fruit and vegetable processing, but these are matters of common sense and will depend on the availability of resources and on the assistance the microenterprise may obtain at the time of implementing its project.

Of the mentioned aspects, maybe the one to which the least attention is paid when planning an activity as proposed in this Manual is the relationship between the processing plant and the environment. In this respect, it is very important to understand clearly that the environment around an installation such as this, which carries out processes of certain characteristics, may be very hostile. For example, the presence of insects around processes using important amounts of sugar; high temperatures which affect the preservation of raw materials before processing; possible contamination with sewage in very humid environments, are some of the cases in which special procedures will have to be implemented to prevent important deficiencies in the management of the enterprise.

Also present is the effect of the process on the environment which is one of the most critical points, and which sometimes is difficult to control. A fruit and vegetable processing plant can produce important volumes of solid residues and also of liquid effluents.

These effluents are not very dangerous to people, nor to the environment, but they pose the problem of causing chronic and gradual deterioration of the environment which is systematically attacked by such residues, which have a high sugar content and a great volume of fermentable material which is highly oxygen consuming.

Thus, it is very important to have a means to control and dispose of effluents. This is particularly true when the environment is highly sensitive to impact, as in the case of the most isolated areas of the Amazon region. Therefore, the most important thing is to be aware of the significance of this subject; the technical means to solve the problem will come by themselves.

One way to tackle the problem may be to use the residues and by-products of the process, which would also make it possible to use resources more integrally.

A point worth emphasizing is the care that must be taken not to contaminate the plant’s water sources with industrial residues, and even less with the staff’s domestic and septic residues. This appears to be obvious, but it is not so much so, especially when water courses are natural and are not easily controlled. It is particularly important to keep sanitary facilities and the disposal of their residues far from water sources for the industrial process, in other words, it is necessary to maintain adequate distances between the cesspool and the water well (not less than 80 meters horizontally, and the water well must always be higher than the cesspool).

In summary, it is advisable when planning an installation as that required for fruit and vegetable processing, that due consideration be given to the compromise that must always exist between available financing and technical requirements to be met. For instance, however great the need and effort to create a microenterprise, and even if the necessary resources are available, it is not possible to implement the project unless potable water or water that may be made potable is available, in other words, there are factors that constitute unsurmountable limitations, and nothing can be done if they are not available.

2.3.2 Machinery and equipment

The implementation of the plant with the necessary equipment to satisfactorily process fruits and vegetables, including roots and tubers, is a widely varying subject. Everything is determined by the variety of resources, but generally, it can be said that, given the scale at which it is intended to operate, the required level of technology is basic and consequently, the equipment is also simple and, therefore, not costly.

It must be kept in mind that this type of processing has an important labour component, due to which the equipment considered, is rather meant to support the task of the members of the enterprise.

A number of small size utensils are required to increase the normal efficiency of a housekeeper and turn her into an efficient microenterprise operator. Some of these elements are different types of knives, spoons, colanders; different types of trays and pots and jugs, wood or plastic cutting boards, and cleaning elements.

On the other hand, it is important to have some mechanical elements to help in the process of operations that cannot be done by hand, especially because of the inefficiency this involves. In this case, mechanical, manual or electrical appliances are available for grinding and filtering fruits, extracting pulp and juices, cutting up of various raw materials, capping bottles, putting lids on jars, sealing flexible containers, measuring large weights.

Finally, there are some elements which constitute the group of required instruments, including those with which to measure sugar contents (refractometer), small accurate weights (gram level scales).

Additionally, all elements which might help improve production as a whole and control activities in a plant of this type may be included, for instance, mention may be made of adequate furniture, computers, calculators. Most of this equipment and machinery may be easily acquired in several Latin American countries, the United States and Europe, at accessible prices for a small scale project.

Two essential elements, which should be adequately designed are the washing system for raw materials and others and the pot heating system. The first must be of a design such that it will permit efficient washing of important volumes of fruits and vegetables, allowing for soaking, treatment with sanitizers and drainage, avoiding loss of time and excessive use of water. The second, must be adequate for quick and efficient heating of important volumes of fruits and vegetables, juices and nectars; large volumes of water for sterilization and heating of the containers for various products.

3. TRAINING THE MICROENTREPRENEUR

When the reasons for training were discussed, it was pointed out that the main objective was to enable the persons who were to work in a microenterprise processing fruits and vegetables or in any other type of microenterprise, will be able to carry out their tasks at an adequate level of efficiency and ensure the success of the business with their performance.

For this purpose, it is necessary for microentrepreneurs to gradually become experts, technically and entrepreneurially speaking, by gradually overcoming the limitations they may have, so that they will be capable of tackling the challenges with a quality criterion which will distinguish them.

For a beautiful dream to become a vision for the future requires an effort, and in this respect it must be kept in mind that work of good quality is only possible if done by a trained person; amateurs will only be spectators in a real project; the actual executors will be those who are really trained to place their products in a highly competitive world, taking advantage of the opportunities that come up and trying to overcome the weaknesses often arising in a small enterprise.

Therefore, it is necessary for entrepreneurs, each in his field, to be capable of contributing their best, and for this it is essential for them to be acquainted with the various elements that are important to carry out the activity adequately. In this respect, it is advisable for everyone in an enterprise to receive the same training so that subsequently, they may be assigned the specific tasks they will carry out.

Some of the fundamental principles on which training for entrepreneurs should be based, will be presented in this chapter.

3.1 Basic principles of food preservation

There are some basic principles in food processing which make this a very special activity.

Some of these principles are the following:

- The raw material used will be reflected in the processed product. This means that a good quality product can only be obtained with good quality raw material.

- The quality of the process depends on the capacity of the workers and on the manner in which the process is conducted. This implies that the entire process must be carefully controlled, no matter how simple or short it is.

- The processes must be ordered, divided into clearly identifiable and assessable operations. Such flow charts should be constant, so that products will be continually reproduced.

- Uniformity of the products in the short, medium and long terms is a determinant characteristic of the quality and acceptability of the products of the enterprise.

- Personal hygiene, sanitation of the equipment and infrastructure, the hygiene of raw materials and their origin, are highly determinant in the product's sanitary quality.

- There are key operations in each of the processes that must be strictly controlled to ensure their effectiveness in food preservation. Some examples are: sterilization of preserves, sugar content in marmalades and adequate mixture of ingredients in sauces and nectars.

These basic principles are especially important and must always be kept in mind to produce food of minimum acceptable quality, to be safely consumed by all who trust that an adequately sealed and labelled food has been correctly processed. In fact, quality should be far superior to the required minimum to be successful in the market.

3.1.1 . Importance of the raw material

Considering the large variety of raw material existing in the Amazon region, care for its quality constitutes one of the most important aspects to obtain products of uniform quality. In view of circumstances, it is recommendable for enterprises to become specialized in a few products and, in the measure that they learn to handle these raw materials, they may gradually incorporate new species.

Environmental conditions in the Amazon region cause highly perishable raw material to decay quickly, such as those that are processed for the purpose of this Manual. Some of them are more resistant, but after harvesting most fruits and vegetables do not tolerate the high temperature and humidity conditions prevailing in the Amazon region.

For these reasons, ideally the time between harvest and processing should be as brief as possible, taking care that the condition of raw materials when harvested is the best possible. At the same time, care must be taken regarding conditions during waiting periods, in other words, transportation and temporary storage conditions must be adequate, controlling environmental conditions as far as possible with the implementation of cooler locations with better protection from insects and other harmful animals.

In the measure that raw material meets processing requirements, the characteristics of the products will be better. The contents of soluble solids, the firmness of the fruit, colour of the pulp, fiber contents of roots and stems, the degree of turgency when processed, are some of the attributes that affect the industrial quality of the raw material.

On the other hand, industrial yield will be important in determining the profitability of the processes, and it will often affect processing efficiency and therefore the productivity of the enterprise. Industrial yield is the relation between the product and the raw material, as regards weight, i.e., the quantity of raw material required to produce a mass unit of product. Thus the greater the ratio, in other words, the more kilograms of raw material required to produce one kg., of product, the lower the yield will be, and therefore, the incidence of the cost of raw materials in the cost of production will be greater.

In this respect it must be kept in mind that the cost of raw material equivalent to a mass of finished product, must be calculated taking into account industrial yield.

If the raw material yields 50%, that is, if two kilos of raw material are needed to produce one kilo of product, then the cost of the raw material in the product will be its purchasing price multiplied by two. Thus, if a price of 100 is given for a raw material, the real cost of this raw material will be 200, as half of it is worthless waste.

This ratio must be taken into account carefully because often the process is highly determinant of the raw materials' industrial yield, and in other cases the quality of the raw material varies considerably. In both cases there is the possibility of a mistaken estimate of the value of the raw material and, therefore, the possibility of making a serious mistake leading to economic loss.

The quality of a given raw material in general, is determined by:

- Its aptitude for the selected process.
- The history of the crop as regards health and hygiene.
- Agricultural or harvest yield of the specie and variety.
- Industrial yield and its processing qualities.
- The uniformity of the variety or cultivar used.

3.1.2 Quality of the process

This is an aspect requiring special attention and is the basic objective of every training process for fruit and vegetable industrialization projects, other foods and every type of manufactured product. In recent years, attention has been focused on the quality of the process rather than on the quality of the products. This is because it has been verified on many occasions that, in as far as the process is adequately controlled the product will be of a satisfactory quality. This implies that every stage of the process, or every operation, is controlled by the workers themselves and in turn verified by the workers of the following stages.

Therefore, it is a matter of acting properly from the beginning; of not having to go back along the processing line; of complying with the requirements of the following stages and in the briefest time possible, thus ensuring adequate productivity with good quality products.

All the above may be achieved only with trained personnel, who knows exactly what to do in each case, who will carry out their task conscientiously. The existence of written control measures is very important for this purpose, of a manual on procedure to ensure that control is established, always the same and as a routine, and not administered arbitrarily by those in charge of the process.

3.1.3 Flow charts and their usefulness

In the measure that each enterprise has defined the products to be manufactured, it will need to develop flow charts for all processes and adhere to them as strictly as possible. This will produce the necessary uniformity to keep the consumers' interest in the products. The uniformity of the processes will help keep the uniformity of the products in great measure.

After a product has been developed and it has met the consumers' expectations, its formula and processing must not be altered, in order to satisfy the consumers.

Another important aspect of the established flow charts, is that in the measure that written procedures are followed accurately, it is very unlikely that mistakes will be made, in other words, the quality of the procedures and the performance of the staff will be maintained even under routine conditions.

Flow charts must meet certain requisites in order to be useful:

- They must be clear, i.e. be designed in such a way that they may be understood by everyone who must use them.
- They must be complete, i.e., they must include all the necessary elements to show the entire process.
- They must be as simple and as unequivocal as possible. They must not be misleading and must be self-explanatory.
- They must be stable, i.e., they must not be modified continually, but only as a result of justified changes.

3.1.4 Uniformity: the central aspect of quality

This is one of the most relevant aspects of quality. Uniformity is the first attribute that consumers look for when visualizing any product. Appearance comes before aroma, before taste; it is the factor which often determines consumer acceptance.

Therefore, efforts must be made to maintain the uniformity with which consumers will identify products, in the short term of one season, in the medium term of consecutive seasons and in the long term over the years. Recognition of a given attribute will always be the factor which will determine consumer acceptance, and this is borne out by the "bouquet" of a good wine, the aroma of a good "dried and salted meat". Maintaining uniformity between batches of a same product, therefore, is a matter of the utmost importance.

3.1.5 Hygiene and sanitation: determinant factors

These two factors are always important among those determining the quality of a process and a product. Personal hygiene is one of the most important external factors for food preservation.

Handling of food by persons with contaminated hands, the use of water contaminated with human residues, contamination with hair, skin and clothes, constitute the most frequent problems and the most difficult to control in the food industry.

The sanitary quality or hygiene of raw materials is also the cause of inadequate quality. All raw materials are contaminated to some degree. The point is that its level should be such that it may be counteracted by the process, either during washing and sanitizing, or through treatment for the control of micro-organisms.

If the level of microbe contamination is very high, the processes will not be sufficient and, therefore, the product's micro-biologic quality. will be deficient.

When contamination is due to micro-organisms dangerous to consumer health, the problem becomes complex, and it is necessary to be very careful when selecting raw materials, recognizing their micro-biologic quality from their cultivation or harvest history.

Lastly, the cleanliness of the equipment and infrastructure and their sanitary condition are also very important to the quality of the processes and products. Clean material is always susceptible of being re-contaminated and this is one of the most difficult problems to solve in a processing room. There is a very important point in this respect, and that is that no sanitizing process will be effective if the surface on which the sanitizing agent is applied is dirty. This means that every sanitation process of equipment, work tables, floors and walls, must be preceded by careful cleaning. Fortunately, possible dirt on fruits and vegetables is always very easy to remove, because it is mostly soluble in water.

3.1.6 Every process has a basic operation

All processes pertaining to food preservation have a basic operation.

The basic operation for food preservation is the transfer of heat, in other words, thermic treatment to destroy micro-organisms harmful to human beings and which deteriorate food. This thermic treatment consists of a combination of temperature and time to meet the necessary sterilization objectives.

Under small scale conditions, it is not advisable to work with thermic processes using temperatures over the boiling point of water at atmospheric pressure. The use of pressure cookers is possible but difficult to control accurately. It is not expected to have a source of steam available, so that pots would be heated by the conventional system of an industrial burner, which makes their control difficult. This situation leads to the recommendation that only acid or acidified products should be used, which can be treated at 100º C (boiling point of water at the normal pressure of one atm.) Once more it is necessary to emphasize that a product with a low initial contamination level will be easier to treat than one that is more contaminated.

The basic principle in the marmalade production process, is the product's sugar contents. This is obtained by evaporation of water and the addition of pure sugar. When increasing the sugar contents water activity, or the free water contents, available for micro-biologic, chemical and bio-chemical deterioration processes decreases. The use of uncontaminated raw material and the decision to use only fruit and sugar to ensure the product's natural quality is the key for this type of process.

When preparing fruit sauces and nectars and eventually, certain vegetable sauces, the basic principle of the process is the adequate formulation of the products, but in terms of preservation, pasteurization is the fundamental operation. The latter is a thermic treatment similar to that for the sterilization of preserves, but sometimes less intensive. It must be kept in mind that this always refers to acid products with a pH below 4.5.

As in the case of pickles, acidification is fundamental for the preservation of many fermented products or for preserves for which vinegar is used as a packing medium. Acidity at pH levels of 4.0 or less, has a selection effect on the bacterial flora that makes it possible to eliminate all organisms harmful to health and most of the saprophytes which cause deterioration. A pasteurization operation may be useful to stabilize the product.

These are some examples relating to processes applicable to fruits and vegetables. Further on more details will be given regarding the processes and their use.

3.2 How to develop an efficient *layout*

The *layout* is the organization of the processing room in such a way as to allow efficient management of work, the best use of time and the best control of operations.

It is often assumed that an adequate organization of processes in a microenterprise is impossible because of space limitations, lack of resources and, above all, because it is believed that orderly line processes are the privilege of medium and large scale enterprises. However, experience has shown that it is possible to develop organization even in a kitchen. The important thing is to have a clear basic design.

The adequate design of a processing room involves a series of advantages relating to the use of space, optimization of the use of time and organization of the operations.

In this respect it is important to consider the following elements when designing a *layout* for the processes of a microenterprise:

- It is advisable to divide processes into sections, identifiable by their nature, for example, it is necessary to have a clear separation between the dirty zone of the processing room, which is used for receiving and cleaning raw materials and the zones for clean processing to avoid recontamination of clean semiprocessed products.

- The processing line should be straight or with 90º changes of direction. Such changes should coincide with sections of the room and, inter-crossing of the line should be avoided as they cause serious flow interruption problems. This situation is always related with serious problems of efficiency and loss of time.

- The packing zone must be the cleanest area of the room and must always be kept clean and sanitized.

- The heating area must be safe and should be located in such a way as not to interfere with the circulation of staff. It should also be near the cooling area (a drainage pool), to avoid the transfer of pots with containers and hot water over large distances.

- The rest room area must be totally isolated from the processing room. The possibility should never be allowed that water from the bathrooms may reach the processing room. A recommendation is to place the bathrooms at a lower level than that of the processing room floor.

- A very important aspect of a microenterprise processing room is that it must be versatile, it must be capable of being quickly adapted for processing different raw materials, and using different processes for different products.

Therefore, an adequate *layout* will make it possible for a microenterprise to come near industrial management: evaluate efficiency and the performance of personnel at every stage of the process and, at the same time, make it possible to gather information to provide the bases for the adequate administration of the enterprise. All of this will be possible thanks to the design of an orderly and rational process. Finally, a principle that must be kept in mind is that it is always possible to improve a design; all organizations may be improved.

3.3 Processes and flow charts

As has already been proposed all processes and products should be clearly defined in the so-called flow charts. There should be a precise chart for every process and particular product, at any given time, as a basis for its implementation and operation in production activities.

Following are the most common processes applicable to Amazon raw materials with their respective flow charts. Flow charts for the different products will be developed in Part II.

The processes which will be considered in this chapter are the following:

- **PREPARATION OF PRESERVES**
- **PREPARATION OF MARMALADE**
- **PREPARATION OF NECTAR**
- **PREPARATION OF SAUCES AND PURÉES**
- **PREPARATION OF PICKLES**
- **OSMOTIC DEHYDRATION**

Each of these processes will be analyzed on the basis of their flow charts, which may be adapted to the particular conditions of each enterprise.

As stated earlier, no process has a rigid permanent process, change is a condition for growth, and therefore, it must be clear that evolution always implies modifying pre-established schemes. It is also important to keep in mind that such changes are not arbitrary, nor hazardous, but rather the result of analytical processes in which the bases for such changes must be clearly set out.

As will be seen, there are a series of operations that are present in the flow charts of all the processes, and others that are specific to each process. This must be considered as a very important factor when designing a processing room, as it implies that there are areas which may be used simultaneously for several processes and products. Such is the case of the reception of raw materials, cleaning, selection, packing of products and sterilization, among others. This implies that the necessary action must be taken to avoid confusion, contamination of one product with another and above all, accidents which unfortunately occur more often.

Basic operations included in flow charts

In this section a listing will be given of the operations included in flow charts with a brief description, which considers the technology of small-scale fruit and vegetable processing. Obviously not all existing operations will be considered, but only those of a general nature, that is, the ones included in all processes.

- **Reception:** This is an operation of great importance in any productive activity of the agroindustrial enterprise. It consists in receiving from the suppliers the raw material required in accordance with the specifications previously delivered by the enterprise. The fact of receiving implies acceptance of what is delivered, that is, acceptance of the fact that the condition of the material meets the requirements of the enterprise and its process. This operation implies a commitment for payment of the material received and, care must be taken to clearly specify if what meets requirements is all or part of the batch received for the purpose of fixing the amount to be paid for same.

- **Weighing:** This is one of the operations of greatest commercial significance among the activities of the enterprise, as it involves quantifying several aspects, including the volume purchased, the volume of adequate quality for processing, the data on the volume for quantifying yield and, lastly, what is more important, the volume to be paid to the supplier and the volume which will be processed.

- **Washing:** Cleaning of raw materials, the removal of dirt, remnants of crop contaminants, traces of pesticides, is an operation that must be done in the case of practically every product. Except some berries, most fruits and vegetables must be washed and sanitized by immersion in a water solution with chlorine. The quantity of water must be enough to remove dirt, without adding excess water, producing lixiviation or washing off nutritive elements or components of the raw material.

- **Selection and classification:** These operations imply a separation. Selection means to separate according to the criteria of "**it passes or does not pass**", in other words, acceptance or rejection of a given material. Classification on its part, means ordering the material in categories, assuming that all the material to be classified has been previously selected and accepted. Selection is normally carried out on the basis of size, maturity, mechanical damages, phytopathological damage, or other physical characteristics such as colour, texture, etc.

- **Peeling:** This operation consists in eliminating the peel from a raw material through mechanical or chemical means. Normally, as it is a small scale operation, it is advisable not to use chemical means and, therefore the use of manual peeling with knives is preferred. Special care must be taken during this operation because of its incidence on yield, in other words, what percentage of pulp is removed by peeling.

- **Commercial sterilization:** This is the central operation in most processes, as far as the conservation of the products is concerned. It corresponds to thermic treatment to reduce the number of micro-organisms to safety levels. In a small scale process, the temperature is normally near that of the boiling point of water, that is, at 100º C at sea level. The treatment time depends on the nature of the product, but in general, for acid or acidified products times near 20 minutes at 100ºC are used. For low acidity products, of a pH of around 4.5, treatment time at 100ºC, should be 30-40 minutes. A small scale operation is unlikely to have pressure sterilization systems, especially for glass jars which require counter-pressure to keep lids hermetic.

- **Importance of altitude on the boiling point of water:** In this respect, it is important to keep in mind that the altitude of the locality where the process is being carried out, with respect to sea level, has an important incidence on the boiling point of water. This means that water boils at a different temperature depending on the altitude above sea level where the processing plant is located. Table 1 shows the relation between altitude above sea level, boiling point (temperature at which water boils) and concentration of the product being boiled.

TABLE 1

Brix º	Sea level	500 m	1000 m	1500 m	2000 m	2500 m	3000 m
50	102.2	100.5	98.8	97.1	95.4	93.7	91.9
60	103.7	102.0	100.3	98.6	96.9	95.2	93.4
62	104.1	102.4	100.7	99.0	97.3	95.6	93.8
64	104.6	102.9	101.2	99.5	97.8	96.1	94.3
66	105.1	103.4	101.7	100.0	98.3	96.6	94.8
68	105.7	104.0	102.3	100.6	98.9	97.2	95.4
70	106.4	104.7	103.0	101.3	99.6	97.9	96.2
72	107.3	105.1	103.8	102.1	100.4	98.7	96.9
74	108.3	106.6	104.8	103.1	101.4	99.7	98.0
76	109.5	107.8	106.1	104.4	102.7	101.0	99.2

Source: Prepared by the authors

These operations are the ones mostly used . When in some processes other specific operations must be applied, they will de described in the flow charts of the respective process.

All the processes listed, have different technological possibilities and their implementation may go from simple manual lines to large very complex lines, with high levels of technology. In this case a general scheme will be shown which may be adapted to existing conditions and resources.

3.3.1 Preserves

This process considers two basic principles for food preservation:

- Commercial sterilization of the product, that is, the elimination of all microorganisms harmful to human health and the drastic decrease of microorganisms which deteriorate food, or saprophytes. This is a thermic treatment involving the application of a given temperature for an established period of time.

- The use of hermetic containers to maintain the sterile conditions of the food. Normally tin cans or glass containers are used.

Theoretically, any food may be processed this way. However, sensorial quality will be determinant in selecting the products to be made through this process.

This is a process generally used in fruit and vegetable processing, but not all of them can be treated with this preservation method. Many will present serious problems regarding their organoleptic nature which will make them unacceptable to the consumer.

The composition of a preserve generally includes a solid component which is the basis of the product and a liquid or semiliquid component, which is the packing medium for the first. In some cases the product is only a semi-solid, as in the case of some fruit pastes and purées which, because of their consistency, are considered as solids for the purposes of the thermic treatment to be applied.

The intensity of the thermic treatment of a preserve will depend on three aspects:

- The pH of the material to be sterilized, will be very important when choosing the thermic treatment. Products with a pH below 4.5, will be treated less intensively because of their acidity, than products with a pH over 4.5, in which case their low acidity is considered. It is highly advisable for small scale installations to process only acid or acidified products, because of the difficulties of excess pressure involved in a treatment for low acidity products.

- The physical nature of a food product in the container. Thus, if it is a case of low consistency liquid foods or solid foods in chunks in a liquid, the treatment will be briefer because the transfer of heat by convection in a liquid is easier than the transfer of heat in a solid.

- The size of the containers will also be determinant as regards treatment. For large containers, the treatment should mean more time at a same temperature than in the case of small containers.

Fruit and vegetable preserves may be covered or packed differently, such as with sugar or salt solutions, acidified brines, pure vinegar or acetic acid solutions, aromatic vinegar or acetic acid solutions, oil, fruit juices, etc.

In general, packing mediums do not differ in relation with the thermic treatment, except if their viscosity is very high, as in the case of some products preserved in sauce. Therefore, thermic treatment will be the same for products with an equal pH and containers of approximately an equal size. A preserve that has been treated adequately and is in an adequate hermetic container should have a duration of not less than two years. In general, it can be said that a properly prepared preserve, in a glass container will have a very long practically indefinite duration. As it would be expected that it will be consumed within a reasonable period of time, its duration, or rather, its usefulness would be indefinite.

Some examples of preserves are chunk fruit in syrup, vegetables in brine, vegetables in aromatic vinegar (pickles), sauces and vegetables in oil. Figure 1 shows the general flow chart for preserves.

FIGURE 1 **_PRESERVES_**

RECEPTION

↓

WEIGHING OF RAW MATERIAL

↓

WASHING OF RAW MATERIAL

↓

SELECTION

↓

PEELING

↓

CUTTING IN ACCORDANCE WITH THE NEEDS FOR THE PRODUCT

↓

WEIGHING

↓

FORMULATION
(depends on the packing medium used)

↓

PACKING OF SOLIDS
(in the adequate weight proportion)

↓

FILLING WITH PACKING MEDIUM
(the adequate proportion in weight)

↓

PREHEATING TO ELIMINATE AIR
(at least up to 85ºC)

↓

REFILL CONTAINER WITH HOT PACKING MEDIUM

↓

HERMETIC SEALING OF THE CONTAINER

↓

STERILIZATION
(Time and temperature according to product.
In general terms 15/20 minutes at 100ºC
for acid products)

↓

COOLING CONTAINERS

↓

DRYING, LABELLING AND STORAGE

3.3.2 Marmalade processing

A marmalade, from the view point of this Manual and of most of the Latin American countries, consists of a mixture of whole, chopped or ground fruit with an equal quantity of sugar (granulated saccharose), which has been heated and evaporated until a sugar concentration equivalent to 65º Brix has been reached. The basic preservation principle of marmalade is its low water activity because of its high sugar concentration. To measure Brix degrees through temperature, see Table 1.

The quality of a marmalade will always be determined by the quality of the raw material used, but whole fruit or in chunks will give the product a special characteristic, for which it will always be considered to be of better quality than a product prepared with pulped fruit.

Another aspect of utmost importance in determining the quality of a marmalade is the presence or absence of preservatives. It is assumed that a marmalade made with healthy raw material, well processed and vacuum packed will be a very stable product over time.

This product will not require preservatives as the vacuum will keep fungus and leavenings from developing inside the container, and preservation at 65º Brix will avoid the appearance of bacteria. After opening the container it must be kept cool (refrigerated). There is a growing demand for this type of product, without preservatives, nor additives, from good quality fresh fruit and free from contaminants, in discriminating markets in countries with greater purchasing power.

