

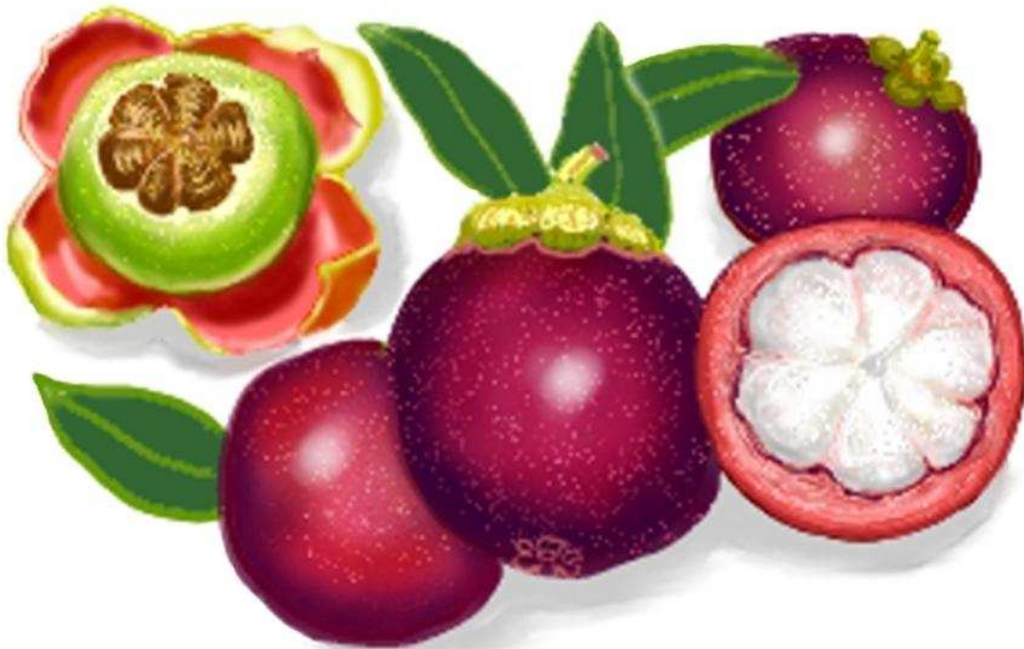


CD/K/029:2010  
ICS 67.080.10

## EAST AFRICAN STANDARD

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Fresh mangosteens — Specification and grading



EAST AFRICAN COMMUNITY

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HS 0804.50.00

## 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:

CODEX STAN 204:1997 (Rev. 2005), *Standard for Mangosteens*

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 mangosteens — Specification and grading

### 1 Scope

This Standard applies to commercial varieties of mangosteens grown from *Garcinia mangostana* L., of the *Guttiferae* family, to be supplied fresh to the consumer, after preparation and packaging. Mangosteens for industrial processing are excluded.

### 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 Description of mangosteen

The mangosteen is a small to medium height evergreen tree, 6 to 25 m tall with a straight trunk and evenly spaced branches, which form a conical crown.

The dark green shiny leaves are oblong to elliptical, 19 to 23 cm long and 7 to 10 cm wide.

Only female flowers are produced on the ends of branchlets. They have four petals, which are yellow/green with red margins.

The fruit is rounded and dark purple in colour when ripe. It is 4 to 7 cm in diameter and weighs 55 to 75 g.

The rind or pericarp, almost 1 cm thick, encloses the edible part or aril, which consists of 5 to 7 snowy white segments.

The segments contain 2 to 3 well-developed seeds. The small dark purple seed is enveloped by weak fibres, which extend to the aril.

The pulp, which is very light and soft with an exquisite flavour, is best eaten fresh, preferably after chilling the fruit in a refrigerator.

### 4 Provisions concerning quality

#### 4.1 General

The purpose of the standard is to define the quality requirements of mangosteens at the export control stage, after preparation and packaging.

