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EAST AFRICAN STANDARD

Fresh avocados — Specification and grading



EAST AFRICAN COMMUNITY

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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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East African Community

P O Box 1096

Arusha

Tanzania

Tel: 255 27 2504253/8

Fax: 255-27-2504481/2504255

E-Mail: eac@eachq.org

Web: www.each.int

Introduction

This second edition of this standard supersedes and cancels EAS 19:2000, *Fresh avocados Specifications*

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

United States Standards for Grades of Florida Avocados, Effective September 3 1957

UNECE STANDARD FFV 42:2009, *Marketing and commercial quality control of avocados*

CODEX STAN 197:1995 (Rev. 2005), *Standard for Avocado*

CODEX STAN 193:1995 (Rev.4:2009), *General Standard for Contaminants and Toxins in Foods*

ISO 2295:1974, *Avocados — Guide for storage and transport*

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

USDA Foreign Agricultural Service website: <http://www.mrls.usda.gov>

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

European Union: 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 avocados — Specification and grading

1 Scope

This East African Standard applies to commercial varieties (cultivars) of avocados grown from *Persea americana* Mill. (Syn. *Persea gratissima* Gaertn), of the Lauraceae family, to be supplied fresh to the consumer, after preparation and packaging. Parthenocarpic fruit and avocados for industrial processing are excluded. See Figures 1 to 3.

The standard also stipulates requirements for handling, grading and packaging of the produce up to the dispatching state.

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 Packaging and Transport of Fresh Fruits and Vegetables*

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

EAS 38, *Labelling of prepackaged foods — Specification*

ISO 6561-1, *Fruits, vegetables and derived products — Determination of cadmium content — Part 1: Method using graphite furnace atomic absorption spectrometry*

ISO 6561-2, *Fruits, vegetables and derived products — Determination of cadmium content — Part 2: Method using flame atomic absorption spectrometry*

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

the avocados in any container are similar in shape, texture, and colour of skin and flesh

3.2

mature

the avocado has reached a stage of growth which will insure a proper completion of the ripening process

3.3

overripe

the avocado is dead ripe with flesh soft or discoloured and past commercial use

3.4

well formed; well developed

the avocado has the normal shape characteristic of the variety

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3.5

clean

the avocado is practically free from dirt, staining or other foreign material

3.6

well coloured

the avocado has the colour characteristic of the variety

3.7

well trimmed

the stem, when present, is cut off fairly smoothly at a point not more than 6.35 mm beyond the shoulder of the avocado

3.8

damage

any defect which materially affects the appearance, or the edible or shipping quality of the individual fruit, or the general appearance of the avocados in the container. Any one of the following defects, or any combination of defects the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as damage:

- (a) Cuts or other skin breaks when not healed and penetrating beneath the epidermis or the aggregate area exceeds that of a rectangle 25 mm in length and 3 mm in width, or when healed and the appearance is materially affected;
- (b) Pulled stems when the exposed stem cavity is excessively deep, or when skin surrounding the stem cavity is more than slightly torn;
- (c) Russeting or similar discoloration when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown surface discoloration aggregating 10 percent of the fruit surface;
- (d) Scars or scab when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown superficial, fairly smooth scars aggregating 10 percent of the fruit surface;
- (e) Sunburn when the appearance of the avocado is affected to a greater extent than that of an avocado which has greenish-yellow coloured sunburn aggregating 10 percent of the fruit surface; and,
- (f) Sunscald or sprayburn when not well healed, or when soft, or when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown, superficial scars aggregating 10 percent of the fruit surface.

3.9

fairly well formed

the avocado may be slightly abnormal in shape but not to the extent that the appearance is seriously affected

3.10

fairly well coloured

the avocado shows a shade of colour which is fairly characteristic of the variety

3.11

serious damage

any defect which seriously affects the appearance, or the edible or shipping quality of the individual fruit, or the general appearance of the avocados in the container. Any one of the following defects, or any combination of defects the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as serious damage:

- (a) Anthracnose when any spot exceeds the area of a circle 6.35 mm in diameter, or when more than 3 spots each of which exceeds the area of a circle three-sixteenths inch in diameter;
- (b) Cuts or other skin breaks when not healed and penetrating into the flesh of the fruit, or the aggregate area exceeds that of a rectangle 25.4 mm in length and 6.35 mm in width, or when healed and the appearance is seriously affected;
- (c) Pulled stems when the skin surrounding the exposed stem cavity is torn more than an aggregate area of a circle 6.35 mm in diameter, or when the flesh is torn;
- (d) Russetting or similar discoloration when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown surface discoloration aggregating 25 percent of the fruit surface;
- (e) Scars or scab when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown superficial fairly smooth scars aggregating 25 percent of the fruit surface;
- (f) Sunburn when the appearance of the avocado is affected to a greater extent than that of an avocado which has greenish-yellow coloured sunburn aggregating 25 percent of the fruit surface;
- (g) Sunscald or sprayburn when not well healed, or when soft, or when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown superficial, fairly smooth scars aggregating 25 percent of the fruit surface; and
- (h) Cercospora spot when any spot exceeds the area of a circle 6.35 mm in diameter, or when more than 3 spots each of which exceeds the area of a circle three-sixteenths inch in diameter, or when the aggregate area of all spots exceeds the area of a circle 25.4 mm in diameter.

