

Organic Farming in the Tropics and Subtropics

Exemplary Description of 20 Crops

Papaya



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Naturland would like mention the following authors and thank them for their contributions:

Franz Augstburger, Jörn Berger, Udo Censkowsky,
Petra Heid, Joachim Milz, Christine Streit.

The cultivation guidelines are available in English, Spanish and German for the following crops:
banana, brazil nut, cashew nut, cocoa, coconut, coffee,
cotton, hibiscus, macadamia, mango, papaya, peanut,
pepper, pineapple, sugar cane, sesame, tea, vanilla.

The cultivation guidelines for Bananas, Mangoes, Pineapples and Pepper were revised in 2001 for the United Nations Conference on Trade and Development (UNCTAD) by Udo Censkowsky and Friederike Höngen.

In 2002 two more guidelines, for rice and date palms, were published in English.

All the authors emphasize, that the cultivation recommendations at hand can just provide general information. They do not substitute technical assistance to the farmers with regard to the location.

All indications, data and results of this cultivation guidelines have been compiled and cross-checked most carefully by the authors. Yet mistakes with regard to the contents cannot be precluded. The indicated legal regulations are based on the state of the year 1999 and are subject to alterations in future. Consequently all information has to be given in exclusion of any obligation or guarantee by Naturland e.V. or the authors. Both Naturland e.V. and authors therefore do not accept any responsibility or liability.

Furthermore the authors kindly call upon for critical remarks, additions and other important information to be forwarded to the address below. The cultivation guidelines will be updated regularly by Naturland e.V.

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Organic Papaya Cultivation

1. Introduction

1.1. Botany

The natural habitat of the papaya (also: papaw; Fr.: papaya; Sp.: papaya) lies in tropical central and south America. Papaya is a large-leafed, quickly growing mainly unligified and perennial herbaceous plant. Botanically, it is difficult to assign *Carica papaya* to either the trees, shrubs or bushes. It grows to more than 10 m high, and can live for between 15-30 years. The fruit is of varying size and weight, and can range from a few 100 g up to 10 kg. The shape is elongated oval round, the fruit pulp is white yellow, deep yellow, orange or red.

1.2. Varieties and countries of origin

Today, it is the species *Carica papaya* from the genus *Carica*, from the family of Caricaceae that has achieved world-wide commercial importance. The most important export varieties are having female or hermaphrodite blossoms.

Papaya grown ecologically are usually exported to Europe by the following countries: Burundi, the Camaroons (dried), Ghana, Guinea, India (dried), Sri Lanka, Togo and Venezuela (pulp).

1.3. Uses and contents

The trees begin to bear fruit at the end of the 1st year. Blossoms and fruit are produced continuously in tropical climates. Blossoming is interrupted in subtropical climates during the cooler period. The yield is highest during the 2nd year. The average number of harvest-ripe fruits per year and tree varies between 25 - 100. During the 3rd year, the yield diminishes considerably, and continues to do so over the years. With increasing age, harvesting also becomes progressively more difficult, so that commercially trees are usually kept for 3–5 years.

Exporting papayas is limited due to difficulties in storing them and their susceptibility to bruising. The export market concentrates on processed papaya products like papaya pulp and dried papaya. In addition to the fruit, latex taken from peel can also be exploited commercially by scoring the fruit. This contains the protein-splitting enzyme papain, that can be utilised in a variety of ways in the food and tanning industries, and in processing natural rubber.

All of the waste, including the leaves, can be used as feed (e.g. to pigs). The leaves contain carpain and other alkaloids useful to heart treatment which are used pharmaceutically, whereas locally they are cooked as a vegetable. Papaya seeds

are used in many places to combat endoparasites (worms) in both humans and animals.

2. Aspects of plant cultivation

2.1. Site requirements

Papaya flourishes in the frost-free and humid areas of the tropics and subtropics. An average temperature of 25° C is optimum. The plant requires rainfall between 1500-2000 mm, which needs to be spread throughout the year. Due to its soft wood and flat root system, the papaya is very susceptible to wind break, especially in a monoculture. Fertile, light to middle-hard alluvial and volcanic earth with a pH-value from 6-7 makes an ideal site. Because papayas only develop a flat root system, a medium depth of soil is sufficient. This must be well drained though, as papayas are susceptible to stagnant water. Dry periods longer than 2 months may lead to the necessity of irrigation.

Papaya reacts very sensitively to cultivation mistakes. Even on optimum sites, plantations have encountered phytosanitary problems that have brought production to a standstill, and which were not able to be relieved even through the intensive use of agro-chemicals.

In natural forestry systems, the papaya is actually a secondary plant with a short life-span. After giant trees have been felled in primary forests, it is capable of dominating the new growth during the first few years. This illustrates its low shade tolerance, and heavy light demands.

On agroforestry systems, the papaya is useful as a so-called nursery plant, which then furthers the development of other trees and bushes through its own development. At a re-forestation project in Bolivia, the trees planted under papayas grew at double to triple the rate compared to those grown without papaya. A similar has also been observed in other newly laid out agroforestry plantations where papaya had been integrated. These systems are not only notable for their extraordinary growth, but also for the robust nature of their stock. On organic papaya plantations, these natural attributes of the plant should be noted and utilised.

2.2. Seeds and seedlings

The monoecious papaya needs cross-fertilisation, and therefore segregates very rapidly, when male plants of differing varieties are found at one site. In order to harvest your own seeds, it is therefore necessary to ensure a varietal purity. This is achieved by removing any unidentified male plants in the proximity of the plantation.

Seeds for own use are gathered from the ripened fruit and spread out on mats or wooden planks to dry in the shade. The seeds should nevertheless be sown within a week.

As well as direct sowing, papaya can also be grown from seeds at tree nurseries. Polyethylene (PE) bags have proven useful here. 2-3 seeds are sown in each PE bag. The tree nursery should be set up about 2 months before the actual planting time. Substrates consisting of tilled clay and sand soil mixed with compost should be placed into the bags around 2 weeks before sowing. The seeds are sown 1-2 cm deep. After 2 months in the nursery, the young trees will have attained a height of 15-20 cm, and are now ready to be transplanted.

The distances between each plant depends on the soil, variety and plantation system and should also be co-ordinated with the requirements of any additional crops. The root system of papayas consists of a tap root with hair roots in the upper parts. Care should be taken not to damage the hair roots during planting. With dioecious varieties, 5 trees are planted per plot (or also a sufficient number of seeds sown directly). When the first flower buds appear (after ca. 3 - 5 months), the plants are thinned out so that only the number of male trees (1 male tree to 25 female trees) required remain. With hermaphrodite varieties, only one tree per plot is necessary.

2.3. Diversification strategies

As already mentioned, papaya can play a mayor role in establishing other crops sharing similar requirements in agroforestry systems and on fertile soils. It can be combined very well, for example, with cocoa and bananas. Examples of mixed plantations can be viewed in the appropriate crop sheets for cocoa and banana. Dry rice and maize can be sown as a starting crop (several months to annual crops), which are then set out at practically the same time as the papayas, bananas and the other species.