Generally a marmalade may be prepared with all fruits and many vegetables, but as in the case of other products, some raw materials have important sensorial advantages. A general flow chart for processing marmalades is presented in Figure 2.

3.3.3 Nectar processing

Nectar is a drink prepared with fruit pulp, either natural or concentrated, with the addition of sugar and water. In other words, there is an important difference between a fruit juice and a fruit nectar; it is expected that juice is the result of pressing the fruit or its pulp or the vegetable, and that it does not contain any other ingredients including water.

Thus, nectar is a formulated product, in other words it is prepared according to a pre-established recipe or formula which may vary according to the preference of the processors. Consequently, every enterprise may have its own formula for the preparation of aguaje nectar.

Normally, a nectar is a product containing 15º Brix or 15% sugar. The pulp content per kilo of nectar or the relation between pulp and water of a nectar, is established by the formula developed by the enterprise itself.

This formulation, which will be discussed in detail in the second part of this Manual is an empirical process, of trial and error, until the product is acceptable to all those responsible for its development.

The formulation process consists in the preparation of several formulas with different proportions of pulp and water, all of them standardized with sugar to a given Brix, which is generally of 14/15º Brix. This means that formulas of 1:1; 1:2; 1:3; and 1:4 pulp/water are used, taken to 14/15º Brix adding sugar and submitted to the approval of the group of technicians. After the product has been developed, it will be tried with normal, non-specialized consumers, within the enterprise itself, to make sure that the appreciation of the technician's taste is adequate.

As was stated earlier a nectar is pulp, sugar and water which therefore, may be prepared with any fruit or vegetable that can be pulped. Nectar can be produced from fruits, stems, leaves, roots or tubers, it is only desirable that they can be pulped, and that an adequate yield is obtained, with a small fiber content and sensorially acceptable.

A nectar is not a stable product by itself, it needs to be preserved through commercial sterilization. If it is of a low acidity level, it must be acidified to make the thermic process as short as possible, so as not to damage the product's nutritive and sensorial quality too much. Normally, the product is acidified with the addition of citric acid or lemon juice.

Nectars are usually bottled in glass bottles and sterilized after having filled the bottle with the hot product. Figure 3 shows the general flow chart for preparing nectar.

3.3.4 Preparation of sauces and purées

This process is not a preservation method in itself, because of applies several of the general principles for the preparation of different products with culinary attributes and serves to use raw materials commonly existing in different productive or natural systems.

These products are formulated on the basis of a large variety if ingredients and all of them are mixed in proportions which, once more, will depend on the taste of the processors and their appreciation of consumer demand. These are usually finely pulped products, used as dressings to accompany dishes, and contributors of flavour and aroma. They are products that are preserved by a combination of solid concentrates and commercial sterilization.

Due to their nature, they are not self preserving, their water activity is too high for preservation and they require thermic treatment and hermetic packing to be preserved for one to two year periods.

These sauces may contain preservatives, but as in the case of marmalades, they are preferred when they are free of preservatives and additives and are the expression of a natural product. This is especially true in the case of microenterprises with small production volumes and when they are to be placed on select markets, with a great discriminating capacity as to quality.

Among the most common products are tomato, mango and garlic sauces; although it is possible to find others of varying nature and it is expected that with the diversity of Amazon products, there will be many other possibilities for exotic products with a reasonable potential demand.

Figure 4, shows a general flow chart which might be applied to products such as those mentioned. As stated earlier, the formulas for the products are part of patrimony of every enterprise and their development will depend on the particular interest placed on this type of process.

Due to the complex composition of most of these products, it is necessary to be very rigorous as regards the quality of the ingredients, as each of them may affect the quality of the final product. Many such ingredients are previously processed material, powdered, and it is advisable to make sure that they are of outstanding quality, purchasing trade marks which are reliable in this respect.

Another aspect requiring special attention is related with the uniformity between different lots of the same product. For the same reason as before, i.e., the complexity of the formulas, there is a great risk of error in this type of process and it is necessary to be extremely careful in adhering strictly to the -pre-established flow charts and the formulas.

FIGURE 2 ***MARMALADE***

WEIGHING RAW MATERIAL
↓
WASHING RAW MATERIAL
↓
PEELING (Optional)
↓
CUTTING ACCORDING TO COMMON STANDARDS FOR THE PRODUCT
↓
WEIGHING AND FORMULATION (1 kg. sugar for each kg. of prepared fruit)
↓
HEATING FRUIT TO THE BOILINGPOINT WITH 10% OF THE SUGAR (stirring constantly)
↓
MEASUREMENT OF BRIX DEGREES
↓
ADDITION OF 30% SUGAR; MAINTAIN EVAPORATION FOR 15 MINUTES (stirring constantly)
↓
MEASUREMENT OF BRIX DEGREES
↓
ADDITION OF 30% SUGAR, CONTINUING EVAPORATION FOR 15 MINUTES (stirring constantly)
↓
MEASUREMENT OF BRIX DEGREES
↓
ADDITION LAST 30% SUGAR; EVENTUALLY ADDITION OF 0.5-1% PECTIN
↓
MEASUREMENT OF BRIX DEGREE (do not exceed 55-60 º Brix)
↓
STIRRING AND EVAPORATION UNTIL 65º BRIX (never concentrate to less than 65º Brix)
↓
FILLING CONTAINERS HOT (not less than 90ºC)
↓
HERMETIC SEALING OF THE CONTAINERS
↓
NATURAL COOLING OF THE CONTAINERS
↓
WASHING CONTAINERS
↓
DRYING,LABELLING AND STORAGE

FIGURE 3 ***NECTAR***

WEIGHING RAW MATERIAL

WASHING RAW MATERIAL

SELECTION

CUTTING AND REMOVAL OF SEEDS IN FRUIT WITH PITS
(small seeds may be left in)

HEATING FRUIT TO BOILING POINT (stirring constantly)

MEASURMENT OF BRIX DEGREES OF FRUIT

PULPING OF HOT FRUIT

MEASURMENT OF BRIX DEGREES OF PULP

FORMULATION OF NECTAR

DILUTION OF PULP WITH A GIVEN AMOUNT OF WATER

ADDITION ESTIMATED AMOUNT SUGAR TO REACH DESIRED CONCENTRATION ((Normally around 15º Brix)

MIXING AND HEATING TO THE BOILING POINT

VERIFICATION OF CONCENTRATION

MIXING AND HEATING AGAIN TO BOILING POINT

REMOVAL OF SURFACE FOAM

FILLING OF CONTAINERS, HOT (not less than 90º C)

HERMETIC SEALING OF CONTAINERS

STERILIZATION (100º C for 15 minutes)

COOLING CONTAINERS TO ROOM TEMPERATURE

DRYING, LABELLING AND STORAGE

FIGURE 4 **_SAUCES AND PURÉES_**

WEIGHING OF RAW MATERIAL

↓

WASHING RAW MATERIAL

↓

SELECTION

↓

MEASUREMENT OF DEGREES BRIX OF EACH COMPONENT

↓

FINE CUTTING OF EACH PRODUCT INCLUDED

↓

FORMULATION OF THE PRODUCT

↓

SPECIAL PREPARATION OF SOME COMPONENTS

↓

MIXTURE AND HEATING TO BOILING POINT

↓

COOKING TO TENDERIZE COMPONENTS

↓

PULPING HOT MIXTURE

↓

MEASUREMENT OF BRIX DEGREES OF MIXTURE

↓

EVAPORATION OF PULPED MIXTURE UNTIL ESTABLISHED CONCENTRATION IS REACHED

↓

VERIFICATION OF BRIX DEGREES

↓

FILLING CONTAINERS HOT(not less than 90ºC)

↓

HERMETIC SEALING OF CONTAINERS

↓

STERILIZATION OF THE CONTAINERS (100ºC for 40 minutes)

↓

COOLING CONTAINERS TO ROOM TEMPERATURE

↓

DRYING, LABELLING AND STORAGE

3.3.5 Pickle processing

As was mentioned earlier, the basic principle controlling the pickling process is acidification of the medium.

This decrease of the medium's pH may be achieved by natural acidification as a result of a fermentation process with obliged anaerobic bacteria of the homo-fermentative type, which produce lactic acid. This process may in most cases take several months, reaching stability in a term of nearly 3-4 months.

FIGURE 5 ***PICKLING***

WEIGHING OF RAW MATERIAL
↓
WASHING OF RAW MATERIAL
↓
SELECTION
↓
PEELING (optional)
↓
CUTTING OF ALL PRODUCTS INCLUDED
↓
FORMULATION OF PACKING MEDIUM (pure or aromatic vinegar)
↓
PREPARATION OF PACKING MEDIUM
↓
FILLING THE CONTAINERS WITH SOLIDS ACCORDING TO ESTABLISHED WEIGHT
↓
FILLING THE CONTAINERS WITH HOT PACKING MEDIUM
↓
PREHEATING OF CONTAINERS TO 90ºC
↓
REFILLING CONTAINERS WITH HOT PACKING MEDIUM
↓
HERMETIC SEALING OF CONTAINERS
↓
STERILIZATION OF CONTAINERS IN WATER AT 100º C FOR 20 MINUTES
↓
COOLING OF CONTAINERS
↓
DRYING, LABELLING AND STORAGE

But acidification of the medium may also be achieved by adding an edible organic acid, such as lactic, citric and acetic acid. Citric and acetic acid are the ones mostly used in industrial processes.

In small-scale vegetable pickling, an ascetic acid solution is used, or wine vinegar or vinegar from other fruit sources. Normally, acid levels equivalent to 4% are used, although in some cases acidity may be increased to 6%.

Figure 5 shows the general flow chart for pickles processing by adding acid to the packing medium. The fermentation process may be reviewed as part of the training process, but it is impractical to process products during the practical sessions, because it is not possible to do so in the short time available.

In spite of acidification of the packing medium a product of this nature must be pasteurized (commercially sterilized), for the purpose of achieving its microbiologic stability. In addition to being vacuum packed to ensure a duration of one to two years. Packing without vacuum may mean a useful life of not more than three to six months. Common pickles are prepared with mixed vegetables (carrots, cauliflower and small cucumbers), red and green chili. Other vegetables may also be pickled.

3.3.6 Osmotic dehydration

This is a dehydration process brought about by transportation phenomena, diffusion in a liquid medium. It is a matter of partially extracting the water from a product through the use of the osmotic strength from a concentrated solution of various solutes. The high concentration of the medium must promote water transportation from the product due to the existing osmotic pressure gradient and the water concentration gradient between the product and the medium.

In this dehydration process, dependence on external ecological conditions disappears and it is possible to control all the variables of the process in the plant. The disadvantage of this process is that the osmotic pressure gradient does not permit the elimination of water to a sufficiently low level due to which absolute preservation of the material autonomously is not possible and, therefore, this process must be considered as an intermediate processing stage, and the products as intermediate products of a chain in which dehydration may continue through warm air or by freeze-drying , or the use of materials for extracting pulps or juices, or processing preserves.

In this intermediate process the material may be vacuum packed and perfectly preserved, as it is an intermediate humidity product, to which some preservatives and additives can be added. Bacterial development is limited by water activity and the development of fungus and leavenings, through the use of sulfur dioxide or solutions of sodium benzoate or potassium sorbitol.

Figure 6 shows the general flow chart for osmotic dehydration, a process which can be carried out under Amazon conditions, contrary to traditional drying processes, for which there are great difficulties because of environmental humidity conditions of the tropical forest.

It has been possible to process a number of products by osmotic dehydration, many of them of tropical nature. At the same time, raw materials may be of a different nature, fruits or vegetables. In the first case, syrups of different pure sugars have been used, such as from fructose, glucose, saccharose; and corn syrups with several components. In the case of vegetables, it is possible to use salt solutions with different concentrations and maltodextrine, and mixtures of both.

As has already been stated, this process can be controlled, but it is also necessary to maintain a strict control over the variables, such as temperature, concentration of osmotic solutions, the product's behavior with respect to the process and the effective determination of the point at which the process is completed.

There are some phenomena which may cause a variation in the behaviour of the material during the process, such as, over ripeness of the raw material or some pre-treatments with heat, both of which increment the permeability of tissues increasing the transfer of mass toward the fruit or vegetable, rather than to the removal of water, affecting the sensorial quality of the material.

3.4 Quality as a fundamental factor for success

It is important to take into account the fact that a microenterprise more than any other, has the capacity for producing goods and services of superior quality. This is due to the nature of the work and degree of commitment which can be achieved by the persons involved in the production process.

FIGURE 6 ***OSMOTIC DEHYDRATION***

WEIGHING OF RAW MATERIAL
↓
WASHING OF RAW MATERIAL
↓
SELECTION
↓
PEELING (optional)
↓
CUTTING OF THE PRODUCT ACCORDING TO STANDARDS
↓
PRE-TREATMENT OF THE FRUIT OR VEGETABLE
(such as scalding, sulfiting, addition of vitamin C)
↓
PREPARATION OF THE OSMOTIC SOLUTION AT WORKING TEMPERATURE
(from 20 to 50º C)
↓
DETERMINATION OF RAW MATERIAL-OSMOTIC SOLUTION RATIO
↓
OSMOTIC TREATMENT
(stirring occasionally and leave submerged from 15 to 240 minutes)
↓
DRAINING AND EXTERNAL DRYING OF THE CHUNKS
↓
VACUUM PACKING
(flexible CRYOVAC containers)
↓
LABELLING OF THE CONTAINERS AND STORAGE

At present, quality is a requisite of efficiency in addition to being a sales requisite. This means not only that the profitability of the business is affected by the product's quality, but also the continuity of the activity, as it cannot exist without the necessary quality to be the best and achieve a privileged position to compete in a highly demanding world.

Quality is a requisite that must be applied in every activity of the microenterprise, from its organization, personal relations, the productive process, the accounting system, to the external relations of the enterprise and its development. Quality must pervade the entire system of the microenterprise, that is, there must be TOTAL QUALITY MANAGEMENT .

This quality in management constitutes the best tool for small enterprises to compete with large societies or large consortiums. Personalized attention of customers, permanent management of the variables of the process, the possibility for developing necessary adjustments quickly and efficiently, as an immediate response to the creation of the need to satisfy the market, are some of the advantages of a system which operates within a model of total quality applied to its management.

It is necessary for the system's organization to allow for the development of a permanent process control model, applying the criterion that every work post will also be a control post and that every operator of the system will also be an element of control. The establishment of critical points to ensure the quality of the product, is a real necessity that must be met by procedural manuals, in order to find the weaknesses of the processes and the way to correct them systematically and consistently.

When speaking of quality, an independent department is normally considered, having a very narrow and strict control system and, generally, disconnected from productive reality and an external view of the process, waiting for someone to make a mistake in order to correct it without pity. This is an outdated criterion and above all impossible to implement in a microenterprise.

Modern criteria advise that each person should be responsible for his own control and the control of the operations with which he is connected, in the form of a chain, whose links are the providers or clients in terms of services to the productive process.

The supplier who is late in supplying a client, is making two serious mistakes; he produces an oversupply of material that cannot be handled and delays the process.

Untimely delivery of the material means that the entire line from that point onwards will be working less than it should be, and for this reason its unit efficiency will decrease considerably.

It must be kept in mind that the sum of small repeated errors will result in an accumulation which will constitute a large mistake. The concept of **"Just on time"** is perfectly applicable to small-scale processes; moreover, it is fully desirable for a small-scale process. The main purpose of a training process as described in this Manual is to achieve the highly desired **total quality** and this requires goodwill to undertake the difficult road to the establishment of a business which will make it possible to advance in the search for personal development, leading to family and collective development, and to shorten the distance between those who have it all and those who have very little.

PART II

4. FORMULATIONS

4.1 Raw materials

4.2 Preserves
4.2.1 Formulation of preserves in syrup
4.2.2 Formulation of preserves in brine
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4.2.4 Formulation of preserves in vegetable oil
4.2.5 Processing of specific products

4.3 Marmalades, jellies, syrups, preserves and sweets
4.3.1 Calculations for formulating and proportioning marmalade
4.3.2 Preparation
4.3.3 Processing of specific products

4.4 Nectars
4.4.1 Calculations for formulating and proportioning nectar
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4-5 Sauces and purées
4.5.1 Products, quality and markets
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4-6 Pickles
4.6.1 Preparation of aromatic vinegar
4.6.2 Solid/packing medium ratio
4.6.3 Processing of specific products

4.7 Osmotic dehydration
4.7.1 Principles and basics
4.7.2 Factors affecting the efficiency of the process
4.7.3 Processing of specific products

The Second Part of the Manual deals with the various processes and their application to some fruits and vegetables , in order to establish the theoretical flow charts. At the same time, some examples of products will be presented, including some variations, to illustrate the necessary calculations for each variable.

The operations to formulate various products and the way in which the different raw material components, as well as the ingredients influence the preparation and final result, are also presented.

For the sake of a better presentation, as well as for better understanding, formulations are discussed separately, that is, preserves, marmalades, nectars, pickles and dehydrated products. In turn, there may be one or more different ways to process each one of them. For instance, there are preserves in sugar solutions, in salt, in brine with vinegar, in pure or aromatic vinegar and in oil. In other words, the packing medium may vary, but the basic principles of conservation are the same, with small variations, desirable for the product.

In the case of pickles, there are two basic forms for their preparation, one is natural fermentation of the raw materials, with a natural production of lactic acid and acidification and the other is the preparation of a preserve using pure or aromatic vinegar as a packing medium. In the latter case, the fruit or vegetable is preserved in the acid medium provided by the vinegar, and it will have the flavour of acetic acid; it will not be a fermentation process but one of acidification; however, for the general purposes of this training process, both are pickles.

Regarding dehydrates, osmotic dehydration was chosen because it is a process that can be implemented during the training process, mainly because due to highly humid environmental conditions in many Amazon areas, natural drying is very difficult and artificial drying requires very high investments.

4. FORMULATIONS

This chapter includes the practical aspects of the different processes that can be implemented in an industrial micro-enterprise, such as that proposed for the Amazon region.

The basic outline of the processes is presented, so that the working group of this exercise may establish the specific flow charts for each proposed product on the basis of this outline.

This chapter considers the practical operations to implement the processes, step by step. The various calculations to be made are presented, including some suggestions on how to carry them out. It is not intended to make the subject rigid with this methodology, but to establish bases for comparison for those who wish to apply their own methodology and to serve as a basis for learning for those who are not familiar with the subject of food formulation.

The uniformity of the products depends on this procedure in great measure and therefore their quality, but at the same time it is possible to gather the necessary data to study costs and raw material and input supplies with a view to planning. The development of theoretical schemes or “industrial recipes” makes it possible to make long term plans which is evidently advantageous for the efficient operation of the enterprise.

For many of the products to be processed in an agro-industrial microenterprise as the one it is intended to implement in this programme, advance development of formulations is a decisive point regarding the possibility for the business to be successful. Improvisation may be interesting in the kitchen, in a restaurant, but it will surely be the cause of serious problems in small scale industrial production and an unavoidable necessity on larger scales. To know before hand what to do, how to do it and when to do it, is a fundamental point in the management of a quality enterprise.

As has been stated, it is necessary to emphasize that formulations for a given product may vary in the course of time, as they are not rigid or fixed, but changes must appear subtle to consumers. Products cannot be reengineered continuously, new products may be created to substitute others, but continuous changes in one product create uncertainty among consumers. A product must remain in the market as long as it is accepted by the consumers and, if this is so, it must be as unchanging as possible; why change that which is well accepted? It is in the search for new products where innovation should be.

In this sense observation of the latent needs of consumers is vital. This chapter also includes the different products that were developed during the various training courses carried out as part of the second part of the Joint Programme between the *Pro Tempore* Secretariat of the Amazon Cooperation Treaty and the FAO Regional Office for Latin America and the Caribbean, entitled “Agroindustrial Microenterprises as a Factor for Sustainable Development of the Biodiversity of the Amazon Watershed”.

Due to the incidence of the quality of raw material on the quality of the final product, it is necessary to coordinate actions to obtain a secure supply, as to quality and quantity, of the various raw materials involved in the industrial productive process.
Following is a list of the various raw materials included in this Manual, with scientific names and illustrations.

4.1 Raw materials

In this chapter a listing is made of the raw materials used in the programme developed in the processing of the products presented further on.

List of raw materials included in this Manual

COMMON NAME	SCIENTIFIC NAME
Aguaje	*Mauritia flexuosa* L
Araza	*Eugenia stipitata* Mc Vaugh
Chili	*Capsicum annum* L
Breadfruit tree	*Artocarpus altilis* (Park) Fosb
Carambola	*Averrhoa carambola* L
Cocona	*Solanm spp.*
Copuazu	*Theobroma grandiflora*
Guaba	*Inga edulis* Martius
Guava	*Psidium guayaba* L
Granadilla	*Passiflora nitida* H.B.K..
Lemon	*Citrus lemon*
Tangerine	*Citrus reticulata*
Mango	*Manguifera indica*
Apple	*Malus domestica*
Passion fruit	*Passiflora edulis*
Cashew "apple"	*Anacardium oxidentale* L
Orange	*Citrus sinensis*
Naranjilla	*Solanum quitoense* Lamb
Brazil nut	*Bertholletia excelsa* H.B.K.
Palm heart	*Bactris gasipaes* Burret (Asai) *Euterpa precatoria* Mart. (tijuayo)
Papaya	*Carica papaya* L
Pepper	*Capsicum annum*
Pineapple	*Ananas comosus* (L) Merril var.*comosus*
Banana	*Musa spp.*
Quila or wild cacao	*Theobroma bicolor*
Bell peppers	*Capsicum annum*
Watermelon	*Citrullus vulgaris*
Tamarind	*Tamarindus indica* L.
Tomato	*Lycopersicum sculentum* L.
Tree Tomato	*Cyphomandra betacea*
Ungurahui	*Oenocarpus bataua* subsp. *Bataua* C. Martius
Uvilla	*Pourouma Cecropiaefolia* Martius ex Miquel
Vainita	*Phaseolus vulgaris*
Carrot	*Daucus carota* L

Many of these raw materials are not cultivated in the Amazon region, but are brought to the area from other production zones. They were included in the programme due to their strategic importance in completing the productive cycle of the agroindustrial enterprise**. See Photographs 1 to 20 for some of the mentioned raw materials.**

4.2 Preserves

As was already stated a preserve is a product which consists in placing a solid, semi-solid or a solid immersed in a packing medium into an hermetic container. In accordance with this, the final product will be the result of the combination of the material's own characteristics, and those of the packing medium.

As shown in Figure 1, the process for the production of preserves consists of a series of steps including the formulation with the various components of the preserve, which may be very simple, that is, a raw material in a syrup packing medium (**Photograph 22**), or it may be more complex with a mixture of several raw materials (**Photograph 21**) in a packing medium.

The formulation step is applicable to each packing medium in particular as it involves particular calculations for each ingredient or group of specific ingredients. In this way a general scheme will be applied for the preservation process, but the formulation step of the products, must be considered separately for the different cases.

4.2.1 Formulation of preserves in syrup

Some preliminary steps to formulate a preserve to be packed in syrup are to:

- Determine the sugar concentration of the raw material, by refractometry (Brix degree)
- Fix sugar concentration of the final product (Brix degree)
- Establish the proportion of solids to be put in the container
- Determine sugar concentration of the packing medium to reach the final desired concentration.

To achieve an adequate balance in the preserve, in accordance with the pre-established sugar concentration values, a calculation must be made of the sugar from both sources considered in the process, the fruit and the pure sugar to prepare the syrup.

Calculation of the fruit's sugar content:

I. Sugar concentration is measured in a small amount of fruit juice using a refractometer.

II. The concentration expressed in a fraction (percentage divided by 100) is multiplied by the total amount of fruit to be placed in each container, thus, the sugar content contributed by the fruit to be placed in the container is obtained.

III. The total weight of sugar in the container is obtained by multiplying the desired sugar concentration in the container, expressed as a fraction, by the total pre-established weight of the container.

IV. The sugar contributed by the fruit is subtracted from the total sugar in the container to obtain the total amount of sugar to be added in the form of syrup.

V. The weight of the fruit is subtracted from the total weight of the container to obtain the weight of the syrup which should contain all the previously calculated sugar. The sugar fraction of the syrup is obtained by dividing the weight of the sugar in the syrup by the total weight of the syrup. The percentage of sugar or Brix degrees of the syrup to be prepared is obtained by multiplying the sugar fraction of the syrup by one hundred.

NOTE: Scalded fruit must be used to determine the weight of the fruit in the container, otherwise the glass container will look empty after heating and sterilization. It is recommended to weigh fruit in five containers to obtain an average figure for the calculations.

Thus, if:

BF	:ºBrix of the fruit
BA	:ºBrix of sugar = 100
XAF	: Fraction of sugar in the fruit
BP	:ºBrix of the final product.
PT	: Total weight in the container
PF	: Weight of scalded fruit in the container
PAL	: Weight of syrup in the container
PAF	: Weight of the sugar contributed by the fruit in the container
PAAL	: Weight of sugar contributed by the syrup in the container
XAAL	: Fraction of sugar in the syrup
PAT	: Weight of total sugar in the container
BAL	: ºBrix of the syrup

Then:

BF : 100:	= XAF
PF x XAF:	= PAF
PT x BP: 100	= PAT
PAT - PAF:	= PAAL
PAAL : PAL:	= XAAL
XAAL x 100:	= BAL

In this way, the number of jars that can be obtained is calculated from the total weight of available fruit and the necessary quantity of a syrup is calculated according to the following:

Example:

There are 50 kg., of carambola for preserves, with an industrial yield of 85%, thus, 85% is available to be put in the containers. The carambola has a sugar concentration of 12º Brix and it is desired to prepare a preserve with a final concentration of 22º Brix. Calculate how many jars of 500 gr., total weight (net weight) and 300 gr., of fruit (drained weight), can be prepared; indicate how many kg. of sugar are needed to do it.

Solution 1:

If each container contains 300 gr., of fruit then there are 200 gr., of syrup as packing medium. If 85% of 50 kg. of fruit is available, then, there are 42.5 kg., which divided into 300 gr., units gives a total of 141 jars and there are 180 gr. of fruit left over. If a real yield of 95% is considered, the total number of jars would be 134, assuming a 5% fruit loss in the process.

Thus, there should be 134 jars and their lids; 40.2 kg., of prepared fruit, cut up and scalded; and 26.8 kg., of prepared syrup, with the adequate concentration, which will be calculated as follows.