3.12

badly misshapen

the avocado is so badly curved, constricted, pointed or otherwise deformed that the appearance is very seriously affected

3.13

very serious damage

any defect which very seriously affects the appearance, or the edible or shipping quality of the avocado. Any one of the following defects, or any combination of defects the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as very serious damage:

- (a) Cuts or other skin breaks when not healed and penetrating into the flesh of the fruit, or any skin break very seriously affecting the appearance, or the edible or shipping quality;
- (b) Pulled stems when the skin surrounding the exposed stem cavity is torn more than an aggregate area of a circle one-half inch in diameter, or when the flesh is torn;
- (c) Russetting or similar discoloration when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown surface discoloration aggregating 50 percent of the fruit surface;
- (d) Scars or scab when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown superficial, fairly smooth scars aggregating 50 percent of the fruit surface;
- (e) Sunburn when the appearance of the avocado is affected to a greater extent than that of an avocado which has greenish-yellow coloured sunburn aggregating 50 percent of the fruit surface; and,

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- (f) Sunscald or sprayburn when not well healed, or when the appearance of the avocado is affected to a greater extent than that of an avocado which has light brown superficial, fairly smooth scars aggregating 50 percent of the fruit surface.

4 Provisions concerning quality

4.1 General

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

However, if applied at stages following export, products may show in relation to the requirements of the standard:

- a slight lack of freshness and turgidity
- for products graded in classes other than the “Extra” Class, a slight deterioration due to their development and their tendency to perish.

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 avocados must be:

- (a) **intact/whole**; not having any mutilation or injury spoiling the integrity of the fruit, such as cuts or punctures or other significant physical damage sustained during harvesting or post harvest handling. Figures 4 to 6
- (b) **sound**; produce affected by rotting or deterioration such as to make it unfit for consumption is excluded. Avocados must be free from disease or serious deterioration which appreciably affects their appearance, edibility or market value. In particular, this excludes avocados affected by rotting, even if the signs are very slight but liable to make the avocados unfit for consumption upon arrival at their destination. Avocados showing the following defects are therefore excluded:
- (i) **Bruising**: the result of impact or compression damages the flesh and causes soft patches and a greyish discolouration of the flesh. Figure 7
 - (ii) **Sunburn**: mild symptoms are yellowing of fruit surface facing the sun. More severe symptoms are darkening of affected areas with a sunken appearance. Figure 8
 - (iii) **Rots** Figures 9 to 11
- (c) clean, practically free of any visible foreign matter. Avocados must be practically free of visible soil, dust, chemical residue or other visible foreign matter. Figures 12 to 13
- (d) practically free of pests affecting the general appearance of the produce. The presence of pests can detract from the commercial presentation and acceptance of the avocados. Figure 14
- (e) practically free from damage caused by pests affecting the flesh. Pest damage can detract from the general appearance, keeping quality and edibility of avocados. Figure 15
- (f) free of damage caused by low temperature. Damage caused by frost prior to harvest or by chilling due to low temperature during storage: the external signs include darkening of the skin. Internally, flesh texture is changed, its colour is grey and the vascular bundles appear dark brown. Figures 16 to 19

- (g) free of abnormal external moisture, excluding condensation following removal from cold storage. This provision applies to excessive moisture, for example, free water lying inside the package but does not include condensation on produce following release from cool storage or refrigerated vehicle.
- (h) having a stalk not more than 10 mm in length which must be cut off cleanly. However, its absence is not considered a defect on condition that the place of the stalk attachment is dry and intact. An injured place of attachment may cause stem end rot. Figures 20 to 21
- (i) free of any foreign smell and/or taste.¹ This refers particularly to avocados which have been stored on badly kept premises or have travelled in a badly maintained vehicle, especially avocados which have acquired a strong smell from other produce stored on the same premises or travelling in the same vehicle. It does not refer to any smell emanating from products used in conformity with the regulations for their use to improve keeping properties. Therefore, care should be taken to use only non-smelling materials as protection in packaging.

4.2.2 The avocados must have been carefully picked. Their development should have reached a physiological stage which will ensure a continuation of the maturation process to completion. The mature fruit should be free of bitterness and/or rubbery taste. Avocados should be firm at the point of dispatch. The degree of softening which makes the fruit ready for consumption should occur only at the retail or consumer level.

The development and condition of the avocados must be such as to enable them:

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

4.3 Maturity requirements

The fruit should have a minimum dry matter content, to be measured by drying to constant weight:

- (a) 21 % for the variety Hass
- (b) 20 % for the varieties Fuerte, Pinkerton, Reed and Edranol
- (c) 19 % for the other varieties except for Antillian varieties² that may show a lower dry matter content.

Avocados must attain a minimum degree of maturity prior to picking. As an indicator of maturity, the fruit must have reached a minimum oil content in the flesh. The required oil content is different, according to different varieties and correlated to the total dry matter content. Therefore, the standard sets out minimum values for the dry matter content of different varieties. The reference laboratory method as well as a quick method using the microwave oven are shown in the annex.

The ripe fruit should be free from bitterness.

4.4 Classification

Avocados are classified in three classes, as defined below:

4.4.1 "Extra" Class

Avocados in this class must be of superior quality. In shape and colouring they must be characteristic of the variety and/or commercial type (Figure 22); avocados of similar varietal characteristics which are mature but not overripe, well formed, clean, well coloured, well trimmed and which are free from decay, anthracnose, and freezing injury and are free from damage caused by bruises, cuts or other

¹ The use of preserving agents or any other chemical substance liable to leave a foreign smell on the skin of the fruit is permitted where it is compatible with the regulations of the importing country.

² Reservation from the United States: Antillean varieties should not be included in the standard because they are substantially different.

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skin breaks, pulled stems, russeting or similar discoloration, scars or scab, sunburn, sunscald or sprayburn, cercospora spot, other disease, insects, or mechanical or other means.

Avocados must be very carefully presented.

