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ICS 67.080.10

## EAST AFRICAN STANDARD

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Fresh breadfruit — Specification and grading



EAST AFRICAN COMMUNITY

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HS 0810.90.00

## Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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## Introduction

In the preparation of this East African Standard, the following sources were consulted extensively:

*Standard specification fresh breadfruit*, published by the Ministry of Agriculture, Jamaica, 1987 (Revised 1999)

CODEX STAN 193:1995 (Rev.5:2009), *General Standard for Contaminants and Toxins in Foods*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*

CODEX STAN 230:2001 (Rev.1:2003), *Maximum levels for lead*

Codex Alimentarius website: [http://www.codexalimentarius.net/mrls/pestdes/jsp/pest\\_q-e.jsp](http://www.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp)

USDA Foreign Agricultural Service website: <http://www.mrlatabase.com>

USDA Agricultural Marketing Service website: <http://www.ams.usda.gov/AMSV1.0/Standards>

USDA Plant Inspectorate Service website: [http://www.aphis.usda.gov/import\\_export/plants](http://www.aphis.usda.gov/import_export/plants)

European Union: [http://ec.europa.eu/sanco\\_pesticides/public](http://ec.europa.eu/sanco_pesticides/public)

Assistance derived from these sources and others inadvertently not mentioned is hereby acknowledged.

This standard has been developed to take into account:

- the needs of the market for the product;
- the need to facilitate fair domestic, regional and international trade and prevent technical barriers to trade by establishing a common trading language for buyers and sellers.
- the structure of the CODEX, UNECE, USA, ISO and other internationally significant standards;
- the needs of the producers in gaining knowledge of market standards, conformity assessment, commercial cultivars and crop production process;
- the need to transport the product in a manner that ensures keeping of quality until it reaches the consumer;
- the need for the plant protection authority to certify, through a simplified form, that the product is fit for crossborder and international trade without carrying plant disease vectors;
- the need to promote good agricultural practices that will enhance wider market access, involvement of small-scale traders and hence making fruit and vegetable production a viable means of wealth creation; and
- the need to keep unsatisfactory produce from the market by allowing the removal of unsatisfactory produce from the markets and to discourage unfair trade practices e.g. trying to sell immature produce at the beginning of the season when high profits can be made. Immature produce leads to dissatisfaction of customers and influences their choices negatively, which disadvantages those traders who have waited until the produce is mature.

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## Fresh breadfruit — Specification and grading

### 1 Scope

This Standard applies to varieties of breadfruit grown from *Artocarpus altilis* of the family *Moraceae*, to be supplied fresh to the consumer, after preparation and packaging and for industrial processing.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CAC/GL 21, *Principles for the Establishment and Application of Microbiological Criteria for Foods*

CAC/RCP 1, *Recommended International Code of Practice — General Principles of Food Hygiene*

CAC/RCP 44, *Recommended International Code of Practice for the Packaging and Transport of Tropical Fresh Fruit and Vegetables*

CAC/RCP 53, *Code of Hygienic Practice for Fresh Fruits and Vegetables*

EAS 38, *Labelling of prepackaged foods — Specification*

CD/K/378:2010, *Horticultural industry — Code of practice*

### 3 Definitions

For the purpose of this standard the following definition shall apply:

#### 3.1

##### **similar varietal characteristics**

breadfruit in any lot have the same general shape, colour, characteristic of skin and flesh

#### 3.2

##### **clean**

free from adhering soil, latex, pest and foreign matter

#### 3.3

##### **firm**

not soft, nor shrivelled

#### 3.4

##### **maturity**

the breadfruits are at a stage of development that is suitable for the market requirement

#### 3.5

##### **disease**

any visible defect or combination of defects caused by micro organisms

#### 3.6

##### **well shaped**

breadfruits shall have the shape characteristic of the variety

**3.7**

**fairly well shaped**

85% or more of breadfruits shall not be flat sided or any way abnormal in shape

**3.8**

**damage**

any defect or combination of defects of physical or physiological causes which detracts from the edible or marketing quality such as scars or bruises

**3.9**

**serious damage**

any defect or combination of defect of physiological or physical (external or internal causes such as cuts punctures and internal dehydration which could lead to the abnormally quick deterioration of the fruit and cause rejection

**3.10**

**latex**

the residue from the sap

**3.11**

**well trimmed**

breadfruits' stem is intact with length not greater than 2.5 cm. above the shoulder of the fruit

**3.12**

**fairly well trimmed**

85% or more of breadfruits in any lot shall have stems intact with length not greater than 2.5 cm long above the shoulder of the fruit

**3.13**

**similar maturity**

there shall be no very distinct visual difference in maturity between breadfruit in the same box or lot

**3.14**

**weight**

the weight stated on the container shall be the minimum net weight delivered to the customer

**3.15**

**major defects**

- **Insects** With evidence of live insects or insect infestation.
- **Diseases** With evidence of fungal or bacterial rots.
- **Physical / pest damage** With unhealed cuts, holes or splits from physical or pest damage.
  - With large areas of brown discolouration (latex leakage).
- **Physiological disorders** With evidence of dry hard flesh or flesh lifting from shell (dehydration).
  - With angular skin segments and glossy green skin colour (excessive immaturity)
  - With strong odour (excessive maturity).
- **Temperature injury** With skin browning/blackening and areas of softened flesh (chilling injury).

**3.16**

**minor defects**

- physical/pest damage — *With superficial bruising > 2 sq cm.*
- Skin marks / blemishes — *With healed scars > 2 sq cm.*

## 4 Provisions concerning quality

### 4.1 General

The purpose of the standard is to define the quality requirements of breadfruits at the market-control stage, after preparation and packaging.

The holder/seller of products may not display such products or offer them for sale, or deliver or market them in any manner other than in conformity with this standard. The holder shall be responsible for observing such conformity.

### 4.2 Minimum requirements

**4.2.1** In all classes, subject to the special provisions for each class and the tolerances allowed, the breadfruit must be:

- (a) intact, firm and of similar varietal characteristics;
- (b) sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- (c) clean, practically free of any visible foreign matter;
- (d) practically free of pests affecting the general appearance of the produce;
- (e) practically free of damage caused by pests;
- (f) free of abnormal external moisture, excluding condensation following removal from cold storage;
- (g) free of any foreign smell and/or taste;
- (h) free of damage caused by low and/or high temperatures;
- (i) free of damage caused by frost;
- (j) free of signs of internal shrivelling;
- (k) practically free of bruising and/or extensive healed-over cuts.

The breadfruits must have been carefully picked and have reached an appropriate degree of development and ripeness account being taken of the characteristics of the variety, the time of picking and the area in which they are grown.

**4.2.2** The development and condition of the breadfruits must be such as to enable them:

- (a) to withstand transport and handling; and
- (b) to arrive in satisfactory condition at the place of destination.

### 4.3 Maturity criteria

The maturity of breadfruits is defined by the following parameters:

- Colour — Dark green to greenish yellow skin with light brown markings, cream to yellow flesh.
- General visual appearance — Smooth, pebbled skin composed of small rounded segments; skin often with brownish latex stains; short stem present with clean cut.

- Fully mature fruits show a dark green skin color, a light browning and a lack of luster, when compared to less mature fruits. In addition, the segments on the surface of the fully mature fruits are more rounded and smoother than less mature fruits, in which they tend to be angular and ridged. Full maturity is also indicated by the presence of latex stains on the surface of the fruit. Over-mature fruit are indicated by a slight yellowing of the skin, together with a yellowing of the stem. Breadfruits showing these characteristics should not be used for export.
- Shape — Generally round to oval, not badly misshapen
- General appearance — Rough skin composed of small spiny segments; skin often with brownish latex stains; short stem present with clean cut
- Sensory — Firm fruit with moderately thin skin, flesh somewhat soft, sweet, and aromatic when fruit is fully ripe; may contain many brown seeds or be seedless

#### **4.4 Classes**

Each class shall be graded according to its general appearance, quality and condition.