If the papaya is to be combined with cocoa, then this should first be planted when there is enough shade available. During the vegetation period of rice and maize, the papaya will grow among the crop, and eventually come to dominate it towards the end of the ripening period. Depending upon which rice or maize variety is used, as well as the weather and soil conditions, it may make sense to sow the papaya 2-3 weeks after the others have been sown. This would hinder the papaya dominating the plantation too early, which would lead to drastically reduced yields among the annual crops. This type of fine-tuning must be carried out on site. A whole mixture of different trees should be sown along with the papaya seeds or seedlings.

A papaya plantation set up not in combination with an agro forestry or mixed-crop system covering a large area is not recommended. Papayas can also dominate on isolated areas on a farm, nevertheless, adequate provision must be made for ground cover from green manure crops, a dispersion of the plantation through other trees and shrubs, as well as protection from the wind (e.g. with green fences). After

a 3-5 year period of use, the area cultivated should be allowed to lie fallow for the same amount of time, in order that secondary woods may develop.

The area can then be cultivated once more. On no account should the area be eroded by burning, as this would completely mineralise the organic material that has accumulated. A second cycle with papaya can then be initiated. As natural vegetation grows very rapidly on land that has not been burnt, it is advisable to raise the papayas beforehand in nurseries. If preferred, the papaya can be directly sown, but then it should be accompanied by a mixture of ash and poultry dung¹, or compost. A handful per plot is sufficient. This starting aid is necessary, because the trees need to establish their standing area early enough to be able to dominate the system within a few weeks.

2.4. Supplying nutrients and organic fertilisation management

As already mentioned, papayas prefer a high soil-fertility. This should be considered when choosing a site. Additionally, a balanced mixed cultivation system with a substantial production of organic material, high turnover and plenty of soil activity is essential to a healthy papaya plantation. Well rotted compost should be added to each seedling before covering. The compost can be mixed with the excavated soil. For a yield of 50 tons of papayas per harvest, the following nutrients must be added annually per hectare:

Nitrogen (N):	100 kg
Phosphate (P):	40 kg
Potassium (K):	60 kg

In complex agro forestry systems, the question of nutrient dosing and deficiency is not so paramount as for conventional agriculture. In the case of papaya, the soil fertility is also either maintained or improved. Fertilisers, in the form of compost and other methods allowed in organic systems, are not normally required.

2.5. Biological methods of plant protection

The basic principle in organic farming systems is a preventative strategy to avoid a severe outbreak of diseases and pests. Healthy, well-fed plants that are adapted to the site, and are part of a balanced plantation system which includes a wide variety of species of both plants and insects, will effectively preclude any epidemics of diseases or pests. The following descriptions of diseases and pests appear at all

¹ The EU regulation for Organic Agriculture (EEC) 2092/91 requires that the origin of chicken manure shall be from extensive chicken husbandry. Landless husbandry systems are not permitted. Application of chicken manure has to be approved by the certification body.

conventionally cultivated papaya plantations sooner or later, and have brought production in many regions to an absolute standstill.

2.5.1. Diseases

A range of **viral diseases** have been described for papaya. These include:

- **Spotted wilt disease** (virus; Hawaii; transmitted mechanically or by *Thrips tabaci*),
- **Papaw ring spot virus**; all areas; transmitted by grafting or lice,
- **Leaf curl virus** of papayas; India and the Philippines; transmitted by white flies and grafting.

The viruses must be dealt with prophylactically. Therefore the proliferation of the virus must be limited by reducing the number of vectors (epidemic). This is prevented through varied mixed cultivations and agroforestry systems.

Here is a more detailed description of two viruses. The “spotted wilt virus”, which can be transmitted by thrips (*Thrips tabaci*), is especially common on Hawaii. It causes the **Spotted wilt disease**, which appears as premature leaf loss. Other symptoms include necroses on the upper leaves, as well as ring spots and necrotic zones on the fruits. Infestation by thrips can only effectively be controlled over a long period through diversification of the plantation, and support of useful insects. An acute infestation can be tackled with sulphur.

The **papaya bunchy top disease** is most prevalent in the West Indies. The upper leaves become weakly chequered, wrinkled and yellowed. Because the trees stop growing upwards, they take on a bushy appearance. Latex also ceases to flow following a cut. Transmission is via grafting and dwarf cicadas. Measures which will help combat cicadas are, short term: usage of plant extracts and liquid manure, as an exception, pyrethrum² may also be used in extreme cases, middle to long term: diversification of the plantation, and thereby support for useful insects.

A variety of **fungi** have been observed on papaya plantations, e.g.:

- **Leaf or fruit spot** of the papaya, caused by *Mycosphaerelle caricae*,
- *Phytophthora nicotiana* causes **Root rot**, leaf and fruit rot,
- *Colletotrichum gloeosporioides* (imperfect form of *Glomerella cingulata*) causes **blight** on the fruits, as well as drying of the tips of young twigs. Blight always occurs as a follow up disease to the leaf spot disease through *Cercospora ssp.*,
- *Oidium caricae*, **powdery mildew** of the papaya,
- *Rigidoporus lignosus* leads to white **root rot** and surrounds the roots with a white mycelium. Indirect symptoms of whether the main root is affected can be seen on the leaves which appear to lack water and nutrients.

² The European Regulation for Organic Agriculture (EEC) 2092/91 as well as the IFOAM Basic Standards do only allow for the use of natural pyrethrins (extract from the flower heads of Chrysanthemum). Synthetical pyrethroids persist in the environment and are forbidden.

Mycosphaerelle caricae, leaf spot disease and scabs can be treated in extreme cases with copper solutions (Bordeaux mixture)³, and powdery mildew with wettable sulphur. Precisely in the case of soil fungi such as root rot, the best defence are plant hygiene measures. Rigidoporus is a weakening parasite, that can only infest a plant when a nutrient basis, such as dead plant material, is present. Once this material is removed along with the infected root parts, the plant will recover. Yet in the case of papaya, it is recommended to re-plant the tree.

2.5.2. Pests

Out of a total of 35 types of insect that have been observed on a papaya, only 3 of them are considered serious pests. The remaining insects only cause negligible damage, or appear only in exceptional cases. The three main pests are:

- Lice
- Pseudo-spider mite (*Brevipalpus phoenicis*, G.)
- Red mite (*Tetranychus cinnabarinus*, B.)

The **mites** are especially dangerous because they are so small and difficult to spot. They are usually only noticed after they have already caused a lot of damage. They cause the leaves to wilt, reduce the strength of a tree, and can damage the shell of a fruit, thus reducing its market value.