There is a natural variation in shape for each variety according to the growing area. Nevertheless, the shape must be regular with no distortions or malformations. Figure 23

The colour of ripe fruit may be dark green, pale green or black. Black varieties such as Hass may still be green when picked at proper physiological stage, and attain their typical black colour during the softening process. Figures 24 to 25

They must be free from 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. If present, the stalk must be intact.

Very slight superficial defects may appear during cultivation, harvest, storage, packaging or transport. Figure 26

4.4.2 Class I

Avocados in this class must be of good quality. They must be characteristic of the variety and/or commercial type: avocados of similar varietal characteristics which are mature but not overripe, fairly well formed, clean, fairly well coloured, well trimmed and which are free from decay and freezing injury and are free from serious damage caused by anthracnose, bruises, cuts or other skin breaks, pulled stems, russeting or similar discoloration, scars or scab, sunburn, sunscald or sprayburn, cercospora spot, other disease, insects, or mechanical or other means. 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:

- a slight defect in shape. Figures 27 to 28
- slight defects in colouring
- slight skin defects (corkiness, healed lenticels) and sunburn, provided they are not progressive; the maximum total area should not exceed 4 cm². Figures 29 to 31

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

The stalk, if present, may be slightly damaged.

4.4.3 Class II (U.S. No. 3)

This class includes avocados that do not qualify for inclusion in the higher classes but satisfy the minimum requirements specified in 4.2.1. This class consists of avocados of similar varietal characteristics which are mature but not overripe, which are not badly misshapen, and which are free from decay and are free from serious damage caused by anthracnose and are free from very serious damage caused by freezing injury, bruises, cuts or other skin breaks, pulled stems, russeting or similar discoloration, scars or scab, sunburn, sunscald or sprayburn, cercospora spot, other disease, insects, dirt or mechanical or other means.

Avocados in this class must be of marketable quality, suitably presented and suitable for human consumption.

The following defects may be allowed, provided the avocados retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape. Figures 32 to 33

- defects in colouring
- skin defects (corkiness, healed lenticels) and sunburn, provided they are not progressive; the maximum total area should not exceed 6 cm². Figures 34 to 36.

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

The stalk, if present, may be damaged.

4.4.4 Combination Class

The Combination Class consists of a combination of Extra Class and Class I avocados. However, at least 60 percent, by count, of the avocados in each container shall meet the requirements of the Extra Class.

4.4.5 Unclassified

"Unclassified" consists of avocados which have not been classified in accordance with any of the foregoing grades but meet the minimum requirements specified in 4.2.1. The term "unclassified" is not a grade within the meaning of this standard, but is provided as a designation to show that no grade has been applied to the lot.

5 Provisions concerning sizing

Size is determined by the weight or count of the fruit.

Minimum weight for avocados is 123 g except for Hass where it is 80 g and for Antillean varieties where it is 170 g.

To ensure uniformity in size:

- (a) For Antillean varieties

The weight of the smallest fruit shall be not less than 75 percent of the weight of the largest fruit in the same package.

- (b) For other varieties the following size scale applies:

Size code	Weight scale (g)
4	781 to 1220
6	576 to 780
8	456 to 576
10	364 to 462
12	300 to 371
14	258 to 313
16	227 to 274
18	203 to 243
20	184 to 217
22	165 to 196
24	151 to 175
26	144 to 157
28	134 to 147
30	123 to 137
S ³	80 to 123 (Hass variety only)

³ The difference between the smallest and largest fruit within a package should not be more than 25 g.

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6 Provisions concerning tolerances

At all marketing stages, tolerances in respect of quality and size shall be allowed in each lot for produce not satisfying the requirements for the class indicated. Tolerances are provided to allow for human error during the grading and packing process. During grading and sizing it is not permitted to deliberately include out of grade produce, i.e. to exploit the tolerances deliberately.

The tolerances are determined after examining each sample package and taking the average of all samples examined. The tolerances are stated in terms of percentage, by number or weight of fruit in the total sample not conforming to the class (or to the size) indicated on the package.

6.1 Quality tolerances

6.1.1 "Extra" Class

A total tolerance of 5 per cent, by number or weight, of avocados not satisfying the requirements of the class but meeting those of Class I is allowed. Within this tolerance, not more than 0.5 per cent in total may consist of produce satisfying the requirements of class II quality. Not more than 2.5 per cent shall be allowed for avocados affected by decay or anthracnose, including therein not more than 1 per cent for avocados affected by decay.

6.1.2 Class I

A total tolerance of 10 per cent, by number or weight, of avocados not satisfying the requirements of the class but meeting those of Class II is allowed. Within this tolerance not more than 1 per cent in total may consist of produce neither satisfying the requirements of Class II quality nor the minimum requirements or of produce affected by decay.

6.1.3 Class II

A total tolerance of 10 per cent, by number or weight, of avocados satisfying neither the requirements of the class nor the minimum requirements is allowed. Within this tolerance not more than 2 per cent in total may consist of produce affected by decay.

Under no circumstances shall these tolerances apply to fruit affected by rotting, severely damaged fruit, fruit too soft to eat, or any other deterioration rendering it unfit for consumption.

6.1.4 Combination class

In order to allow for variations incident to proper grading and handling, not more than a total of 10 per cent, by count, of the avocados in any lot may fail to meet the requirements of the Class I. However, not more than one-half of this amount, or 5 %, shall be allowed for avocados affected by decay or seriously damaged by anthracnose, including therein not more than 1 per cent for avocados affected by decay. No part of any tolerance shall be allowed to reduce for the lot as a whole the percentage of Extra Class fruit required or specified in the combination, but individual containers may have not more than 10 per cent less than the percentage of Extra Class fruit required or specified.

6.1.5 Unclassified

"Unclassified" consists of avocados which have not been classified in accordance with any of the foregoing grades. The term "unclassified" is not a grade within the meaning of these standards, but is provided as a designation to show that no grade has been applied to the lot.