##### **4.4.1 Class I**

The fruit is of similar varietal characteristics, similar maturity, not overripe, clean, well trimmed, fairly well formed: free from soft bruises, decay, worm holes, growth cracks, cuts or other skin breaks, and damage caused by discoloration or scars, disease, insects, mechanical or other means.

##### **4.4.2 Class II**

The fruit is of similar varietal characteristics, similar maturity, well shaped, not overripe, fairly well trimmed, fairly clean and reasonably free from soft bruises, cuts and other skin damages, free from decay, worm holes and growth cracks.

##### **4.4.3 Class III**

The fruit is of similar varietal characteristics, mature, fairly well shaped, not overripe, fairly well trimmed, fairly clean and reasonably free from soft bruises, cuts and other skin damages, free from decay, worm holes and growth cracks.

### **5 Provisions concerning sizing**

Size is determined by the weight of the fruit as follows:

- Large, weighing 2500 grammes and above.
- Medium, weighing from 1500 – 2500 grammes to less than 16 kilogrammes.
- Small, weighing from less than 1500 grammes.

### **6 Provisions concerning tolerances**

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

#### **6.1 Quality tolerances**

##### **6.1.1 Class I**

Not more than 5% by number or weight of breadfruit shall fail to meet the specifications of this grade but those of Class II. There shall be zero tolerance for damage at the dispatching stage.

### 6.1.2 Class II

Not more than 10% by number or weight of breadfruit shall fail to meet the specifications of this grade but meet those of Class III. Damage shall not exceed more than 2% at the dispatching stage.

### 6.1.3 Class III

Not more than 10% by number or weight of breadfruit shall fail to meet the minimum quality and grade requirements.

## 6.2 Size tolerances

For all classes, ten percent (10%) by number or weight of breadfruit corresponding to the size immediately below or above the size indicated on the package.

## 7 Provisions concerning presentation

### 7.1 Uniformity

The contents of each package must be uniform and contain only breadfruits of the same origin, variety and/or commercial type, quality and size, and appreciably of the same degree of maturity and development. The visible part of the contents of the package must be representative of the entire contents.

### 7.2 Packaging

Breadfruits must be properly packed in such a way as to protect the produce. The materials used inside the package must be new<sup>1</sup>, clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed, provided the printing or labelling has been done with non-toxic ink or glue.

Breadfruits shall be packed in each container in compliance with CAC/RCP 44.

#### 7.2.1 Description of containers

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the breadfruits. Packages must be free of all foreign matter and smell.

## 8 Marking or labelling

### 8.1 Consumer packages

In addition to the requirements of EAS 38, the following specific provisions apply:

#### 8.1.1 Nature of produce

If the produce is not visible from the outside, each package (or lot for produce presented in bulk) shall be labelled as to the name of the produce and may be labelled as to the name of the variety and/or commercial type.

#### 8.2 Non-retail containers

Each package must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside, or in the documents accompanying the shipment.

---

<sup>1</sup>For the purposes of this Standard, this includes recycled material of food-grade quality.

### 8.2.1 Identification

Name and address of exporter, packer and/or dispatcher. Identification code (optional).<sup>2</sup>

### 8.2.2 Nature of produce

Name of the produce if the contents are not visible from the outside. Name of the variety and/or commercial type (optional).<sup>3</sup>

### 8.2.3 Origin of produce

Country of origin and, optionally, district where grown or national, regional or local place name.

### 8.2.4 Commercial Identification

- Class and variety;
- Number of fruit container (count);
- Grower/lot identification number;
- If appropriate, a statement indicating the use of preservatives;
- Storage temperature
- Net weight of package (kg).

### 8.2.5 Official Inspection Mark (optional)

## 9 Contaminants

### 9.1 Heavy metals

Breadfruits shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity. The current limits are as indicated below:

Metal	Unit of measurement	Maximum limit	Test method
Lead (Pb)	mg/kg wet weight	0.10	ISO 6633 (AAS)
Cadmium (Cd)	mg/kg wet weight	0.050	ISO 6561-1 or 6561-2

### 9.2 Pesticide residues

Breadfruits shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity. Annex E provides current MRLs for the USA, EU and Codex markets.

## 10 Hygiene

**10.1** It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of CAC/RCP 1, CAC/RCP 53, and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

<sup>2</sup> The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark.

<sup>3</sup> The national legislation of a number of countries requires the explicit declaration of the variety.

10.2 The produce should comply with any microbiological criteria established in accordance with CAC/GL 21.



Breadfruit fruiting trees and fresh fruits — Various varieties



Immature breadfruit — Different varieties

Draft for

**Annex B**  
(informative)

**Post-harvest handling and processing**

**Harvesting**

Harvesting should be carried out on the day of shipment, or on the previous day, if cool storage and adequate supervision of grading and packing are available. Harvesting should be carried out in the early part of the day, to avoid buildup of field heat. Due to the nature of the breadfruit tree, harvesting invariably involves climbing the tree. When harvesting, the fruit should be snapped from the tree (at the point adjacent to the branch and not the fruit). The long stems of the fruit harvested in this way, should be removed with a sharp knife to leave the stem flush with the level of the fruit shoulders or slightly protruding (up to 1.5 cm). Harvesting implements may be used. The most suitable involves a pruning pole, where the fruit is cut, allowed to fall and caught by hand or in a net, before hitting the ground. Breadfruit should never be knocked from the tree, dropped or thrown directly to the ground, as the resultant bruising will cause rapid softening. Trimming of the stems should be carried out in the field immediately after harvest and the fruit placed on the ground with the stems downwards to allow latex drainage. Outgrading should be carried out in the field to remove immature, undersized, damaged, bruised, scarred, ripe, or fruits with the stems completely removed.

The fruit of any one tree are of different physiological ages and therefore, all the fruits do not reach maturity simultaneously. Fruit are usually harvested from individual trees on several occasions during the season.

After harvest, latex should be allowed to drain away and the fruit placed in field crates or mesh bags. Harvested breadfruit should not be left in direct sunlight or wind, either in the field or on transport to the packing facilities. On arrival at the packing area, the acceptable fruit should be placed in a tank (containing 100 ppm sodium hypochlorite) for washing to remove fresh latex stains and debris. The fruit should then be placed into field crates and allowed to drain prior to packing.

**Export Grading and Packing**

Quality checks are required prior to packing to ensure the removal of all fruits not meeting the export requirements, particularly in terms of maturity and mechanical damage. Fruits should be graded in each carton according to the size, giving a range of counts for each shipment. Net weights should range from 12 to 16 kg (27 to 35 lbs). Each individual carton should be weighed, recorded and the carton marked (breadfruit is generally sold on a per kilogram basis, rather than by the carton). Cartons should not be overfilled during packing.

**Packaging**

Full telescopic two-piece fiberboard carton ("banana" type) or one-piece selflocking waxed carton (bushel type); bursting strength 275 lb/in<sup>2</sup>. Fruit dividers may be used to reduce fruit movement and rubbing. Where staples are used, care should be taken to ensure complete staple closure to avoid fruit damage.

Carton internal dimensions:

- 20 x 51 x 34 cm (7.9" x 20" x 13.4")
- 29.5 by 44 by 29.5 cm (12" by 18" by 12")

**Pre-cooling**

Pre-cooling of breadfruit to 12 °C prior to shipment (by air) is preferable. Harvests made the day prior to shipment should always be placed in cold storage. Temperature controlled rooms are the most suitable. Cooling will be slow if stacking and ventilation are inadequate or if the cooling capacity of the

system is low. Cooling is required to a minimum of 12 °C. Iced water or air systems below 12 °C should not be used as this will result in rapid browning of the fruit surface.