In a well-balanced plantation system, mites and lice have plenty of natural enemies such as predator mites and ladybird larvae. Thrips will also attack the mites. Should the mite population gain the upper hand on the plantation, due to an imbalance, they can be generally combated with a sulphur treatment (spraying with 1% wettable sulphur). On tea plantations, good results in combating red mites have also been achieved using neem oil⁴. A 1 % soap solution made of potash soap is useful in keeping lice under control. In cases of extreme infestation, 1% methanol (methyl alcohol) may be added.

Scales and mealy bugs form another group of pests. Because these pests are not mobile when fully grown, they are disseminated by the wind, ants, caterpillars and also by birds and mammals. It therefore makes sense to control the methods of dispersing. If a scale colony does need to be combated, then this should be carried out during the larvae stage. Good results can be achieved using white oil (Paraffin oil as a 3% water emulsion).

³ According to the European Regulation for Organic Agriculture (EEC) 2092/91 the use of copper preparations for plant protection (e.g. Bordeaux Mixture) is allowed for a transitional period which will end at the 31st of March 2002. However, any use of copper preparations until 2002 has to be approved by the certification body. In case copper preparations have to be applied it is recommended to use preparations which contain less copper and therefore to reduce the accumulation of copper in soils (e.g. tribasic copper sulphate, copper hydroxide).

⁴ According to the European Regulation for Organic Agriculture (EEC) 2092/91 the application of Neem preparations is restricted and only allowed for the production of seed and seedlings. This regulation is discussed controversial. An up-date information is available from your certification body.

Thrips and fruit flies are described as being minor pests. Thrips are known to pass on a virus that causes the “spotted wilt disease”. Fruit flies damage fruit that has ripened on the tree, that have not been harvested in time. Both types of pests do not appear on organically cultivated, well-balanced plantations above a certain manageable level. Thrips can be combated with the use of proper selection of culture types. A cure can usually be found by lightly adjusting the underseeds or additional vegetation covering the ground, that has been infected with the spotted wilt disease.

2.6. Crop cultivation and maintenance

Protection of the crop consists in the main of providing the slow-growing young papaya plants with optimum conditions, and by supporting the overall dynamics of the system. This includes selective weeding, by cutting down mature weeds to use for mulching, and removing grasses with their roots intact. A sufficiently thick layer of mulching is especially important in areas with dry seasons.

In agroforestry systems, all secondary plants (bushes, young trees), that loom over the papaya after 6-8 months are cut back. In addition, the surplus male papaya plants need to be removed. If several seeds have been sown in one plot, then the surplus female plants must also be removed.

Moreover, during the first few years, trees in successive stages of development should be planted on those sites in agroforestry systems where plants have been removed, and free plots appear in the system.

But the main concern in regularly maintaining the crops is the health of the plants. Diseased and dead plants need to be removed and turned into compost.

2.7. Harvesting and post-harvest treatment

2.7.1. Harvesting

The fruits are ripe for harvesting once the tips have yellowed. After this time, it takes another 5–7 days until they are fully ripened. Fruits picked while still green will never attain their full aroma. The fruits can be easily plucked from the branches by twisting them, and pushing upwards slightly. If the fruits cannot be reached from the ground and by hand, then special baskets affixed to long poles will do the trick, whereby the fruits are allowed to fall into a collecting net.

The stem on the fruit should be at least 1 cm long, so that it is not damaged. Each individual fruit should be stored in a box without it touching either other fruits nor the walls of the box. This can be achieved e.g. by using wood-wool. The fruits must be well aerated to prevent fungus causing mould. Fully ripened fruits are extremely susceptible to bruising, and can only be stored for a few days. At 10–13 °C, they can be stored for up to 3 weeks.

2.7.2. Post-harvest handling

Papaya fruits are very sensitive to pressure. The fungus *Colletotrichum gloeosporioides* can easily spread through cuts or where the fruit is attached to the stem. Placing them in hot water (49°C for about 20 minutes) helps prevent this. The fungicide baths used in conventional papaya plantations are not permitted.

3. Product specifications

3.1. Fresh papayas

3.1.1. Processing

Papayas are melon-like fruits with a thin, soft, yellow-green to yellow skin and yellow to orange-red pulp. They have a pumpkin-like consistency, and contain many black seeds. The fruits have a sweet, melon-like taste, and weigh between 400 g and 10 kg. Because green papayas do not develop their full flavour, they are generally harvested just before they become ripe.

Generally, fruits between 220-600 g are in demand on the international markets. It is recommended to harvest the fruits for exporting as soon as the tips have turned from green to yellow. The fruit pulp can attain a brix value of 10-11,5%. After harvesting, the fruits are washed in hot water, which varies in temperature and duration according to the type of fruit. On average, the papayas are bathed at 49°C for 20 minutes or at 42°C for 30 minutes. The fruits can also be treated with a steam bath at 60°C for ca. 30 seconds. After this treatment, the fruits are slowly cooled down to room temperature, dried, sorted, classified, packed and then stored in the cool place until being shipped.

3.1.2. Quality requirements

The '**Codex Alimentarius Standard for Papayas**' (Codex Stan 183-1993) defines the quality requirements for trading with fresh papayas. These do not necessarily have to be adhered to, yet they supply recommended guidelines. Papayas intended for export are not included here. Different minimum and maximum values can be agreed between importers and exporters, providing they do not clash with official regulations.

The following is an excerpt from the 'Codex Alimentarius Standard for Papayas (Codex Stan 183-1993)':

I. Defining terms

These standards apply to papayas *Carica papaya L.*, that are delivered fresh to consumers.

II. Quality characteristics regulations

A. Minimum requirements

The papayas must be as follows:

- Fresh and healthy
- Clean, practically free of visible foreign substances
- Practically free of pests and damage caused by them
- Free of fungus
- Free of bruising and frost-damage
- Free of strange taste or smell
- Well developed, ripe

B. Classifications

Papayas are sold in three categories:

- **Class extra**

Papayas in this class must be of the highest quality. They must possess the characteristics typical of their variety and/or trading type. The fruits must be unblemished, with the exception of very light surface flaws that do not detract from the fruit's general appearance, quality, the time it will keep and its presentation.

- **Class I**

Papayas in this class must be of good quality. They must possess the characteristics typical of their variety and/or trading type. The following blemishes are permissible, providing they do not detract from the fruit's general appearance, quality, the time it will keep and the presentation of the bunch or cluster in their packaging:

- Slightly misshapen
- Light flaws in the skin caused by friction or by other means, providing the area does not exceed 3 % of the total surface area of the fruit.

- **Class II**

This class is composed of those papayas that cannot be placed in the upper classes, yet which fulfil the definitions of minimum requirements. The following faults

are allowed, providing the papayas retain their essential characteristics in terms of quality, preservability and presentation:

- Shape and colour defects,
- Skin flaws, caused by scratches, friction or other means, providing the less than 10 % of the total surface is affected.

The flaws are not permitted to affect the fruit's pulp.

III. Size classification regulations

The papayas are sorted according to weight. The fruits must weigh at least 200 grams.