6.2 Standard pack

- (a) The avocados shall be packed in accordance with good commercial practice and the pack shall be at least fairly tight. The weight of the smallest fruit in any container shall be not less than 75 per cent of the weight of the largest fruit in the container. Size of the avocados may be specified by count.

- (b) In order to allow for variations incident to proper sizing and packing, not more than 5 percent, by count, of the avocados in any container may weigh less than 75 percent of the weight of the largest fruit. However, no fruit in any container shall weigh less than 60 percent of the weight of the largest fruit in the container. In addition, not more than 5 percent of the containers in any lot may fail to meet the requirement as to tightness of pack.

6.3 Application of tolerances

The contents of individual packages in the lot, based on sample inspection, are subject to the following limitations on the condition that the averages for the entire lot are within the tolerances specified for the grade:

- (a) For packages which contain more than 20 avocados and a tolerance of 10 percent or more is provided, individual packages in any lot shall have not more than one and one-half times the tolerance specified. For packages which contain more than 20 avocados and a tolerance of less than 10 percent is provided, individual packages in any lot shall have not more than double the tolerance specified, except that at least one defective and one off-size specimen may be permitted in any package; and,
- (b) For packages which contain 20 avocados or less, individual packages shall have not more than double the tolerance specified, except that at least one defective and one off-size specimen may be permitted in any package.

6.4 Size tolerances

For all classes: a total tolerance of 10 per cent, by number or weight, of avocados not satisfying the requirements as regards sizing is allowed.

A deviation of 2 % from the indicated weight of the range is permitted for some of the fruit in the package.

7 Provisions concerning presentation

7.1 Uniformity

The contents of each package must be uniform and contain only avocados of the same origin, variety, quality, colouring⁴ and size. The visible part of the contents of the package must be representative of the entire contents. Figures 37 to 39.

A special effort should be made to suppress camouflage, i.e. concealing in the lower layers of the package produce inferior in quality and size to that displayed and marked.

Similarly prohibited is any packaging method or practice intended to give a deceptively superior appearance to the top layer of the consignment.

7.2 Packaging

The avocados shall be packed in such a way as to protect the produce properly. Packages must be of a quality, strength and characteristics to protect the produce during transport and handling. The materials used inside the package shall be new⁵, 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.

⁴ A change in the colour of the dark-skinned varieties is not considered as a defect, but the colouring of the fruit in each package must be uniform at the point of dispatch.

⁵ For the purposes of this Standard, this includes recycled material of food-grade quality.

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Stickers individually affixed on the produce shall be such that, when removed, they neither leave visible traces of glue nor lead to skin defects.

This provision is designed to ensure suitable protection of the produce by means of materials inside the package which are new and clean and also to prevent foreign bodies such as leaves, sand or soil from spoiling its good presentation.

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the avocados. Packages must be free of all foreign matter and smell. A visible lack of cleanliness in several packages could result in the goods being rejected.

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

8 Marking or labelling

Each package⁶ must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside. In the case of packed produce, all particulars must be grouped on the same side of the package, either on a label attached to or printed on the package with water-insoluble ink. Figure 40

In the case of reused packages, all previous labels must be carefully removed and previous indications deleted.

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. The name of the variety is compulsory for all classes.

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

The exporter, packer and/or dispatcher shall be identified by name and physical address (e.g. street/city/region/postal code and, if different from the country of origin, the country) or a code mark officially recognized by the national authority.⁷

8.2.2 Nature of produce

- Name of the produce "avocados" if the contents are not visible from the outside.
- "Antillean/Florida" or equivalent denomination, where appropriate

⁶ According to the Geneva Protocol, footnote 2, "Package units of produce prepacked for direct sale to the consumer shall not be subject to these marking provisions but shall conform to the national requirements. However, the markings referred to shall in any event be shown on the transport packaging containing such package units".

⁷ 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, and the code mark should be preceded by the ISO 3166 (alpha) country/area code of the recognizing country, if not the country of origin.

— Name of the variety or commercial type.

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 expressed in minimum and maximum weight in grams;
- Code number of the size scale and number of fruits when it is different from reference number. Stating the size range is compulsory. Additionally the code number of the size scale and the number of fruits when this is different from the code number must be stated on the package, or optionally, the code number and net weight of the package.
- Net weight of the package.

8.2.5 Official Inspection Mark (optional)

9 Contaminants

9.1 Heavy metals

Avocados 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

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

Maximum pesticide residue limits and extraneous maximum residue limits in avocados (current as at 2009-06-08)

Type	Unit symbol	Limit	Method of test	Notes
BROMIDE ION	MRL (mg/kg)	75		
ENDOSULFAN	MRL (mg/kg)	0.5		
METALAXYL	MRL (mg/kg)	0.2		
TEBUFENOZIDE	MRL (mg/kg)	1		
THIABENAZOLE	MRL (mg/kg) Po	15		used also as veterinary drug

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.