### **Storage**

Long term storage of breadfruit for sea shipment under commercial conditions is not feasible, at the present stage of technical development, as high levels of softening are likely to occur. Prolonged storage of more than one day should not be used for air shipments if out-turns are to be acceptable. At storage temperature below 12 °C for even short periods of time, breadfruit will develop chilling injury, which will lead to a drastic reduction in quality and increase spoilage. During storage it should be ensured that ventilation is sufficient to prevent localized build-up of heat and ethylene.

### **Shipment conditions**

Exports should only be made by air. Aircraft pallets are preferable to containers due to the increased ventilation. Short delays and increases in container temperatures within aircraft containers with no ventilation will greatly increase the levels of softening.

### **Potential post-harvest losses**

Losses in breadfruit are as a result of fruit softening.

### **Mechanical damage**

Mechanically damaged fruit will normally deteriorate rapidly and should not be exported. Careful handling should therefore be used during harvesting and subsequent operations such as grading, packing and transportation.

### **Low temperature**


Storage at temperatures below 12 °C will result in chilling injury, as indicated by brown scald-like discoloration of the skin, increased water loss, increased susceptibility to decay organisms and detrimental changes in flavor characteristics.

### **Pathological factors**

Fungal and bacterial infection are rare in breadfruit. They are usually seen as secondary infections where the fruits are very ripe and the internal structure begins to break down.

**Annex C**  
(informative)

**Model certificate of conformity with standards for fresh fruits and vegetables**

1. Trader:	Certificate of conformity with the Community marketing standards applicable to fresh fruits and vegetables  No. ....  (This certificate is exclusively for the use of inspection bodies)		
2. Packer identified on packaging (if other than trader)	3. Inspection body		
	4. Place of inspection/country of origin (*)	5. Region or country of destination	
6. Identifier of means of transport	7. <input type="checkbox"/> Internal <input type="checkbox"/> Import <input type="checkbox"/> Export		
8. Packages (number and type)	9. Type of product (variety if the standards specifies)	10. Quality Class	11. Total net weight in kg
<p>12. The consignment referred to above conforms, at the time of issue, with the Community standards in force, vide:</p> <p><u>CD/K/109:2010, Fresh breadfruit -- Specification and grading</u></p> <p>_____</p> <p>Customs office foreseen ..... Place and date of issue .....</p> <p>Valid until (date): .....</p> <p>Signatory (name in block letters): .....</p> <p>Signature _____ Seal of competent authority _____</p>			
13. Observations:			

(\*) Where the goods are being re-exported, indicate the origin in box 9.

## Annex D (informative)

### Breadfruit (*Artocarpus altilis*) — Fact sheet

#### D.1 Introduction

One of the great food producers in its realm and widely known, at least by name, through its romanticized and dramatized history, the breadfruit, *Artocarpus altilis* Fosc. (syns. *A. communis* J.R. and G. Forst.; *A. incisus* L.f.) belongs to the mulberry family, Moraceae. The common name is almost universal, in English, or translated into Spanish as *fruta de pan* (fruit), or *arbor de pan*, *arbor del pan* (tree), or *pan de pobre*; into French, as *fruit a pain* (seedless), *chataignier* (with seeds), *arbre a pain* (tree); Portuguese, *fruta pao*, or *pao de massa*; Dutch, *broodvrucht* (fruit), *broodboom* (tree). In Venezuela it may be called *pan de ano*, *pan de todo el ano*, *pan de palo*, *pan de name*, *topan*, or *tupan*; in Guatemala and Honduras, *mazapan* (seedless), *castana* (with seeds); in Peru, *marure*; in Yucatan, *castano de Malabar* (with seeds); in Puerto Rico, *panapen* (seedless), *pana de pepitas* (with seeds). In Malaya and Java, it is *suku* or *sukun* (seedless); *kulur*, *kelur*, or *kulor* (with seeds); in Thailand, *sa-ke*, in the Philippines, *rimas* (seedless); in Hawaii, *ulu*. The type with seeds is sometimes called "breadnut", a name better limited to *Brosimum alicastrum* Swartz, an edible-seeded tree of Yucatan, Central America and nearby areas. Its Spanish name is *ramon* and the seeds, leaves and twigs are prized as stock feed.

#### D.2 Description

The breadfruit tree is handsome and fast growing, reaching 26 m in height, often with a clear trunk to 6 m becoming 0.6-1.8 m in width and often buttressed at the base, though some varieties may never exceed 1/4 or 1/2 of these dimensions. There are many spreading branches, some thick with lateral foliage-bearing branchlets, others long and slender with foliage clustered only at their tips. The leaves, evergreen or deciduous depending on climatic conditions, on thick, yellow petioles to 3.8 cm long, are ovate, 22.8-90 cm long, 20-50 cm wide, entire at the base, then more or less deeply cut into 5 to 11 pointed lobes. They are bright-green and glossy on the upper surface, with conspicuous yellow veins; dull, yellowish and coated with minute, stiff hairs on the underside.

The tree bears a multitude of tiny flowers, the male densely set on a drooping, cylindrical or club-shaped spike 12.5-30 cm long and 2.5-3.75 cm thick, yellowish at first and becoming brown. The female are massed in a somewhat rounded or elliptic, green, prickly head, 6.35 cm long and 3.8 cm across, which develops into the compound fruit (or syncarp), oblong, cylindrical, ovoid, rounded or pearshaped, 9-45 cm in length and 5-30 cm in diameter. The thin rind is patterned with irregular, 4- to 6-sided faces, in some "smooth" fruits level with the surface, in others conical; in some, there may rise from the center of each face a sharp, black point, or a green, pliable spine to 3 mm long or longer. Some fruits may have a harsh, sandpaper-like rind. Generally the rind is green at first, turning yellowish-green, yellow or yellow-brown when ripe, though one variety is lavender.

In the green stage, the fruit is hard and the interior is white, starchy and somewhat fibrous. When fully ripe, the fruit is somewhat soft, the interior is cream colored or yellow and pasty, also sweetly fragrant. The seeds are irregularly oval, rounded at one end, pointed at the other, about 2 cm long, dull-brown with darker stripes. In the center of seedless fruits there is a cylindrical or oblong core, in some types covered with hairs bearing flat, brown, abortive seeds about 3 mm long. The fruit is borne singly or in clusters of 2 or 3, at the branch tips. The fruit stalk (pedicel) varies from 2.5-12.5 cm long.

All parts of the tree, including the unripe fruit, are rich in milky, gummy latex. There are two main types: the normal, "wild" type (cultivated in some areas) with seeds and little pulp, and the "cultivated" (more widely grown) seedless type, but occasionally a few fully developed seeds are found in usually seedless cultivars. Some forms with entire leaves and with both seeds and edible pulp have been classified by as belonging to a separate species, *A. mariannensis* Trecul. but these commonly integrate with *A. altilis* and some other botanists regard them as included in that highly variable species.

### D.3 Origin and distribution

The breadfruit is believed to be native to a vast area extending from New Guinea through the Indo-Malayan Archipelago to Western Micronesia. It is said to have been widely spread in the Pacific area by migrating Polynesians, and Hawaiians believed that it was brought from the Samoan island of Upalu to Oahu in the 12th Century A.D. It is said to have been first seen by Europeans in the Marquesas in 1595, then in Tahiti in 1606. At the beginning of the 18th Century, the early English explorers were loud in its praises, and its fame, together with several periods of famine in Jamaica between 1780 and 1786, inspired plantation owners in the British West Indies to petition King George III to import seedless breadfruit trees to provide food for their slaves.