The steps to calculate the syrup's sugar concentration are shown below, as a way to obtain the desired sugar concentration in the final product

Calculation:

BF : 12º Brix
XAF : BF : 100 = 0.12
PAF : PF x XAF = 0.300 x 0.12 = 0.036 kg., of fruit sugar per container
BP : 22º Brix
PT x BP : 100 = PAT = 0.500 x 0.22 = 0.11 kg., total sugar per container
PAT - PAF-:PAAL= 0.11 kg . -0.036 kg = 0.074 kg. sugar from syrup per container

PAAL : PAL : XAAL = 0.074 : 0.200 = 0.37
BAL: XAAL x 100 = 0.37 x 100 = 37º Brix

Therefore, 26.8 kg., of syrup will have to be prepared with a concentration of 37º Brix. For this purpose 37% of the total weight is calculated, which in this case amounts to 9.916 kg., of sugar. This sugar is weighed into a 30 liter container.

After the sugar is weighed (do not forget to uncover the container), the volume is completed with water up to the weight of 26.8 kilograms. This corresponds to a weight percentage of 37% or 37º Brix.

It is very important to keep in mind at least two punctual recommendations for preparing a solution:

NEVER ADD A VOLUME OF WATER, EQUAL TO THE TOTAL AMOUNT OF SYRUP DESIRED, TO THE WEIGHED SUGAR BECAUSE THIS WILL REDUCE THE CONCENTRATION,. ONLY ENOUGH WATER TO COMPLETE THE VOLUME MUST ALWAYS BE ADDED.

This is one of the most common errors when preparing sugar or salt solutions to use them as packing mediums. Whenever possible the final concentration of the solutions should be measured with a refractometer in the case of sugar solutions and with a densimeter in the case of brines.

NEITHER MUST IT BE ASSUMED THAT THE SUGAR OR SALT VOLUME IS EQUAL TO THAT OF WATER FOR THE SAME WEIGHT.

For the purpose of comparing the effect of different stages of maturity of the fruit, that is, fruit with a different

sugar concentration, it will be assumed that carambola instead of having a sugar concentration of 12%, or , 12º Brix, has 18% or 18º Brix.

Thus, if the above procedure is repeated, the following is obtained:

Solution 2:

As in the above case, there are 300 gr., of fruit in each container, and 200 gr., of syrup as packing medium. If 85% of 50 kg., of fruit is available then there are 42.5 kg., which divided into 300 gr., units, gives a total of 141 jars and some 180 gr., of fruit remain. If a real yield of 95% is considered, the total number of jars would be 134, assuming a loss of 5% during processing.

Thus, we need 134 jars and their lids, 42.2 kg., of prepared fruit, cut and scalded; and 26.8 kg., of prepared syrup at the adequate concentration, which will be calculated as shown below.
The various steps to calculate the sugar concentration of the syrup are shown below, to obtain the desired sugar concentration in the final product.

Calculations:

BF: 18º Brix
XAF: BF : 100 = 0.18
PAF: PF x XAF = 0.300 x 0.18 = 0.054 kg of fruit sugar per container
BP: 22º Brix
PT x BP : 100 = PAT = 0.500 x 0.22 = 0.11 kg total sugar per container

PAT - PAF : PAAL = 0.11 kg - 0.054 kg = 0.056 kg of syrup sugar per container
PAAL : PAL : XAAL = 0.056 : 0.200 =0 .28
BAL: XAAL x 100 = 0.28 x 100 = 28ºBrix

Thus, 26.8 kg., of syrup must be prepared with a concentration of 28º Brix. For this purpose 28% of the total weight is calculated, which in this case amounts to 7.504 kg., of sugar. This sugar is weighed in a 30 liter container.

After weighing the sugar (do not forget to uncover the container), the volume is completed with water until the weight of 26.8 kg., is reached. This corresponds to a weight percentage of 28% or 28º Brix.

Thus, if a fruit with a higher sugar content is available, in this case, 18º Brix instead of 12º Brix, it represents a saving of 2.412 kg., of sugar in the 134 jars prepared. If this is expressed in tons of fruit raw material or by one thousand jars, a saving of 48.24 kg., of sugar is made per ton of fruit raw material used; or a saving of 18 kg., of sugar per every thousand containers prepared.

Due to the foregoing, it is evidently desirable to have fruit with a higher sugar content, but this has a limitation and that is that the fruit must also have a series of quality characteristics that are also affected by the state of maturity, such as their texture, color and flavour. Thus, it must be kept in mind that the sugar content in a fruit for a preserve is very important but other factors must also be taken into account, therefore:

- The raw material must contain the highest possible amount of sugar but maintain other desirable characteristics to obtain a product of good quality.
- A similar saving could be obtained if with an equal initial sugar content in fruit, it is decided to work with a lower sugar content in the final product.

In fact, if it is assumed that the final sugar content in the preserve will be of 20ºBrix instead of 22º Brix, a calculation similar to the one above could be developed by changing the sugar contents expressed in BP, in one of the previous examples.

Thus, in the case fruits with 18º Brix, we have:

Calculations.

BF: 18º Brix
XAF: BF : 100 = 0.18
PAF: PF x XAF = 0.300 x 0.18 = 0.054 kg of fruit sugar per container
BP: 22º Brix
PT x BP : 100 = PAT = 0.500 x 0.20 = 0.10kg of total sugar per container
PAT-PAF:PAAL= 0.10 kg -0.054 kg = 0.046 syrup sugar per container
PAAL:PAL:XAAL= 0.046:= 0.200= 0.23
BAL:XAALx100= 0.23x100= 23ºBrix

Thus, 26.8 kg., of syrup with a concentration of 23º Brix must be prepared. For this purpose 23% of the total weight is calculated, which in this case amounts to 6.164 kg., of sugar. This sugar is weighed in a 30 liter container.

After sugar has been weighed (do not forget to uncover the container), the volume is completed with water to a total of 26.8 kilograms. This corresponds to a percentage weight of : 23% or 23º Brix.

As may be seen on the basis of fruit with 18º Brix and a final concentration of 20% sugar in the preserve, a saving of 1.248 kg has been made in 134 jars, or the equivalent of 9.31 kg per 1000 containers. This is of great importance when formulating the products, as it must be kept in mind that neither the price of the fruit nor the final price of the product, will vary greatly with respect to the original values presented. This means that the price of fruit is generally not based on its sugar contents, neither are the preserves sold for their balanced sugar contents. Moreover, in some cases a preserve with a lower sugar content may be more valued than one with a higher sugar content, not as regards the price, but in connection with commercial opportunities and the acceptance of the final consumers.

4.2.2 Formulation of preserves in brine

This process is much simpler than that for preserves with a sugar based packing medium, because here there is no balance point to be calculated.

The packing medium used has a salt concentration established through previous trials to find a balance point which will determine the product's final flavour and aroma. Normally, the salt level used is of approximately 2% with a maximum of 3% for some previously fermented products.

Thus, it is very easy to prepare brine at the mentioned concentration.

The following should be kept in mind:

- It is preferable to use rough mine salt, since fine salt has a higher concentration of impurities. In any event, it is always advisable to filter brines through a cloth before using them.

- Solutions must always be prepared on the basis of a weight:weight concentration. It is always more convenient to measure weight than volume.

- In the heating process of brines care must be taken not to evaporate the water as this increases their concentration. This requires the filling operation to be very quick so as not to lose temperature which would require continuous heating of the product.

In accordance with the above a brine solution may be prepared as follows:

1. Determine the volume (or weight) of the brine to be used, knowing the number of containers, the weight of solids in each container and keeping in mind that the relation between solids and packing medium in a preserve must be equal to or above 60:40. It must be remembered that, as in the above case, previously scalded material must be used to determine the drained weight of the preserve.

2. Establish the brine concentration to be used, for instance 2%.

3. Weigh the amount of salt required to prepare the desired quantity of brine in a previously weighed container.

4. Complete the required brine weight with water.

Example:

For preparing a palm heart preserve brine must be prepared for 350 jars with a total weight of 600 gr., each with a solid - packing medium ratio of 65:35. Brine with a 2.5% concentration is required. Calculate the quantity of brine to be prepared.

Solution:

If the total weight of the container is of 600 gr., then 35% will be equivalent to 210 gr., of brine. If each jar has that quantity, it will be necessary to prepare 73.5 kg. of brine for the 350 jars. If the brine must be prepared at 2.5%, then 3.675 kg of salt will be required.

The 3.675 kg, of salt are weighed in a previously weighed container with a capacity equal to or above 80 liters and water is added until completing 73.675 kg., of brine. Normally a round figure over that estimated should be prepared, although it should not be too much higher to avoid excessive losses.

It is necessary to make sure that all the salt has been dissolved in the solution, to obtain an adequate concentration.

In this case, contrary to the case of preserves in syrup, the nature of the raw material, its condition at the time of processing, do not have an important effect on the quantity of salt to be used.

4.2.3 Formulation of preserves in acidified brine

Acidified brine as a packing medium, is prepared in the same way as in the previous case, it is only necessary to consider the addition of a new ingredient to establish the required acidity.

The purpose of acidifying preserves is to reduce pH and thus decrease their thermic treatment. A type of preserve commonly processed are tomatoes in their juice and, in most cases, it is necessary to acidify the medium with citric acid because of the nature of the tomatoes. This acid is one of the most widely used because of its strong acidifying power and therefore, only small quantities are required for a relatively significant change of the medium's pH.

Acidifying requirements are determined by the original pH and the pH that it is desired to obtain. Thus, for the preserve not to develop too many sensorial changes, the change of pH must be as close as possible to strict requirements, that is, as close as possible below the value of 4.5.

The adjustment of the medium's pH will determine the quantity of acid that needs to be added and, for practical reasons, a pH determining paper may be used in the empirical formulation. Normally, additions of citric acid of around 0.1-0.5% in relation with the product's final weight, may be reasonable to achieve the required change.

An aspect worth keeping in mind is that ascorbic acid or vitamin C is not as good an acidifier as citric acid, its cost is higher and it is also thermosensitive. Therefore, although it is true that ascorbic acid is widely used as an antioxidant, it is important to take into account the mentioned characteristics.

Acidified brines are also used for other vegetables with a very high pH, such as the case of artichokes, string beans (green bean pods), peppers and chili peppers. The preparation of an acidified brine after establishing the quantity of a given acidifier is very similar to that shown for brine alone.

Vinegar is a widely used acidifier. This is the result of acetic fermentation of various products which have developed alcoholic fermentation as in the case of wines, apple cider and cider from other fruits.
Vinegar normally has a minimum acidity of 4%, expressed in acetic acid, although higher values are also common in those of good quality.

Example:

It is desired to prepare brine acidified with acetic acid, for which vinegar with 4% acidity is used. The brine will be used to prepare 500 jars of sweet unpeeled red peppers. Each jar contains 350 gr., of solids and 150 gr., of 3% salt and 12% vinegar brine. Calculate the salt and vinegar needed and the total brine to be prepared.

Solution:

If each jar contains 250 gr., of brine it will be necessary to prepare 125 kg., of brine. Then this brine must contain 3% salt equivalent to 125 x 0.03, which means 3.75 kg., of salt; and it must also contain 12% vinegar, which means 125 x 0.12, resulting in 15 kg. (or liters) of vinegar.

Preparation:

As it may be inconvenient to prepare the entire volume of brine at once, a smaller container may be used to prepare the mixture. For example, a 50 liter container may be used, in which three fractions of the total volume are prepared. Two 40 kg. fractions and one of 45 kg.

Therefore, the calculation for 40 kg., of acidified brine should be:

Salt:	40 x 0.03	= 1.2 kg., for to prepare 40 kg.
	45 x 0.03	= 1.35 kg for the preparation of 45 kg.
Vinegar:	40 x 0.12	= 4.8 kg for each preparation of 40 kg.
	45 x 0.12	= 5.4 kg for the preparation of 45 kg.

In every case the ingredients are weighed in the previously treated container and then water is added to complete 40 or 45 kg., depending on the case.

In the case of salt, possibly it will be necessary to heat the water a little for the salt to dissolve completely. In this case, it is important to avoid excessive evaporation of the vinegar and therefore, of the acetic acid it contains.

It is advisable to repeat that the vinegar concentration that must be added to the brine will be the result of an empirical process, or of several trials until the formula agreeable to taste and compatible with the need to reduce pH to below 4.5 as a safety factor are reached. Concentrations of 15, 20 and 25% vinegar in brine are common.

The use of pure or aromatic vinegar as a packing medium, will be discussed in the chapter on pickles.

4.2.4 Formulation of preserves in vegetable oil

This process corresponds exactly to a preserve whose packing medium is very special. In this case pure vegetable oil is used as a packing medium. This means that the medium itself contains a very small amount of water and, thus, very low water activity (Aw) in the total preserve, which assists preservation, and requires very light thermic treatment.

The reason for using vegetable oil is to ensure the transparent liquid characteristics of the packing medium, taking into account the fact that vegetable materials are being prepared. Some of them such as peppers, and eggplant.
For the purpose of avoiding water migration from the product which makes the medium turbid, the raw material is prepared previously to dehydrate it partially. This may be done in three different ways, by salting, as in the case of eggplant, frying as in the case of peppers or by natural drying as in the case of a certain type of tomato. In the three cases the purpose is the same: decrease free water in the products.

In preserves for which oil is used as a packing medium, the calculation of the amount to be added is reduced to the operation of establishing the weight of solids in each jar and determining the weight of the oil to complete the total weight of each container. Again it must be kept in mind that the product must be heated before putting it into the jar so as to accommodate it well and achieve an adequate filling.

A special precaution that must be taken when using oil as a packing medium is to avoid overheating it through lack of attention as the boiling point of oil is very high. Oil may reach temperatures above 100º C without any apparent signs of this, so that if it is applied on the product already in the jar there is a risk of burning the product or breaking the jar.

The possibility of adding the oil at a few degrees above 100ºC, makes it possible to pack preserves in oil at approximately 105 or 108º C, if the product is prepared carefully under adequate sanitary conditions, and seal the containers hermetically, leaving them to cool at room temperature, without applying a thermic treatment. This practice has proven to be effective in preserving products prepared in this manner, with a duration of up to two years, depending on the product. The filling temperature, together with low water activity, will permit preserving these products.

4.2.5 Processing of specific products

In this chapter the following products are presented for which we will show the procedures and corresponding flow charts:

- Breadfruit in syrup
- Carambolas in syrup
- Guaba in syrup
- Guava segments in syrup
- Tangerine in syrup
- Brazil nut in syrup
- Palm heart in acidified brine
- Papaya cut in chunks in syrup
- Pineapple cubes in syrup
- Sweet peppers and bell peppers in oil
- Bananas in syrup
- Whole tomatoes in brine
- Tree tomatoes in syrup
- Uvilla in syrup
- Bean pods in acidified brine

4.2.5.1 Breadfruit tree seeds in syrup

These seeds are in the fruit of the breadfruit tree which grows in the Amazon region. (**See Photograph 4**). The seeds are loose, forming a non-pulpy bunch in the inside of the fruit's shell, there is no pulp around the seed. The following versions of this Manual will include the botanical classification of the specie, to differentiate it from other similar species existing in the Amazon watershed and the Caribbean. This is an experimental product.

In this case seeds similar to European chestnut are used and processed in a similar manner as Brazil nut in syrup at 50º Brix.

The seeds are complete, with their shell and cuticle or tegument, which must be removed to give them the required appearance.

For this purpose the weighed seeds, selected for their size and presentation, are pre-cooked in boiling water for 45 minutes, until the shell and the cuticles are loosened.

Then the seeds are drained and peeled by hand for the purpose of good quality. A yield of approximately 35% is obtained per peeling. The peeled seeds are split in half and packed in glass jars to be mixed with the syrup.

The syrup is similar to that used for Brazil nut.

After the jars are filled with the solid material, the packing medium is added hot, filling the jars. The lids are put on loose and the jars are preheated in a pan to 85ºC on the inside.

After preheating, the jars are refilled to the brim, if necessary, hermetically sealed and sterilized during 20 minutes.

Then the jars are cooled by overflow, cleaned and dried, and labelled indicating all the data pertinent to the product. The flow chart of this product is presented in Figure 7.

As in the case of Brazil nut, this product requires a waiting period of 4 to 6 months before consumption, to observe its stability.

4.2.5.2 Carambola in syrup

Raw material:

The fruit must be ripe but firm. (**See Photograph 5**). On the basis of the raw material the following yield is obtained:

Carambola in chunks:	100%
Sugar content of the fruit	5-7º Brix

Syrup is calculated in accordance with requirements, according to the estimated solid/liquid ratio in the container, as explained in chapter 4.2.1 of this Manual.

Finished product: Preserve with 22-25º Brix, depending on local consumer taste or that of the market of destination.

The selected carambolas are washed, weighed and scalded until they are tender and cut into even slices of 0.5 cm., in such a way as to form small stars, optionally, the stars can be scalded for one minute in the packing medium.

The cut fruit is packed in the jars and the hot syrup which has been prepared in accordance with the sugar content of the fruit is added.

After the jars have been filled they must be pre-heated if necessary, to a temperature of 85º C in the product. When this temperature has been reached the jars are covered and sealed to be sterilized in boiling water during 20 minutes, and then cooled by overflow, labelled and stored.

The flow chart for the process is shown in Figure 8. **Some operations of this process may be seen in Photographs 31 to 34.**

4.2.5.3 Guaba in syrup (with or without seeds)

Raw material:

This product is another case of an experimental process**. (See Photograph 8).** The following yield was obtained from the experimentally processed product

Pulp with seed with respect to the entire pod:	23%
Pods without pulp	77%
Pulp without seed with respect to pulp with seed	62%
Sugar content of pulp	10.2º Brix

Syrup as required in accordance with calculated solid/liquid relation of the jar.

Finished product: "buds in syrup, with or without seeds" with 20º Brix for buds with seeds and 18º Brix for buds without seeds, on balance.

Pods are received and selected, choosing the thickest with the highest pulp contents (placentary seminal tissue). The small ones are used to prepare nectar. The pods are washed to avoid contaminating the pulp.

FIGURE 7 ***BREADFRUIT SEEDS IN SYRUP***

RECEPTION
↓
SELECTION
↓
WEIGHING
↓
PRE-COOKING
(45 minutes in boiling water)
↓
DRAINING
↓
WASHING IN COLD WATER
↓
PEELING
↓
HALVING
↓
PACKING
↓
WEIGHING
↓
PREPARATION OF THE SYRUP
↓
PACKING
(of solids and syrup)
↓
PRE-HEATING
(to 85ºC in the product)
↓
SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
DRYING OF JARS
↓
LABELLING
↓
STORAGE

FIGURE 8 ***CARAMBOLA IN SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(2 minutes in boiling water)
↓
CUTTING
↓
PACKING
(of solids)
↓
FILLING
(with hot syrup)
↓
PREHEATING
(to 85º C in the product)
↓
SEALING
(of the containers)
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
(by overflow in cold water)
↓
LABELLING
↓
STORAGE

Then the pods are opened and the "pulp buds" are separated.

The "buds" are scalded in the same syrup in which they will be packed and then placed in the containers, after having determined the weight of the solids and liquid that each jar will contain.

The syrup is added in accordance with the desired final ºBrix and the Brix degrees of the solids and the solid/liquid proportion of the container. If the product was scalded in water, the containers must be preheated semi-closed; if it was scalded in the syrup the containers are simply hermetically sealed.

The syrup contains 10 gr., of lemon juice for each kg., of syrup.

The closed containers are sterilized during 20 minutes in water at 100ºC.

The sterilized containers are cooled, dried and labelled. The syrup of guavas with seeds becomes purple red at the point of balance, due to the presence of the seeds.

The flow chart for this process is shown in Figure 9. **Some operations of this process can be seen in Photographs 35 to 38.**

4.2.5.4 Guava segments in syrup

Raw material:

Using the raw material received the yield obtained is:

Guava segments:	45%
Waste	55% (17% peel, 38% pulp and seeds)
Sugar contents of the fruit:	5.5º Brix

Syrup according to needs, as per calculation of solid/liquid in the container

Finished product: 22º Brix preserve or in accordance with the market request.

The guavas received are weighed and washed, selecting the ones with best peel characteristics, if it is desired to place the segments with peel in the preserve. Otherwise, the fruit is carefully peeled so as not to cause too many losses.

The peeled fruit is halved and the pulp and the seeds removed. The pulp removed from the seeds can be used to prepare nectar or marmalade. The guava is cut into even pieces which are weighed and their sugar contents measured.

The pieces of guava are scalded in the syrup for 1 minute and put into the jars. The drained weight of the fruit in one jar was determined in advance to calculate the syrup contents and, thus, the sugar contents of the syrup to obtain the desired ºBrix. The jars with the solids and packing medium are heated until the contents reach 85º C, and refilled with hot syrup if necessary, hermetically sealed and sterilized for 20 minutes.

The sterilized jars are cooled by overflowing with cold water. Then they are dried, labelled and stored. The process is shown in the flow chart, Figure 10. **Some operations of this process may be seen in Photographs 39 to 42.**

FIGURE 9 ***GUABA IN SYRUP***

RECEPTION
↓
WEIHGHING
↓
WASHING
↓
OPENING THE PODS
↓
SEPARATION OF THE "BUDS" FROM THE PODS"
↓
REMOVAL OF SEEDS
(optional)
↓
SCALDING
(0.5-1 minute in boiling water or in the syrup
↓
PACKING
(solids and hot syrup)
↓
PRE-HEATING
(optional for scalding in water)
↓
HERMETIC SEALING
(of the containers)
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

FIGURE 10 ***GUAVA SEGMENTS IN SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
PEELING (of tissue)
↓
HALVING
↓
REMOVAL OF SEEDS
↓
CUTTING IN SEGMENTS
↓
SCALDING
(one minute in boiling syrup)
↓
FILLING
(solids and syrup)
↓
PRE-HEATING
(to 85ºC)
↓
SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

FIGURE 11 ***MANDARIN SEGMENTS IN SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
PEELING AND SEPARATION OF SEGMENTS
↓
REMOVAL OF SEEDS
↓
WEIGHING
↓
PACKING
(solids)
↓
FILLING
(with hot syrup)
↓
PRE-HEATING
(to 85º c)
↓
SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

4.2.5.5 Mandarin segments in syrup (seedless)

Raw material:
Yield of the raw material is the following:

Segments:	75-78%
Waste:	22-25%

Syrup as required, according to estimated solid/liquid in the jar.

Finished product: 22-25º Brix preserve, or in accordance with market requirements.

After reception the mandarins must be weighed, washed and selected. The selected fruit must be peeled carefully and divided into segments.

The white adhered to the segments, and the seeds, are removed from the segments, being careful not to damage them, to avoid bitterness or other unpleasant flavours.

The segments are placed in the jars which are then filled with the hot syrup, previously prepared in accordance with the sugar contents of the fruit and the desired final sugar contents.

The jars are preheated immediately in a pan to a temperature of 85º C in the product, and refilled with hot syrup if necessary, then they are hermetically sealed and sterilized in boiling water for 20 minutes, and cooled by overflowing, labelled and stored.

The flow chart for this process is shown in Figure 11. **Some operations of this process may be seen in Photographs 43 to 46.**

4.2.5.6 Brazil nut in syrup.

The raw material for this process is the peeled Brazil nut. In the first place the most perfect and uniformly sized seeds are selected for processing. This is an experimental process**. See Photograph 13.**

The seeds are weighed to determine their yield and calculate the syrup to be prepared. Then they are scalded in boiling water during 20 minutes, drained and rinsed in cold water.

The drained seed is packed in glass jars with metal lids; spices such as cinnamon and cloves are added according to taste to improve presentation and flavour.

A syrup with 50% sugar is prepared separately, to which some cinnamon sticks and cloves are added to flavour the packing medium. Also, 10 gr., of lemon juice are added to the syrup, i.e., one tablespoon for every kg., of syrup.

The syrup is boiled one minute and left to stand for one hour with the cinnamon and cloves.

Then the syrup is preheated to the boiling point and filtered to remove the spices and the jars are filled with the still hot medium. Then the spices are introduced in the jars.

Later the jars are preheated until the inside temperature is above 85º C.

The jars are refilled with hot syrup if necessary sealed hermetically at this temperature, and sterilized for 30 minutes in boiling water.

FIGURE 12 ***BRAZIL NUT IN SYRUP***

RECEPTION
↓
WEIGHING
↓
CRACKING AND PEELING
↓
SELECTION
↓
WEIGHING
↓
PRE-COOKING
(or scalding in boiling water for 20 minutes)
↓
DRAINING
↓
WASHING WITH COLD WATER
↓
WEIGHING
↓
PREPARATION OF THE SYRUP
↓
PACKING OF SOLIDS
↓
PACKING SYRUP
↓
PRE-HEATING
(to 85º C in the product)
↓
SEALING
↓
STERILIZATION
(30 minutes in boiling water)
↓
COOLING
↓
DRYING THE JARS
↓
LABELLING
↓
STORAGE

Depending on the quality of the lids, sometimes it may be necessary to cool the jars at room temperature to avoid losses. Good quality jars may be cooled with cold water by overflowing the pot.

The sterilized and cool jars are dried, cleaned and labelled, indicating all pertinent data on the label, and then stored. As in the case of breadfruit tree seeds, this product also requires a waiting period of 4 to 6 months before it can be consumed, so that the balance between the nuts and the packing medium may be reached.

The flow chart for this process is shown in Figure 12**. Some operations can be seen in Photographs 47 to 50.**

FIGURE 13 ***PALM HEART IN ACIDIFIED BRINE***

RECEPTION
↓
WEIGHING
↓
PEELING
↓
SOAKING STALKS IN ACID AND SALT SOLUTION
↓
CUTTING
10-11 cm. pieces to be soaked in the above solution)
↓
FORMULATION OF THE BRINE
(25% salt + 1.2% citric acid
or
2% salt + 20% vinegar with 5% acidity)
↓
FILLING CONTAINERS
↓
PRE-HEATING
(to 85º C in the product)
↓
STERILIZATION
(15 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

4.2.5.7 Palm heart in acidified brine

There are several possibilities for processing palm heart. One is in brine acidified with citric acid. Another in brine with vinegar; and a third, in pure vinegar, either aromatic or not.

In this case palm heart processing in brines acidified with citric acid and with wine vinegar, are shown. In the first case citric acid is used at a concentration of 1.2% in a 2% salt solution. In the second case, 20% vinegar with 5% acetic acidity is added to a 2% salt solution.

The wild palm heart (**Asai or Uasai palm, see Photographs 14 and 15)** stems are very delicate and their yield is low, they are usually gathered two or three days before the process and are stored under relatively adequate conditions.

At the time of processing, it is necessary to prepare brine with citric acid and lemon juice in which to keep the peeled "hearts", before cutting them to be put in the containers. This is particularly true in the case of wild palm heart which becomes easily oxidized.