Reference letter	weight
A	200 - 700 g
B	700 - 1300 g
C	1300 - 1700 g
D	1700 - 2300 g
E	more than 2300 g

IV. Tolerance regulations

Not dealt with here.

V. Presentation regulations

A. Uniformity

- The contents of a carton must be uniform, and may only contain papayas of identical origin, variety and/or trade type, and quality.
- The visible part of the carton must be representative of the entire contents.

B. Packaging

- The papayas must be packed in a way that ensures they are sufficiently protected
- Packing material used inside the carton must be new, clean, and so shaped that it cannot cause any damage to either the inside or outside of the fruit. The usage of materials such as papers and stickers with company details on them is permitted providing that no toxic inks, dyes or glues have been used.
- The packaging must be free of all other materials.

VI. Regulations of carton labelling

Each carton must display the following details in unbroken, legible, permanent letters visible from the outside:

A. Identification

- Name and address of the exporter and packer

B. Type of product

- "Papayas", when the contents are not visible
- Name of the variety

C. Origin of product

- Country of origin, and optionally, national, regional or local description

D. Commercial characteristics

- Class
- Size (reference letter or weight class)
- Number of fruits (optional)
- Net weight (optional)

Although the following values are not laid down in the 'Codex Alimentarius Standard for Papayas' they should nevertheless be adhered to:

Quality characteristics	Minimum and maximum values
Heavy metals	
lead (Pb)	max. 0.50 mg/kg
Cadmium (Cd)	max. 0.05 mg/kg
Mercury (Hg)	max. 0.03 mg/kg
residues	
Pesticides	not measurable
Sulphur oxide	not measurable
Bromide	not measurable
Ethylene oxide	not measurable

3.1.3. Packaging and storage

Packaging

The regulations concerning carton labelling were dealt with in section VI of the 'Codex Alimentarius Standard for Papayas'.

Storage

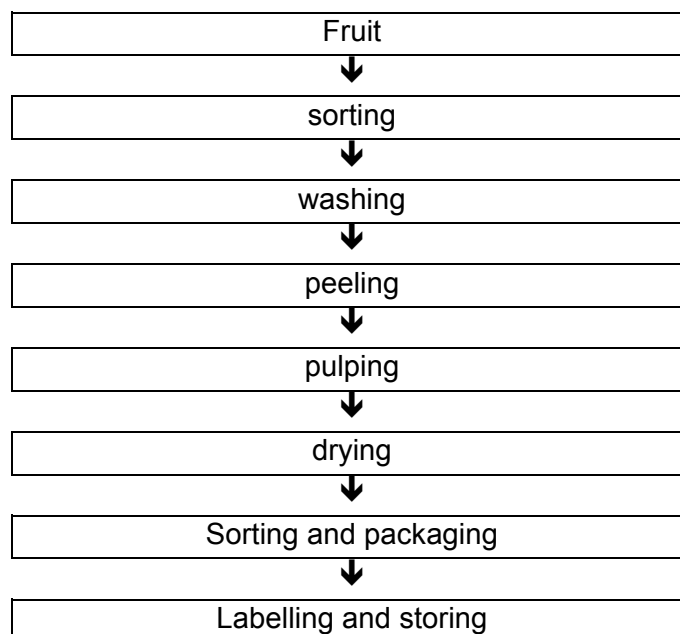
- Papayas not yet fully ripened that are transported by sea (max. 14 days), should be stored at a relative humidity of 90% and not under 12°C.
- Ripe papayas, that are shipped by air, can be stored for several days at 90% relative humidity and at a temperature of 7°C.

3.2. Dried papayas

3.2.1. Processing

De-hydration is the oldest method of making food storable for longer periods. It is based on the fact that micro-organisms tend to cease growing below a certain level of water content. During drying, it is important to extract the water from the fruit as carefully as possible. The most important features are a good circulation of air and not too high temperatures

The preparation stages from fresh to dried fruit are outlined and then described more fully below:



- **Sorting**

After harvesting, the fruits are sorted as only fresh, unripe and not fermented fruits can be used for drying.

- **Washing and peeling**

Papayas must be washed very carefully, in order not to damage them. Afterwards, inedible parts such as leaves, seeds, pips, heartwood and skins are removed.

- **Pulping and drying the fruits**

The fruits are now cut into same-sized pieces, and laid out to dry in the air and sun in thin layers on racks, in solar dryers (drying tunnels) or drying ovens (artificial drying at 70°C).

- **Sorting and packaging**

Before they are packed, the fruits are inspected and sorted again, to rid them of discoloured, skin remnants and seeds etc..

- **Labelling and storage**

The packaged fruits can now be labelled and stored prior to being shipped.

During and after drying, the dried fruits are not permitted to be treated with methyl bromide, ethylene oxide, sulphur oxides or with ionising radiation.

3.2.2. Quality requirements

The following is a list of quality characteristics with minimum and maximum values for dried fruits, that are usually required officially or by importers. Different minimum and maximum values can be agreed between importers and exporters, providing these do not clash with official regulations.

Quality characteristics	Minimum and maximum values
Taste and smell	Variety-specific, aromatic, fresh, not mouldy
cleanliness	Free from foreign particles, such as insects, sand, small stones etc.
Water content	max. 18 %
aw-value	0.55 to 0.65 (at 20 °C)
Residues	
Pesticides	Not measurable
Sulphur oxide	Not measurable
Bromide and ethylene oxide	Not measurable

Micro-organisms	
Total number of parts	max. 10,000/g
Yeasts	max. 10/g
Mould fungus	max. 10/g
Staphylococcus aureus	max. 10/g
Coliforms	max. 1/g
Escherichia coli	Not measurable in 0.01 g
Enterococci	Not measurable in 1 g
Salmonella	Not measurable in 20 g
Mycotoxins	
Staphylococcus enterotoxin	Not measurable
Aflatoxin B1	max. 2 µg/kg
Total aflatoxins B1, B2, G1, G2	max. 4 µg/kg
Patulin	max. 50 µg/kg
Heavy metals	
Lead (Pb)	max. 1.25 mg/kg
Cadmium (Cd)	max. 0.125 mg/kg
Mercury (Hg)	max. 0.10 mg/kg

In order that the quality requirements are upheld, and no contamination of the fruits occurs, preparation should take place under clean, hygienic and ideal conditions. The following aspects should be adhered to:

- Equipment (tubs, knives etc.), as well as working and drying surfaces (racks, mats etc.) and preparing and storage rooms, should be cleaned regularly.
- Personnel should be healthy, and have the possibility to wash themselves, or at least their hands (washrooms, toilets) and wear clean, washable overgarments.
- Water used for cleansing purposes must be free from faeces and other contaminants.
- Animals or animal faeces must not come into contact with the fruits. If the fruits are to be dried in the open, then fences must be erected to guard the racks against birds and nearby animals.

3.2.3. Packaging and storage

Packaging types and material

In order to be exported to Europe, the dried fruits can be packed in consumer packs, or wholesaler packs (bulk) in bags made of sealable, foils, impermeable to steam

(e.g. polyethylene or polypropylene). Before sealing, a gas (e.g. nitrogen) may be added (nitrogen flushing).