Figure 1 — Examples of varieties (cultivars) — Top : Benik, Hass, Nabal — Bottom : Ettinger, Fuerte, Pinkerton



Figure 2 — Examples of varieties (cultivars) — Gwen, Ardith

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Standard

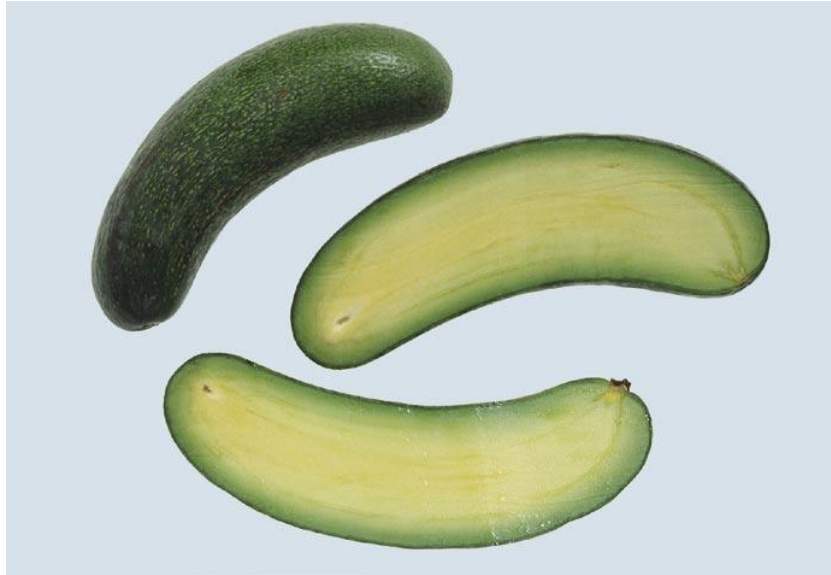


Figure 3 — Parthenocarpic fruit — Excluded from standard

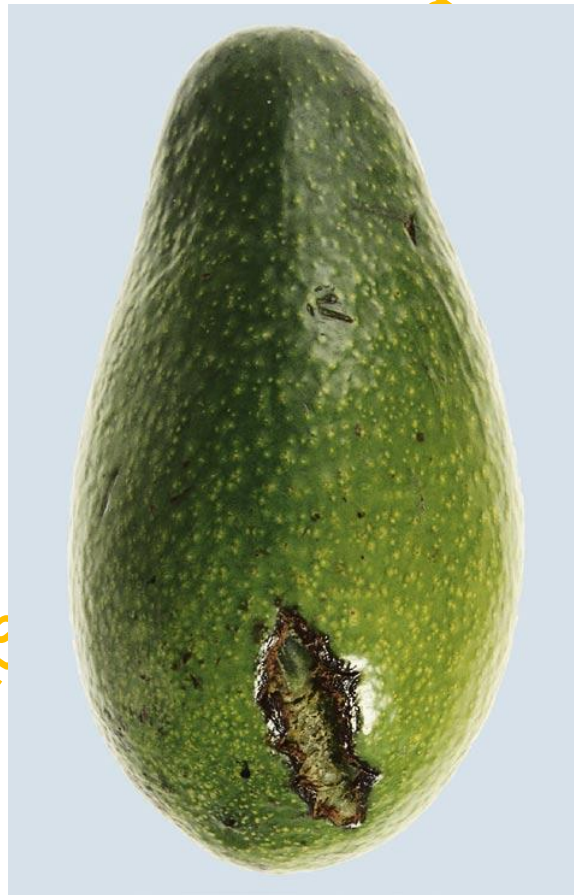


Figure 4 — Cutting damage — Not allowed

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Figure 5 — Punctured fruit — Not allowed

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Figure 6 — Severe rub — Not allowed

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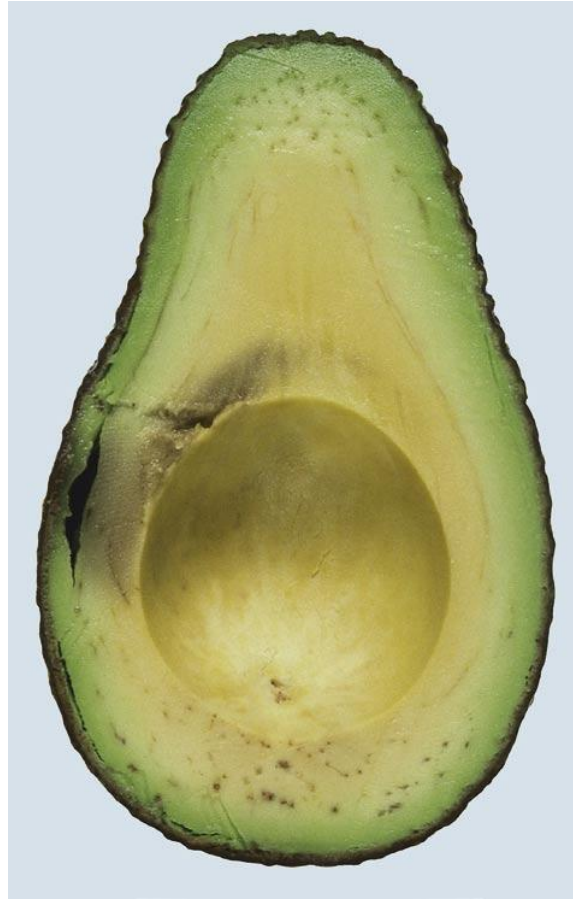


Figure 7 — Bruised fruit — Not allowed

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Figure 8 — Sunburn — Not allowed