## **4.2 Minimum requirements**

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

- (a) whole;
- (b) with the calyx and pedicel intact;
- (c) sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- (d) clean, practically free of any visible foreign matter;
- (e) practically free of pests affecting the general appearance of the produce;
- (f) practically free of damage caused by pests;
- (g) free of abnormal external moisture, excluding condensation following removal from cold storage;
- (h) free of any foreign smell and/or taste;
- (i) fresh in appearance, have a shape, colour and taste characteristic of the species;
- (j) free of latex;
- (k) free of pronounced blemishes;
- (l) allowing the fruit to be cut open normally.

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

- (a) to ensure a continuation of the ripening process until they reach the appropriate degree of ripeness (the skin should be at least of a pink colour);
- (b) to withstand transport and handling; and
- (c) to arrive in satisfactory condition at the place of destination.

## **4.3 Classification**

Mangosteens are classified in three classes defined below:

### **4.3.1 "Extra" Class**

Mangosteens in this class must be of superior quality. They must be characteristic of the variety and/or commercial type. They must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

### **4.3.2 Class I**

Mangosteens in this class must be of good quality. They must be characteristic of the variety and/or commercial type. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- slight defects in shape;

- slight defects on the peel and calyx such as bruising, scratches or other mechanical damage. The total area affected shall not exceed 10%.

The defects must not, in any case, affect the pulp of the fruit.

## 5 Provisions concerning sizing

Size is determined by the weight or the diameter of the equatorial section of the fruit, in accordance with the following table:

Size Code	Weight (in grams)	Diameter (in millimetres)
A	30 — 50	38 — 45
B	51 — 75	46 — 52
C	76 — 100	53 — 58
D	101 — 125	59 — 62
E	> 125	> 62

## 6 Provisions concerning tolerances

Tolerances in respect of quality and size shall be allowed in each package (or in each lot for produce presented in bulk) for produce not satisfying the requirements of the class indicated.

### 6.1 Quality tolerances

#### 6.1.1 “Extra” Class

Five percent by number or weight of mangosteens not satisfying the requirements of the class, but meeting those of Class I or, exceptionally, coming within the tolerances of that class.

#### 6.1.2 Class I

Ten percent by number or weight of mangosteens satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting or any other deterioration rendering it unfit for consumption.

### 6.2 Size tolerances

For all classes, 10% by number or weight of mangosteens not satisfying the requirements as regards sizing, but falling within the size immediately above or below those indicated in Clause 5.

## 7 Provisions concerning presentation

### 7.1 Uniformity

The contents of each package (or lot for produce presented in bulk) must be uniform and contain only mangosteens of the same origin, quality and size. The visible part of the contents of the package (or lot for produce presented in bulk) must be representative of the entire contents.

### 7.2 Packaging

Mangosteens must be packed in such a way as to protect the produce properly. 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.

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

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

## 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 mangosteens. Packages (or lot for produce presented in bulk) 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 shall be labelled as to the name of the produce and may be labelled as to name of the variety.

### 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. For produce transported in bulk, these particulars must appear on a document accompanying the goods.

#### 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 or commercial type (optional).

#### 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;
- Size (size code or minimum and maximum weight or length in grams or millimetres, respectively);
- Net weight (optional).

#### 8.2.5 Official inspection mark (optional)

## 9 Contaminants

### 9.1 Heavy metals

Mangosteens 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

<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.

## 9.2 Pesticide residues

Mangosteens 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.

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



Fresh market mangosteens



Unripe mangosteens



Ripe mangosteen



Mangosteen fruit



Imbe (African mangosteen)



Mangosteens packed in 1kg

Draft for comments on



Fresh mangosteens

Draft for comments only — Not for publication

## Annex B (informative)

### Informative details of Mangosteen

#### B.1 Climatic requirements for mangosteen

Mangosteen is a crop of humid tropical environments. It thrives in high temperature and high humidity conditions.