The selected stems are peeled, washed and cut into pieces.

The following yield was obtained from these operations:

Peel	51.6%
Base of palm heart	10.7%
Tips	24.3% (they can be used for dehydration or packing in chunks)
Useful palm heart	13.4%; (10.7% are pieces 11 cm., long, and 2.7% are pieces of less than 10 cm.,)

After cutting, the chunks are placed in the jars and one of the packing solutions mentioned is added hot.

Then the palm heart are preheated to 85º C, before proceeding to seal the containers hermetically for sterilization, Before this, refill them with hot packing medium if necessary. They are sterilized in boiling water for 15 minutes and cooled.

The jars are dried, labelled and stored.

The flow chart for this process is shown in Figure 13 . **Some of the operations may be seen in Photographs 75 to 86.**

4.2.5.8 Sliced papaya in syrup

Raw material:

The following is obtained from the whole fruit:

Sliced papaya:	74%
Waste:	26%
Sugar contents of the fruit:	9.0-9.5 º Brix

Syrup is required in accordance with the calculated solid/liquid ratio in the container, as discussed in Chapter 4.2.1 of this Manual.

Finished product: 22-25º Brix preserve or in accordance with market demand.

After reception, weighing and washing, the papayas are selected, separating the ripest ones that are used for marmalade and/or nectar production.

FIGURE 14 ***SLICED PAPAYA IN SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
PEELING AND HALVING
↓
REMOVAL OF SEEDS
↓
CUTTING IN SLICES
↓
PACKING
(of solids)
↓
FILLING
(with syrup)
↓
PREHEATING
(to 85º C in the product)
↓
SEALING
↓
STERILIZATION
(30 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The selected fruit is peeled, seeded and cut into regular pieces of approximately 2 cm per side. Optionally, the pieces may be scalded for one minute in the syrup, in case they are not ripe enough.

The papaya is put in the jars, taking care to fill them with as much fruit as possible without damaging it. This is achieved by tapping the bottom of the jars against a board placed on the table.

After this operation, the quantity of syrup as well as the amount of fruit for each jar are calculated. The first operation is carried out by filling one jar with water and measuring the required amount, and the second, by weighing five jars filled with fruit and five empty jars, and dividing the difference by five, thus obtaining the quantity of fruit in each jar.

With these data, the required syrup is prepared with the amount of sugar needed to reach the desired Brix degrees. The syrup is heated to the boiling point and poured into the jars with the fruit, which are then preheated up to 85º C, taking care to refill them with hot syrup if necessary. The jars are sealed immediately and sterilized in boiling water for 30 minutes.

After cooling the jars, they are labelled and stored. Figure 14 shows the flow chart for this process. **Some operations may be seen in Photographs 51 to 54.**

4.2.5.9 Pineapple cubes in syrup

Raw material:

The following yield is obtained from whole raw material.

Pineapple cubes	65%
Waste:	35%

Syrup according to requirements, as per calculated solid/liquid ratio in the jar.

Finished product: a 22-25 Brix degree preserve, or in accordance with market demand.

After reception the pineapples are weighed, washed and the leaves removed. Then they are peeled eliminating the “eyes” without eliminating too much pulp.

The completely peeled pineapples are cut into slices 1.5 to 2 cm thick, and the center, known as the core, is removed. The slices are then cut into even sized pieces of about 1.5 cm on each side.

Depending on the product’s maturity, **see Photograph 16,** the pineapple pieces may be scalded in the syrup which, after filtration, will later be used as packing medium. The duration of this operation also depends on the fruit’s maturity.

The scalded pineapple will be put in the containers when hot, filling the jars with the hot syrup immediately and then sealing, sterilizing, cooling, labelling and storing them.

On the other hand, if the fruit is packed cold, or at a temperature lower than 85º C, the jars must be preheated to a temperature of 85º C, being careful to refill the jars with hot syrup if necessary. The jars are then hermetically sealed, sterilized, cooled, dried, labelled and stored.

A flow chart for this process is shown in Figure 15. **Some of its operations may be seen in Photographs 55 to 58.**

4.2.5.10 Banana in syrup

In this case syrup is used as the packing medium and is calculated in accordance with the sugar contents of the raw material and the solid/liquid contents of the container.

Raw material:

The bananas are received and selected, their yield is:

Fruit per bunch:	87%
Discard bunch:	13%
Peeled fruit:	60%
Peel:	40%
Fruit sliced lengthwise:	95%
Discard	5%
Slices for syrup per peeled fruit:	75%
Discard:	25%
Sugar contents of bananas:	12-14º Brix

Syrup according to requirements, in accordance with calculated solid/liquid ratio in the container.

Finished product: bananas in syrup with final 22º Brix or according to market demands.

The bananas are received and selected when immature and green in colour. **See Photograph 17.** They are weighed and washed to avoid contaminating the pulp, and peeled. The peeled bananas are scalded in boiling syrup for 3 minutes, either whole or cut up. Then they are cooled and prepared as desired. For instance, in slices or quarters; optionally they may be scalded after cutting.

The chunks are packed and the packing medium is added hot. The partly closed containers are preheated until the chunks reach 85º C, being careful to refill with hot syrup if necessary.

The containers are hermetically sealed and sterilized for 20 minutes at 100ºC.

After cooling by water overflow, the jars are dried, labelled and stored.

The flow chart for this process is shown in Figure 17. **Some operations of this process may be seen in Photographs 59 to 62.**

4.2.5.11 Sweet and hot pepper in oil

This product is a preserve which is packed in oil, with a water activity near zero. This ensures its preservation for 1 to 3 years, after sterilization.

Raw material:

In this case the raw material is a combination of sweet red peppers and bell peppers or red or yellow hot peppers. This provides a good appearance and an adequate flavour relation. Sweet peppers and hot peppers can also be processed separately.

FIGURE 15 ***PINEAPPLE CUBES IN SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
PEELING
↓
SLICING, DECORING AND CUTTING IN CUBES
↓
SCALDING (optional)
↓
PACKING (of solids)
↓
FILLING (with syrup)
↓
PREHEATING (to 85º C in the product)
↓
SEALING
↓
STERILIZATION (20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The raw material yields the following:

Peppers without peduncles and cores, cut in pieces:	67%
Peduncles:	5.2%
Cores:	7.8%
Waste:	20%
Hot peppers, peduncles and cores removed and cut up:	88%
Peduncles:	1.7%
Cores and waste:	10.3%

The peduncles and cores are removed from the peppers and then they are cut into quarters or octaves and scalded in a solution of water with 50% vinegar and 2% salt.

After scalding the fruit is dried and lightly fried in oil with a few cloves of garlic and a few grains of black pepper, until it is transparent and has released part of its water content. The hot fruit is packed in the containers and then hot oil is added at not less than 90º C, up to 1 cm from the rim of the container. Care must be taken that the solid pieces fill most of the container and there should be no bubbles when adding the oil. The bubbles are eliminated with a knife. A few cloves of the lightly fried garlic and pepper and a tablespoon of the frying oil are added.

The filled jars are tightly sealed and sterilized in boiling water for 20 minutes. Then they are cooled at room temperature. The sterilized product has a duration of over two years. If it is not sterilized and left to cool at room temperature after closing the containers, the duration of the product may be from 6 to 8 months.

The jars must be washed with detergent to remove any remaining oil, then dried, labelled and stored. Figure 16 shows the flow chart for this process. **Some of its operations can be seen in Photographs 91to 94**.

4.2.5.12 Whole peeled tomato in brine

This is a traditional preserve. The tomatoes are packed in the container whole and peeled, then the packing medium is added, which may be brine, brine with tomato juice or tomato juice alone.

This process considers a mixture of 50%tomato juice with 50% of water and at 2 % of salt. Tomato yield after peeling is of 86 %. Waste (skins), represents 14 %. Sugar concentration in the tomatoes varies from 4 to 5.5º Brix.

The tomatoes are received, washed, selected, scalded and cooled to peel them more easily. A peeling test must be made as in the case of tree tomatoes.

Part of the tomatoes are pulped to obtain the juice to be added to the packing medium.

A solution of 50% tomato juice and 50% water is prepared with 2% salt. It is advisable to add an acid in the form of 10 gr./kg. lemon juice or 0.6-0.8% citric acid.

The peeled tomatoes are placed in the container in an orderly manner and the packing medium is added. They are preheated to 85º C and hermetically sealed for sterilization.

FIGURE 16 **_SWEET AND HOT PEPPER IN OIL_**

RECEPTION
↓
WEIGHING
↓
SELECTION
↓
WASHING
↓
REMOVAL OF PEDUNCLE
↓
REMOVAL OF CORES
↓
CUTTING
(in quarters)
↓
SCALDING
(3 minutes in boiling water with 2% salt and 50% vinegar)
↓
FRYING LIGHTLY
↓
FILLING CONTAINERS
(solids and hot oil)
↓
PREHEATING
(optional, to 85º C when sterilizing)
↓
HERMETIC SEALING
↓
STERILIZATION
(optional, 20 minutes in boiling water)
↓
COOLING
↓
WASHING CONTAINERS
↓
LABELLING
↓
STORAGE

FIGURE 17 ***BANANA IN SYRUP***

RECEPTION
↓
WEIGHING
↓
SEPARATION OF THE FRUIT FROM THE BUNCH
↓
WEIGHING
↓
WASHING
↓
PEELING
↓
SCALDING
(3 minutes in boiling syrup)
↓
SLICING
↓
SCALDING
(optional)
↓
FILLING CONTAINERS
(solids and syrup with 10 gr. lemon juice per kg. of syrup
↓
PREHEATING
(to 85ºC in the product)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

FIGURE 18 ***WHOLE PEELED TOMATO IN BRINE***

RECEPTION
↓
WEIGHING
↓
WASHING AND SELECTION
↓
SCALDING from 1 to 2 minutes in boiling water and COOLING
↓
PEELING
↓
FORMULATION OF THE PACKING MEDIUM
(solution 50% tomato juice and 2% salt in water)
↓
FILLING CONTAINERS
(with solids and packing medium)
↓
PREHEATING
(to 85º C in the product)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

FIGURE 19 — *TREE TOMATO IN SYRUP*

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(30 seconds to 1 minute in boiling water)
AND COOLING
↓
PEELING
↓
PACKING
(of solids)
↓
FILLING
(with syrup)
↓
PREHEATING
(up to 85º C in the product)
↓
SEALING
↓
STERILIZATION
(30 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The containers are sterilized in boiling water for 20 minutes. After cooling with overflowing water, the jars are dried, labelled and stored. The flow chart for this process is shown in Figure 18**. Some operations of this process may be seen in Photographs 87 to 90.**

4.2.5.13 Tree tomato in syrup

Raw Material:
The following yield is obtained from the raw material:

Clean fruit:	86%
Waste (skins):	14%
Sugar contents of the fruit:	8-8.5º Brix

Syrup as required, according to estimates of solid/liquid in the container.

Finished product: a 20 to 25º Brix preserve or according to market requirements.

After receiving fruit, of the yellow variety**, see Photograph 18**, it is weighed and selected.

Then the fruit is scalded in boiling water for easy peeling.

The optimum scalding time may be determined by selecting 5 tomatoes and putting them in boiling water, then withdrawing them at 30 second intervals, cooling them in cold water and testing them for peeling.

The fruit should peel easily, but must have a firm consistency for good appearance in the jar.

The peeled tomatoes, with or without peduncles, are placed in 500 cc., jars to be filled with hot syrup.

Taking the fruit's sugar concentration into account, the syrup is prepared in such a way as to obtain the final concentration desired.
.
Before sealing the jars it is necessary to preheat them in a pan, to ensure the formation of the necessary vacuum for their preservation.

After sealing the jars they are sterilized in boiling water for 30 minutes, and then they are carefully cooled by overflowing with cold water.

The clean jars are dried, labelled, provided with a safety band joining the lid with the glass container, and stored. Figure 19 shows a flow chart for this process. **Some operations of the process may be seen in Photographs 63 to 70.**

4.2.5.14 Uvilla in syrup

Processing of this product, **see Photograph 20**, must be considered as experimental and, for this reason two different types of the product have been developed, with and without seeds, and in two different syrups, natural and coloured with the fruit's own pigment which is in the skin.

Therefore, a product may be prepared by scalding the fruit before peeling it and removing the seeds from some of them later. Then a natural syrup is prepared and the scalded fruit is placed directly into the glass jars and filled with the hot syrup; the containers are preheated open to eliminate the air still present in the fruit and syrup, then they are hermetically sealed for sterilization during 20 minutes at 100º C.

Lemon juice is added to the syrup at a rate of 10 gr./kg., of syrup.
Raw material:

The received and processed product yields the following:

Product without seeds:

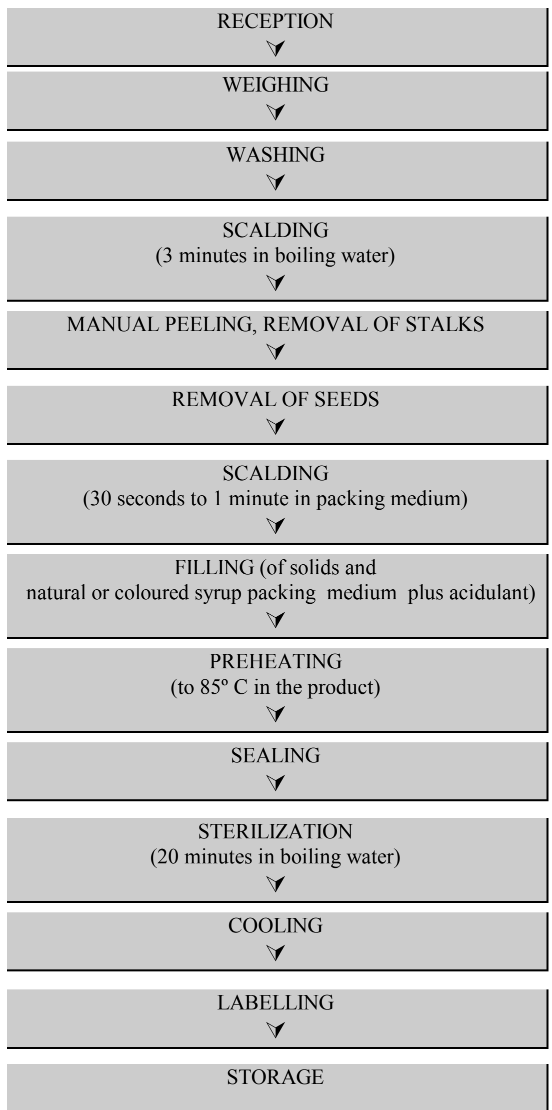
Peel:	18%
Seeds:	7%
Stalks and peduncles:	14%
Pulp without seeds:	61%

Product with seeds:

Peel:	18%
Stalks and peduncles:	14%
Pulp with seeds:	68%

Sugar contents of the fruit 13º Brix: (after scalding the fruit has 7.5º Brix)

FIGURE 20 ***UVILLA IN SYRUP***



Finished product: Peeled uvilla without seeds in natural syrup
Peeled uvilla without seeds in coloured syrup

Peeled uvilla with seeds in natural syrup
Peeled uvilla with seeds in coloured syrup

Preserve balanced at 20º Brix or in accordance with consumer demand.

Syrup in accordance with the fruit's sugar contents and the weight of the fruit and syrup in the container.

The syrup may be natural, that is water and sugar, or it may be water with colouring from steeping the fruit's peels from 5 to 10 minutes at a temperature of not less than 60º C, then filtering and adding the sugar.

Figure 20 shows the flow chart with details of the process operations, **some of which may be seen in Photographs 71 to 74.**

4.2.5.15 String bean in acidified brine

The packing medium is of great importance in this preserve. In fact, it is the packing medium that produces the acidifying effect on a vegetable with a normally very alkaline pH, which brings about the risk of bacterial contamination.

Therefore, this preserve can be produced without risk by adding an acidulant such as vinegar (acetic acid), in this case.

The yield of string beans is 80% (lower values indicate deficient quality of the raw material).

The string beans are received, weighed, washed, selected and weighed again to establish industrial yield.

Then, after cutting off the ends they are cut into pieces of approximately 2.5cm, washed and weighed again. They are scalded 3 minutes in boiling water (100º C), cooled in running water and put into the containers.

The brine formula is of 2% salt and 20% wine vinegar, of 5% acetic acidity. The brine is prepared and heated; then the containers are filled with the hot brine.

The containers are preheated to 85º C, taking care to refill them with hot brine if necessary, then hermetically sealed for sterilization.

They are sterilized in boiling water for 20 minutes; then cooled, dried, labelled with the pertinent information, and stored. The flow chart is shown in Figure 21.

4.3 Marmalades, jellies, syrups, preserves, sweets and candies

As proposed earlier, marmalade is a product formulated mainly on the basis of fruit and sugar. In some cases it is advisable to adjust the pH of the mixture by adding an acidulant such as citric acid. Eventually, it will be necessary to increase the mixture's pectin contents, adding citric or malic pectin to achieve an adequate gel.

Marmalade is a mixture of the fruit's sugar and added sugar, either with present or added pectin to form a gel, which gives the product a special characteristic.

The gel is formed when the mixture reaches 65º Brix (65% sugar), an acidity of 1% and a total pectin contents of 1%. In the case of low acid raw materials with a low pectin content, it is necessary to add exogenous acid and pectin.

FIGURE 21 ***STRING BEAN IN BRINE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
TIPPING
↓
CUTTING INTO PIECES
↓
SOAKING IN WATER
(solution with 10 gr./kg lemon juice)
↓
SCALDING
(3 minutes in boiling water)
↓
COOLING
(in cold water)
↓
FORMULATION OF THE BRINE
(solution of 2% salt and 20% vinegar with 5% acidity
↓
FILLING CONTAINERS
↓
PREHEATING
(to 85º C in the product)
↓
SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

Marrmalade processing is common at the household level, especially in the communities of certain countries. Therefore, competition between products of different origin, calls for very special products, on the basis of the raw materials used, the formula and particularly the marmalade's naturalness, without preservatives and additives. This is possible in the small scale production of a microenterprise.

Because of its great bio-diversity, the Amazon region has interesting resources for the production of concentrated products such as marmalades and jellies. The latter, contrary to marmalades which are prepared with whole fruit and all the pulp, jellies are prepared with clarified fruit juice due to which pectin and acid must always be added.

The formulation of marmalades is very simple, only fruit and sugar are required in a proportion of 50% and 50%.

The fruit may be in either of the three following forms: whole, in the case of small fruit; chopped for medium **(see Photograph 23**) and large fruit; and pulped, for any type of fruit. In the latter case the fruit is generally sieved to remove most of the fiber and seeds.

Thus, the marmalade will contain 50% fruit, in any of its forms, and 50% sugar (cane or sugar beet saccharose). The sugar may be refined or semi-refined. The acid and pectin added when necessary do not represent more than 1% of the total mixture. The fruit or vegetable raw material may be alone or in a mixture of two or three.

4.3.1 Calculations for formulating and proportioning marmalade (similar in the case of jelly)

As stated, the marmalade reaches a finishing point when the mixture's sugar concentration reaches 65º Brix. This means that if equal parts of sugar and fruit are mixed, part of the fruit's water must evaporate during processing and the product will weigh less than the original mixture. It is important to calculate the final weight in advance for several reasons.

Advance knowledge of the final weight of the marmalade, based on the fruit's initial weight, makes it possible to:

- Prepare the containers required for all the marmalade.
- Calculate the amount of pectin that, eventually, may need to be added.
- Plan the production process.

As in the case of preserves:

BF	: Brix º of the fruit
BA	: Brix º of sugar = 100
XAF	: Sugar fraction of the fruit
PF	: Weight of fruit
PA	: Weight of sugar = initial fruit weight
PAF	: Weight of sugar contributed by fruit
PTA	: Total weight of sugar in the product
BP	: Brix º of finished marmalade
XAP	: Sugar fraction in the product
XAA	: Sugar fraction in the sugar = 1
PTP	: Total weight of marmalade

and that:

BF : 100	= XAF
PF x XAF	= PAF
BP : 100	= XAP
PTA : XAP	= PTP

The formulation and result of any marmalade may be calculated this way.

In case a refractometer is not available, the sugar contents of the fruit may be assumed on the basis of data available in literature, by applying an average of these figures, without fear of making serious mistakes, as will be shown in the following examples.

Example:
A marmalade is to be made with 100 kg of pineapple which have a sugar concentration of 18º Brix. The industrial yield of pineapple is of 62% and it is desired to prepare the marmalade with all the available pulp cut into 1cm square cubes. Calculate the kilograms of marmalade that will be obtained and the number of 400 gr., containers required. The marmalade must have 65º Brix.

Solution:
If 100 kg. of fruit with a 62% yield are available, there will be 62 kg. of chopped pulp available; therefore, 62 kg. of sugar will be required.

Thus,

BF	: 18º Brix
BA	: 100º Brix
XAF	: 0.18
PAF	: 62 kg x 0.18 = 11.16 kg
PA	: 62 kg
PTA	: 11.6 kg + 62 kg = 73.6 kg
BP	: 65º Brix
XAP	: 65º Brix : 100 = 0.65
PTP	: PTA : XAP = 73.6 kg : 0.65 = 113.1 kg

Therefore, if 62 kg., of 18 º Brix pineapple in chunks are mixed with 62 kg., of sugar and this mixture is brought to 65º Brix, the final weight of the marmalade will be 113.1 kilograms. As 400 gr., of marmalade will go into each container, 282 containers will be needed and there will be marmalade left for ¾ of another container.

4.3.2 Preparation

To obtain a good quality product it is advisable to follow a procedure that will make it possible to maintain certain uniformity and, for this reason, it is recommended to follow the process as shown in Figure 2 of the First Part of the Manual.

The addition of a portion of the sugar to the fruit during preliminary heating, serves to achieve a certain degree of inversion of the saccharose used, that is, to transform part of the sugar into inverted sugar, which is a mixture of glucose and fructose, two simple sugars produced on the basis of saccharose through the action of the fruit's acid. This avoids crystallization due to the product's over concentration, in addition, a special shine is also obtained due to the glucose.

Some aspects to be considered to maintain the marmalade's quality, are:

- Only use very good quality fruit.
- Use good quality sugar.
- Mix in the sugar in portions and not all at a time, so that it will dissolve completely.
- When adding the last portion of sugar do not exceed 60º Brix, in order to control the concentration process in the last stage of evaporation. Over concentration must be avoided, constantly controlling the Brix degrees or the product's weight in case no refractometer is available.

To prove the importance of knowing the exact Brix degrees of the fruit, the above problem will be repeated with two new sugar concentration values in the fruit, one considerably higher and the other much lower. In this case the yield of marmalade obtained from each fruit will be compared.

Solution for fruit with 25º Brix:

If we have 100 kg., of fruit with a 62% yield, 62 kg., of chopped pulp will be obtained; therefore 62 kg., of sugar will be required. Thus,

BF	: 25º Brix
BA	: 100º Brix
XAF	: 0.25
PAF	: 62 kg x 0.25 = 15.5 kg
PA	: 62 kg
PTA	: 15.5 kg + 62 kg = 77.5 kg
BP	: 65º Brix
XAP	: 65º Brix : 100 = 0.65
PTP	: PTA : XAP 0 77.5 kg : 0.65 = 119.2 kg

Therefore, if 62 kg. of chopped pineapple with 25º Brix are mixed with 62 kg. of sugar and the mixture is brought to 65º Brix, the final weight of the marmalade will be 119.2 kilograms. Thus, 298 containers of 400 gr., will be needed, with very little product left over.

This figure represents an increase in marmalade yield of nearly 5%, for an increase of almost 39% in the fruit's Brix degrees.

Solution for fruit with 10º Brix:

If 100 kg., of fruit yielding 62% are to be used, the available chopped pulp will weigh 62 kg.; therefore, 62 kg., of sugar will be needed. Thus,

BF	: 10º Brix
BA	: 100º Brix
XAF	: 0,10
PAF	: 62 kg x 0.10 = 6,2 kg
PA	: 62 kg
PTA	: 6.2 kg + 62 kg = 68.2 kg
BP	: 65º Brix
XAP	: 65º Brix : 100 = 0.65
PTP	: PTA : XAP = 68.2 kg : 0.65 = 104.9 kg

Thus, if 62 kg. of pineapple in chunks with 10º Brix, are mixed with 62 kg. of sugar and the mixture is brought to 65º Brix, the final weight of the marmalade will be 104.9 kilograms. As each container will hold 400 gr., of marmalade, 262 containers will be needed and there will be a surplus of a quarter container.

This figure represents a decrease of around 7% in marmalade yield, for a 45% decrease in the fruit's ºBrix contents.

This exercise implies that the effect of the fruit on yield is negligible, and therefore, it is perfectly possible to use an approximate ºBrix value for the fruit without fear of making serious mistakes. The difference between a yield of 262 containers with 10º Brix fruit and 298 containers with 25º Brix fruit is about 14% and the difference of Brix degrees of that same fruit is 250%.

When the case of preserves was studied it was noted that the fruit's sugar contents was determinant in obtaining a considerable increase in economic yield; in this case, the fruit's sugar content is insignificant due to the great influence of the added sugar.

The importance of this lies in the possibility of producing marmalades with a high degree of accuracy at the 65º Brix cut off point, without a refractometer, only with a good estimate of the fruit's Brix contents. This implies that it is possible to work without a refractometer, but with a good scale to weigh the marmalade pot continually with a certain degree of accuracy. Such a scale costs less than a refractometer at a 65º Brix scale, and is more useful.

The procedure and the principle of sweets and candies are similar to those for marmalade, the only difference being that of their sugar contents and that, in some cases, the chunks or while fruit are suspended in a dense syrup with a high content of soluble solids, of around 75-80º Brix.

In the case of jellies the principle is the same, but instead of fruit chunks or pulp, the part of the fruit used is juice as clear as possible, that is, containing as little pulp as possible.

In addition, Brazil nut marzipan has been included in this chapter. This is basically a mixture of nut paste with sugar.

4.3.3 Processing of specific products

The following products are presented in this chapter together with the corresponding flow charts:

- Carambola marmalade
- Cocona marmalade
- Copuazu marmalade
- Guava marmalade
- Orange marmalade
- Naranilla marmalade
- Papaya marmalade in chunks
- Pulped papaya marmalade
- Pineapple marmalade in chunks
- Tamarind marmalade and syrup
- Tree tomato marmalade
- Carrot and lemon/orange marmalade
- Carambola sweet
- Cashew “apple” sweet
- Candied watermelon rind
- Passion fruit syrup
- Brazil nut marzipan

4.3.3.1 Carambola marmalade

Raw material:

The carambolas are received and weighed, washed and selected, leaving the firmer ones for preserves, the softer ones for nectar and the intermediate ones for the production of marmalade in chunks.