Figure 9 — Stem end rot — Not allowed



Figure 10 — Anthracnose — External aspect — Not allowed

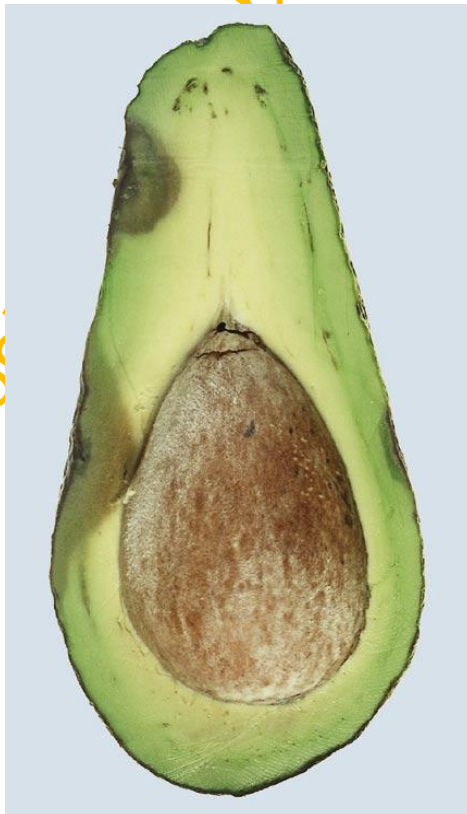


Figure 11 — Anthracnose — Internal aspect — Not allowed



Figure 12 — Chemical residue — Not allowed

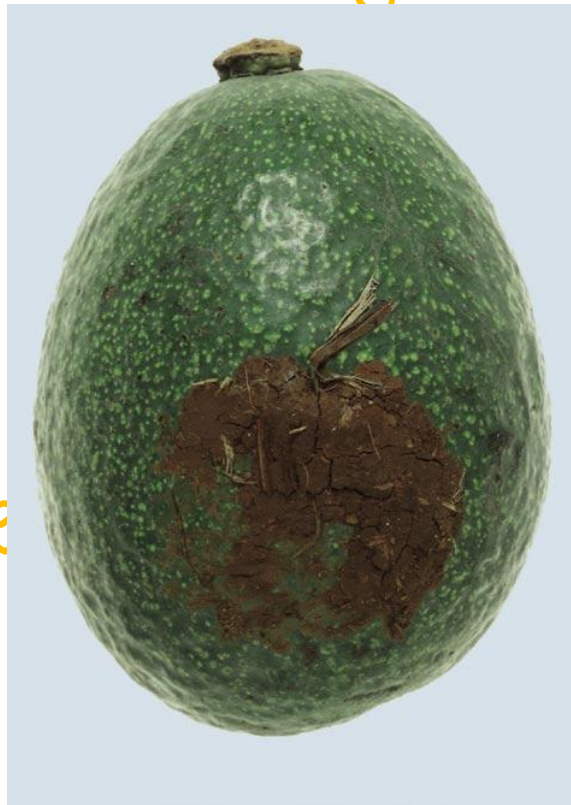


Figure 13 — Soiled fruit — Not allowed



Figure 14 — Scale insects — Not allowed

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Figure 15 — Damage by rodents — Not allowed



Figure 16 — External frost damage — Variety (cv.) Hass — Not allowed



Figure 17 — Chilling injury — External signs — Not allowed

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Figure 18 — Chilling injury — Internal signs — Not allowed

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Figure 19 — Chilling injury — Brown vascular bundles — Not allowed

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Figure 20 — Stalk longer than 10mm — Not allowed

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Figure 21 — Place of stalk attachment not intact — Not allowed

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Figure 22 — Variety (cv.) Fuerte — Perfect fruit



Figure 23 — Examples of shape — Varieties (cvs.) Fuerte, Pinkerton, Reed

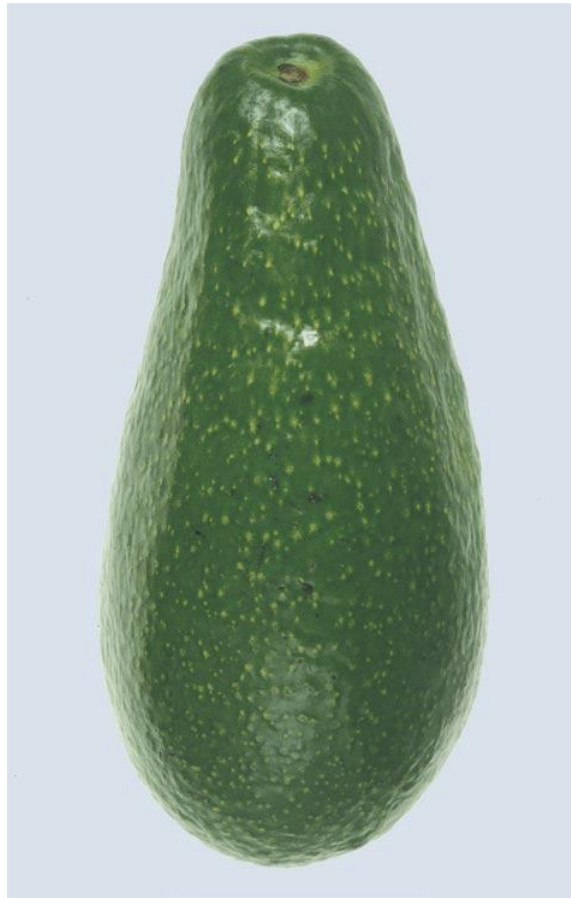


Figure 24 — Variety (cv.) Ettinger — Typical colour



Figure 25 — Variety (cv.) Hass — Typical colour — Left : fully developed green fruit — Right : black ripe fruit



Figure 26 — Variety (cv.) Fuerte - “Extra” Class — Very slight superficial skin defect — Limit allowed



Figure 27 — Variety (cv.) Fuerte — Left : typical shape — Right : slight shape defect — Limit allowed in Class I



Figure 28 — Variety (cv.) Ettinger — Slight colour defect — Limit allowed in Class I



Figure 29 — Slight corkiness — Limit allowed in Class I



Figure 30 — Slight rubbing — Limit allowed in Class I

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Figure 31 — Slight sunburn — Limit allowed in Class I



Figure 32 — Variety (cv.) Fuerte — Left: typical shape — Right: shape defect — Limit allowed in Class II



Figure 33 — Variety (cv.) Ettinger — Colour defect — Limit allowed in Class II

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Figure 34 — Corkiness — Limit allowed in Class II