Details given on packaging

If final packaging is already done in the country of origin, then the following details must be included on the outside of the packets:

- **Product name ('trade name')**

The name of the product, e.g.: Papaya slices organically grown⁵

- **Manufacturer**

Name and address of the manufacturer, importer, exporter or trader within the country of origin, and which country.

- **List of contents**

A list of ingredients and additions, beginning with the heaviest proportion of total weight at the time of packaging.

- **Weight**

Details of the total packed weight in grams

The numbers describing the weight of the contents must be of the following sizes

Weight of contents	Letter size
Less than 50 g	2 mm
More than 50 g to 200 g	3 mm
More than 200 g to 1000 g	4 mm
More than 1000 g	6 mm

- **Best before date**

The 'Best before ...' details must include day, month and year; e.g.. best before 30.11.2001

- **Batch number**

Function of the product packaging

The product packaging should fulfil the following functions:

- Protect it from loss of aroma and against undesirable smells and tastes from its surroundings (aroma protection).
- Offer sufficient conservation properties, especially against loss or gain of moisture.
- Protect the contents against damaging.
- Provide a surface area for advertising and product information.

⁵ When products from organic farms are being labelled as such, it is necessary to adhere to the requisite government regulations of the importing country. Information concerning this is available from the appropriate certification body. The regulation for organic agriculture (EEC) 2092/91 is applicable to organic products being imported into Europe.

Transport packaging

Some form of transport packaging is required in order to ship the bulk or singly packed fruits. In choosing a type of packaging, the following should be heeded:

- Transport packaging made, for example, out of cardboard, should be strong enough to protect the contents against being damaged by outside pressure.
- The packaging should be dimensioned to allow the contents to be held firmly, but not too tightly in place.
- The dimensions should be compatible with standard pallet and container dimensions.

Information printed on transport packaging

The transport packaging should display details of the following:

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested
- Net weight, number
- Batch number
- Destination, with the trader's/importer's address
- Visible indication of the organic source of the product⁶

Storage

The dried fruits should be stored in dark areas at low temperatures and relative humidity.

Under optimum conditions, dried fruits can be stored for up to 1 year.

If the organic product is being stored in a single warehouse together with conventional papayas mixing of the different qualities must be avoided. This is best achieved using the following methods:

- Training and informing of warehouse personnel
- Explicit signs in the warehouse (silos, pallets, tanks etc.)
- Colour differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

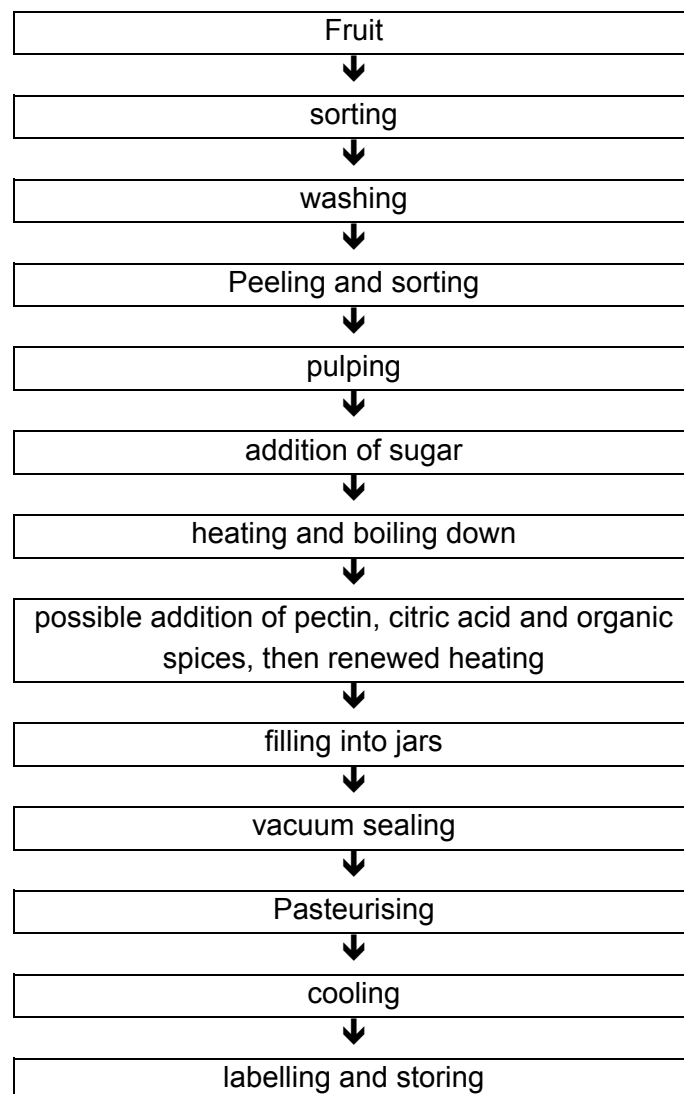
⁶ Organic products must be protected from contamination by non-compliant substances at each stage in the process, i.e. processing, packaging, shipping. Therefore, products originating from a certified organic farm must be recognisably declared as such.

3.3. Papaya marmalades

3.3.1. Processing

Jams are basically preparations made of fruit (jams) and various sugars that are made conservable mainly by heat treatment (boil down). The half-set yet spreadable consistency of these products is achieved by releasing the pectin found in the fruit pulp during the boiling process, and using this together with further pectin added to form a jelly-like mass.

The preparation stages from fresh fruit to jam are outlined and then described more fully below:



- **Sorting**

After harvesting, the fruits are sorted, because only those that are fresh, ripe and not rotten can be used to make jams. Jams can also be made from previously prepared, frozen fruits and pulp.

- **Washing**

The fruit should be washed very carefully as it can easily be damaged.

- **Peeling and sorting**

This follows the procedure of removing leaves, wooden pieces, pips or seeds and peel. Peeling is often done manually, or with knives, yet sometimes the skin is loosened with steam and then subsequently rubbed away mechanically. Finally, the fruits are sorted again to remove any blackened pieces, bits of peeling seeds etc.

- **Pulping and adding sugar**

The peeled fruits are then pulped, and sugar added. They might also be mixed with water or fruit juice. To make jam, at least 350 g fruit per 1000 g finished product must be used; to make jam extra, at least 450 g fruit per 1000 g finished product must be used. The sugar must be organically grown.

Description	Fruit content during manufacture
Jam, extra	450 g fruit per 1000 g product
Jam	350 g fruit per 1000 g product

- **Heating and boiling**

The mixture is now heated to 70-80°C and boiled down, while constantly being stirred, at 65°C until shortly before it reaches the desired consistency.

- **Adding citric acid, pectin and spices (optional)**

If necessary or desired, citric acid, pectin and spices (spices from certified organic agriculture)

natural flavourings can be added, and the mixture again briefly heated to 80°C.