### D.4 Varieties

There are 70 named varieties of seeded and seedless breadfruits in Fiji. They are locally separated into 8 classes by leaf form. The following, briefly presented, are those that are recorded as "very good". It will be noted that some varietal names are reported under more than one class.

#### **Class I: Leaf entire, or with one or two, occasionally, three lobes.**

'**Koqo**'—round; 10 cm wide; seedless; does not deteriorate quickly.

'**Tamaikora**'—gourd shaped (constricted around middle); to 11.5 cm long, 7.5 cm wide; with many seeds. Can be eaten raw when ripe. Highly perishable. Tree to 12-13.5 m.

#### **Class II: Leaf dissected at apex.**

'**Temaipo**'—round; 9 cm long; seedless. Can be eaten raw when ripe. There is also an oblong form with many seeds.

#### **Class III: Leaf moderately deeply dissected at apex.**

'**Uto Kuro**'—round; 12.5 cm long; does not deteriorate quickly.

#### **Class IV: Leaf moderately deeply dissected on upper half.**

'**Samoa**'—('Kasa Balavu') round; 10-15 cm long; seeds sparse to many.

'**Uto Yalewa**'—oblong; to 20 cm long and 15 cm wide; seedless.

'**Kulu Dina**'—oblong; to 40 cm long and 33 cm wide; seedless. Need not be peeled after cooking. Tree bears all year.

'**Sogasoga**'—oblong; to 23 cm long and 16.5 cm wide; seedless.

'**Uto Dina**'—oblong; to 15 cm long and 7.5-9 cm wide; seedless; need not be peeled after cooking. Tree 18-21 m high.

'**Buco Ni Viti**'—oblong; 28-35.5 cm long, 15-18 cm wide; seedless; one of the best cultivars.

'**Tamaikora**'—oblong; 18-23 cm long, 12.5-16.5 cm wide; seeds sparse; pulp eaten raw when ripe. Tree to 23-26 m high; bears 2 crops per year.

'**Kulu Mabomabo**'—oval; 15-20 cm long, 10-14 cm wide; seedless.

#### **Class V: Leaf moderately deeply dissected; shape of leaf base variable.**

'**Uto Dina**'—round; 11.5-12.5 cm wide; seed less. Highly recommended. Tree is 7.5-9 m tall.

'**Balekana Ni Samoa**'—round; 10-12.5 cm long; seeds sparse. Best of all Samoan varieties. There is an oval form by the same name; seedless; deteriorates very quickly.

'**Balekana Ni Vita**'—round; 9-10 cm long; seedless. Does not deteriorate quickly.

'**Balekana Dina**'—oval; 15-20 cm long, 7.5-12.5 cm wide; seeds sparse. One of the best, especially when boiled.

'**Tabukiraro**'—round; 20 cm long; seedless; skin sometimes eaten after cooking.

'**Sici Ni Samoa**'—oval; 12.5-15 cm long, 7.5-9 cm wide; seedless. One of the highly recommended Samoan varieties.

'**Uto Me**'—oval; 12.5-17 cm long, 11.5 cm wide; with many seeds; does not deteriorate quickly.

'**Uto Wa**'—oval; 15-19 cm long, 12.5-14 cm wide. The variety most recommended.

'**Kulu Vawiri**'—oval; 22-30 cm long, 20-22 cm wide; especially good when boiled.

**Class VI: Leaf deeply dissected.**

'**Kulu Dina**'—round; 7.5-10 cm long; seedless. Need not be peeled after boiling. Highly recommended.

'**Balekana**'—oval; 10 cm long, 7.5 cm wide; of the best quality. Tree 21-24 m high.

'**Balekana Ni Samoa**'—round; 7.5 cm long; seeds sparse. Best of all Samoan varieties.

'**Balekana Ni Viti**'—oblong; 12.5-15 cm long, 7.5-10 cm wide; seedless. The best native-type variety.

'**Uto Dina**'—('Kasa Leka') round; 10 cm long; seedless.

'**Uto Matala**'—round; 7.5-10 cm long. Especially fine when boiled. Tree bears 3 times a year.

**Class VII: Leaf deeply dissected; apex pointed.**

'**Balekana Ni Samoa**'—round; 12.5-14 cm long; seeds sparse. Best of all Samoan varieties.

'**Kulu Dina**'—('Kasa Balavu') oval; 15-18 cm long, 10-12.5 cm wide; seedless.

'**Uto Dina**'—(Large) oval; 20-22 cm long, 10-18 cm wide; seedless. Also, by the same name, a form with only moderately dissected leaves.

'**Bokasi**'—round; 10 cm long, 7.5 cm wide.

**Class VIII: Leaf deeply dissected, wide spaces between lobes.**

'**Savisavi Ni Samoa**'—oval; 10-12.5 cm long, 7.5-9 cm wide. Ranks with best Samoan varieties.

'**Savisavi Ni Viti**'—oblong; 16-20 cm long, 10-15 cm wide; seedless; especially good when boiled.

'**Savisavi**'—round; 7.5-9 cm wide; especially good when boiled.

'**Balawa Ni Viti**'—oval; 15-18 cm long, 9-10 cm wide; seedless.

'**Uto Kasekasei**'—round; 10-12.5 cm long; seeds sparse.

'**Via Loa**'—oblong; 15-18 cm long, 10-12.5 cm wide; seedless; does not deteriorate quickly.

Conventional classification provides descriptions of 52 breadfruit cultivars of the Pacific Islands. Including the following:

'**Aata**' — an oblong fruit, is described as of poor quality and eaten by humans only when better breadfruits are scarce, but it is important as feed for pigs and horses. The tree bears heavily.

'**Aravei**'—fruit ellipsoidal; large, 10-30 cm long, 15-22 cm wide; rind yellowish-green with brown spots on the sunny side; rough, with sharp points which are shed on maturity. Pulp is light-yellow, dry or flaky and of delicious flavor after cooking which takes very little time. Core long, slim, with many abortive seeds.

'**Havana**'—fruit oval-round; the rind yellowish-green, spiny; pulp golden-yellow, moist, pasty, separates into loose flakes when cooked; very sweet with excellent flavor; core oval, large, with a row of abortive seeds. Very perishable; must be used within 2 days; cooks quickly over fire. Fruit borne in 2's and 3's. Popularly claimed to be one of the best breadfruits.

'**Maohi**'—fruit round; 6 in (15 cm) wide; rind bright yellow-green with patches of red-brown; rough, with spines, and often bears much exuded latex. Pulp cream-colored and smooth when cooked; of very good flavor; slow cooking, needs even heat. Core is large. Fruit is borne in 2's and 3's. Tree a heavy bearer. This is the most common breadfruit of Tahiti.

'**Paea**'—ellipsoidal; very large, to 11 in (28 cm) long and 9 in (22.8 cm) wide; rind yellowish-green, spiny; core oblong, thick, with a row of brown, abortive seeds; pulp bright-yellow, moist, slightly pasty, separating into flakes when cooked; agreeable but only one of its forms, 'Paea Maaroaro', is really sweet. Formerly, 'Paea' was reserved for chiefs only. Needs one hour to roast on open fire. The tree is tall, especially well formed and elegant.

'**Pei**'—broad-ellipsoidal; large; rind light-green, relatively smooth; pulp light-yellow and flaky when cooked, aromatic, of sweet, delicious "fruity" flavor; cooks quickly. Ripens earlier than others. When the breadfruit crop is scant, the fruits of this cultivar are stored by burying in the ground until needed, even for a year, then taken up, wrapped in *Cordyline* leaves and boiled.