- Mangosteen requires an uninterrupted water supply and a short dry season of 15 to 30 days, the latter to stimulate flowering.
- An annual rainfall of at least 1270 mm is necessary for good growth.
- Mangosteen thrives in a temperature range of 25 to 35 °C. Below 20°C growth is very slow.
- Temperatures below 5°C and above 38.40°C may kill the tree.
- Relative humidity should be about 80%.

**Table B.1 — Climatic requirements for cultivation of mangosteen**

Climatic factor	Minimum	Maximum
Altitude (m)	From sea level	1500
Rainfall (mm)	1000 (with irrigation)	2500 (evenly distributed)
Temperature (°C)	20	38 (above this may kill the tree)

#### B.2 Site requirements

Mangosteen can grow on a wide range of soils so long as they are not alkaline. Mangosteen is a shade-loving tree, and both leaves and fruit are susceptible to sunburn. Shade is critical during early vegetative growth.

**Table B.2 — Suitable habitats for mangosteen**

Characteristic	Suitable habitat
Soil type	Deep clay loam Rich in organic matter Does not tolerate limestone soils, sandy alluvial, or sandy soils
Drainage	Porous, well drained Avoid waterlogged soils
Soil pH	Slightly acid pH 5.5 to 6.5
Aspect	Withstands moderate winds

#### B.3 Land-use systems

Individual trees may be grown in the backyard by smallholder farmers. Mangosteen may be grown in small orchards.

#### B.4 Nutritional value

The aril is a nutritious food containing high amounts of energy and vitamins (see Table B.3). It can be processed into food preparations such as canned segments, candies, jam, pulp preserve, toppings

and flavouring for ice cream, sherbet, and wine. The pulp and seed when boiled with sugar have a delicious nutty flavour.

**Table B.3 — Nutritional properties of mangosteen (per 100 g of edible portion)**

Constituents	Quantity
Edible portion %	26
Food energy cal	76.00
Protein g	0.7
Fat g	0.8
Carbohydrate g	18.6
Fibre g	1.3
Ash g	0.2
Calcium, mg	18.0
Phosphorus, mg	11.0
Iron, mg	0.3
Thiamine, mg	0.06
Riboflavin, mg	0.01
Niacin, mg	0.4
Ascorbic acid, mg	2.0

#### B.5 Medicinal value

Most parts of the mangosteen tree can be used for medicinal purposes.

- The leaves and bark can be used as an astringent for the cure of aphtha or thrush, a fungal disease affecting the tongue and throat.
- A leaf infusion can be applied to wounds.
- The rind is effective in curing chronic intestinal catarrh.
- Rind consists of 7.15% tannin, and is used to tan leather and dye fabric black.
- Dried fruit rind is used pharmaceutically as an astringent.
- Seed contains 30% valuable oil used in skin preparations, soap and shampoo.
- Fruits contain flavones and xanthenes, which are compounds used in medicines and as antibacterial agents.

#### B.6 Timber

The heartwood of the trunk is dark brown and strong, used for furniture making and in carpentry.

## B.7 Major pests and diseases of mangosteen and their control


Pests	Damage	Control
Leaf eater <i>Stictopter</i> sp (Noctuidae)	Larval stage eats young leaves and shoots. Often occurs in nursery. High populations may consume all the leaves.	Spray with systemic insecticide such as dimethoate  Spray at two-week intervals
Leaf miner <i>Phyllocnistis citrella</i> (Lynotiidae)	Larvae often found on young shoots. Larval stage makes tunnels in the epidermis	Insecticides containing <i>Bacillus thuringiensis</i> are effective in controlling leaf eating caterpillars. Also Azadirachtin extract from neem plants is found effective. Only spray with fenthion if infestation is very high.
Fruit borer <i>Curculio</i> sp (Curculionidae)	Larvae burrow into fruit from mature to ripe stage. Borer eats into mesocarp, aril and seed. Larvae move out of the fruit and pupate in the soil, later becoming adult beetles.	No control recommendation available. Destroy all affected fruit to reduce beetle population in the field.
<b>Diseases</b>		
Stem canker <i>Zignolla garcineae</i>	The disease infects branches and stems. Leaves become wilted and drop causing the plant to die. Stems become cankerous	Plants infected by this fungus must be completely eradicated. Infected parts should be burned to stop the spread of disease.
Sooty mould <i>Corticium salmonicolor</i>	Infects branches, causing leaves to wilt. Affected areas turn pink.	Improve aeration and sunlight penetration by pruning overlapping branches will reduce infection. Scrape and paint affected parts with Tridemorth (Calicin).