- **Filling into jars, vacuum-sealing and Pasteurising**

The liquid mass is now poured into jars, vacuum-sealed and pasteurised.

- **Cooling, labelling and storage**

After the heating process, the jams are first cooled to 40°C, and then subsequently down to storage temperature, labelled, and finally stored.

3.3.2. Quality requirements

In addition to the previously mentioned quality requirements, such as clearly defined fruit content, the jams also have to conform to the following specifications. These quality requirements, with their minimum and maximum values, are generally issued by the authorities or importers. Yet agreements may be reached between individual

manufacturers and importers upon different values, providing they still conform to official requirements.

Quality requirements	Minimum and maximum values
Smell and taste	Variety-specific, aromatic
Cleanliness	Free of foreign substances such as peel, stalks etc.
Contents of jam extra	Min. 450 g per 1000 g product
Contents of jam	min. 350 g per 1000 g product
Soluble dry mass in percent (measured refractometrically)	min. 60 %
Mycotoxins	
Aflatoxin B1	max. 2 µg/kg
Total aflatoxins B1, B2, G1, G2	max. 4 µg/kg
Patulin	max. 50 µg/kg
Residues	
Pesticides	Not measurable
Sulphur oxide	Not measurable
Bromide	Not measurable
Ethylene oxide	Not measurable

In order to conform to the quality requirements, and to prevent the fruit becoming contaminated, all preparations must be carried out under clean, hygienic and acceptable conditions. The following aspects must be heeded:

- Equipment (tubs, knives etc.), as well as working surfaces (tables etc.) and preparing and storage rooms, should be cleaned regularly.
- Personnel should be healthy, and have the possibility to wash themselves, or at least their hands (washrooms, toilets) and wear clean, washable overgarments.
- Water used for cleansing purposes must be free from faeces and other contaminants.
- Animals or animal faeces must not come into contact with the processed fruits.

3.3.3. Packaging and storage

Packaging types and material

In order to be exported to Europe, the jams are usually filled into consumer-size jars with twist-off lids.

Details given on packaging

The label on the jar must display the following:

- **Product name ('Trade name')**

The name of the product, consisting of: Name of the fruit with or without the description extra – according to fruit content; e.g.: Papaya jam extra, organically grown⁷

- **Manufacturer**

Name and address of the manufacturer, importer, exporter or product trader, plus country of origin.

- **List of contents**

A list of ingredients and additives in the jam, beginning with the heaviest proportion of total weight at the time of packaging

- **Details of the total sugar content**

Total sugar content per 100 g product (measured refractometrically at 20 °C) must be represented with the words "Total sugar contentg per 100 g".

e.g.: Total sugar content 55 g per 100 g.

- **Details of fruit content**

The fruit content per 100 g product must be given with the words "manufactured from....g fruit per 100 g".

e.g.: manufactured from 45 g fruit per 100 g.

- **Notice about cooling**

The notice about storing the product in a cool place must be given with the words:

"After opening, store in a cool place".

- **Weight**

Details of the total weight in grams

- **Best before date**

The 'Best before ...' details must include day, month and year; e.g.. best before 30.11.2001

- **Batch number**

Transport packaging

A form of transport packaging is required to ship the sales packages. In choosing them, the following aspects should be heeded:

- Transport packaging made, for example, out of cardboard, should be strong enough to protect the contents against being damaged by outside pressure.
- The packaging should be dimensioned to allow the contents to be held firmly, but not too tightly in place.
- The dimensions should be compatible with standard pallet and container dimensions.

⁷ comp. 5

Information printed on transport packaging

The transport packaging should display details of the following:

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested
- Net weight, number
- Batch number
- Destination, with the trader's/importer's address
- Visible indication of the organic quality of the product⁸

Storage

The jams should be stored in a dark, cool room at temperatures of max. 15°C. Under optimum conditions, jam may be stored for 1-2 years.

If the organic product is being stored in a single warehouse together with conventional papayas mixing of the different qualities must be avoided. This is best achieved using the following methods:

- Training and informing of warehouse personnel
- Explicit signs in the warehouse (silos, pallets, tanks etc.)
- Colour differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

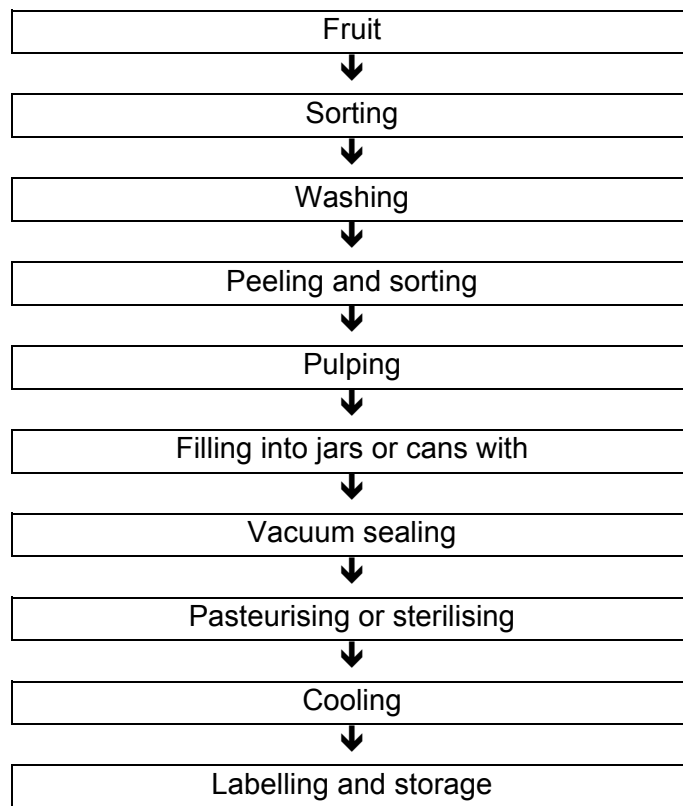
3.4. Canned papayas

3.4.1. Processing

Canned foods are products that can be stored over a long period in airtight containers (metal or glass jars). They are preserved mainly by heat treatment, during which the micro-organisms present in the fruit are significantly reduced in number and growth potential that they are prevented from spoiling the product.

The process involved in turning fresh fruit into canned products is described schematically, and then in more detail below:

⁸ comp. 2



Sorting

After harvesting, the fruits are sorted, because only those that are fresh, ripe and not rotten can be used to make jams. Jams can also be made from previously prepared, frozen fruits and pulp.

Washing

The fruit should be washed very carefully as it can easily be damaged.

Peeling and sorting

This follows the procedure of removing leaves, wooden pieces, pips or seeds and peel. Peeling is often done manually, or with knives, yet sometimes the skin is loosened with steam and then subsequently rubbed away mechanically. Finally, the fruits are sorted again to remove any blackened pieces, bits of peeling, seeds etc.