'**Pucro**'—fruit spherical or elongated; large; rind yellow-green with small brown spots, very rough, spiny, thin; pulp light-yellow and smooth, of excellent flavor. Cooks quickly. Highly esteemed, ranked with the very best breadfruits. There are two oblong forms, one with a large, hairy core.

'**Rare**'—fruit broad-ovoid; to 7 in (17.5 cm) long, rind bright-green, rough, spiny; pulp of deep-cream tone, fine-grained, smooth, flaky when cooked; of very sweet, excellent flavor. Core is small with a great many small abortive seeds. Must be cooked for about one hour. There are 3 forms that are well recognized. Fruits are borne singly on a tall, open, short branched tree.

'**Rare Aumee**'—fruit round; 6 1/2 in (16.5 cm) across; rind bright-green with red-brown splotches, fairly smooth at the base but rough at the apex; pulp deep-ivory, firm, smooth when cooked; not very sweet but of excellent flavor. Cooks quickly. Highly prized; in scarce supply because the tall, few branched tree bears scantily.

'**Rare Autia**'—fruit round; 6 in (15 cm) across; rind dull-green with red-brown markings. Pulp light-yellow when cooked and separates into chunks; has excellent flavor. Core is large with small abortive seeds all around. This cultivar is so superior it was restricted to royalty and high chiefs in olden times.

'**Tatara**'—fruit broad-ellipsoid; very large, up to 10 lbs(4.5 kg) in weight; rind has prominent faces with long green spines; pulp light-yellow, smooth when cooked and of pleasant flavor. Core is oblong. This variety is greatly esteemed. The tree is found only in a small coastal valley where there is heavy rainfall. It is of large dimensions and high-branching and it is difficult to harvest the fruits.

'**Vai Paere**'—fruit is obovoid; 10 to 12 in (25-30 cm) long, 7 to 8 in (17.5-20 cm) wide; rind is yellow-green with red-brown splotches and there is a short raised point at the center of each face; pulp light-yellow, firm, smooth, a little dryish when cooked, with a slightly acid, but excellent flavor. Core is oblong, large, with a few abortive seeds attached. Fruit cooks easily. Tree is very tall, bears fruit in clusters. Grows at sea level in fairly dry locations.

There are at least 50 cultivars on Ponape and about the same number on Truk. In Samoa, a variety known as '**Maopo**', with leaves that are almost entire or sometimes very shallowly lobed, is very common and considered one of the best.

'**Puou**' is another choice and much planted variety since early times. It has deeply cut leaves and nearly round fruits 6 in (15 cm) long. 'Ulu Ea', with leaves even more deeply lobed, has oblong fruits to 6 1/8 in (15.5 cm) long and 5 in (12.5 cm) wide; is a longtime favorite.

In the past three decades there has been an awakening to the possibilities of increasing the food supply of tropical countries by more plantings of selected varieties of seedless breadfruit.

#### **D.5 Climate**

The breadfruit is ultra-tropical, much tenderer than the mango tree. It has been reported that it requires a temperature range of 15.56°-37.78°C, an annual rainfall of 203-254 cm, and a relative humidity of 70 to 80%. However, in southern India, it is cultivated at sea level and up humid slopes to an altitude of 1,065 m, also in thickets in dry regions where it can be irrigated. In the "equatorial dry climate" of the Marquesas, where the breadfruit is an essential crop, there is an average rainfall of only 100-150 cm and frequent droughts. In Central America, it is grown only below 600 m.

#### **D.6 Soil**

The breadfruit tree must have deep, fertile, well-drained soil. The seedless breadfruit does well on sandy coral soils, and seeded types grow naturally on "coraline limestone" islands in Micronesia. In New Guinea, the breadfruit tree occurs wild along waterways and on the margins of forests in the flood plain, and often in freshwater swamps. It is believed that there is great variation in the adaptability of different strains to climatic and soil conditions, and that each should be matched with its proper environment. The Tahitian 'Manitarvaka' is known to be drought-resistant. The variety 'Mai-Tarika', of the Gilbert Islands, is salt-tolerant. 'Mejwaan', a seeded variety of the Marshall Islands, is not harmed by brackish water nor salt spray and has been introduced into Western Samoa and Tahiti.

#### **D.7 Propagation**

The seeded breadfruit is always grown from seeds, which must be planted when fairly fresh as they lose viability in a few weeks. The seedless breadfruit is often propagated by transplanting suckers which spring up naturally from the roots. One can deliberately induce suckers by uncovering and injuring a root. Pruning the parent tree will increase the number of suckers, and root pruning each sucker several times over a period of months before taking it up will contribute to its survival when transplanted. For multiplication in quantity, it is better to make root cuttings about 2.5-6.35 cm thick and 22 cm long. The ends may be dipped into a solution of potassium permanganate to coagulate the latex, and the cuttings are planted close together horizontally in sand. They should be shaded and watered daily, unless it is possible to apply intermittent mist. Calluses may form in 6 weeks (though rooting time may vary from 2 to 5 months) and the cuttings are transplanted to pots, at a slant, and watered once or twice a day for several months or until the plants are 60 cm high. A refined method of rapid propagation uses stem cuttings taken from root shoots. In Puerto Rico, the cuttings are transplanted into plastic bags containing a mixture of soil, peat and sand, kept under mist for a week, then under 65% shade, and given liquid fertilizer and regular waterings. When the root system is well developed, they are allowed full sun until time to set out in the field.

In India, it is reported that breadfruit scions can be successfully grafted or budded onto seedlings of wild jackfruit trees.

#### **D.8 Culture**

Young breadfruit trees are planted in well-enriched holes 40 cm deep and 0.9 m wide that are first prepared by burning trash in them to sterilize the soil and then insecticide is mixed with the soil to protect the roots and shoots from grubs. The trees are spaced 7.5-12 m apart in plantations. Usually there are about 25 trees per acre (84/ha). Those grown from root suckers will bear in 5 years and will be productive for 50 years. Some growers recommend pruning of branches that have borne fruit and

would normally die back, because this practice stimulates new shoots and also tends to keep the tree from being too tall for convenient harvesting.

Standard mixtures of NPK are applied seasonally. When the trees reach bearing age, they each receive, in addition, 2 kg superphosphate per year to increase the size and quality of the fruits.

#### D.9 Season

In the South Seas, the tree fruits more or less continuously, fruit in all stages of development being present on the tree the year around. Seedless varieties introduced from Ponape bear 2 to 3 times a year. In the Bahamas, breadfruit is available mainly from June to November, but some fruits may mature at other times during the year.

#### D.10 Harvesting and yield

Breadfruits are picked when maturity is indicated by the appearance of small drops of latex on the surface. Harvesters climb the trees and break the fruit stalk with a forked stick so that the fruit will fall. Even though this may cause some bruising or splitting, it is considered better than catching the fruits by hand because the broken pedicel leaks much latex. They are packed in cartons in which they are separated individually by dividers.

In the South Pacific, the trees yield 50 to 150 fruits per year. In southern India, normal production is 150 to 200 fruits annually. Productivity varies between wet and dry areas. In the West Indies, a conservative estimate is 25 fruits per tree. Studies in Barbados indicate a reasonable potential of 6.7 to 13.4 tons per acre (16-32 tons/ha). Much higher yields have been forecasted, but experts are skeptical and view these as unrealistic.

#### D.11 Keeping quality

In Jamaica, surplus breadfruits are often kept under water until needed. Fully ripe fruits that have fallen from the tree can be wrapped in polyethylene, or put into polyethylene bags, and kept for 10 days in storage at a temperature of 53.6°F (12°C). At lower temperature, the fruit shows chilling injury. Slightly unripe fruits that have been caught by hand when knocked down can be maintained for 15 days under the same conditions. The thickness of the polyethylene is important: 38- or even 50-micrometer bags are beneficial, but not 25-micrometer.