## B.8 Maturity indices of mangosteen

Maturity index	Peel colour	Description
1	Yellowish green	Immature fruit Very heavy latex on skin
2	Greenish yellow	Maturing fruit Heavy latex on skin Not ready for harvest
3	Reddish yellow	Almost mature fruit Moderate latex on skin Not recommended for harvest
4	Yellowish red	Mature fruit Slight latex on skin Suitable for export as fresh fruit
5	Reddish brown	Almost ripe fruit Very little or no latex stain Suitable for export as fresh fruit and deep freezing
6	Brownish purple	Ripe fruit, no latex on skin Suitable for deep freezing and local market
7	Dark purple	Over-ripe fruit Not suitable for export

**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 <sup>(1)</sup>	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	
12. The consignment referred to above conforms, at the time of issue, with the Community standards in force, vide: <u>CD/K/029:2010, Fresh mangosteens — Specification and grading</u> <hr/> Customs office foreseen ..... Place and date of issue ..... Valid until (date): ..... Signatory (name in block letters): .....  <div style="display: flex; justify-content: space-around;"> <span>Signature</span> <span>Seal of competent authority</span> </div>				
13. Observations:				

(<sup>1</sup>) Where the goods are being re-exported, indicate the origin in box 9.

## Annex D (informative)

### Mangosteen (*Garcinia mangostana* L.) — Factsheet

#### D.1 Introduction

One of the most praised of tropical fruits, and certainly the most esteemed fruit in the family Guttiferae, the mangosteen, *Garcinia mangostana* L., is almost universally known or heard of by this name. There are numerous variations in nomenclature: among Spanish-speaking people, it is called *mangostan*; to the French, it is *mangostanier*, *mangoustanier*, *mangouste* or *mangostier*; in Portuguese, it is *mangostao*, *mangosta* or *mangusta*; in Dutch, it is *manggis* or *manggistan*; in Vietnamese, *mang cut*; in Malaya, it may be referred to in any of these languages or by the local terms, *mesetor*, *semetah*, or *sementah*; in the Philippines, it is *mangis* or *mangostan*. Throughout the Malay Archipelago, there are many different spellings of names similar to most of the above.

#### D.2 Description

The mangosteen tree is very slow-growing, erect, with a pyramidal crown; attains 6-25 m in height, has dark-brown or nearly black, flaking bark, the inner bark containing much yellow, gummy, bitter latex. The evergreen, opposite, short-stalked leaves are ovate-oblong or elliptic, leathery and thick, dark-green, slightly glossy above, yellowish-green and dull beneath; 9-25 cm long, 4.5-10 cm wide, with conspicuous, pale midrib. New leaves are rosy. Flowers, 4-5 cm wide and fleshy, may be male or hermaphrodite on the same tree. The former are in clusters of 3-9 at the branch tips; there are 4 sepals and 4 ovate, thick, fleshy petals, green with red spots on the outside, yellowish-red inside, and many stamens though the aborted anthers bear no pollen. The hermaphrodite are borne singly or in pairs at the tips of young branchlets; their petals may be yellowish-green edged with red or mostly red, and are quickly shed.

The fruit, capped by the prominent calyx at the stem end and with 4 to 8 triangular, flat remnants of the stigma in a rosette at the apex, is round, dark purple to red-purple and smooth externally; 3.4-7.5 cm in diameter. The rind is 6-10 mm thick, red in cross-section, purplish-white on the inside. It contains bitter yellow latex and a purple, staining juice. There are 4 to 8 triangular segments of snow-white, juicy, soft flesh (actually the arils of the seeds). The fruit may be seedless or have 1 to 5 fully developed seeds, ovoid-oblong, somewhat flattened, 2.5 cm long and 1.6 cm wide, that cling to the flesh. The flesh is slightly acid and mild to distinctly acid in flavour and is acclaimed as exquisitely luscious and delicious.