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Figure 35 — Rubbing — Limit allowed in Class II

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Figure 36 — Sunburn — Limit allowed in Class II

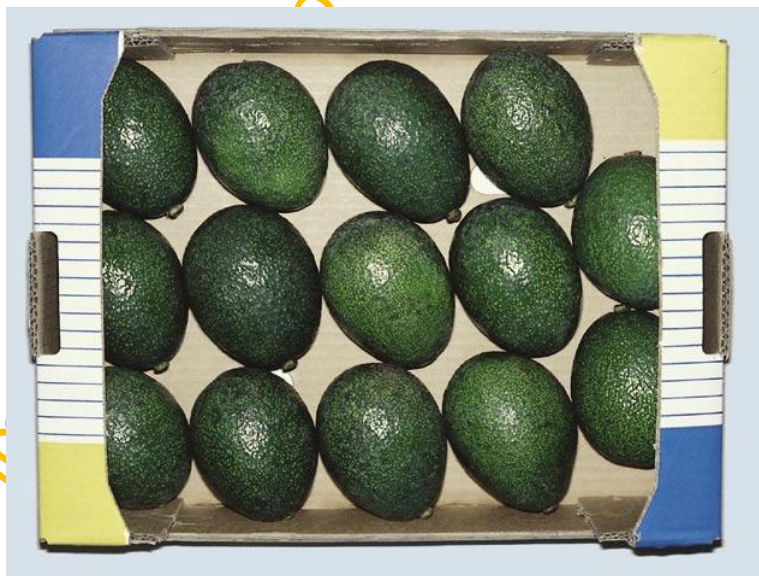


Figure 37 — Very careful presentation — “Extra” Class

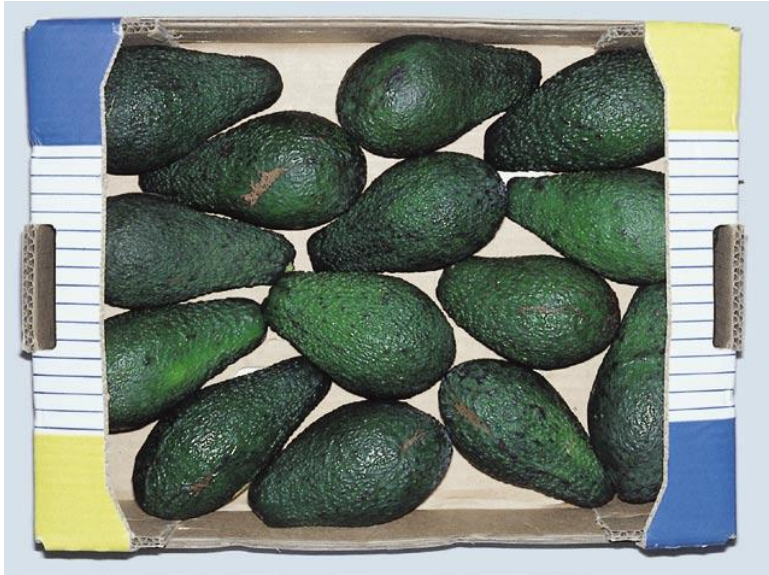


Figure 38 — Careful presentation — Class I

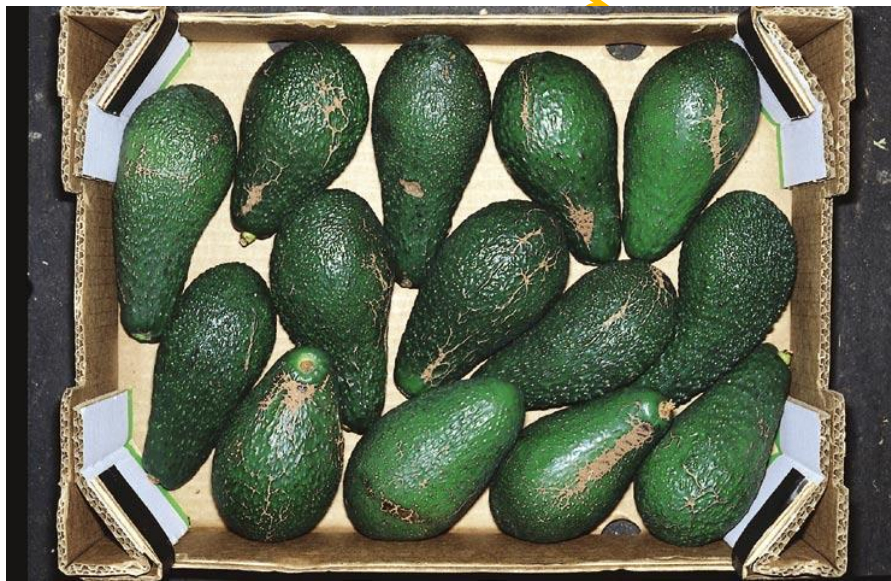


Figure 39 — Suitable presentation — Class II

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Figure 40 — Example of marking printed on the package