Some Jamaican exporters partly roast the whole fruits to coagulate the latex, let them cool, and then ship them by sea to New York and Europe.

#### D.12 Pests and diseases

Soft-scales and mealybugs are found on breadfruit trees in the West Indies and ants infest branches that die back after fruiting. In southern India, the fruits on the tree are subject to soft rot. This fungus disease can be controlled by two sprays of Bordeaux mixture, one month apart. Young breadfruit trees in Trinidad have been killed by a disease caused by *Rosellinia* sp. In the Pacific Islands *Fusarium* sp. is believed to be the cause of die back, and *Pythium* sp. is suspected in cases of root rot. The fungus, *Phytophthora palmivora*, attacks the fruit on the island of Truk. *Phomopsis*, *Dothiorella* and *Phyllospora* cause stem-end rot.

#### D.13 Food uses

Breadfruit is a versatile food and can be cooked and eaten at all stages of maturity, although it is most commonly harvested and consumed when mature, but still firm, and used as a starchy staple. The relatively bland fruit can form the basis for an array of dishes, and it takes on the flavour of other ingredients in the dish. Very small fruits, 2-6 cm or larger in diameter, can be boiled and have a flavour similar to that of artichoke hearts. These can be pickled or marinated. Mature and almost mature breadfruit can be boiled and substituted for potatoes in many recipes. Ripe fruits are very sweet and used to make pies, cakes and other desserts.

The dried fruit has been made into flour and substituted in part for wheat flour in breadmaking. The combination has been found more nutritious than wheat flour alone. Breadfruit flour is much richer than wheat flour in lysine and other essential amino acids. In Jamaica, the flour is boiled, sweetened, and eaten as porridge for breakfast.

Soft or overripe breadfruit is best for making chips. Some breadfruit is canned in Dominica and Trinidad for shipment to London and New York.

The seeds are boiled, steamed, roasted over a fire or in hot coals and eaten with salt. In West Africa, they are sometimes made into a puree.

**Table D.1 — Food value per 100 g of edible portion\***

	<i>Fruit (underripe, raw)</i>	<i>Ripe (cooked)</i>	<i>Seeds (fresh)</i>	<i>Seeds (roasted)</i>	<i>Seeds (dried)</i>
Calories	105-109				
Moisture	62.7-89.16 g	67.8 g	35.08-56.80 g	43.80 g	
Protein	1.3-2.24 g	1.34 g	5.25-13.3 g	7.72 g	13.8-19.96 g
Fat	0.1-0.86 g	0.31 g	2.59-5.59 g	3.30 g	5.1-12.79 g
Carbohydrates	21.5-29.49 g	27.82 g	30.83-44.03 g	41.61 g	15.95 g
Fiber	1.08-2.1 g	1.5 g	1.34-2.14g	1.67 g	3.0-3.87 g
Ash	0.56-1.2 g	1.23 g	1.50-5.58 g	1.90 g	3.42-3.5 g
Calcium	0.05 mg	0.022 g	0.11 mg	40 mg	0.12 mg
Phosphorus	0.04 mg	0.062mg	0.35 mg	178 mg	0.37 mg
Iron	0.61-2.4 mg		3.78 mg	2.66 mg	
Carotene	0.004 mg (35-40 I.U.)				
Thiamine	0.08-0.085 mg		0.25 mg	0.32 mg	180 mcg
Riboflavin	0.033-0.07 mg		0.10 mg	0.10 mg	84 mcg
Niacin	0.506 - 0.92 mg		3.54 mg	2.94 mg	2.6 mg
Ascorbic Acid	15 - 33 mg		13.70 mg	14 mg	
Amino Acids	[N = 16 p. 100]				
Arginine	4.9		0.66		
Cystine	-		0.62		
Histidine	1.6		0.91		
Isoleucine	6.7		2.41		
Leucine	7.4		2.60		
Lysine	5.8				
Methionine	1.2		3.17		
Phenylalanine	8.3		1.05		
Threonine	6.8		0.78		
Tryptophan	7.0				
Valine	7.8				
Aspartic Acid	10.8				
Glutamic Acid	11.3		0.98		
Alanine	3.9		1.53		
Glycine	7.2		0.95		
Proline	6.5		0.72		
Serine	5.7		2.08		
Tyrosine			1.45		

\*A composite of analyses made in Central America, Mexico, Colombia, Africa and India.

NOTE There are reportedly two enzymes in the breadfruit—*papayotin* and *artocarpine*.

Niacin content can rise up to 8.33 mg in dried, ground seeds.

It will be seen from the above that the seedless breadfruit is low in protein, the seeds considerably higher, and therefore the seeded breadfruit is actually of more value as food.

Breadfruit flour contains 4.05% protein; 76.70% carbohydrates, and 331 calories, while cassava flour contains, 1.16% protein, 83.83% carbohydrates, and 347 calories per 100 g.

#### D.14 Toxicity

Most varieties of breadfruit are purgative if eaten raw. Some varieties are boiled twice and the water thrown away, to avoid unpleasant effects, while there are a few named cultivars that can be safely eaten without cooking.

The cyclopropane-containing sterol, *cycloartenol*, has been isolated from the fresh fruit. It constitutes 12% of the non-saponifiable extract.

#### D.15 Other uses

##### Leaves

Breadfruit leaves are eagerly eaten by domestic livestock. In India, they are fed to cattle and goats; in Guam, to cattle, horses and pigs. Horses are apt to eat the bark of young trees as well, so new plantings must be protected from them.

##### Latex

Breadfruit latex has been used in the past as birdlime on the tips of posts to catch birds. The early Hawaiians plucked the feathers for their ceremonial cloaks, then removed the gummy substance from the birds' feet with oil from the candlenut, *Aleurites moluccana* Willd., or with sugarcane juice, and released them.

After boiling with coconut oil, the latex serves for caulking boats and, mixed with colored earth, is used as a paint for boats.

##### Wood

The wood is yellowish or yellow-gray with dark markings or orange speckles; light in weight; not very hard but strong, elastic and termite resistant (except for drywood termites) and is used for construction and furniture.

##### Fiber

Fiber from the bark is difficult to extract but highly durable. Malaysians fashioned it into clothing. Material for tape cloth is obtained from the inner bark of young trees and branches. In the Philippines, it is made into harnesses for water buffalo.

##### Flowers

The male flower spike used to be blended with the fiber of the paper mulberry, *Broussonetia papyrifera* Vent. to make elegant loincloths. When thoroughly dry, the flower spikes also serve as tinder.

##### Medicinal uses

In Trinidad and the Bahamas, a decoction of the breadfruit leaf is believed to lower blood pressure, and is also said to relieve asthma. Crushed leaves are applied on the tongue as a treatment for thrush. The leaf juice is employed as ear-drops. Ashes of burned leaves are used on skin infections. A powder of roasted leaves is employed as a remedy for enlarged spleen. The crushed fruit is poulticed on tumors to "ripen" them. Toasted flowers are rubbed on the gums around an aching tooth. The latex is used on skin diseases and is bandaged on the spine to relieve sciatica. Diluted latex is taken internally to overcome diarrhea.