Pulping

The peeled fruit can be cut into a variety of shapes, according to type (indicated by the crosses in the table). The shape of the cut fruit must be given on the can (slices, diced, pieces etc.).

Description	Cut shape	Pine-apple	Mango	Papaya	Banana
Whole fruit	Peeled				X
Slices	Slices of fruit cut into approximately the same size	X	X	X	X
Half slices	Uniformly cut, semi-circle shaped slices.	X			
Diced	Fruit cut into dice shapes of roughly the same size.	X	X	X	
Balls	Fruit pulp pieces cut into roughly ball shapes		X		
Pieces	Pieces of fruit cut into irregular shapes	X			
Grated	Irregular thin strips and pieces of fruit	X			
Chunks	Large regularly cut pieces of pineapple	X			
Titbits	Trapeze-shaped segments of pineapple	X			

- **Filling in jars or cans**

The cut pieces are now filled into jars or cans and covered with syrup. Additional information must be given on the can according to the sugar content of the syrup.

Sugar concentration* of the syrup	Description on the can
9-14 %	Very lightly sugared
14-17 %	Lightly sugared
17-20 %	Sugared
over 20 %	Strongly sugared

* The sugar must be organically grown.

If the appropriate fruit juice has been used as syrup then "...in natural juice" must be included on the label, e.g.: Papaya in natural juice.

Vacuum sealing, pasteurising or sterilising

After the jars or cans have been vacuum sealed, they are either pasteurised (temperatures above 80°C) or sterilised (temperatures above 100°C).

Cooling

After the heating process, the canned fruits are first cooled to 40°C, and then subsequently down to storage temperature.

Labelling and storage

After they have been cooled, the canned fruits are labelled and stored.

3.4.2. Quality requirements

In addition to the previously listed quality requirements, such as clearly defined sugar concentrations of the syrup and shapes specific to certain fruits, the contents should also conform to the following characteristics. These quality requirements, with their minimum and maximum values, are generally issued by the authorities or importers. Yet agreements may be reached between individual manufacturers and importers upon different values, providing they still conform to official requirements.

Quality requirements	Minimum and maximum values
Taste and smell	Variety-specific, aromatic, not mouldy
Cleanliness	Free of foreign substances such as peel, stalks etc.
Mycotoxins	
Aflatoxins B1	max. 2 µg/kg
Total aflatoxines B1, B2, G1, G2	max. 4 µg/kg
Patulin	max. 50 µg/kg
Residue	
Pesticide	Not measurable
Sulphur oxide	Not measurable
Bromide	Not measurable
Ethylene oxide	Not measurable

In order to conform to the quality requirements, and to prevent the fruit becoming contaminated, all preparations must be carried out under clean, hygienic and acceptable conditions. The following aspects must be heeded:

- Equipment (tubs, knives etc.), as well as working surfaces (tables etc.) and preparing and storage rooms, should be cleaned regularly.
- Personnel should be healthy, and have the possibility to wash themselves, or at least their hands (washrooms, toilets) and wear clean, washable overgarments.
- Water used for cleansing purposes must be free from faeces and other contaminants.
- Animals or animal faeces must not come into contact with the processed fruits.

3.4.3. Packaging and storage

Packaging type and material

In order to be exported to Europe, the fruits can be packed into single or wholesale packages (bulk) made of glass, aluminium or tin cans.

Details given on packaging

The label on the jar must display the following:

- **Product name ('Trade name')**

The name of the product, consisting of: Name of the fruit with or without the description extra – according to fruit content; e.g.: Papayas in slices, lightly sugared, organically grown⁹

- **Manufacturer**

Name and address of the manufacturer, importer, exporter or product trader, plus country of origin.

- **List of contents**

A list of ingredients and additives in the jam, beginning with the heaviest proportion of total weight at the time of packaging

- **Weight**

Total and dry weight of the fruit

The numbers describing the weight of the contents must be of the following sizes

Weight of contents	Letter size
Less than 50 g	2 mm
More than 50 g to 200 g	3 mm
More than 200 g to 1000 g	4 mm
More than 1000 g	6 mm

- **Best before date**

The 'Best before ...' details must include day, month and year; e.g.. best before 30.11.2001

- **Batch number**

Transport packaging

A form of transport packaging is required to ship the sales packages. In choosing them, the following aspects should be heeded:

- Transport packaging made, for example, out of cardboard, should be strong enough to protect the contents against being damaged by outside pressure.
- The packaging should be dimensioned to allow the contents to be held firmly, but not too tightly in place.

⁹ comp. 5

- The dimensions should be compatible with standard pallet and container dimensions.

Information printed on transport packaging The transport packaging should display details of the following:

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested
- Net weight, number
- Batch number
- Destination, with the trader's/importer's address
- Visible notice of the organic nature of the product¹⁰

Storage

The conserved fruit (especially in jars) should be stored in dark rooms at low temperatures (max. 15°C). Under optimum conditions, conserved fruit can be stored for 1 year (when pasteurised) or 2 years (when sterilised).

If the organic product is being stored in a single warehouse together with conventional papayas mixing of the different qualities must be avoided. This is best achieved using the following methods:

- Training and informing of warehouse personnel
- Explicit signs in the warehouse (silos, pallets, tanks etc.)
- Colour differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

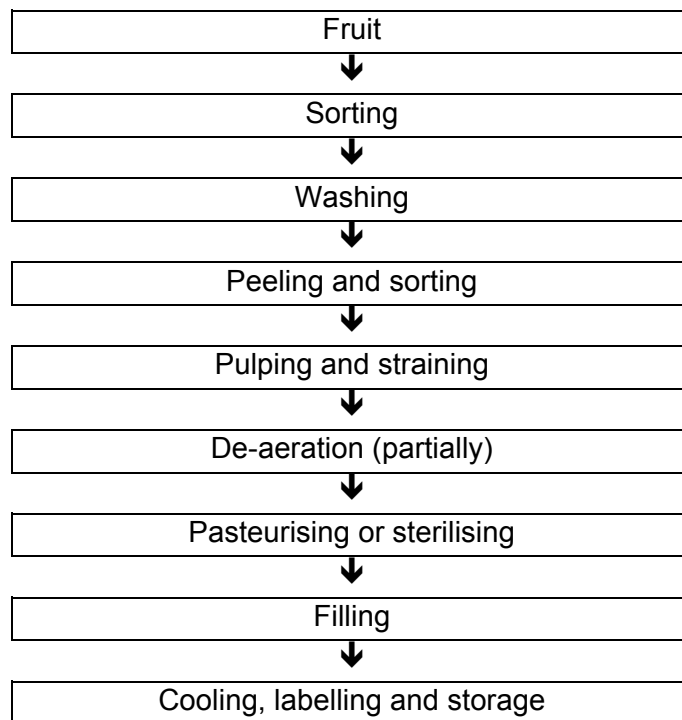
3.5. Papaya pulp

3.5.1. Processing

Canned foods are products that can be stored over a long period in airtight containers (metal or glass jars). They are preserved mainly by heat treatment, during which the micro-organisms present in the fruit are significantly reduced in number, or their development so restricted, that they are prevented from spoiling the product.