After preparing the fruit for processing the following yields are obtained:

Fruit:	97%
Waste from cutting off ends	3%

The fruit’s sugar concentration is of 8º Brix.

Finished product: Carambola marmalade with 65º Brix.

The marmalade is formulated in the same traditional proportion of 1 : 1 fruit and sugar.

The fruit is cut into slices and half slices.
The carambola chunks are cooked with 10% of the sugar and 10 gr., lemon juice per kg., of fruit plus sugar.

It is brought to the boil for 15 - 20 minutes, then the first third of the sugar is added, stirring constantly to preserve the product’s characteristics. After 15 - 20 minutes, the second third is added and then, after 20 minutes the last third. Variation in cooking time depends on intensity of heat and type and thinness of the pan.

After adding the last third, the Brix contents of the marmalade should be of the order of 60 - 62 degrees.

Cooking is continued to a concentration of 65º Brix, and then the containers are filled up to the top.

The filled containers are quickly sealed and placed upside down to sterilize the lids. The cold containers are washed to remove marmalade drippings from the outside, then dried, labelled and stored.

A flow chart for this process is shown in Figure 22. **Some of its operations may be seen in Photographs 95 to 98.**

4.3.3.2 Cocona marmalade

Raw material:

As a result of preparing the product for processing the following yield is obtained:

Pulp from raw material received:	76%
Pulp with seed from selected product:	89%
Peel from selected product:	11%
Seedless pulp from selected product	68%
Seeds and fiber from selected product:	20%
Sugar contents of the fruit:	7.0º Brix

Sugar: in a quantity similar to the weight of fruit.
Lemon juice: 10 gr./kg. of marmalade

Finished product: Marmalade with 65º Brix .

The fruit is received must be ripe (**see Photograph 6**), weighed and selected. Then it is weighed to determine discards due to quality. The weighed fruit is washed and scalded in boiling water for some minutes until tender. The scalded product is either peeled or halved to remove the pulp with a spoon.

The removed pulp is sieved to eliminate seeds and fiber using a pulping machine. This pulp is weighed to formulate the product. One kilogram of sugar will be added for each kilogram of pulp. The pulp is heated with 10% of the sugar and 10 gr., of lemon juice per kg., of marmalade in accordance with estimated yield.

Then the product is boiled for 20 minutes and the rest of the sugar is added in thirds (30% each time), after boiling approximately 20 minutes every time. After the last third of sugar is added the product should have a sugar content not exceeding 60 -62º Brix.

When the marmalade has reached 65º Brix, the pot is withdrawn from the fire and the glass jars are filled with the hot marmalade and hermetically sealed. The containers filled to the brim and sealed, are turned upside down and left to cool overnight. When the containers are cold they are washed, dried, labelled and stored. A flow chart for this process is shown in Figure 23. **Some of its operations may be seen in Photographs 99 to 102**.

FIGURE 22 **_CARAMBOLA MARMALADE_**

RECEPTION
↓
WEIGHING
↓
WASHING AND SELECTION
↓
CUTTING IN PIECES
↓
WEIGHING AND FORMULATION
↓
FRUIT MIXTURE WITH 10% SUGAR
↓
HEATING DURING 20 MINUTES
↓
ADDITION OF 30% SUGAR
↓
HEATING DURING 20 MINUTES)
↓
ADDITION OF 30% SUGAR
↓
HEATING 20 MINUTES)
↓
ADDITION OF LAST 30% SUGAR
↓
HEATING TO 65º Brix
↓
FILLING CONTAINERS WITH HOT PRODUCT
(at not less than 85º C)
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING THE CONTAINERS
↓
LABELLING
↓
STORAGE

4.3.3.3 Copuazu marmalade

This product is shown in Photograph 7. The fruit is weighed to determine the yield of the product as well as of by-products and waste.

The fruit is opened by breaking the fruit's shell with a hammer or a stick then the pulp removed from the seeds manually.

The pulp is separated from the seeds making a slit with scissors and taking care to separate as much pulp as possible. This is a traditional artisanal method.

The following yield is obtained from this process:

Pulp:	35%
Seeds:	18%
Shell and waste:	47%

The pulp is homogenized obtaining an 84% yield from this operation.

The pulp has a sugar concentration of 11º Brix.

The traditional 1:1 formula of pulp and sugar is used to process this marmalade.

The homogenized pulp is heated and 50% of the sugar plus 0.5% pectin are added, heating the mixture for about 20 minutes, until the sugar is completely dissolved. The mixture's concentration is around 40º Brix.

At this point the remaining 50% sugar plus another 0 5% pectin are added. Boiling is continued until the mixture reaches the final concentration of 65º Brix.

The finished product at 65º Brix is put in glass containers, taking care that the temperature does not drop below 90º C. The containers are hermetically sealed and turned upside down to sterilize the inside of the lids.

Then the containers are cooled at room temperature, washed, dried and labelled indicating all pertinent data.

The flow chart for this product is shown in Figure 24. **Some operations of the process may be seen in Photographs 103 to 106.**

4.3.3.4 Guava marmalade

Raw material:
The yield of the raw material was the following:

Guava pulp:	86%
Waste:	14%
Sugar contents of the fruit:	9º Brix

Sugar: equal quantities of sugar and fruit at a rate of 1:1.

Finished product: 65º Brix marmalade

FIGURE 23 ***COCONA MARMALADE***

RECEPTION
↓
WEIGHING
↓
SELECTION
↓
WASHING
↓
SCALDING
(in boiling water until tender)
↓
PEELING
↓
PULPING
(separation of seeds and fiber)
↓
WEIGHING
↓
FORMULATION
(fruit, sugar = 1 : 1)
↓
COOKING WITH 10% SUGAR AND LEMON JUICE
(during 20 minutes)
↓
ADDITION OF 30% SUGAR AND COOKING
(during 20 minutes)
↓
ADDITION OF 30% SUGAR AND COOKING
(during 20 minutes)
↓
ADDITION OF 30% SUGAR AND COOKING
(during 20 minutes)
↓
PACKING HOT (not less than 85º C)
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING THE CONTAINERS
↓
LABELLING
↓
STORAGE

FIGURE 24 ***COPUAZU MARMALADE***

RECEPTION
↓
WEIGHING
↓
PREPARATION OF THE RAW MATERIAL
↓
PULPING
(by slitting with scissors)
↓
HOMOGENIZING THE PULP
↓
FORMULATION
(pulp: sugar = 1:1)
↓
COOKING WITH 50% SUGAR ADDED, PLUS 0.5% PECTIN (for 20 minutes)
↓
COOKING WITH 50% SUGAR ADDED, 0.5% PECTIN (up to 65º Brix)
↓
PACKING HOT PRODUCT
↓
SEALING AND COOLING
↓
WASHING THE JARS
↓
COOLING AND DRYING
↓
LABELLING
↓
STORAGE

FIGURE 25

GUAVA MARMALADE

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(5 minutes in boiling water)
↓
CUTTING
↓
PULPING
↓
COOKING WITH 1/3 SUGAR
(20 minutes)
↓
COOKING WITH 1/3 SUGAR
(20 MINUTES)
↓
COOKING WITH 1/3 SUGAR
(until 65º Brix)
↓
PACKING
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING CONTAINERS
↓
LABELLING
↓
STORAGE

After the general reception, weighing, washing and selection operations the fruit is scalded. This is necessary to facilitate manual pulping of the guava. Depending on its maturity the fruit is scalded in boiling water until tender but firm.

The scalded guavas are quartered then pulped with the help of a manual or electric pulper.

An amount of sugar equal to the amount of pulp is weighed and divided into three equal parts. When the guava pulp has begun to boil the first third of the sugar is added and cooking is continued, the remaining two thirds of sugar are added at 20 minute intervals.

When the mixture has reached 65º Brix, it is withdrawn from the fire and the jars are filled with the help of a cut off funnel, hermetically sealed and turned upside down.

Later the jars are washed, dried, labelled and stored.

Figure 25 shows the flow chart for this process. **Some of its operations may be seen in Photographs 107 to 110**.

4.3.3.5 Orange marmalade

Raw material:

The following yield is obtained from raw material:

Strained orange juice:	29%
Total waste:	71%
Sugar contents of fruit:	10.4º Brix

Around 2-3% finely sliced peel is added. (Only the yellow part, the white of the peel having been removed):

Optionally, the peels may be scalded for 10-15 minutes in a small amount of boiling water to reduce the sharp flavour of the essential oils in the finished product and to tenderize them at the same time.

Sugar: Equal amounts of sugar and juice.

Finished product: jelly type marmalade with 65º Brix.

To obtain orange marmalade, after receiving, washing and weighing the fruit, the juice is extracted as quickly as possible to keep it from becoming too bitter. The juice is filtered through a cloth.

Then the juice and peel are cooked with 10% of the sugar for 15 minutes.

Later, 30% of the remaining sugar is added followed at 20 minute intervals by the other two thirds.

A sufficient quantity of pectin equivalent to 1% is added together with the last third of the sugar for the jelly to gel. Also 0.5% citric acid is added to favour acidity and the formation of gel, especially in the case of oranges that are not very acid.

At 65º Brix the marmalade is ready and must be withdrawn from the fire to proceed to fill the jars, which after cooling upside down, must be washed, labelled and stored.

Figure 26 shows the flow chart for this process**. Some of its operations may be seen in Photographs 111 to 114**.

FIGURE 26 ***ORANGE MARMALADE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
EXTRACTION OF JUICE
↓
STRAINING AND WEIGHING
↓
ADDITION OF PEEL AND 10% SUGAR
↓
COOKING
(for 15 minutes)
↓
COOKING
(adding 1/3 sugar every 20 minutes up to 60º Brix)
↓
ADDING 0.5% AND 1% PECTIN AND CONTINUE COOKING
UP TO 65º Brix
↓
PACKING
↓
SEALING
↓
COOLING
↓
WASHING
↓
LABELLING
↓
STORAGE

4.3.3.6 Naranjilla marmalade

Raw Material:

The following yield is obtained from the raw material:

Naranjilla pulp:	59%
Waste:	41%
Sugar contents of the fruit:	6.0º Brix

Sugar: equal to the amount of fruit.

Finished product: 65º Brix marmalade

Naranjilla is a fruit which becomes easily oxidized, turning from light green to dark brown. Therefore, some precautions must be taken, one of them is to scald the fruit for an appropriate length of time depending on the variety.

To obtain naranjilla marmalade, after receiving ripe fruits (**see Photograph 12**), washing and weighing them, they are scalded for not less than 10 minutes. This also facilitates peeling.

FIGURE 27 ***NARANJILLA MARMALADE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(due to hardness of pulp in hybrid varieties
↓
PEELING
(optional chopping)
↓
COOKING
(adding 1/3 sugar every 20 minutes, up to 65º Brix)
↓
PACKING
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING OF CONTAINERS
↓
LABELLING
↓
STORAGE

After peeling the pulp is removed with a manual pulper and cooked. Optionally, fruits may be chopped into small pieces before cooking.

The amount of sugar is equal to the pulp's weight, i.e., 1: 1, and is added in three equal portions, one after the other at 20 minute intervals after the mixture has started boiling.

The marmalade is ready when it reaches 65º Brix, without the need for pectin, and must be withdrawn from the fire to proceed to fill the jars. After the jars have been sealed turned upside down and cooled, they must be washed, dried, labelled and stored.

The described process is shown in Figure 27.

Some operations of the process may be seen in Photographs 115 to 118.

4.3.3.7 Papaya marmalade in chunks

Raw material:

This marmalade is made with ripe fruit. To process slightly immature fruit, although this should be avoided, it is necessary to cook longer than usual and add water.

The approximate yield is:

Chopped pulp:	67%
Skins and seeds:	33%
Sugar content of the fruit:	9.0-9.5º Brix

Finished product: marmalade with 65º Brix

The best and ripe fruit is selected.

Then the raw material is weighed to determine yield and make the necessary calculations for the formulation.

The fruit is washed with running potable water and then peeled and halved.

Then the seeds are removed and the fruit is cut into 1 cm square cubes.

Fruit/sugar ratio: 1 to 1

The cut fruit is put in a pot with 10% of the sugar. If the fruit is not ripe enough, it must be precooked in water.

One percent lemon juice is added together with the first portion of sugar to favour sugar inversion.

When the fruit is tender add half of the sugar and boil until pieces start breaking. Then add the remaining sugar and, optionally 1% pectin in relation to the product's final weight.

The mixture is evaporated until 65º Brix is reached and packed hot in glass jars with metal lids, taking care to seal the containers hermetically to produce the adequate vacuum. The sealed jars are turned upside down to sterilize the lids.

When the jars are cold they are washed to remove marmalade on the outside, dried, labelled indicating the pertinent data and stored. The flow chart for slightly immature fruit is shown in Figure 28. **Some operations of the process are shown in Photographs 119 to 122.**

FIGURE 28 ***PAPAYA MARMALADE***

RECEPTION

WEIGHING
↓
WASHING
↓
PEELING THE FRUIT
↓
CUTTING IN PIECES
↓
COOKING THE PIECES IN WATER WITH 10% SUGAR
↓
FORMULATION
(pulp: fruit ratio = 1:1)
↓
COOKING WITH ADDITION OF REMAINING SUGAR
IN TWO PARTS, PLUS ACID AND PECTIN
↓
PACKING HOT PRODUCT
↓
HERMETIC SEALING
↓
WASHING OF JARS
↓
LABELLING
↓
STORAGE

4.3.3.8 Pulped papaya marmalade

The procedure for pulped fruit is similar to the procedure for fruit in chunks, but in this case the fruit is riper.

The weighed fruit is selected to remove rotten fruit. It is peeled, halved and the seed removed.

Then the fruit is cut into small pieces to make pulping easier.

An interesting aspect is that although the texture of the fruit is softer, it generally contains the same amount of soluble solids, 9º Brix, as the firmer fruit used for marmalade in chunks.
The fruit is pulped and homogenized in a semi-industrial grinder, obtaining a yield of approximately 68 percent.

This pulp is brought to the boiling point adding 1/3 of the sugar and 1% citric acid with respect to the final weight of the marmalade, calculated according to the directions contained in the first chapter of the Second Part of the Manual. 10 gr., of lemon juice are added per kilogram of pulp.

The mixture is cooked for 15 to 20 minutes, at the end of which the second third of sugar is added. After another 15 minutes, the last third of sugar is added. If a more consistent marmalade is desired, 1% pectin is added to favour gel formation. At this point, the marmalade should have a sugar content of about 60º Brix.

The mixture is concentrated to a level of 65º Brix, packed hot and the jars are turned upside down to sterilize the insides of the lids. Glass containers with metal lids must be used.

After the jars have cooled at room temperature they are washed, dried and labelled showing all pertinent data. Figure 29 shows the flow chart for this product.

FIGURE 29 ***PULPED PAPAYA MARMALADE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
PEELING AND DESEEDING
↓
CUTTING PIECES AND PULPING
↓
FORMULATION
↓
COOKING
(with 1/3 sugar added every 20 minutes up to 65º Brix and lemon juice)
↓
PACKING HOT PRODUCT
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING JARS
↓
LABELLING
↓
STORAGE

4.3.3.9 Pineapple marmalade in chunks

Raw material:

Pineapple yields the following:

Peeled fruit:	61%
Peel and heads:	39%
Chopped pulp:	93% (in relation to peeled fruit)
Sugar contents of the fruit:	11.2º Brix

Finished product: marmalade in chunks with 65º Brix

The mature fruit is received and weighed. Then it is washed to remove impurities and dirt from the field. The heads are removed and the fruit is carefully peeled, endeavouring to match yield with the removal of eyes to obtain a good quality product.

The peeled fruit is sliced and chopped into small even pieces of around 1 centimeter. The chunks are weighed and the marmalade is formulated mixing 1 kg of fruit with 1 kg of sugar.

The pineapple is heated with 10% of the total sugar and 10 gr., of lemon juice per kilogram of finished product. The mixture is cooked for 20 minutes after all the sugar is dissolved. Then the first 30% of the total sugar is added and the mixture is boiled for 20 minutes. The second 30% portion of sugar is added and the mixture is boiled for another 20 minutes. After which the last 30% portion of sugar is added.

At this point the marmalade should have no more than 60-62º Brix, optionally 1% of pectin can be added. The mixture is boiled until 65º Brix are reached, and the product is then withdrawn from the fire, the containers are filled with the hot marmalade, at no less than 85º C and hermetically sealed. The jars are turned upside down to sterilize the lids and left to cool overnight. When the jars are cold they are washed, dried, labelled, indicating all pertinent information and stored.

Figure 30 shows the corresponding flow chart. **Some operations of the process may be seen in Photographs 123 to 126.**

4.3.3.10 Tamarind marmalade and syrup

Two products are obtained from this process mainly based on pulp extraction. Later a syrup or a marmalade is made from said raw material.

Raw material:

The ripe tamarinds are weighed to determine their industrial yield. The skinned pulp with seeds is used as raw material.

To separate the pulp from the seed the mixture must be put in water in the following proportion:

Tamarind:	60%
Water:	35%
Sugar:	5%
Sugar content of the pulp:	13º Brix

FIGURE 30 ***PINEAPPLE MARMALADE***

RECEPTION
↓
WEIGHING
↓
SELECTION AND WEIGHING
↓
WASHING
↓
PEELING
↓
WEIGHING
↓
CUTTING IN PIECES
↓
WEIGHING
↓
FORMULATION
(fruit: sugar = 1:1)
↓
COOKING
(20 minutes with 10% sugar and 10 gr., lemon juice/kg marmalade)
↓
COOKING WITH 30% SUGAR
(20 minutes)
↓
COOKING WITH 30% SUGAR
(20 minutes)
↓
COOKING WITH 30% SUGAR
(to 65º Brix)
↓
PACKING HOT PRODUCT
(at no less than 85º C)
↓
HERMETIC SEALING
↓
WASHING CONTAINERS
↓
LABELLING
↓
STORAGE

After removal of the seeds, yield is:

Pulp with water and sugar:	54%
Sugar contents:	28º Brix
Seeds with pulp remains:	46%

Tamarind syrup and marmalade are made with the lightly sugared pulp, as shown in the flow charts, corresponding to a normal diagram for marmalades and a similar one for nectar, only more concentrated and a longer preservation period. Figure 31 shows the flow chart for processing tamarind marmalade and syrup. **Some operations of this process may be seen in Photographs 127 to 130.**

4.3.3.11 Tree tomato marmalade

Raw material:

The following yield is obtained from the raw material:

Tree tomato:	86%
Waste:	14%

Sugar contents of the fruit:	8.4º Brix

Finished product: marmalade with 65º Brix.

After the fruit has been received it is weighed and selected.

To process marmalade, nectar and fruit in syrup simultaneously, the large tomatoes are selected for the nectar and marmalade, the smaller fruit to fill 500 cc. jars with 4 to 5 units.

After selecting the fruit it is scalded in boiling water, for two or three minutes, to make peeling easier.

It is not advisable to pulp the fruit as it darkens fast when exposed to air for too long.

The peeled fruit should be cut in slices of a width of approximately 0.5 cm., and placed over medium heat in an aluminum pot for ten minutes, stirring constantly.

After this time the first third of the required sugar must be added, continuing to cook for another 20 minutes, after which the second third of the sugar must be added.

Boil for 20 minutes more, and add the remainder of the sugar. The ºBrix contents, after this addition, should not exceed the value of 60-62º Brix.

Continue cooking, stirring the paste constantly to keep it from sticking to the bottom of the pot, and measuring the Brix degrees from time to time.

When 65º Brix have been reached, the pot is withdrawn from the fire, and the jars are filled to the brim.

As soon as the lids are on, the jars are placed upside down in order to sterilize the inside surface of the lids.

FIGURE 31 ***TAMARIND MARMALADE AND SYRUP***

RECEPTION
↓
WEIGHING
↓
MIXTURE WITH WATER AND SUGAR
↓
PULP EXTRACTION
↓

SYRUP

FORMULATION
↓
ADDITION OF SUGAR TO REACH 40º BRIX
↓
PACKING HOT
↓
HERMETIC SEALING
↓
STERILIZATION AT 100º C, 20MINUTES
↓
COOLING
↓
LABELLING
↓
STORAGE
↓

MARMALADE

FORMULATION
↓
1:1 PULP AND SUGAR
↓
HEATING WITH 10% SUGAR
↓
ADDITION OF 30% SUGAR
↓
ADDITION OF 30% SUGAR
↓
ADDITION OF LAST 30% SUGAR
↓
COOKING TO 65º BRIX
↓
FILLING OF CONTAINERS
↓
SEALING
↓
COOLING
↓
WASHING CONTAINERS
↓
LABELLING
↓
STORAGE

When the product is cold, the jars must be cleaned and labelled, clearly indicating the name of the product, its ingredients and processing and expiry dates. It is advisable to stick a strip of paper covering the lid and glass, in order to know whether the jar has been opened.

Figure 32 shows a flow chart of the process.

Some operations of this process may be seen in Photographs 131 to 134.

FIGURE 32 ***TREE TOMATO MARMALADE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(3 minutes)
↓
PEELING
↓
COOKING
(adding 1/3 sugar every 20 minutes until 65º Brix are reached)
↓
PACKING, AT NOT LESS THAN 85º C
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING
↓
LABELLING
↓
STORAGE

4.3.3.12 Carrot and lemon/orange marmalade

Raw Material:

The following yield is obtained from the raw material:

Carrots:	98%
Sugar contents of carrots:	11º Brix
Lemon:	90%
Sugar contents of lemon:	9º Brix

The following proportions are used to process marmalade:

Carrots:	90%	(900 g, for instance)
Lemon:	10% (or orange)	(100 g, for instance)

Sugar in the same proportion as the total amount of fruits: 1000 gr., sugar.

Finished product: marmalade with 65º Brix.

The procedure for processing carrot and lemon marmalades and carrot and orange marmalades, is similar, therefore, only the first will be described.

After washing the carrots, using a brush, the green parts are removed and the carrots grated. After weighing, the grated carrots are placed in an aluminum pot with a thick bottom, having previously added water so that the carrots will be slightly covered.

The lemons are washed, weighed and sliced as finely as possible. The seeds are removed and the slices chopped into 5mm., pieces approximately.

The grated carrots and lemon are cooked until the carrots are tender and translucent. If this point is not reached at the end of the day's work, there is the option of adding the first third of the sugar to the product cook for 20 minutes and leave it to stand until the following day.

Cooking is continued the next day until the carrots are translucent. Water may be added if the jam gets hard. After which the second third of the sugar is added and, after 30 minutes the last third of the sugar, taking care that the Brix degree does not exceed 60-62 degrees after this last addition.

When 65º Brix have been reached the heat is turned off, and the jars are filled with the help of a funnel with the end cut off.

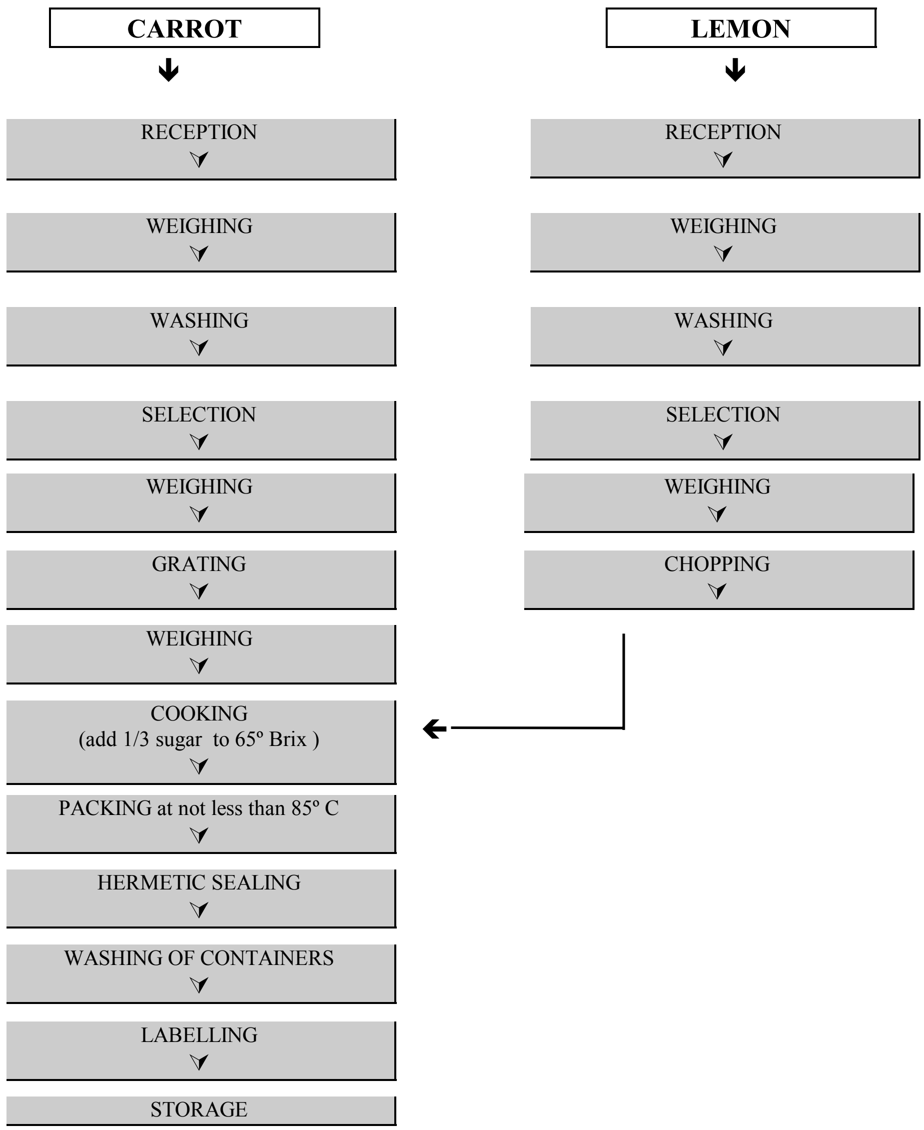
After covering the full jars, they are turned upside down to sterilize the lids.

The jars are left to cool and then they are washed, dried, labelled and stored.

Figure 33 shows the flow chart for this process.

Some of its operations may be seen in Photographs 135 to 138.

FIGURE 33 ***CARROT AND LEMON MARMALADE***



4.3.3.13 Carambola sweet

Carambola processing yields the following:

Prepared carambola: 67%
Waste: 33%

Sugar contents of the fruit: 10º Brix

Finished product: carambola fruit with a high sugar concentration, suspended in syrup around 75-80º Brix. Final balance point above 65º Brix.

The carambola fruit is cooked for a long time in syrup with an initial sugar content of 70º Brix which causes the osmotic dehydration of the fruit.