#### **Artocarpus altilis**



<b>Authority</b>	(Parkinson) Fosberg
<b>Family</b>	Magnoliopsida: Dilleniidae: Urticales: Moraceae
<b>Synonyms</b>	Artocarpus incisus (Thunb.) Linnaeus, Artocarpus communis J.R. & G. Forster (1776), Artocarpus camansi Blanco (1837)
<b>Common names</b>	breadfruit, arbre à pain, fruit a pain, chataignier, fruta de pan, arbor de pan, arbor del pan, pan de pobre, pan de ano, pan de todo el ano, pan de palo, pan de name, topan, tupan, mazapan, castana, marure, castano de Malabar, panapen, pana de pepitas, sukun, kelur, timbul, fruta pao, pao de massa, broodvrucht, broodboom, suku, kulur, kelor, kulor, sa-ke, ulu, kula, uto, uto-sore, kapiak, rimas, kamansi, sakéé, khnaor sámloo, Khanun-sampalor, saké
<b>Editor</b>	
<b>Ecocrop code</b>	3423

#### Notes

**BRIEF DESCRIPTION** A medium-sized tree reaching 20-30 m in height, with a straight trunk 5-8 m tall and 60-180 cm in diameter, often buttressed. The tree has large alternate lobed leaves, milky latex, and grapefruit-sized or larger composite fruits, each weighing 400-1200 g. It is evergreen in the ever-wet tropics, deciduous in monsoon countries. The seedless varieties (breadfruits) usually have fruits with a pebbled surface, while the fruits of the seedy varieties (breadnuts) often are covered with short stubby spines. **USES** The edible fruits are used as a vegetable and the seeds are eaten boiled or roasted. The fruit is a source of vitamins A and B, starch, and calcium, it is eaten cooked, boiled, baked, roasted, or fried. Fermented fruit is made into a cheese-like paste, which is formed to cakes and baked. For longterm storage it can be cooked and dried. The bark provides a fiber and the latex are used for caulking boats, as a glue to catch birds, as a chewing gum and it also has medicinal properties. Leaves and fallen fruit are fed to livestock. The wood is used for canoes, surfboards, toys and light constructions. Trees provide shade and shelter and are grown as ornamentals. Mentioned as a useful agroforestry species. **GROWING PERIOD** Short-lived perennial. Bear fruit when 3-6 years old. The fruit should be picked while still firm, about 60-90 days after fruit set. The main cropping season lasts about 120 days. **COMMON NAMES** Breadfruit, Breadnut, Arbol del pan, Masa pan, Arbre a pain, Arvore do pao, Fruta pao, Albero del pane, Brotbaum, Saake, Sakee, Sa-ke, Sukun, Rimas, Uto, Fruta de pan, Kelur, Kelor, Timbul, Kapiak, Kamansi, Khnaor samloo, Khanun-sampalor. **FURTHER INF** Scientific synonym: *A. communis*, *A. indica*, *A. incisa*, *A. camansi*. Breadfruit is indigenous to the Polynesian region. It require warm, humid, tropical conditions and thrives at elevations below 600 m, but can be found up to about 2000 m and does not thrive far from the sea. It grows best in a relative humidity from 70-90% and occurs within the latitudinal range 23°N-17°S. Young trees grow better under shade but later full sun is required. The trees shed their leaves under dry conditions and are said to shed the fruit when the soil is excessively wet. Cultivars differ greatly in their tolerance of adverse conditions and there are cultivars that cope well with shallow, calcareous soils, brackish water and salt sprays. Optimal yields of 0.7-3.5 t or up to 700 fruits per tree can be expected from a mature tree. In the South Pacific, average yields may be 50-150 fruits per tree, in India 200 fruits and in Barbados the yields may be 16-30 t/ha.

### Artocarpus altilis

**Plant ID:** 3423

<b>Introduction</b>		<b>2001-08-06</b>
	<b>Authority</b>	(Parkinson) Fosberg
	<b>ID Standing</b>	
	<b>Family</b>	Magnoliophyta : Magnoliopsida : Urticales : Moraceae ( <a href="#">see lineages</a> )
	<b>Topic Editors</b> <b>Data Stewards</b> <b>Referees</b>	
	<b>Synonyms</b>	Artocarpus camansi Blanco (1837), Artocarpus communis J.R. & G. Forster (1776), Artocarpus incisus (Thunb.) Linnaeus( <a href="#">full list</a> )
	<b>Common names</b>	arbor de pan, arbor del pan, arbre à pain, breadfruit, broodboom, broodvrucht, castana, castano de Malabar, chataignier, fruit a pain ( <a href="#">full list</a> )

<b>Introduction</b>		<b>2001-08-06</b>
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**Codes****Categories** [Crop plant](#)**Roles** [Host,Pest](#)

It is a handsome, evergreen or semi-deciduous and fast growing tree, up to 25-30 m tall. The fruit and seed are edible, the leaves have medicinal properties, the wood is used for light constructions and the tree is planted for shade.

<b>Description</b>		<b>2001-08-06</b>
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It is a [monoecious](#), handsome and fast growing tree, up to 25-30 m tall, [evergreen](#) in the humid tropics, semi-[deciduous](#) in monsoon climates. All parts of the tree, including the unripe fruit, are rich in white gummy latex.

<b>Morphology</b>	<b>Roots:</b>
	<p><b>Stems:</b> Trunk straight, 5-8 m tall, 0.6-1.8 m in diameter, though some varieties may never exceed 1/4 or 1/2 of these dimensions, often buttressed. There are many spreading branches, some thick with lateral foliage-bearing branchlets, others long and slender with foliage clustered only at their tips. The trunks of clonally propagated trees branched low; twigs spreading, very thick, with pronounced leaf and stipule scars and lenticels; buds 10-20 cm long, covered with big conical keeled <a href="#">stipules</a>.</p> <p><b>Leaves:</b> Leaves <a href="#">alternate</a>, ovate to elliptical in outline, 20-60(-90) cm x 20-40(-50) cm, undivided when young, older ones entire or deeply <a href="#">pinnately</a> cut into 5-11-pointed lobes, thick, leathery, dark green and shiny above, pale green and rough below coated with minute, stiff hairs, <a href="#">petiole</a> thick, yellow, 3-5 cm long.</p> <p><b>Flowers:</b> <a href="#">Inflorescences</a> axillary, <a href="#">peduncles</a> 4-8 cm long; male ones drooping, club-shaped, 15-25 cm x 3-4 cm, spongy, yellow, flowers minute with single <a href="#">stamen</a>; female ones stiffly upright, globose or cylindrical, 8-10 cm x 5-7 cm, green, flowers numerous, embedded in <a href="#">receptacle</a>, <a href="#">calyx</a> tubular, <a href="#">ovary</a> 2-celled, <a href="#">style</a> narrow, <a href="#">stigma</a> 2-lobed.</p> <p><b>Fruits:</b> Fruit a <a href="#">syncarp</a> formed from the entire inflorescence, cylindrical to globose or pearshaped 10-45 in length and 5-30 cm in diameter, reticulately marked with irregular 4-6-sided faces, in some "smooth" fruits level with the surface, in others conical; in some, there may rise from the center of each face a sharp, black point, or a green, pliable spine to 3 mm long or longer. Some fruits may have a harsh, sandpaper-like rind. Generally the rind is green at first, turning yellowish-green, yellow or yellow-brown when ripe, though one variety is lavender, sometimes bearing short spines. A large central core is surrounded by numerous abortive flowers which form a pale yellow juicy pulp, the edible portion of the fruit.</p> <p>In the green stage, the fruit is hard and the interior is white, starchy and</p>

somewhat fibrous. When fully ripe, the fruit is somewhat soft, the interior is cream coloured or yellow and pasty, also sweetly fragrant. In the center of seedless fruits there is a cylindrical or oblong core, in some types covered with hairs bearing flat, brown, abortive seeds about 3 mm long. The fruit is borne singly or in clusters of 2 or 3 at the branch tips. The fruit stalk ([pedicel](#)) varies from 2.5-12.5 cm long.