The process involved in turning fresh fruit into canned products is described schematically, and then in more detail below:

¹⁰ comp. 6



Manufacturing papaya pulp

The following must be heeded when working with papaya:

- Papaya is often contaminated with insects and fungi.
- Juice found in the peel should not be allowed to mix with pulp.
- The multitudinous and highly active enzymes should be inactivated during processing.
- The kernels have a high fat content and own taste, and should be removed during the processing without breaking them.
- All machine parts that come into contact with the pulp must be constructed out of stainless steel to prevent discolouring.

In order to make papaya marmalade, only fresh, ripe and not mouldy fruits should be used. After harvesting, the fruits are then sorted and washed in a water bath at 50°C for 20 minutes. Next, they are sent through a steam tunnel, where they are treated with steam (100°C) in order to: prevent latex from oozing out of the peel; to deactivate the enzymes in the peel; to clean the surface of the fruit; to reduce the number of micro-organisms, and to soften the outer parts of the fruit in order to increase the amount of pulp produced.

The fruit is then cooled down with water jets for 3-4 minutes, subsequently peeled, and then fed into a strainer (0,6-mm screen) to remove the kernels. Afterwards, the pulp is generally treated with a 50% citric acid solution in order to lower the pH value

to 3-3,5. Another strainer (< 0,5- mm screen) removes the fine fibres and particles, before the pulp is heated to 93-96°C in a heat exchanger for 2 minutes.

The papaya pulp can now be filled into tin cans (lead-free, and up to 5 kg) whilst still hot, whereby the cans are sealed while being steamed, the temperature maintained for 5 min., and then rapidly cooled down. At temperatures of around 15°C, the pulp can be stored for up to 1 year. After pasteurising, the pulp can also be cooled down and filled into polyethylene bags placed in 50-200 kg barrels. It is then rapidly frozen, and can be stored at -18°C for 18 months. Pulp which has been filled under antiseptic conditions (bag-in-box) can be stored for up to 1 year at room temperature.

3.5.2. Quality requirements

These quality requirements, with their minimum and maximum values, are generally issued by the authorities or importers. Yet agreements may be reached between individual manufacturers and importers upon different values, providing they still conform to official requirements.

Quality requirements	minimum and maximum values
Smell and taste	Variety-specific, aromatic
Cleanliness	Free of foreign substances such as peel, stalks etc.
Relative density (20/20) for pineapple juice	min 1.045
Brix degree for pineapple juice	min 11.2 %
Relative density (20/20) for Banana pulp	min 1.083
Brix degree for Banana pulp	min 20.0 %
Relative density (20/20) for Mango pulp	min 1.057
Brix degree for Mango pulp	min 14.0 %
Ethanol	max 3.0 g/kg
Volatile acids, evaluated as acetic acid	max 0.4 g/kg
Lactic acid	max 0.5 g/kg
D-Malic acid	Not measurable
Sulphuric acid	Not measurable
Hydroxymethylfurfural (HMF)	max 20 mg/kg

Heavy metals	
Arsenic (As)	max 0.1 mg/kg
Lead (Pb)	max 0.2 mg/kg
Copper (Cu)	max 5.0 mg/kg
Zinc (Zn)	max 5.0 mg/kg
Iron (Fe)	max 5.0 mg/kg
Tin (Sn)	max 1.0 mg/kg
Mercury (Hg)	max 0.01 mg/kg
Cadmium (Cd)	max 0.02 mg/kg
Residues	
Pesticide	Not measurable
Sulphur oxide	Not measurable
Bromide	Not measurable
Ethylene oxide	Not measurable
Mycotoxins	
Aflatoxin B1	max 2 µg/kg
Total aflatoxins B1, B2, G1, G2	max 4 µg/kg
Patulin	max 50 µg/kg

In order to conform to the quality requirements, and to prevent the fruit becoming contaminated, all preparations must be carried out under clean, hygienic and acceptable conditions. The following aspects must be heeded:

- Equipment (tubs, knives etc.), as well as working surfaces (tables etc.) and preparing and storage rooms, should be cleaned regularly.
- Personnel should be healthy, and have the possibility to wash themselves, or at least their hands (washrooms, toilets) and wear clean, washable overgarments.
- Water used for cleansing purposes must be free from faeces and other contaminants.
- Animals or animal faeces must not come into contact with the processed fruits.

3.5.3. Packaging and storage

Packaging type and material

In order to be exported to Europe, the pulp/juices can be packed into single or wholesale packages (bulk) consisting of glass jars, tin cans or polyethylene or polypropylene bags, and also filled antiseptically into 'bag-in-boxes'.

Details given on packaging

The label on the jar must display the following:

- **Product name ('Trade name')**

The name of the product, e.g.: Papaya pulp, grown organically¹¹

- **Manufacturer**

Name and address of the manufacturer, importer, exporter or product trader, plus country of origin.

- **List of contents**

A list of ingredients and additives, beginning with the heaviest proportion of total weight at the time of packaging, e.g.: papayas, citric acid...

- **Weight**

Total weight

The numbers describing the weight of the contents must be of the following sizes

Weight of contents	Letter size
Less than 50 g	2 mm
More than 50 g to 200 g	3 mm
More than 200 g to 1000 g	4 mm
More than 1000 g	6 mm

- **Best before date**

The 'Best before ...' details must include day, month and year; e.g.. best before 30.11.2001

- **Batch number**

Transport packaging

A form of transport packaging is required to ship the sales packages. In choosing them, the following aspects should be heeded:

- Transport packaging made, for example, out of cardboard, should be strong enough to protect the contents against being damaged by outside pressure.
- The packaging should be dimensioned to allow the contents to be held firmly, but not too tightly in place.
- The dimensions should be compatible with standard pallet and container dimensions.

Information printed on transport packaging

The transport packaging should display details of the following:

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested

¹¹ comp. 5

- Net weight, number
- Batch number
- Destination, with the trader's/importer's address
- Visible notice of the organic nature of the product¹²

Storage

Pasteurised pineapple juice, as well as pasteurised banana, mango and papaya pulp can be stored as follows:

Packaging material/ storage temperature	Pineapple juice	Banana pulp	Mango pulp	Papaya pulp
Tin cans/glass jars storage temperature below 15°C	1 year	1 year	1 year	9-12 months
Polyethylene bags/ Deep frozen at -18°C	-	18 months	18 months	12 months
Filled antiseptically, bag-in-box/ Room temperature	1 year	1 year	1 year	6-9 months

If the organic product is being stored in a single warehouse together with conventional papayas mixing of the different qualities must be avoided. This is best achieved using the following methods:

- Training and informing of warehouse personnel
- Explicit signs in the warehouse (silos, pallets, tanks etc.)
- Colour differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

¹² comp. 6