FIGURE 34 ***CARAMBOLA SWEET***

RECEPTION
↓
WEIGHING
↓
SELECTION
↓
WASHING
↓
PREPARATION OF RAW MATERIAL
(a thin strip is cut off the fruit's wings)
↓
PREPARATION OF SYRUP to 60ºBRIX
↓
COOKING FOR TWO HOURS
↓
CONCENTRATION OF SYRUP TO 80º BRIX
↓
FILLING OF CONTAINERS
(at not less than 85º C
↓
HERMETIC SEALING
↓
COOLING
↓
WASHING OF CONTAINERS
↓
LABELLING
↓
STORAGE

Cooking time depends on the type of fruit, its quality and maturity, etc. Generally, two hours. Thin slices are cut off the carambola fruit's edges lengthwise to favour sugar penetration.

During cooking the fruit loses water, acquires more sugar and becomes wrinkled, taking on a characteristic texture and a caramel or golden colour. It must not be allowed to darken excessively.

When the fruit is cooked and dehydrated and has acquired an adequate texture and colour, the concentration of the syrup may be increased to 80º Brix without it becoming caramelized. The containers are then filled with the solid and hot product, adding the packing medium which is the concentrated syrup. As the product is packed hot, the containers are tightly sealed and turned upside down to cool, the same as with marmalade.

When the containers are cold, they are washed, dried, labelled and stored.

The flow chart is shown in Figure 34**. Some operations of the process may be seen in Photographs 139 to 142**.

4.3.3.14 Cashew "apple" sweet

Processing of this fruit yields the following:

Prepared cashew "apple":	82%
Waste:	18% (nuts and peduncles)

Sugar contents of the fruit: 7.5-10º Brix, depending on maturity.

Finished product: fruit with a high sugar concentration, suspended in syrup of about 75-80º Brix. Final balance point over 65º Brix.

The fruits of the yellow or red variety are cooked a long time in syrup with an initial sugar contents of 70º Brix, which produces osmotic dehydration of the fruit. Cooking time depends on the fruit's type, quality, maturity, etc. (See photograph 11).

Generally, two hours cooking are required or up to 67º Brix of the syrup. The ends of the fruit are pricked with a fine pick to permit sugar to penetrate.

During cooking, the fruit loses water, acquires more sugar and becomes wrinkled, taking on a characteristic texture and a pale caramel to golden colour. It should not be allowed to darken excessively.

When the fruit is cooked and dehydrated and its texture and colour are adequate, the syrup is allowed to concentrate up to around 80º Brix, without becoming caramelized and the jars are filled with the hot solid product, after which the packing medium, which is the concentrated syrup, is added. As the containers are filled with the hot product they are sealed hermetically, turned upside down and left to cool, as in the case of marmalade. When the containers are cool they are washed, dried, labelled and stored.

The flow chart is shown in Figure 35. **Some operations of the process may be seen in Photographs 143 to 146**.

4.3.3.15 Candied watermelon rind

This product is prepared from watermelon rinds which are discarded when preparing pickled watermelon pulp or after having been consumed fresh.

The watermelon rinds without pulp are peeled, removing the external green cuticle.

The slices are put on to boil in a little water, stirring once in a while, until they are tender. The quantity of water must be enough to cover the watermelon chunks.

An 80º Brix syrup is prepared to which 20 gr., of lemon juice is added for every kg., of syrup.

The rinds are put into this syrup and boiled slowly for about 4 hours.

Almond essence is added. At this point the watermelon rinds should be transparent.

They are removed from the heat and left standing overnight. Then the slices are removed from the syrup and cut up into small strips or cubes.

FIGURE 35 ***CASHEW APPLE SWEET***

RECEPTION

↓

WEIGHING

↓

SELECTION

↓

WASHING

↓

PREPARATION OF RAW MATERIAL
(after removing nuts and peduncles the fruit is pricked with a fine pick to permit sugar penetration)

↓

PREPARATION OF SYRUP AT 70ºBRIX

↓

COOKING FOR TWO HOURS

↓

SYRUP CONCENTRATION 80º Brix

↓

FILLING OF CONTAINERS
(at not less than 85º C)

↓

HERMETIC SEALING

↓

COOLING

↓

WASHING THE CONTAINERS

↓

LABELLING

↓

STORAGE

At the same time, a syrup the same as the previous one, is prepared, that is water, sugar and 10 gr., of lemon juice per kg. of syrup. The syrup must be of at least 65º Brix .

The pieces of rind are heated to the boiling point.

The jars are filled with hot solid and liquid material, making sure that they are completely full. The temperature must not be less than 85º centigrade.

FIGURE 36 ***CANDIED WATERMELON RIND***

- RECEPTION
- WEIGHING
- PEELING THE RINDS
- PREPARATION OF SYRUP at 80º BRIX
- IMMERSION OF RINDS IN THE SYRUP
- COOKING ON LOW HEAT FOR 4 HOURS (addition of almond essence)
- LEFT TO STAND OVERNIGHT
- CUTTING RINDS IN SMALL PIECES
- PREPARATION OF PACKING SYRUP WITH LEMON JUICE
- PREHEATING OF THE PIECES IN THE SYRUP
- PACKING HOT PRODUCT
- SEALING CONTAINERS
- COOLING AT ROOM TEMPERATURE
- WASHING CONTAINERS
- LABELLING AND STORAGE

The containers are sealed hermetically and cooled upside down to sterilize the inside of the lids.

When the jars are cool they are cleaned with a damp cloth, dried, labelled with all the pertinent data and stored. Figure 36 shows the flow chart for this product.

4.3.3.16 Passion fruit syrup

Completely mature fruit is used to prepare this product. (**See Photograph 10).**

The passion fruit is weighed and washed before cutting to avoid the contamination of the pulp.

After washing the fruit it is selected, eliminating the fruit in poor sanitary condition to avoid preservation problems.

FIGURE 37 ***PASSION FRUIT SYRUP***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
PULPING
↓
WEIGHING
↓
COOKING
(adding sugar in thirds, every 20 minutes, up to 67º Brix)
↓
PACKING HOT PRODUCT
(at no less than 85º C)
↓
HERMETIC SEALING
↓
COOLING AT ROOM TEMPERATURE
↓
WASHING CONTAINERS
↓
LABELLING AND STORAGE

The selected fruit is cut in two and the pulp and seeds are removed manually. Later the pulp is separated from the seeds using a small scale pulping machine.

The pulp yield is measured and then it is heated to the boiling point.

The product is formulated with equal amounts of sugar and pulp.

The pulp is boiled for 15 minutes, at the end of which 1/3 of the sugar is added, allowing it to dissolve completely. Part of the sugar is converted into inverted sugar with the acidity of the fruit and the heat, giving the product special qualities.

After boiling 15 minutes with the sugar, the second third of the sugar is added and boiling is repeated until this portion is completely dissolved.

After another 15 minutes, the last third is added. If it is desired to produce jelly, the medium must be acidified to a pH of 3.5 or less, adding 1% citric acid and 1% of pectin.

Sugar concentration after adding the last portion, must not exceed 60º Brix and the product must be concentrated to 67º Brix by boiling.

The finished syrup is packed hot, at not less than 90º C, in bottles, the jelly is packed in jars which are sealed hermetically, and turned upside down to sterilize the lids.

The containers are cooled at room temperature, washed, dried and labelled, including the pertinent data and stored. Figure 37 shows the flow chart for the syrup.

4.3.3.17 Brazil nut marzipan

This product, which is a substitute for almond marzipan, is made only with Brazil nut paste and sugar.

The nuts are weighed after separation from the shells to establish yield and determine the amount of initial material.

The seeds are peeled or may be bought already peeled, as in this case. Then they are grated and the resulting flour sieved.

The proportions to be mixed are equivalent to 30-32% flour, 5% lemon juice and 70-78% syrup with a concentration of 74-75º Brix. The flour is added to the syrup. To prepare the syrup it is necessary to heat the water to dissolve the sugar. This syrup is called “pearl point syrup”.

The mixture is manually homogenized until a mixture as uniform and soft as possible is obtained.

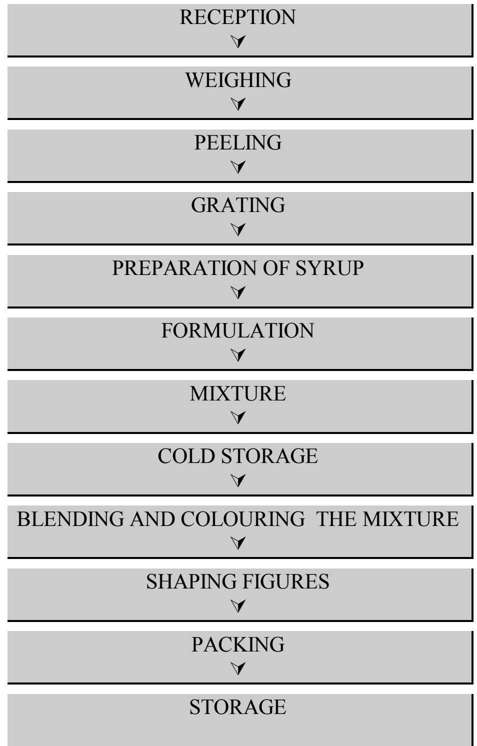
The paste is cooled in the refrigerator overnight.

The following day small figures are shaped with the paste, to which food colouring may be added. The figures are packed in small plastic trays and covered with cellophane or polypropylene/cellophane. Figure 38 shows the flow chart for this product. **Some operations of the process are shown in photographs 147 to 158.**

4.4 Nectars

As stated in the First Part, nectar is a mixture of natural or concentrated liquid fruit pulp (**see Photographs 24 and 25),** sugar and water for a formula which, generally, should yield a finished product of approximately 15º Brix.

FIGURE 38 ***BRAZIL NUT MARZIPAN***



There are many resources available in the Amazon region for the production of nectars, and therefore, it is worth considering the procedure for their production.

4.4.1 Calculations for formulating and proportioning nectar

To explain the procedure to calculate the formula for nectar, we will use the same symbols used for marmalades and preserves.

Thus:

BF	:Brix degrees of the fruit
BA	:Brix degrees of the sugar = 100
XAF	:Sugar fraction of the fruit
PF	:Weight of fruit
PA	:Weight of sugar
PAF	:Weight of sugar contributed by the fruit
PTA	:Total weight of the sugar in the product
OBP	:Brix degrees of the product
XAP	:Sugar fraction of the product
XAA	:Sugar fraction in the sugar = 1
PTP	:Total weight of the product

An important aspect and starting point of nectar processing, is the formulation of the pulp, sugar and water mixture. It is necessary to carry out tasting trials (see photographs 171, 179 and 188) to determine the exact pulp, sugar and water proportions to obtain a sensorially acceptable product. In this regard it is important to establish that what is sought is the balance between flavour and aroma, rather than the sweetness/acidity balance achieved when the sugar has been added.

Therefore, the formula for a nectar is obtained by successive approximations, because every time the amount of sugar to be added is estimated. It must be kept in mind that when sugar is added the volume changes and, consequently, the concentration. The desired concentration is obtained after 3 or 4 approximations.

To illustrate the above a step by step example of how to formulate a nectar will be given.

Example:

Passion fruit with 15º Brix is available to prepare a 15º Brix nectar. The fruit's industrial pulp yield is equivalent to 70% of its total weight. One hundred and twenty kilograms of passion fruit will be used.

Solution:

Given the characteristics of the problem, 84 kg., of seedless pulp will be obtained from the amount of available fruit.
It will be assumed that as a result of sampling, a formula of 1 : 3 has been established as being adequate, that is, one portion of maracuya pulp with three portions of water.

This means that the total volume or weight of the mixture without sugar will be 4 x 84 which equals 336 kilograms.
The problem's data are:

BF	: 15º Brix
XAF	: 0.15
PAF	: 84 x 0.15 = 12.6 kg
BP	: 15º Brix

Solution:

First approximation:

PTP	: 336 kg
XAP	:0.15
PTA	: 336 kg 0.15 = 50.4 kg (to obtain 15º Brix)
PA	: 50.4 kg - 12.6 kg = 37.8 kg (add sugar to 1)

Thus, the new weight of the product will be the original weight plus 37.8 kg of sugar, i.e., 336 kg + 37.8 kg, or, 373.8 kilograms. As the amount of sugar in the mixture is of 50.4 kg, the Brix degrees of this first approximation will be:

BP1	: 50.4 kg : 373.4 kg = 13.49º Brix

Second approximation:

PTP	: 373.4 kg
XAP	: 0.15
PTA	: 373.4 kg x 0.15 = 56.01 kg (to obtain 15º Brix)
PA	: 56.01 kg - 50.4 kg = 5.61 kg (add sugar to 2)

Thus, the new weight of the product , by homology with the previous case, will be 373.4 kg + 5.61 kg, which gives a value of 379.01 kilograms. The mixture will have 56.01 kg of sugar, increasing the Brix degrees of this second approximation to:

BP2	: 56.01 kg : 379.01 kg = 14.77º Brix

Third approximation:

PTP	: 379.01 kg

XAP : 0.15
PTA : 379.01 kg x 0.15 = 56.85 kg (to obtain 15º Brix)
PA : 56.85 kg - 56.01 kg = 0.84 kg (add sugar to 3)

Thus the new weight of the product , by homology with the previous case, will be 379.01 kg + 0.84 kg, which gives a value of 379.85 kilograms. The sugar in the mixture will be 56.85 kg, increasing the Brix to a value of:

BP3 :56.85 kg : 379.85 kg = 14.966º Brix

Fourth approximation:

PTP : 379.85 kg
XAP : 0.15
PTA : 379.85 kg x 0.15 = 56.98 kg (to obtain 15º Brix)
PA : 56.98 kg - 56.85 kg = 0.13 kg (add sugar to 4)

Thus, the new weight of the product, by homology with the previous case, will be 379.85 kg + 0.13 kg, which gives a value of 379.98 kilograms. The sugar in the mixture will be 56.98 kg, increasing Brix degrees of this fourth approximation to:

BP4 : 56.98 kg : 379.98 kg = 14.995 º Brix

The formulation of the nectar may be completed with this approximation, as it is assumed that there will be some evaporation during packing which will give the desired 15º Brix or a slightly higher value.

Thus, there is a successive accumulation of different portions of sugar which are additive, in other words, the total value of sugar to be added will be:

Add sugar to 1 + 2 + 3 + 4.

This means that the total amount of sugar to be added to the original 336 kg of pulp and water mixture is of 44.38 kg and the total quantity of prepared nectar will be 379.98 kg., or 380 kg., if there are no losses during the process.

In this case, as with the marmalades, the effect of the fruit's sugar contents on the industrial yield of the process is not very important, because of the presence of large volumes of two external components, sugar and water.

Again approximate values of the fruit's sugar concentration may be used and no big mistake will be made as the effect of the fruit's sugar is low. In this case it is very important to confirm the initial estimate of the pulp:water proportion after the sugar has been added.

4.4.2 Processing of specific products

The following products are presented in this chapter.

- Aguaje nectar
- Araza nectar
- Carambola nectar
- Copuazu nectar
- Granadilla nectar
- Guaba nectar
- Apple nectar
- Passion fruit nectar
- Cashew "apple" nectar
- Naranjilla nectar
- Pineapple nectar
- Pineapple and papaya nectar
- Quila nectar
- Ungurahui nectar
- Uvilla nectar
- Tomato juice

The processes and flow charts of the above products are included below.

4.4.2.1 Aguaje nectar

Raw material:

Aguaje is an important fruit in the Amazon region (**see Photograph 2).** For this reason it is processed into pulp for nectar production.

The fruit must be tenderized or matured; traditionally this process is carried out by submerging the fruit in water at 45-50º C for a period of 30-45 minutes.

After weighing and selecting the fruit for defects, and maturing it as explained, the pulp is separated from the peel and seeds.

The fruit is peeled by rubbing it with the hands, this separates the pulp and skin from the seed in the form of scales.

The mixture of pulp and skin is weighed and dissolved in water at a proportion of 1:1. The pure pulp to be used in the nectar is obtained by pulping this mixture of pulp + skin and water.

The yields obtained are:

Pulp:	22%
Seed:	52%
Peel:	4.4%
Waste:	21.6%

The sugar content of the fresh fruit is 10º Brix .

This pulp may be packed hot, in bottles at not less than 85º C, hermetically sealed and sterilized for 30 minutes in boiling water. This is a natural partially diluted pulp for various uses.

This already partially diluted pulp is diluted again in a proportion of one part pulp and three parts water. The mixture is standardized with sugar up to 14º Brix, also adding 10 gr., of lemon juice per kilogram of mixture. The mixture is refined by homogenizing it, then preheated to the boiling point and packed hot into glass containers which are hermetically sealed.

FIGURE 39 ***AGUAJE NECTAR***

RECEPTION

↓

WEIGHING

↓

SELECTION

↓

MATURING

↓

MANUAL PEELING AND PULPING
(contains bits of skin)

↓

DILUTION
(1:1 pulp + skin :water)

↓

MECHANIAL PULPING

↓

WEIGHT OF NATURAL PULP
(here the partially diluted natural pulp may be separated)

↓

STANDARDIZATION, FORMULATION AND MIXING THE INGREDIENTS

↓

PREHEATING
(to boiling point)

↓

FILLING OF CONTAINERS
(at not less than 85º C)

↓

HERMETIC SEALING

↓

STERILIZATION
(20 minutes at 100º C)

↓

COOLING

↓

DRYING OF CONTAINERS

↓

LABELLING

↓

STORAGE

The containers are sterilized in boiling water for 20 minutes and cooled at room temperature. When they are cold and dry, they are labelled indicating all pertinent information, and stored.

The flow chart for this process is shown in Figure 39. **Some of its operations may be seen in Photographs 159 to 166.**

4.4.2.2 Araza nectar

The raw material (**see Photograph 1**) is weighed, selected and classified according to its condition, maturity and intended uses. The selected fruit is washed and cut in pieces.

Then the cut up fruit is pulped in a mechanical pulper, obtaining homogenized 3º Brix pulp. Yield is:

Pulp:	53.2%
Seed:	36.4%
Waste:	10.4%

Sugar contents of the fruit: 3º Brix.

With the pulp a formulation is prepared based on weight at an approximate rate of 1:3-4 pulp-water. For example:

Pulp:	18%	(for example, for 18 kg., of pulp)
Sugar:	13.5%	(14 kg., sugar equivalent)
Water:	68.5%	(69 kg., water equivalent)

The mixture is homogenized as best as possible and filtered, making sure that the final sugar level corresponds to 14º Brix.

The nectar mixture is preheated to over 85º C for 2 minutes and then, it is bottled and sealed hot to obtain a good vacuum.

The bottles are sterilized in boiling water for 20 minutes.

After this time they are cooled to room temperature in the sterilization pot by overflowing with cold water.
Later the bottles are dried and labelled showing all pertinent data and stored. Figure 40 shows the flow chart for this product. **Some operations of the process may be seen in photographs 167 to 170**.

4.4.2.3 Carambola nectar

Raw material:

The following yield is obtained from the raw material:

Carambola in chunks:	100%
Carambola pulp:	70%
Sugar contents of fruit:	7º Brix

Sugar: enough to complete 15º Brix in the final product.

Finished product: nectar with 15º Brix.

The carambolas are washed and selected according to maturity, choosing the ripest for nectar.

FIGURE 40 ***ARAZA NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SLICING AND PULPING
↓
CHARACTERIZATION OF THE PULP
↓
FORMULATION
↓
MIXTURE OF INFREDIENTS
(pulp, water, sugar)
↓
PREHEATING
(2 minutes at boiling point)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
DRYING OF BOTTLES
↓
LABELLING
↓
STORAGE

The fruit is scalded in boiling water for 5 minutes to facilitate pulping , then it is quartered lengthwise and pulped with a manual or mechanical pulper.

Then the nectar is formulated with pulp-water proportions of 1:1, 1:2, 1:3, in adequate containers bringing all these combinations to 15º Brix with sugar. Sampling is carried out and the most acceptable combination is used to prepare the entire nectar mixture.

FIGURE 41 **_CARAMBOLA NECTAR_**

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
WEIGHING
↓
SCALDING
(3 minutes in boiling water)
↓
CUTTING
(quartered lengthwise)
↓
PULPING
↓
FORMULATION
(pulp: water ratio = 1:2 at 15º Brix
↓
HEATING
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
DRYING AND LABELLING
↓
STORAGE

Water is added to the pulp according to the selected combination plus the estimated amount of sugar to reach 15º Brix. The mixture is brought to the boiling point and packed hot into the available bottles which are sealed using a manual bottle capper.

After sterilizing the bottles in boiling water for 20 minutes, they are cooled by overflowing, labelled and stored. The flow chart for this process is shown in Figure 41. **Some operations of the process may be seen in Photographs 171 to 174.**

4.4.2.4 Copuazu nectar

The copuazu fruit is washed externally in running water to remove dust and foreign materials.

After washing, the fruit is broken, the defective fruit, or its portion, is removed and the pulp extracted together with the seed. The following yield is obtained:

Pulp:	48%
Seed:	17%
Peel:	35%

As was explained in the case of marmalade, the extracted pulp, refined to a soft and homogeneous paste, is used to formulate the nectar with water and sugar. This pulp has a sugar content of 11.5º Brix before being diluted with water.

The nectar is formulated by mixing one part pulp with different quantities of water (1:1, 1:2, 1:3, 1:4, 1:5). Different amounts of sugar are added until all the mixtures reach 14º Brix. The various samples are tasted by different persons in order to choose the desired formulation.

The water for the chosen combination and the sugar to obtain14-15º Brix are added to the pulp, plus 10 gr., lemon juice for each kilogram of the finished product.

The mixture is brought to the boiling point and the bottles are filled with the hot nectar, at least at 90º C, and sealed with crown caps. The bottles are then sterilized in boiling water for 20 minutes.

The bottles are cooled in the pot by overflowing with cold water, dried and labelled including the pertinent information and stored. The flow chart for this product is shown in Figure 42. **Some operations of the process may be seen in Photographs 175 to 178.**

4.4.2.5 Granadilla nectar

Raw material:

The following yield is obtained from raw material:

Granadilla juice:	22%
Waste:	78%

Sugar contents of the pulp: 16º Brix

Sugar: Enough to reach 15º Brix in the nectar.

Finished product: nectar with 15º Brix.

After reception (**see Photograph 9**) the fruit is washed and selected.

Then the fruit is halved and the inner part separated from the shell with a spoon. Pure juice without seeds is obtained using the pulper.

The nectar is formulated by preparing samples with different amounts of water to which different amounts of sugar are added until all the samples reach the same sugar concentration. Nectars with 14 or 15º Brix are generally prepared.

FIGURE 42 ***COPUAZU NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
BREAKING
↓
PULPING (with scissors)
↓
REFINING
↓
FORMULATION
(pulp:water ratio = 1:4.5,
12% sugar in the mixture for 13-15º Brix)
↓
MIXING
(pulp, water, sugar and lemon juice)
↓
PRECOOKING
(boil 2 minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
DRYING JARS
↓
LABELLING
↓
STORAGE

Proportions are determined by having the different samples tasted by different people, recording their preferences. The quantities of sugar and water to be added to the available pulp are calculated this way.

The mixture is brought to the boiling point and bottled hot, sealing the bottles with crown caps.

FIGURE 43 ***GRANADILLA NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
HALVING
↓
SEPARATION OF SEEDS WITH PULP
↓
PULPING
(separation of the seeds)
↓
WEIGHING
↓
FORMULATION
(pulp: water ratio = 1:2, sugar for 13-15º Brix)
↓
HEATING
(boil 2 minutes)
↓
PACKING
(at not than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

Nectars must be sterilized for 20 minutes in boiling water, then carefully cooled by overflowing and dried.

The bottles are labelled indicating the name of the product, its ingredients and processing and expiry dates. Then the finished product is stored.

The process is shown in Figure 43. **Some of its operations may be seen in Photographs 179 to 182.**

4.4.2.6 Guaba nectar

Raw material:
The processing of this product is also experimental. Yields are as follows:

Pulp with seeds with respect to the entire pod:	46%
Pods without pulp:	54%
Seedless pulp with respect to pulp with seeds:	35%
Waste from seed removal:	27%
Seeds:	38%
Sugar contents of the pulp:	11º Brix
Sugar: enough to reach	14º Brix

Finished product: nectar with 14º Brix.

The pods are selected choosing the thicker ones which contain more pulp (seminal placentary tissue), then washed to avoid contaminating the pulp.

The pods are opened and the pulp "buds" with the seeds are removed to proceed with the separation of the pulp from the seeds.

The seedless pulp is put through a mechanical pulper to eliminate the fiber.

The nectar is formulated in the proportion of 1: 3 pulp-water. Sugar is added to obtain a 14º Brix nectar. Ten grams of lemon juice per kilogram of mixture are added for nectar.

The mixture is brought to the boiling point and the containers are filled with the product at not less than 85º Centigrade. Then they are hermetically sealed.

The containers are sterilized for 20 minutes in boiling water, cooled by overflowing, dried, labelled and stored. The flow chart for this process is shown in Figure 44. **Some of its operations may be seen in Photographs 183 to 186**.

4.4.2.7 Apple nectar

Raw material:

The following yields are obtained:

Apple pulp:	83%
Seed, peel and fiber waste:	17%
Sugar contents of the fruit:	10.8º Brix

Sugar: enough for a 13º Brix nectar.

Finished product: nectar with 13º Brix.

FIGURE 44 ***GUABA NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
OPENING OF PODS
↓
PULPING
(removal of "buds" from pods)
↓
REMOVAL OF SEEDS
↓
MECHANICAL PULPING
(separation of fibers)
↓
FORMULATION AND MIXTURE
(pulp:water ratio = 1:3,
sugar for 14º Brix and lemon juice)
↓
PREHEATING
(boil 2 minutes)
↓
FILLING CONTAINERS
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(boil 20 minutes)
↓
COOLING
↓
LABELLING
↓
STORAGE

After washing, the ripest apples are selected.

To facilitate pulping, the fruit is scalded in boiling water for 10 minutes; then it is quartered and pulped with the help of a manual pulper. Alternatively, the fruit may be quartered first and then scalded in a small amount of water for 5 minutes, before pulping.

FIGURE 45 ***APPLE NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SCALDING
(3 minutes in boiling water)
↓
CUTTING
(lengthwise quarters)
↓
PULPING
↓
FORMULATION
(pulp: water ratio = 1:3, sugar for 13º Brix)
↓
HEATING
(boil 2 minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
LABELLING
↓
STORAGE

The pulp is brought to the boiling point and packed hot in glass jars, hermetically sealed and then sterilized, cooled and labelled. This is natural apple purée.