**Seeds:** Most cultivated breadfruits are seedless, seeded ones are known as breadnuts. Breadnuts bear fleshy prickles, the edible pulp is largely replaced by the seeds, which are irregularly oval, rounded at one end, pointed at the other, about 2-2.5 cm long, dull-brown with darker stripes. In the seeded form there is little pulp and each fruit contains 20-60 edible seeds.

### Anatomy

Seeds germinate about 2 weeks after sowing. The seedlings tend to grow slowly, but they respond well to better growing conditions and may start flowering in 4-10 years. Asexually propagated seedless forms start flowering after 3-4 years. Under stress the trees shed most of their leaves, tufts of young leaves persisting at the tip of the twigs. The flowering pattern appears to depend on the cultivar rather than the climate, at least in the humid tropics. Most cultivars flower throughout the year, but some flower and fruit seasonally. Further from the equator, however, the seasons determine shoot growth and all cultivars flower and fruit more or less simultaneously.

### Physiology

The male and female inflorescences are produced in separate leaf axils of the current season's growth. The proportion of male inflorescences on a tree may vary from 60-80%. If tapped at anthesis they release clouds of pollen, indicating that pollination is largely by wind. The male inflorescences reach [anthesis](#) 10-15 days after emergence and well before the female inflorescences on the same tree, thus limiting self-pollination. The flowers in a female inflorescence are pollinated and fertilized (in seeded cultivars) within a period of 3-6 days. About 75 % of the inflorescences set fruit, but this is considerably reduced during the rainy seasons, strengthening the impression that the seedless fruits also depend on pollination to stimulate, parthenocarpic growth. The fruit matures 60-90(-110) days after the inflorescence emerges.

In the South Seas, the tree fruits more or less continuously, fruit in all stages of development being present on the tree the year around, but there are two or three main fruiting periods. In the Caroline Islands and the Gilbert Islands, the main ripening season is May to July or September; in the Society Islands and New Hebrides, from November to April, the secondary crop being in July and August. Breadfruits are most abundant in Hawaiian markets off and on from July to February. Flowering starts in March in northern India and fruits are ready for harvest in about 3 months. Seeded breadfruits growing in the Eastern Caroline Islands fruit only once a year but the season is 3 months long—from December to March. Seedless varieties introduced from Ponape bear 2 to 3 times a

year. In the Bahamas, breadfruit is available mainly from June to November, but some fruits may mature at other times during the year.

**Ecology**

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It is a species of the wet tropics, preferring a hot and humid (relative humidity 70-90%) climate.

**Habitat**

In [Papua New Guinea](#), the tree occurs wild along waterways and on the margins of forests in the flood plain, and often in freshwater swamps. It is believed that there is great variation in the adaptability of different strains to climatic and soil conditions, and that each should be matched with its proper environment

**Environment**

**Latitude:** The latitudinal limits are approximately 17°N and S; the maritime climate of small islands allows growth to 20-23°N.

**Altitude:** The tree is occasionally found in the highlands (even up to 1500 m) and at higher latitudes, but yield and fruit quality suffer in cooler conditions and the tree is more at home in the equatorial lowlands (below 600 m).

**Temperature:** The temperature range for growth is reported to be 16-40°C with the optimum between 21-33°C.

**Water:** The annual rainfall range for growth is reported to be 1000-3500 mm with the optimum between 1500-3000 mm. Rain apparently stimulates extension growth, flowering and the rate of growth of the fruit. The Tahitian 'Manitaryaka' is known to be drought-resistant.

**Radiation:**

Range & intensity: Young trees grow better under shade but later full sun is required.

Photoperiodism: It has a short-day response.

**Soil:**

Physical: Tree growth is best in deep, well-drained, moist alluvial soils rich in humus. The trees also grow on shallow coralline soils of the atolls, and in [Papua New Guinea](#) they are found at the forest edge in floodplains and swamps. Whereas the trees shed their leaves under dry conditions, it is said that they shed their fruit when the soil is excessively wet; so yield may be depressed on marginal soils. Apparently cultivars differ greatly in their tolerance of adverse conditions; there are cultivars that cope well with shallow calcareous soils, brackish water and salt sprays, etc.

Chemical: The soil pH range for growth is reported to be 4.3-8.7 with the optimum between 5.5-6.5. It thrives on fertile soils low in salinity. The

	variety 'Mai-Tarika', of the Gilbert Islands, is salt-tolerant. 'Mejwaan', a seeded variety of the Marshall Islands, is not harmed by brackish water nor salt spray and has been introduced into <a href="#">Western Samoa</a> and Tahiti.
<b>Distribution</b>	<p>The exact origin of the tree is uncertain. The centre of genetic diversity extends from <a href="#">Indonesia</a> to <a href="#">Papua New Guinea</a>. In a broad sense, it is a native of the Pacific and tropical Asia. It has long been an important staple food in Polynesia. It is now widely distributed throughout the humid tropics. (<a href="#">PROSEA, 1991</a>)</p> <p>On the Pacific coast of Central America, the seeded type is common and standard fare for domestic swine. On the Atlantic Coast, seedless varieties are much consumed by people of African origin. The tree is much grown for shade in Yucatan. It is very common in the lowlands of <a href="#">Colombia</a>, a popular food in the Cauca Valley, the Choco, and the San Andres Islands; mostly fed to live stock in other areas. In <a href="#">Guyana</a>, in 1978, about 1000 new trees were being produced each year but not nearly enough to fill requests for plants. There and in Trinidad, because of many Asians in the population, both seeded and seedless breadfruits are much appreciated as a regular article of the diet; in some other areas of the Caribbean, breadfruit is regarded merely as a food for the poor for use only in emergencies. It is attracting the attention of gourmets and some islands are making small shipments to the <a href="#">United States</a>, <a href="#">Canada</a> and Europe for specialized ethnic markets. (<a href="#">Morton J. 1987</a>)</p>
<b>Pollination</b>	Pollination is largely by wind. Male and female flowers are separate but on the same tree.
<b>Services</b>	
<b>Status</b>	
<b>Ethnobotany</b>	
<b>Notes</b>	<b>2001-12-19</b>
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<b>Bibliography</b>	<b>2001-08-06</b>
<p><a href="#">Verheij E.W.M. Coronel R.E.</a> (1991) PROSEA - Plant Resources of South-East Asia; 2 - Edible fruits and nuts.</p> <p><a href="#">Morton J.</a> (1987) Fruits of warm climates; Breadfruit.</p>	

## Annex E (informative)

### Breadfruit — Codex, EU and USA pesticide residue limits

Users are advised that international regulations and permissible Maximum Residue Levels (MRL) frequently change. Although this International MRL Database is updated frequently, the information in it may not be completely up-to-date or error free. Additionally, commodity nomenclature and residue definitions vary between countries, and country policies regarding deferral to international standards are not always transparent. This database is intended to be an initial reference source only, and users must verify any information obtained from it with knowledgeable parties in the market of interest prior to the sale or shipment of any products. The developers of this database are not liable for any damages, in whole or in part, caused by or arising in any way from user's use of the database.

#### Results Key

MRL values in *{Italics}* are more restrictive than US

--- indicates no MRL value is established.

Cod, EU, etc. indicates the source of the MRL and EXP means the market defers to the exporting market.

All numeric values listed are in parts per million (ppm), unless otherwise noted

	US	Cod	EU
<b>Azoxystrobin</b>	2	---	<i>{0.05}</i>
	US	Cod	EU 1
<b>Glyphosate</b>	0.2	---	<i>{0.1}</i>
	1. European Union does not maintain a specific MRL for the Glyphosate/Jackfruit combination, but does maintain an MRL of 0.1 PPM for its "Inedible peel, large" group.		

*Draft for comments only — Not to be cited as East African Standard*