#### D.3 Origin and distribution

The place of origin of the mangosteen is unknown but is believed to be the Sunda Islands and the Moluccas; still, there are wild trees in the forests of Kemaman, Malaysia. The tree may have been first domesticated in Thailand, or Burma. It is much cultivated in Thailand, Cambodia, Vietnam and Burma, throughout Malaysia and Singapore. The tree is fairly common only in the provinces of Mindanao and Sulu (or Jolo) in the Philippines. It is poorly represented in tropical Africa (Zanzibar, Ghana, Gabon and Liberia).

#### D.4 Varieties

The fruit from seedling trees is fairly uniform; only one distinct variation is known and that is in the Sulu Islands. The fruit is larger, the rind thicker than normal, and the flesh more acid; the flavour more pronounced. In North Borneo, a seemingly wild form has only 4 carpels, each containing a fully-developed seed, and this is probably not unique.

#### D.5 Climate

See Annex B.

**D.6 Soil**

See Annex B. The mangosteen must be sheltered from strong winds and salt spray, as well as saline soil or water.

**D.7 Propagation**

Technically, the so-called "seeds" are not true seeds but adventitious embryos, or hypocotyl tubercles, inasmuch as there has been no sexual fertilization. When growth begins, a shoot emerges from one end of the seed and a root from the other end. But this root is short-lived and is replaced by roots which develop at the base of the shoot. The process of reproduction being vegetative, there is naturally little variation in the resulting trees and their fruits. Some of the seeds are polyembryonic, producing more than one shoot. The individual nucellar embryos can be separated, if desired, before planting.

Inasmuch as the percentage of germination is directly related to the weight of the seed, only plump, fully developed seeds should be chosen for planting. Even these will lose viability in 5 days after removal from the fruit, though they are viable for 3 to 5 weeks in the fruit. Seeds packed in lightly dampened peat moss, sphagnum moss or coconut fiber in airtight containers have remained viable for 3 months. Only 22% germination has been realized in seeds packed in ground charcoal for 15 days. Soaking in water for 24 hours expedites and enhances the rate of germination. Generally, sprouting occurs in 20 to 22 days and is complete in 43 days.

Because of the long, delicate taproot and poor lateral root development, transplanting is notoriously difficult. It must not be attempted after the plants reach 60 cm. At that time the depth of the taproot may exceed that height. There is greater seedling survival if seeds are planted directly in the nursery row than if first grown in containers and then transplanted to the nursery. The nursery soil should be 1 m deep, at least. The young plants take 2 years or more to reach a height of 30 cm, when they can be taken up with a deep ball of earth and set out. Fruiting may take place in 7 to 9 years from planting but usually not for 10 or even 20 years. Conventional vegetative propagation of the mangosteen is difficult.

**D.8 Culture**

A spacing of 10.7-12 m is recommended. Planting is preferably done at the beginning of the rainy season. Pits 1.2 x 1.2 x 1.3 m are prepared at least 30 days in advance, enriched with organic matter and topsoil and left to weather. The young tree is put in place very carefully so as not to injure the root and given a heavy watering. Partial shading with palm fronds or by other means should be maintained for 3 to 5 years.

Some of the most fruitful mangosteen trees are growing on the banks of streams, lakes, ponds or canals where the roots are almost constantly wet. However, dry weather just before blooming time and during flowering induces a good fruit-set. Where a moist planting site is not available, irrigation ditches should be dug to make it possible to maintain an adequate water supply and the trees are irrigated almost daily during the dry season.