The nectar is formulated with the same pulp, by estimating the pulp-water-sugar relation and mixing 1 part of pulp with different parts of water, in appropriate vessels, sugar is added to all the samples to bring them to 13º Brix.

After completing the trials, the most widely accepted combination is used to prepare the final mixture for the nectar. In this case a pulp:water proportion of 1: 3 is used.

The amount of sugar calculated for the nectar to reach 13º Brix is added, plus 10 gr., of lemon juice per kg., of nectar. The mixture is brought to the boiling point, the containers filled with the hot nectar and sealed with crown caps using a manual bottle capper.

After sterilizing the bottles in boiling water they are cooled by overflowing, labelled and stored. The flow chart for this process is shown in Figure 45.

4.4.2.8 Passion fruit nectar

Raw material yields the following:

Passion fruit juice:	58%
Peel and seeds:	42%
Sugar contents of fruit:	13.8º Brix

Sugar: enough to reach 15º Brix

Finished product: nectar with 15º Brix

After reception of the fruit **(see Photograph 10**), it is washed and selected. Then weighed to determine industrial yield.

The fruit is halved and the pulp and seeds removed with a spoon. The seeds are separated using a pulper. The juice is filtered to remove any residual seeds.

Nectar is formulated using equal parts of pure juice diluted with different proportions of water (1:1, 1:2, 1:3, 1:4), to which different quantities of sugar are added, until all the samples have the same sugar concentration. Generally, nectar with 14 or 15º Brix is prepared. Then the ingredients, pulp, water and sugar are measured.

All the ingredients are brought to the boiling point, after which the mixture is bottled hot and the bottles sealed with crown caps.

Nectars must be sterilized during 20 minutes in boiling water, and then carefully cooled by overflowing and dried.

The labels to be placed on the bottles must show the name of the product, its ingredients and processing and expiry dates. The finished product is stored.

Figure 46 shows the flow chart for the process. **Some of its operations may be seen in Photographs 187 to 190**.

4.4.2.9 Cashew "apple" nectar

This nectar is produced from the cashew "apple" or false fruit of yellow or red varieties.

After reception of the material and weighing it, the fruit is washed and selected.

The sugar concentration of the fruit is determined. The material is weighed to establish industrial yield and the nectar's formulation. The seeds (nuts) are removed. The material is weighed.

Fruit:	93%
Pulp:	64%
Seeds (nuts):	7%
Waste:	36%
Sugar contents of the pulp:	9º Brix

The nectar is formulated with the pulp as described earlier in this chapter. Then the mixture is prepared with one part pulp and two parts water.

Lemon juice is added at the rate of 10 gr., per kilogram of the final mixture.

FIGURE 46 **_PASSION FRUIT NECTAR_**

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
HALVING
↓
SEPARATION OF PULP WITH SEEDS
(with a spoon)
↓
PULPING
(extraction of seedless liquid pulp
↓
WEIGHING
↓
FORMULATION
(pulp: water ratio = 1:4, sugar for 15º Brix)
↓
HEATING
(boil two minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The mixture is homogenized as best as possible, filtered and enough sugar is added for the mixture to reach 13º Brix.

The nectar mixture is boiled for 2 minutes and then it is bottled hot to obtain a good vacuum.

FIGURE 47 ***CASHEW APPLE NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
REMOVAL OF SEEDS
↓
WEIGHING
↓
SCALDING
(3 minutes in boiling water)
↓
QUARTERING
↓
MECHANICAL PULPING
↓
FORMULATION
(pulp : water ratio = 1:2, sugar for 13º Brix
and lemon juice)
↓
MIXTURE OF INGREDIENTS
(pulp, water , lemon juice and sugar)
↓
HEATING
(boil 2 for minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
DRYING BOTTLES
↓
LABELING
↓
STORAGE

The bottles are sterilized in boiling water for 20 minutes after which they are cooled to room temperature by overflowing the sterilization pot with water. Later the bottles are dried and labelled indicating all pertinent data. The finished product is stored.

Figure 47 shows the flow chart for this product. **Some of the operations of the process may be seen in Photographs 191 to 194.**

4.4.2.10 Naranjilla nectar

Raw material:

The following yield is obtained from the raw material:

Naranjilla pulp:	65%
Waste:	35%

Sugar contents of the pulp: 5.0º Brix.

Finished product: nectar with 15º Brix

After reception of the fruit it is washed and selected.

In the case of naranjilla. to keep the nectar from darkening, the fruit is scalded in boiling water for 15 minutes, then peeled, quartered and pulped mechanically.

Samples are prepared with equal parts of pure pulp, diluted with different quantities of water, to which different quantities of sugar are added, until all the samples have the same sugar concentration. Generally, nectars are prepared with 13 to 15º Brix, depending on consumer preference.

The nectar is formulated by having the various samples tasted by different people, recording their preferences. The amounts of sugar and water to be added to the pulp obtained are calculated in this way.

The combined ingredients are brought to the boiling point. The bottles are filled with the hot product and sealed with crown caps.

Nectars must be sterilized in boiling water, then carefully cooled to room temperature by overflowing.

The labels to be placed on the dry bottles should show the name of the product, its ingredients and the processing and expiry dates. The finished product is stored.

The processing chart is shown in Figure 48. **Some of the operations may be seen in Photographs 195 to 198.**

4.4.2.11 Pineapple nectar

The following is obtained from the raw material:

Pineapple chunks:	65%
Waste:	35%

FIGURE 48 **_NARANJILLA NECTAR_**

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
SCALDING
(15-20 minutes in boiling water)
↓
SEPARATION OF THE PEEL
↓
QUARTERING AND PULPING
↓
WEIGHING
↓
FORMULATION
(pulp : water ratio = 1:2,
sugar for 15º Brix)
↓
HEATING
(boil 2 minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE
↓

FIGURE 49

PINEAPPLE NECTAR

RECEPTION
↓
WEIGHING AND WASHING
↓
PEELING, SLICING AND PULPING PULPING
↓
FORMULATION
(pulp : water ratio 1: 3, sugar for 15º Brix)
↓
HEATING
(Boil 2 minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The following is obtained from the pineapple chunks:

Pineapple pulp:	93%
Waste:	7%

Sugar contents of the pineapple: 11 - 14º Brix

Finished product: pineapple nectar with 15º Brix.

The pieces of pineapple remaining after peeling and cutting the fruit for "pineapple in syrup", and slices obtained from peeled fruit are gathered, weighed and pulped in the manual pulping machine.

The nectar is formulated with the pulp, combining one part of pulp with different quantities of water, allowing the persons present to select one of the samples that were previously prepared with different dosages and brought to 15º Brix with sugar.

After formulation the mixture is prepared by adding water to the pulp and the necessary amount of sugar to reach 15º Brix. Then it is heated to the boiling point and bottled hot, using a funnel. The full bottles are sealed with crown caps, sterilized and cooled by overflow.

The cool bottles are labelled and stored.

The product thus obtained has a duration of at least one year.

A 300% final yield, was obtained in relation with pineapple pulp.

The flow chart for processing pineapple nectar is shown in Figure 49.

4.4.2.12 Pineapple and papaya nectar

Raw material:

The raw material yields the following:

Papaya:	61%
Seeds:	12%
Peel:	27%
Sugar contents:	9-10.5º Brix
Pineapple:	61%
Peel:	31%
Pulp:	8%
Sugar contents:	11-14º Brix

Sugar: enough to reach 15º Brix

Lemon juice: 10 gr., per kilogram of nectar.

Finished product: Nectar with 15º Brix

After reception of the fruit it is weighed, washed and selected. Then the papayas and pineapples are peeled to use their pulp. The seeds are removed from the papaya.

The papaya is cut into small pieces and pulped directly. The pineapple needs to be cooked to soften it and increase pulp yield for the nectar. The pieces are cooked for 15 minutes in a little boiling water, which after filtration is later added to the nectar. The pineapple cores must be heated during 25 minutes. The papaya and pineapple pulp are mixed in equal parts: 1 to 1.

Samples are prepared with equal parts of the mixed pulps diluted with different quantities of water to which different amounts of sugar are added , so that all of them will have the same sugar concentration. Generally, nectar with 14 or 15º Brix is prepared, depending on consumer taste.

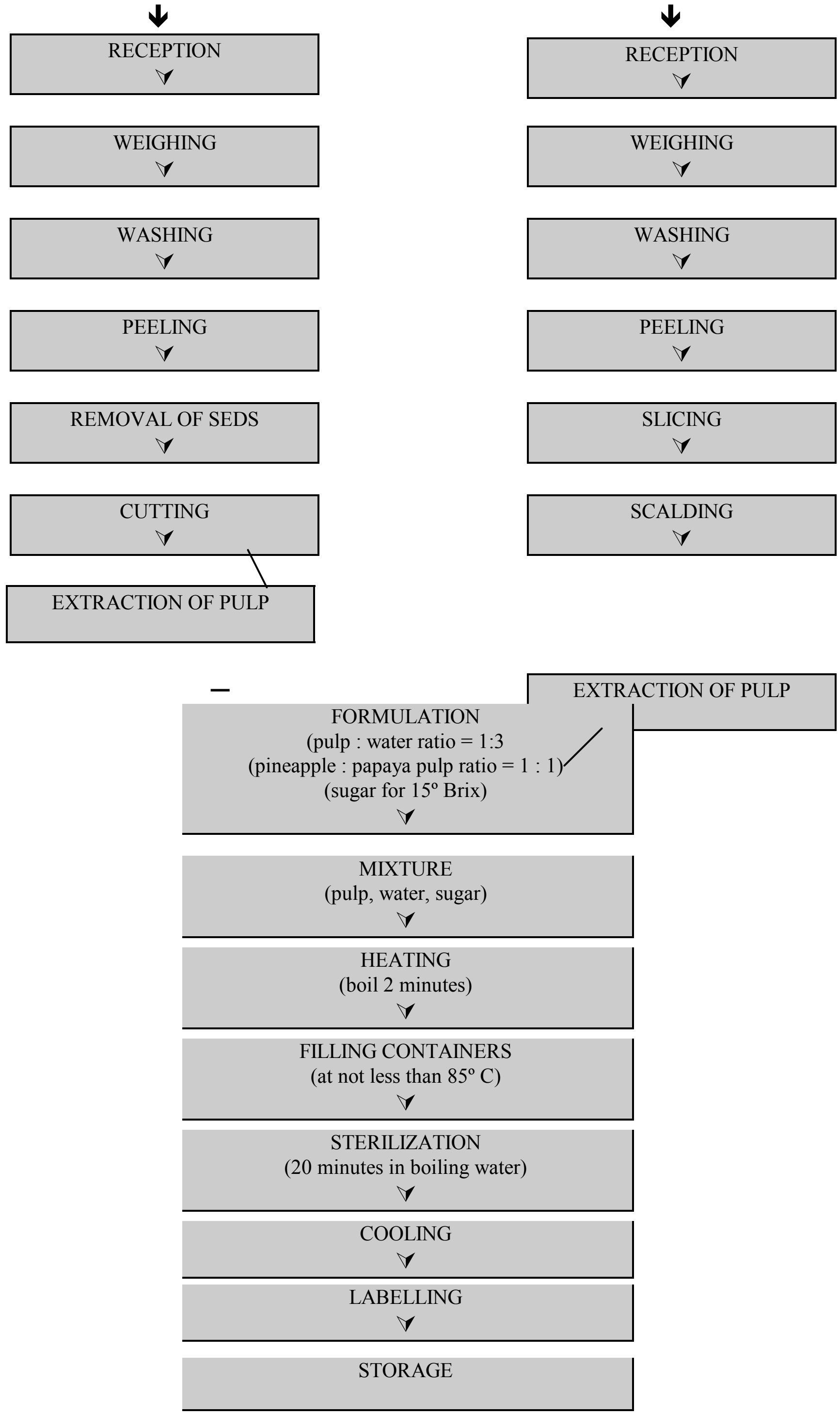
The nectar is formulated by having the samples tasted by different people. The quantities of sugar and water (normally 1:3) to be added to the available pulp are calculated in this manner.

All the ingredients are heated to the boiling point and the nectar is bottled hot, sealing the bottles with crown caps.

Nectars must be sterilized in boiling water for 20 minutes, and carefully cooled by overflowing.

FIGURE 50 ***PINEAPPLE AND PAPAYA NECTAR***

PAPAYA **PINEAPPLE**



The labels to be placed on the bottles should include the name of the product, its ingredients, the processing and expiry dates. The finished product is stored. Figure 50 shows the flow chart for this process. **Some of its operations can be seen in Photographs 199 to 202.**

4.4.2.13 Quila nectar

Raw material:

This product is also experimental. It is also called “wild cacao”.

Raw material yields the following:

Quila pulp:	30%
Seeds:	34%
Waste:	36%
Sugar contents of fruit:	8.4º Brix

Sugar: enough to obtain nectar with 16º Brix

Finished product: nectar with 16º Brix

The quila is washed and weighed. Then the fruit is opoened to proceed to remove the inner portion from which pulp is removed manually. The pulp which is initially light brown, becomes oxidized in the open air turning to a gray-brown colour.

It contains large seeds which can be used as a pickling component.

To process the nectar the pulp must be completely shredded. This is done with a blender adding a sufficient amount of water.

The juice thus obtained is formulated with water and sugar to the taste of the persons present and to a contents of 16º Brix. Details on formulation and dosage are contained in this same chapter.

The mixture of juice and sugar is heated to the boiling point. Then it is bottled hot and the bottles are sealed, sterilized in boiling water and cooled by overflowing, after which they are labelled and the finished product stored.

The flow chart for the process is shown in Figure 51.

4.4.2.14 Ungurahui nectar

Raw material:

This is also an experimental process. (**See Photograph 19).**

The following yield is obtained from the raw material:

Pulp plus peel:	38%
Seeds:	62%
Sugar contents of the pulp:	3º Brix

FIGURE 51 ***QUILA OR WILD CACAO NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
PEELING
↓
MANUAL PULPING
↓
LIQUEFYING
(addition of water)
↓
FORMULATION
(water and sugar for 16º Brix)
↓
HEATING
(boil 2 minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(30 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE
↓

Sugar: enough to obtain a nectar with 13º Brix.

Finished product: nectar with 13º Brix.

After reception the fruit is washed and weighed. It is necessary to put the fruit through a process called “maturing” in the Amazon region, which consists in keeping it in hot water, at no more than 60º C for 2 to 3 hours. Stir the fruit once in a while. If the temperature of the maturing water is higher, the fruit hardens making it impossible to remove the pulp.

Pulping can be done with the help of a heavy object. Adequate results are obtained by adding a sufficient amount of water to the as yet unpeeled fruit, and rubbing it together to break the peel, thus obtaining a mixture of pulp and peel, which must be filtered with a fine sieve or a cloth.

FIGURE 52 **_UNGURAHUI NECTAR_**

RECEPTION
↓
WEIGHING
↓
WASHING
↓
MATURING
(2.5-3 hours in water at 50º C)
↓
WASHING
↓
MANUAL PULPING
↓
FILTERING
↓
FORMULATION
(pulp : water = 1:2) (sugar for 13º Brix)
↓
HEATING
(boil 2 minutes)
↓
BOTTLING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(30 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

It should be noted that this fruit produces a large amount of waste, as in addition to the peel, which is very hard, it has a very large seed.
The pulp obtained is of a chocolate brown colour and contains oil. Depending on consumer taste the oil may be left in the nectar or separated by floating.

After preparing the corresponding formulation and dosage to reach a sugar content of 13º Brix with the addition of sugar, the nectar is preheated to the boiling point, bottled hot, sealed, sterilized in boiling water for 30 minutes and cooled by overflowing, for subsequent labelling and storing.

The flow chart for this process is shown in Figure 52**. Some of its operations may be seen in Photographs 203 to 206**.

4.4.2.15 Uvilla nectar

This nectar must also be considered as an experimental process.

Raw material:

The following yield is obtained:

Skins:	22%
Seeds:	32%
Stalks and peduncles:	9%
Pulp without seeds:	37%
Sugar contents of the fruit:	13º Brix
Sugar needed to obtain:	13º Brix

Finished product: nectar with 13º Brix

The raw material is received weighed and washed; then it is scalded with the berries still attached to the stalks, after which the fruit is removed from the stalks. It is peeled and the seeds removed manually. The resulting pulp is refined in a mechanical pulper to eliminate fibers.

The refined pulp is formulated in the same way as all nectars, with water, sugar and the addition of lemon juice. In this case the pulp : water proportion is 1:2, with the addition of 10 gr., lemon juice per kg. of the pulp + water mixture.

As always, the mixture is brought to the boiling point, bottled hot, hermetically sealed and sterilized. After cooling, the containers are dried and labelled. Figure 53 shows the flow chart for this process. **Some of its operations may be seen in Photographs 207 to 210.**

4.4.2.16 Tomato juice

This product is produced with ripe well textured red tomatoes.

The tomatoes are received and weighed to determine initial weight of the available raw material and to calculate the respective yields.

After the tomatoes have been weighed they are washed in running water to remove residual soil or dirt.

When they have been washed the tomatoes are selected, eliminating only the greenest and the ones with rot.

The selected tomatoes are quartered and then pulped to obtain the natural juice. A manual or electric small scale table model pulping machine is used.

FIGURE 53 ***UVILLA NECTAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
WEIGHING
↓
SCALDING
↓
PEELING AND REMOVAL OF STALKS
↓
REMOVAL OF SEEDS
↓
PULPING
↓
FORMULATION
(pulp : water = 1 : 2, plus sugar for 13º Brix)
↓
MIXING
(pulp, water and sugar)
↓
HEATING
(boil 2 minutes)
↓
FILLING CONTAINERS
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

The extracted juice is weighed to determine yield; it is brought to the boiling point and salt and lemon juice are added. The salt contents should be of 2% and the lemon juice 1%, with respect to the weight of the juice. Both are added during the heating process.

When the boiling point has been reached, any foam that may have appeared on the surface is removed and the juice is bottled at not less than 90º C, and the bottles are hermetically sealed. The containers are sterilized in boiling water for 25 minutes. Then they are cooled to room temperature, in water by overflow.

FIGURE 54 ***TOMATO JUICE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
CUTTING
(into quarters)
↓
REMOVAL OF PULP
↓
MIXING
(with salt and acidulant)
↓
PREHEATING
(boil two minutes)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(25 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

After the containers have been sterilized and cooled, they are cleaned and labelled showing all pertinent data and stored.

Figure 54 shows the flow chart for this process. **Some of its operations may be seen in Photographs 211 to 214.**

4.5 Sauces and purées

The preparation of sauces and purées (**Photographs 26 and 27**) of any type does not constitute a problem, as formulation is based on one recipe. Therefore, if the flow chart shown in Figure 4 in the First Part, is followed, it is easy to achieve the desired results.

In this case formulation consists basically in recording, in a formula register, every detail regarding ingredients and the proportions in which they are used in any formula.

Processing of "Italian style" tomato sauce is a typical example of this, and it has been one of the main products included in the training courses based on the 1993 Manual. This product contains a series of ingredients, which are always present as they constitute the basis of the product, but it also has a series of other products whose use is relatively flexible, such as chili peppers and seasonings. The formula is a matter of creation in this type of product, not a problem of identity. There is a basic product and other complements, the rest is flexible.

The proportion of the various ingredients in relation to one another depends on taste and on the personal seal placed on the product. Obviously, the identity of known products must be maintained and this is where the basis of irreplaceable and non rejectable products is to be found.

4.5.1 Products, quality and markets

One of the aspects to be considered when planning to process this type of product is marketing, in other words, the varying tastes of an heterogeneous population must always be kept in mind. Extreme flavours, which are too pronounced, either too sweet or too salty, with very special characteristics, will affect the marketing of these products. When designing a new product, the average consumer must be considered, in other words, the average of the target population for the products.

One of the factors to which particular consideration should be given in this type of product is the industrial yield of the different ingredients or raw materials involved.

4.5.2 Care during processing

The cost of this type of product depends, in great measure, on the intrinsic quality of the materials used, but also on their industrial yield which depends on the quality acquired by the material during post harvest and pre-processing period. As a wide range of different products is involved in processing these products, the problem is further complicated because of the need to control all of them.

Accuracy in the management of weight is a very sensitive aspect. Generally, there is a great difference between the weights of the principal ingredients, measured with rather inaccurate scales, and the weights of minor ingredients measured with highly accurate, nearly analytical scales. This causes discrepancies in the proportions of the ingredients, resulting in constant changes of the original formulas. A very common mistake is to measure the same product on two different types of instrument, one which is inaccurate and a very accurate one, at two different stages of the process. When determining the industrial yield of a material, the difference in accuracy of the measuring instruments, may cause a serious problem due to the erroneous evaluations resulting from comparisons that are impossible to make.

Measuring raw material at one level of accuracy and the intermediate or final products at others, will always produce discrepancies one way or another.

As all processes must be quantified and recorded, it is of the utmost importance to make evaluations with a uniform criterion; otherwise, evaluations and their results will lead to major mistakes.

4.5.3 Processing of specific products

The following products are included in this chapter:

- Mango and tamarind “Chutney”.
- Tomato purée.
- Apple purée.
- “Italian style” tomato sauce with dry oregano or fresh basil

The procedures and flow charts for the various products mentioned, are included below.

4.5.3.1 Mango and tamarind “Chutney”

Raw Material:

For this process the mangoes must be slightly immature, so that they will be less fibrous.

The mangoes are washed, peeled and sliced.

Yield, after these operations is around 60% pulp in chunks. The remaining 40% corresponds to peels and seeds.

The sugar contents of the unripe mangoes is 9º Brix.

Tamarind prepared in the same way as described in the process for syrup and marmalade in point 4.3.3.10, has a sugar content of 6º Brix.

The chopped mango is placed in a pot and covered with water. Salt is added at the rate of 8-10% of the weight of the fruit, depending on consumer taste.

The mixture is heated until the pieces of mango disintegrate after approximately 45 minutes, on low heat.

At the same time, a solution of vinegar and sugar is prepared in a proportion of 0.7 kg. sugar for 1 liter of vinegar and brought to the boiling point.

When the mango is partially disintegrated, the ingredients are added in the following proportions for 5 kg. of mango:

cinnamon	0.01 kg
green ginger	0.45 kg. or 0.02 kg. powdered ginger
raisins	0.5 kg
nutmeg	0.01 kg.
tamarind pulp	0.5 kg.

The mixture is heated over a low fire for 30 minutes, and the vinegar and sugar solution is slowly added during the last ten minutes. Later, the hot sauce is packed in jars which are hermetically sealed and sterilized for 15 minutes in boiling water. The cold and dry jars are labelled and stored. The flow chart is shown in Figure 55.

FIGURE 55 ***MANGO AND TAMARIND SAUCE***

RECEPTION AND WEIGHING
↓
WASHING THE MANGOES
↓
PEELING THE MANGOES
↓

CUTTING THE MANGOES

↓

COOKING THE PIECES
(with 8-10% salt)

↓

PROCESSING VINEGAR AND SUGAR SOLUTION

↓

MIXTURE OF INGREDIENTS
(mango, tamarind pulp and spices)

↓

COOKING
(low heat for 30 minutes)

↓

ADDITION OF VINEGAR AND SUGAR SOLUTION

↓

COMPLETE COOKING AND PACKING
(at not less than 90º C)

↓

HERMETIC SEALING

↓

STERILIZATION
(15 minutes in boiling water)

↓

COOLING

↓

LABELLING

↓

STORAGE

4.5.3.2 Tomato purée

Raw material:
The following yield is obtained from tomato processing:

Juice:	80%
Peel and seeds:	20%
Sugar contents of tomato:	4º Brix

FIGURE 56 ***TOMATO PUREE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
CUTTING
↓
SCALDING
↓
PULPING WHEN HOT
↓
ADDITION OF 2% SALT
↓
CONCENTRATION (at 17º Brix)
↓
PACKING HOT (not less than 90º C)
↓
SEALING CONTAINERS
↓
STERILIZATION (30 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

Finished product: concentrated tomato purée at 17º Brix

This product is processed with ripe red tomatoes of good texture.

The tomatoes are received and weighed to determine the initial weight of the available raw material and calculate the respective yields.

After weighing the tomatoes are washed in running water to eliminate traces of soil or dirt.

After washing, the tomatoes are selected eliminating only the greenest ones and those with rot, and weighed again.

FIGURE 57 ***APPLE PUREE***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SCALDING
↓
PULPING
↓
NATURAL PURÉE
↓
HEATING
(2 minutes boiling)
↓
PACKING
(at not less than 85º C)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE
↓

The selected tomatoes are quartered and then scalded until they are soft and release their juice. Then they are pulped with a small scale manual or electric, table model, pulping machine to obtain the natural juice.

The extracted juice is weighed to determine its yield and brought to the boiling point, concentrating the pulp to 17º Brix. If desired 2% salt may be added during the concentration process..

When the purée has reached the desired concentration it is bottled or put in jars hot, sealing the containers hermetically.

The containers are sterilized in boiling water for 30 minutes.

After sterilization and cooling, the containers are cleaned and labelled. The labels must contain all pertinent data. The finished product is stored. Figure 56 shows the flow chart for this product. **Some of its operations may be seen in Photographs 215 to 218.**

4.5.3.3 Apple purée

Raw Material:
The following yield is obtained from the raw material:

Apple pulp:	83%
Waste: seeds, peel and fiber	17%
Sugar contents of the fruit:	10.8º Brix

Finished product: natural apple purée

After washing the apples, the ripest are selected.

To make pulping of the fruit easier, it is scalded in boiling water for 10 minutes, after which they are quartered lengthwise and pulped with the help of a pulp extractor.

The pulp is heated to the boiling point and packed hot, into glass jars which are hermetically sealed and sterilized, then cooled and labelled. This is natural apple purée.

The flow chart for this process is shown in Figure 57. **Some of its operations may be seen in photographs 219 to 222**.

4.5.3.4 "Italian style" tomato sauce with basil or oregano

Raw material:
The following yield is obtained from the raw material:

Tomato:	95%
Waste:	5%
Sugar contents of the tomato fruit:	4º Brix
Carrots:	92%
Waste:	8%
Sugar contents of the roots:	13º Brix
Onions:	77%
Waste:	23%
Sugar contents of the bulbs:	10.9º Brix
Garlic:	67%

Waste: 33%
Sugar contents of the cloves: 36º Brix

Formulation: tomato 73%; carrots 14%; onions 12%: and garlic 1%.

This means that the following must be weighed for every 10 kilograms of tomatoes:

Clean chopped carrots: 1.9.kg.
Chopped lightly fried onion: 1.6 kg
Lightly fried garlic: 140 grams

The following must also be added to this mixture: 140 gr., salt, 14 gr., pepper and 55 gr., dry oregano or the leaves of a large bunch of fresh basil leaves.

Finished product: tomato sauce with basil or oregano and approximately 12º Brix

The mixed ingredients are cooked until the carrots are soft.

The onion and garlic are fried in oil until they are transparent and added to the mixture while it is cooking.

Oregano or basil are added 5 or 10 minutes before cooking is finished. When the mixture is cooked and the oregano has been added, it is pulped while hot in a manual or electric pulp extractor.

The sauce obtained after pulping is returned to the pot and concentrated to approximately 11-12º Brix, and bottled hot.

The bottles are sterilized 30 minutes, cooled, dried, labelled and stored. A flow chart of the process is shown in Figure 58. **Some operations of the process may be seen in Photographs 223 to 226.**

4.6 Pickles

Figure 5 of the First Part shows the basic chart for pickle processing. As was explained before, pickles can be processed by natural fermentative acidification or by using an external acidulant as packing medium.

The latter process, acidifying, will be applied in this case, for practical reasons, meaning that the raw material will be placed in a container with vinegar or an acetic acid solution at 4% for a long period of time before marketing. Normally, this period should not be of less than 30 days to achieve a good balance.

4.6.1 Aromatic vinegar processing

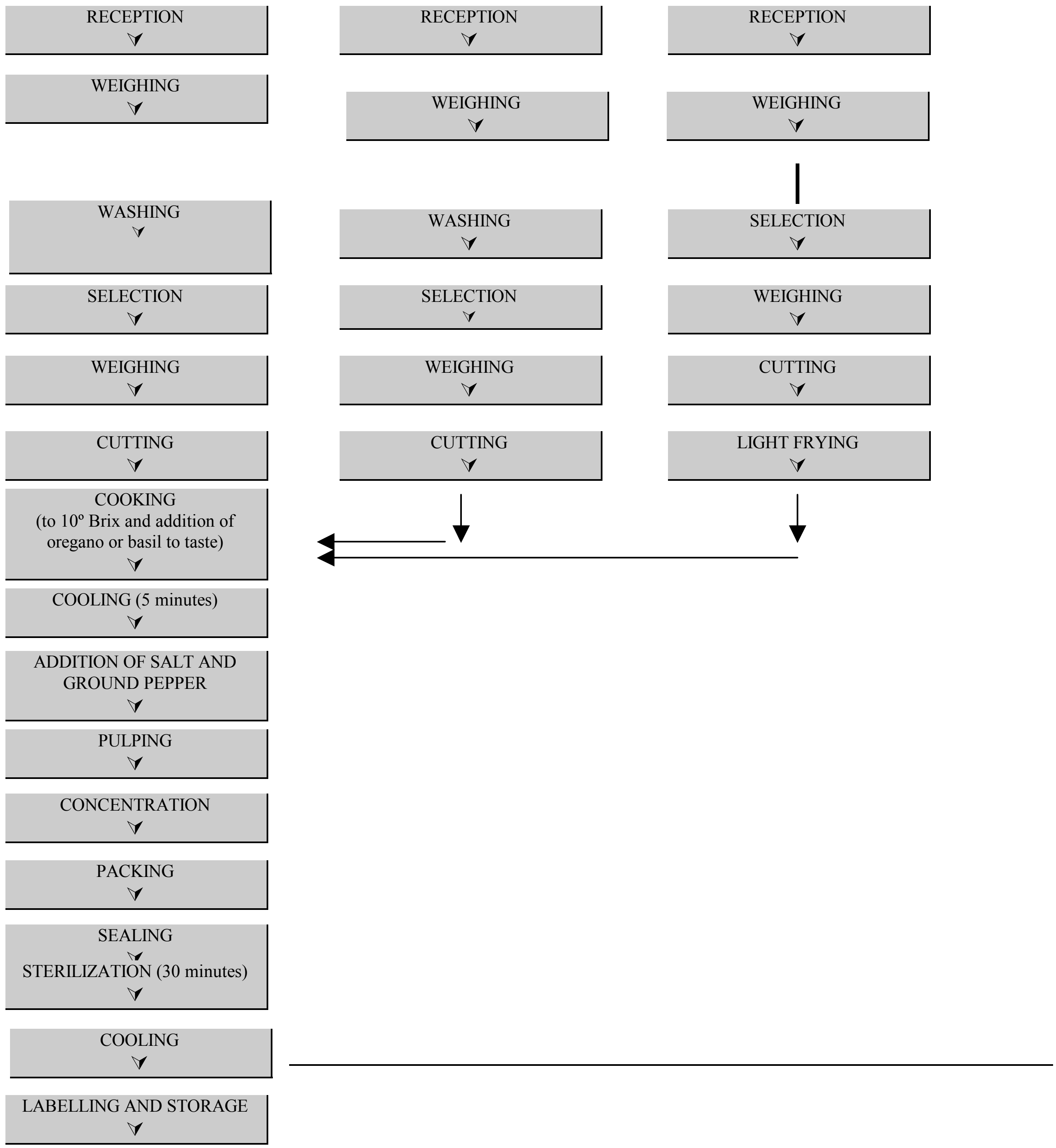
White wine or apple vinegar may be used. As in the case of the acetic acid solution, it may be seasoned with various spices. These aromatic spices will enrich the solution; which will be filtered later to withdraw the spices so that the vinegar or acetic acid will be crystal clear and transparent, to obtain a better looking product.

In this case, formulation is also a matter of a recipe, of creation, which may be managed arbitrarily by the entrepreneurs.

This type of product will probably be most special, because its design is very personal and specific. The herbs used, the spices, the marinating time, temperature, will depend on the inventiveness of the entrepreneur and his observation of potential customers and their requirements.

FIGURE 58 ***"ITALIAN STYLE" TOMATO SAUCE***

TOMATO ↓ **CARROT** ↓ **GARLIC/ONION** ↓


RECEPTION
WEIGHING
WASHING
SELECTION
WEIGHING
CUTTING
COOKING
(to 10º Brix and addition of oregano or basil to taste)
COOLING (5 minutes)
ADDITION OF SALT AND GROUND PEPPER
PULPING
CONCENTRATION
PACKING
SEALING
STERILIZATION (30 minutes)
COOLING
LABELLING AND STORAGE
RECEPTION
WEIGHING
WASHING
SELECTION
WEIGHING
CUTTING
RECEPTION
WEIGHING
SELECTION
WEIGHING
CUTTING
LIGHT FRYING

Once again, in this case measurement of weights must be very accurate, considering that ingredients are many and varied and that the contribution of each one of them is of a set dimension. Moreover, many of the ingredients are very costly and must be used accurately when this type of product is prepared routinely.

4.6.2 Solid/packing medium ratio

This is an important aspect of pickle processing because of the addition of acetic acid. The best relation between the product's components should be determined with certain accuracy, in other words, the best proportion between the solid product and liquid acidulant should be determined to establish an adequate balance between flavour, final acidity and presentation.

As was stated earlier, scalded material should be used to evaluate this relation. The reason for this is to keep the material from shifting its position in the glass jar after processing, decreasing its volume, and therefore, causing the jar to have an empty appearance.

4.6.3 Processing of specific products

The following products are presented in this chapter:

- Red, yellow and bell peppers in aromatic vinegar.
- Pearl onions in aromatic vinegar.
- Mixed vegetables in pure (5%) or aromatic vinegar.
- Palm heart in pure or aromatic vinegar.
- Banana in aromatic vinegar.
- Green tomato in aromatic vinegar.
- Aromatic vinegar.

The procedures and flow charts for the various mentioned products are included below.

4.6.3.1 Red, yellow and bell pepper in aromatic vinegar

This product consists of a chili pepper preserve, for which white vinegar with 5% acidity is used as a packing medium. The vinegar is prepared with spices the day before, in accordance with the procedure shown further on under the heading: Aromatic Vinegar.

The raw material for this process includes piquant chili and bell peppers of three or four mixed local varieties, which are weighed to determine the initial weight of the raw material.

After weighing, the peppers are selected discarding the damaged ones and choosing those which are fully and uniformly coloured. The selected fruit is washed.

Contrary to sweet peppers, piquant peppers are used entirely, cut lengthwise into three or four parts, without removing their peduncles, calyx and, in some cases, the seeds. The peppers are scalded in boiling water for 5 minutes, to inactivate the enzymes of the peduncles and bits of calyx.

The containers are filled with the hot scalded material, taking care to complete the total volume of the jars, approximately 800 gr., of solid material. The drained weight must be established accurately.

The jars with the solid material are filled with the hot packing medium, consisting of aromatic vinegar, at a temperature of not less than 90º centigrade.

The full jars are covered leaving the lids loose and are preheated to a temperature of 85º C, on the inside. When this temperature has been reached the jars are sealed hermetically to proceed with their sterilization in boiling water during

20 minutes. Before putting on the lids the containers must be checked to make sure that they are filled to the brim with packing medium. If necessary packing medium must be added to fill them, at a temperature of not less than 90º centigrade.

FIGURE 59 ***PIQUANT CHILI AND BELL PEPPERS IN VINEGAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
PREPARATION OF MATERIAL
(whole hot chili, or with seeds removed)
↓
WEIGHING
↓
SCALDING
(hot peppers, 5 minutes)
↓
PACKING HOT PRODUCT
↓
ADDITION OF HOT AROMATIC VINEGAR
↓
PREHEATING TO 85º C
↓
HERMETIC SEALING OF CONTAINERS
↓
STERILIZATION, 15 MINUTES IN BOILING WATER
↓
COOLING TO ROOM TEMPERATURE
↓
LABELLING
↓
STORAGE

When sterilization is completed the jars are cooled by overflowing and withdrawn from the water, cleaned with a damp cloth and labelled with the pertinent data.

Figure 59 shows the flow chart for these products**. Photograph 237 shows part of this process**.

4.6.3.2 Pearl onion in aromatic vinegar

Raw Material:

Industrial yield of onions 40% after removing roots, crowns and dry layers.

Red or white wine vinegar, with 5% acetic acid.

Salt for a 2% solution in vinegar.

Finished product: onions pickled in vinegar with 2% salt.

The crowns, that is, the area where the leaves are inserted and the outer dry layers are removed from the onions, and the basal disc is cut away, this is the area where the roots are inserted.

Then they are washed, selected and placed in glass jars, packing the largest possible number into the container.

Pure vinegar with 5% acidity, or aromatic vinegar prepared with spices, is added.

After the hot vinegar has been added to the jars, they are preheated to increase the temperature of the onions to 85º centigrade. When this temperature has been reached the containers are hermetically sealed, sterilized for 15 minutes in water at the boiling point., then they are cooled, dried, labelled and stored.

Figure 60 shows the flow chart for processing pickled onions in vinegar.

4.6.3.3 Mixed vegetables in pure (5%) or aromatic vinegar

Raw material:

The following yield is obtained from raw material:

Carrots:	84%
Cucumbers:	81%
Cauliflower:	40%
Red peppers:	70%
Green peppers:	72%

Other vegetables such as onions, chayote and string beans, may also be used.

Finished product: mixed vegetables pickled in vinegar

The vegetables are washed in abundant water, then cut into slices, small cubes or strips, approximately 0.5 cm., wide and 4 cm., long.

The cut up vegetables are scalded in hot water.

Scalding times are the following:

Carrots:	5 minutes
Small cucumbers:	3 minutes

Peppers:	2 minutes
Cauliflower:	1 minute

After scalding, the vegetables are cooled in water, then the jars are filled with the vegetables, combining them according to colour.

FIGURE 60 ***PEARL ONION IN VINEGAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
PEELING, CUTTING OFF CROWNS AND ROOTS
↓
WASHING
↓
PACKING THE ONIONS
↓
FILLING WITH HOT VINEGAR
(at not less than 85º C, in the product)
↓
PREHEATING
(to 85º C, in the product)
↓
SEALING
↓
STERILIZING
(15 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

When this operation is completed, hot aromatic vinegar is poured over them (see 4.6.3.7), after which they are preheated in a double boiler until they have reached 85º C. Then the jars are sealed, sterilized in boiling water for 15 minutes and cooled by overflow, labelled and stored.

Figure 61 shows a flow chart for processing mixed vegetables in vinegar.

Some operations of this process may be seen in Photographs 227 to 233

FIGURE 61 ***MIXED VEGETABLES IN VINEGAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
CUTTING
↓
SCALDING
(for times indicated for each vegetable, in boiling water)
↓
PACKING OF SOLIDS
↓
FILLING
(with aromatic or pure vinegar)
↓
PREHEATING
(up to 85º C, in the product)
↓
HERMETIC SEALING
↓
STERILIZATION
(15 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

4.6.3.4 Palm heart in pure or aromatic vinegar

This product is processed from the Asai or Huasai palm hearts, which becomes easily oxidized when the stems are cut. Therefore, when processing this palm a solution of 0.5% citric acid is required to keep the stems from darkening while they are being prepared.

The stems may have several layers of tissue covering the useful part; they are weighed to determine yield and selected to choose the stems of adequate size.

The selected stems are peeled, washed and cut into pieces.

The following yield is obtained from this process:

Shells:	51.6%
Palm heart base:	10.7%
Tips:	24.3%
Useful palm heart:	13.4%; pieces 11 cm., long make up 10.7%
	Smaller pieces of less than 10 cm., only 2.7%

The stems are cut into 11cm. pieces and along with pieces measuring less than 10 cm., they are submerged in a 0.5% citric acid solution. These stems are used for preserves in different packing mediums, such as:

- A packing medium consisting of normal vinegar with 5% acetic acidity.
- A packing medium such as the one shown at the end of this chapter (see point4.6.3.7 for processing aromatic vinegar), consisting of aromatic vinegar.

The stems are packed in glass jars with metal lids and the corresponding packing medium is added. Then the jars are preheated in a double boiler, with the lids loose to eliminate the oxygen from the tissue and the packing medium, for about 20 minutes or until the inside temperature of the jars reaches 85º centigrade.

The containers are hermetically sealed and sterilized for 15 minutes at boiling temperature, after which they are cooled by overflowing.

The cold, dry and clean jars are labelled, taking care to include all data pertaining to the product on the labels, their processing and expiry dates, ingredients and, of course, the name of the product.

Figure 62 shows the flow chart for this product.

Photograph 236 shows a part of the operations of this process.

4.6.3.5 Banana in aromatic vinegar

Raw Material:
The bananas are received and selected, obtaining the following yield:

Fruit in relation to the bunch:	87%
Discarded bunch:	13%
Peeled fruit:	60%
Peel:	40%
Strips for pickling in relation to peeled fruit:	75-83%
Discarded material:	17-25%
Sugar contents of the bananas:	12.4º Brix

FIGURE 62 ***PALM HEART IN VINEGAR***

RECEPTION
↓
SELECTION AND CLASSIFICATION
↓
PEELING
(removal of several outer layers)
↓
EXTRACTION OF PALM HEART
(removal of the “heart”
↓
WEIGHING THE PALM HEART
↓
WASHING
↓
CUTTING INTO PIECES
(according to the size of the containers)
↓
IMMERSION IN A 0.5% CITRIC ACID AND SALT SOLUTION
↓
FILLING THE SOLIDS
↓
ADDITION OF VINEGAR COVERING SOLUTION WITH 5% ACETIC ACID
ADDITION OF SPICED AROMATIC VINEGAR PACKING SOLUTION
↓
PREHEATING
(up to 85º C, in the product)
↓
HERMETIC SEALING OF THE CONTAINERS
↓
STERILIZATION
(15 minutes in boiling water)
↓
COOLING
↓
DRYING OF JARS
↓
LABELLING
↓
STORAGE
↓

Aromatic vinegar to complete the volume of the container.

Finished product: bananas cut in slices or strips in aromatic vinegar.

After reception slightly immature, green or yellow coloured bananas are selected. They are weighed and washed to avoid contaminating the pulp and peeled. The peeled bananas are scalded whole for 3 minutes in boiling water. They are cooled and prepared in the chosen manner, for example, sliced.

FIGURE 63 ***BANANA IN VINEGAR***

RECEPTION
↓
WEIGHING
↓
REMOVAL OF FRUIT FROM THE STALKS
↓
WEIGHING
↓
WASHING
↓
PEELING
↓
SCALDING
(3 minutes in boiling water)
↓
CUTTING
(in slices or strips)
↓
FILLING OF CONTAINERS
(solids and pure or aromatic vinegar)
↓
PREHEATING
(up to 85º C in the product)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

Alternatively, the bananas may be sliced before scalding; then packed and the hot syrup poured over them, (see point 4.6.3.7 for processing aromatic vinegar).

The partially closed containers are preheated until the sliced bananas reach 85º C; then they are hermetically sealed and sterilized for 20 minutes in boiling water, cooled by overflowing, dried, labelled and stored.

The flow chart for this process is shown in Figure 63.**Some of its operations may be seen in Photographs 239 to 242.**

4.6.3.6 Green tomato in aromatic vinegar

Raw material:

Industrial yield of tomatoes 80% after removing damaged fruit or fruit with insects.

FIGURE 64 ***GREEN TOMATO IN VINEGAR***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
SELECTION
↓
HALVING
(optional)
↓
PACKING SOLIDS
↓
FILLING WITH HOT VINEGAR
↓
PREHEATING
(to not less than 85º C, in the product)
↓
HERMETIC SEALING
↓
STERILIZATION
(20 minutes in boiling water)
↓
COOLING
↓
LABELLING
↓
STORAGE

White or red wine vinegar, with 5% acetic acidity.

Salt for a 2% solution in aromatic vinegar.

Finished product: tomatoes pickled in vinegar with 2% salt.

Small, healthy and uniform green tomatoes are chosen and weighed after reception to determine their industrial yield.

The tomatoes are washed, scalded, cooled and packed in glass jars, determining drained weight in the containers. Eventually, depending on size the fruit may be halved.

Pure or aromatic vinegar is added to complete the volume of the container. (See aromatic vinegar processing in point 4.6.3.7). The vinegar must be added hot.

The jars with loose lids are preheated until the tomatoes reach a temperature of 85º C and then they are hermetically sealed.

They are sterilized in boiling water for 20 minutes, then cooled, dried, labelled and stored.

Figure 64 shows the flow chart for processing tomatoes pickled in vinegar. **A view of this process may be seen in Photograph 235.**

4.6.3.7 Aromatic vinegar

This is an intermediate product. Although it may be used to season salads or other types of food, in this case it is a medium to cover various vegetables.

The process to prepare it is very simple and entirely flexible as regards the spices to be used to add aroma.

Wine vinegar or vinegar from any other natural source should be used to process this product, or else simply a solution of glacial acetic acid, with acetic acidity of around 5%.

In this case the following spices are used:

Cinnamon:	160gr.
Whole black pepper:	80 gr.
Nutmeg:	80 gr.
Bay leaves:	16
Salt:	320 gr.
Cloves:	80 gr.
Sugar: optional	

These amounts correspond to the preparation of 8 liters of white wine with 5% acetic acidity. Generally, the spices are heated to the boiling point in half the vinegar and left to steep overnight. The day after, it is filtered and the other half of the vinegar is added.

This vinegar can be kept in bottles or jars and sterilized for use over a long period of time. The flow chart is shown in Figure 65. **Some of the operations of the process may be seen in Photographs 243 and 244.**

4.7 Osmotic dehydration:

This is one of the most interesting processes to be applied to a certain type of products with special sensorial qualities.

4.7.1 Basic principles

As this is a case of preserving a material by decreasing water activity using the osmotic strength of a solution of sugar, salt or other materials, it can be done at room temperature. Many benefits are obtained from this, mainly as regards sensorial qualities such as flavour, aroma and colour.

FIGURE 65 ***AROMATIC VINEGAR PREPARATION***

- WEIGH SPICES IN ACCORDANCE WITH THE VOLUME OF VINEGAR
- MEASURE HALF THE VINEGAR
- MIX SPICES INTO VINEGAR, BRING TO BOILING POINT FOR 5 MINUTES (this can be done directly in the pot or the spices may be placed in a thin cloth bag to allow flavour to be extracted)
- STEEP OVERNIGHT IN COVERED POT
- FILTER THROUGH THIN CLOTH
- DILUTE WITH OTHER HALF OF THE VINEGAR, COLD
- FILLING OF CONTAINERS WITH HOT LIQUID AND HERMETIC SEALING
- STERILIZATION (20 minutes in boiling water)
- COOLING
- LABELLING
- STORE FOR SUBSEQUENT USE

The use of this process for tropical fruits which are rich in exotic aromas, appears to have great potential and, it is for this reason, that it has been included in this Manual. In this case, the important thing from the viewpoint of

formulations, is the search for and recognition of solutions with the best possibilities for developing an efficient and quick dehydration process, and permitting material to be of an adequate quality.

The solutions used as osmotic agents are concentrates of saccharose, highly concentrated brines, maltodextrine and corn syrup of different compositions. Solutions with the highest osmotic strength must be sought, but at the same time, they should affect the product as little as possible, water must be extracted from the product, but solutes must not be incorporated.

To begin with recognized osmotic solutions will be used and, gradually, some components may be changed, depending on local availability where the enterprise is located.

An important aspect to be determined is the final use of osmotic dehydrates. They may be used for direct consumption, when they have been vacuum packed in hermetic containers and their attributes have been preserved. They may also be used as raw material for other processes such as dehydration (**Photographs 29 and 30),** frozen products, even for preserves and extraction and processing of juices.

4.7.2 Factors affecting the efficiency of the process

The following points should be considered when selecting the osmotic solution to be used:

- A solution with a higher molecular weight will have a better osmotic effect than a solution with a low molecular weight.

- A solution with a low molecular weight will favour the intake of solute by the product rather than the outflow of water from the product. This is the case of common salt.

- When more mature products are used or higher temperatures are applied, it is possible to use substances with a larger molecular size, because the product's structure is wider open at the level of the cell wall.

4.7.3 Processing of specific products

The following products are presented in this chapter:

- Fruit leathers

4.7.3.1 Fruit leathers

The following fruits may be used for this process: mango, banana, papaya, passion fruit, their combinations, and others.

The fruit is weighed to establish proportions and determine the yield of the fruit to be used.

All the raw materials are washed with clean running water to remove traces of dust and foreign materials.

The papayas are peeled with a knife, split open and the seeds are removed with a spoon.

The pulp is ground in a semi-industrial blender, or it is simply put through a manual or mechanical pulping-sieving machine.

The mangoes are peeled; the pulp around the seed is cut and ground, as in the case of the papaya.

The bananas are peeled cutting off both ends and making a lengthwise slit to separate the peel. The pulp is processed in a semi-industrial blender.

The passion fruit is halved and the pulp together with the seeds is removed with a spoon. The pulp and seeds are put through a manual pulping machine to separate the seeds.

Pulp yields are the following:

Banana:	54.2%
Papaya:	77.3%
Passion fruit	26.0%

Combinations such as the following may be prepared:

Banana pulp with passion fruit pulp at a rate of 3:1
Papaya pulp with passion fruit pulp at a rate of 3:1
Mango pulp with passion fruit pulp at a rate of 3:1

Two products can be obtained from any one of these combinations, one without sugar and another with the addition, to the original mixture, of 10% sugar with respect to the pulp mixture. Thus, four products are obtained:

Combination 1, without sugar.
Combination 1, with 10% sugar.
Combination 2, without sugar.
Combination 2, with 10% sugar.

Each combination is heated to 70º C, in a pot; when this temperature has been reached the pot is withdrawn from the fire and cooled in a double boiler to a temperature of approximately 40º centigrade.

Trays covered with a sheet of cellophane with polypropylene are prepared. The pulp is spread on this sheet the full length of the tray, at a uniform thickness of nearly 5 millimeters.

The trays are placed in a mechanical indirect heat drier, where they are left to dry for several hours. When conditions permit they may be dried in a solar or convection drier using an external source of heat or an external ventilator.

When around 15% humidity has been reached, drying is stopped and the product is packed in cellophane with polypropylene sheets.

Yield is the following:

Combination 1, without sugar:	15%
Combination 1, with 10% sugar:	22.5%
Combination 2, without sugar:	10%
Combination 2, with 10% sugar:	27.5%

Figure 66 shows the flow chart for these products. **Some operations of the process may be seen in Photographs 247 to 254.**

FIGURE 66 ***FRUIT LEATHERS***

RECEPTION
↓
WEIGHING
↓
WASHING
↓
PEELNG ALL THE FRUITS
↓
PULPING
↓
FORMULATION
↓
MIXING
↓
FORMATION OF THIN SHEETS
↓
DRYING
↓
PACKING
↓
LABELLING
↓
STORAGE
↓

P A R T III

PHOTOGRAPHIC DISPLAY OF RAW MATERIALS, EQUIPMENT AND PROCESSING PHASES

Photograph 1
Araza
(G. Paltrinieri)

Photograph 2
Aguaje
(G. Paltrinieri)

Photograph 3
Chili (STT/TCA)

Photograph 4
Breadfruit tree
(G. Paltrinieri)

Photograph 5
Carambola
(G. Paltrinieri)

Photograph 6
Cocona
(G. Paltrinieri)

Photograph 7
Copuazu
(G. Paltrinieri)

Photograph 8
Guaba
(G. Paltrinieri)

Photograph 9
Granadilla
(G. Paltrinieri)

Photograph 10
Passion fruit
(G. Paltrinieri)

Photograph 11
Cashew "apple"
(G. Paltrinieri)

Photograph 12
Naranjilla
(G. Paltrinieri)

Photograph 13
Brazil nut
(G.Paltrinieri)

Photograph 14
Asai palm heart
(G. Paltrinieri)

Photograph 15
Pijuayo palm heart
(J. Jansen)

Photograph 16
Pineapple
(G. Paltrinieri)

Photograph 17
Banana
(G. Paltrinieri)

Photograph 18
Tree tomato
(G. Paltrinieri)

Photograph 19
Ungurahui
(G. Paltrinieri)

Photograph 20
Uvilla
(G. Paltrinieri)

Photograph 21
Sweet and hot peppers
(in oils, being sterilized)
(G. Paltrinieri)

Photograph 22
Tree tomato
(ready for adding syrup)
(G. Paltrinieri)

Photograph 23
Closing jars of guava marmelade
in chunks
(G.Paltrinieri)

Photograph 24
Capping bottles of nectar
(G. Paltrinieri)

Photograph 25
Extraction of pulp for
processing nectar
(G. Paltrinieri)

Photograph 26
Extraction of tomato pulp
for purée
(G. Paltrinieri)
(H.
Photograph 27
Extraction of apple pulp
for processing purée
(G. Paltrinieri)

Photograph 28.
Mixed vegetable pickles
in aromatic vinegar
(G. Paltrinieri)

Photograph 29
Osmotic dehydration of carambola
(G. Paltrinieri)

Photograph 30
Osmotic dehydration of carambola,
combined with solar drying
(G. Paltrinieri)