**D.9 Season and harvesting**

Cropping is irregular and the yield varies from tree to tree and from season to season. The first crop may be 200 to 300 fruits. Average yield of a full-grown tree is about 500 fruits. The yield steadily increases up to the 30th year of bearing when crops of 1,000 to 2,000 fruits may be obtained. Productivity gradually declines thereafter, though the tree will still be fruiting at 100 years of age. See Annex B for maturity gauging. The fruits must be harvested by hand from ladders or by means of a cutting pole and not be allowed to fall.

**D.10 Keeping quality**

In dry, warm, closed storage, mangosteens can be held 20 to 25 days. Longer periods cause the outer skin to toughen and the rind to become rubbery; later, the rind hardens and becomes difficult to open and the flesh turns dry.

Ripe mangosteens keep well for 3 to 4 weeks in storage at 4.44°-12.78° C. Trials in India have shown that optimum conditions for cold storage are temperatures of 3.89 °C – 5.56 °C and relative humidity of 85 to 90%, which maintain quality for 49 days. It is recommended that the fruits be wrapped in tissue paper and packed 25-to-the-box in light wooden crates with excelsior padding.

### D.11 Pests and diseases

Few pests have been reported. See Annex B.

### D.12 Food uses

To select the best table fruits, choose those with the highest number of stigma lobes at the apex, for these have the highest number of fleshy segments and accordingly the fewest seeds. The numbers always correspond. Mangosteens are usually eaten fresh as dessert. One need only hold the fruit with the stem-end downward, take a sharp knife and cut around the middle completely through the rind, and lift off the top half, which leaves the fleshy segments exposed in the colorful "cup"—the bottom half of the rind. The segments are lifted out by fork.

The fleshy segments are sometimes canned, but they are said to lose their delicate flavor in canning, especially if pasteurized for as much as 10 minutes. Tests have shown that it is best to use a 40% sirup and sterilize for only 5 minutes. The more acid fruits are best for preserving. To make jam, seedless segments are boiled with an equal amount of sugar and a few cloves for 15 to 20 minutes and then put into glass jars.

The seeds are sometimes eaten alone after boiling or roasting.

The rind is rich in pectin. After treatment with 6% sodium chloride to eliminate astringency, the rind is made into a purplish jelly.

Phytin (an organic phosphorus compound) constitutes up to 0.68% on a dry-weight basis. The flesh amounts to 31% of the whole fruit.

### D.13 Other uses

Mangosteen twigs are used as chewsticks in Ghana. The fruit rind contains 7 to 14% catechin tannin and rosin, and is used for tanning leather in China. It also yields a black dye.

**Wood:** The wood is dark-brown, heavy, almost sinks in water, and is moderately durable. It has been used to make handles for spears, also rice pounders, and is employed in construction and cabinetwork.

**Medicinal uses:** The sliced and dried rind is powdered and administered to overcome dysentery. Made into an ointment, it is applied on eczema and other skin disorders. The rind decoction is taken to relieve diarrhea and cystitis, gonorrhoea and gleet and is applied externally as an astringent lotion. A portion of the rind is steeped in water overnight and the infusion given as a remedy for chronic diarrhea in adults and children. Filipinos employ a decoction of the leaves and bark as a febrifuge and to treat thrush, diarrhea, dysentery and urinary disorders. In Malaya, an infusion of the leaves, combined with unripe banana and a little benzoin is applied to the wound of circumcision. A root decoction is taken to regulate menstruation. A bark extract called "amibiasine", has been marketed for the treatment of amoebic dysentery.

The rind of partially ripe fruits yields a polyhydroxy-xanthone derivative termed mangostin, also  $\beta$ -mangostin. That of fully ripe fruits contains the xanthenes, gartanin, 8-disoxygartanin, and normangostin. A derivative of mangostin, mangostin-e, 6-di-O-glucoside, is a central nervous system depressant and causes a rise in blood pressure.

**Annex E**  
(informative)

**Mangosteen — 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

	<b>US</b>	<b>Cod</b>	<b>EU</b>
<b>Glyphosate</b>	0.2	---	---

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

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