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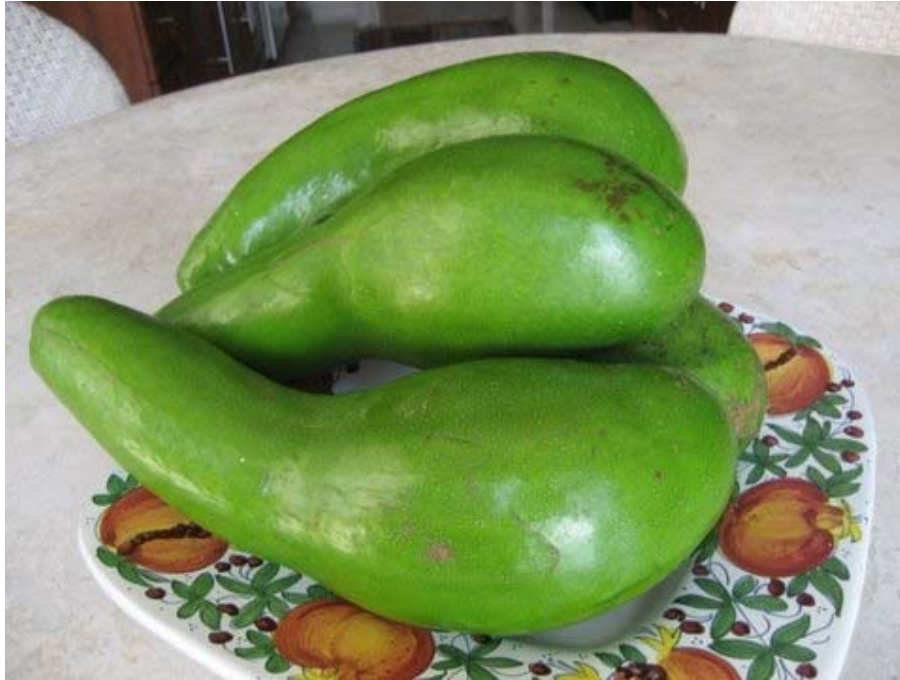
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The 'Wilson Popenoe' avocado



Hass



Fuerte



Sharwill

Draft for comment

Standard

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otandard



Some avocado cultivars

Draft for com



Oro Negro Avocado

Draft for comments only — Not for

Standard



Golden avocados

Draft for comments only — No

Standard

Annex A (informative)

Guide for storage and transport

A.1 Introduction

The avocados should be chilled in the preclimacteric phase to obtain a storage life of more than 1 week after the date of harvesting.

In any particular production area the harvesting period may vary from one year to the next, depending on the ecological conditions.

With the green fruit varieties (which are the most numerous) the colour and texture of avocados change very little at the end of growth on the tree. In practice with these varieties there are no visual indications of the state of ripeness at harvesting time and they are often harvested on an empirical basis.

Avocados which are harvested prematurely have a disagreeable flavour after ripening. They should be harvested after reaching sufficient physiological development to give them a satisfactory taste after ripening.

Avocados give off considerable amounts of carbon dioxide, particularly in the climacteric phase. This fruit is very sensitive to the accumulation of carbon dioxide as well as of ethylene. In current transport practice it is recommended that particular attention should be paid to renewing the atmosphere.

The state of the avocados when put into store (state of health, wounds, etc.) affects the keeping time: this is the reason for recommendations being made on this subject.

A.2 Scope and field of application

This annex lays down the conditions for successful storage of avocados in the preclimacteric phase during the storage period

- either in a cold or refrigerated transport vehicle (wagon, truck or ship),
- or, exceptionally, in a refrigerated enclosure in a warehouse (or in a refrigerated warehouse).

A.3 Conditions of harvesting and putting into storage

A.3.1 Varieties

The products covered by this East African Standard are fresh fruits intended for storage and belonging to the cultivars covered in Annex D.

A.3.2 Harvesting

The degree of maturity of the avocados when harvested shall be determined in relation to the likelihood of producing satisfactory fruit after ripening and in relation to the likelihood of their remaining in the preclimacteric phase during the normal period of storage in a refrigerated enclosure.

Avocados picked prematurely do not ripen normally. They have a rubbery texture, a bitter taste and an unpleasant after-taste.

A.3.2.1 Criteria of maturity

The following criteria are generally taken into account in deciding whether the fruit is sufficiently mature for harvesting:

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- start of colour change in coloured varieties;
- slight lightening of colour in the green fruit varieties (taking fruits which are not over-exposed to the sun); this slight variation in colour is difficult to assess;
- size of the fruit, characterized by its largest diameter (using circular gauges) or its mass;
- number of days to obtain softening of the avocado kept between 20 and 25 °C; this time should be between 4 and 7 days;
- oil content for avocados with a high oil content (Fuerte for example);
- avocados should not wrinkle after reaching maturity (wrinkles appear after premature harvesting);
- falling fruit is a sign of the end of harvesting particularly in the case of seed avocados.

The content in the pulp of dry extract, of reducing sugars or of phenolic compounds cannot be used as criteria of maturity.

A.3.2.2 Checking of the degree of maturity with a view to storage

This check is carried out by examining the following criteria:

- for varieties with coloured fruits (Collinson, Hass, Topa Topa, etc.), examination of the colour;
- for varieties with green fruits, firmness of the pulp;
- for all varieties, size of the fruit, characterized by its largest diameter or its mass, depending on the varieties;
- for all varieties, weakness of the stalk at the insertion with the fruit (the degree of maturity is too far advanced for storage when the stalk cannot hold the mass of the fruit without becoming detached).

A.3.3 Quality characteristics for storage

Avocados shall have a stalk 1 to 2 m.

The place where the stalk is cut shall be clean to avoid damaging neighbouring fruit. Avocados shall be free from any signs of attack by fungi and insects, from open wounds, and from the effects of excessive exposure to direct sunlight.

Old wounds on the fruit which are well covered with scar tissue may be tolerated provided that they are few in number.

A.3.4 Putting into storage

The avocados shall be put into store as quickly as possible after harvesting.

The period between the harvesting of the fruit and its entry into a refrigerated enclosure shall not exceed 48 h.

A.3.5 Method of storage

After harvesting and packing, when avocados are awaiting transportation by land or sea, they shall be placed in the shade in a well-ventilated place.

Avocados shall be stored in packages which will protect them efficiently against wounds and damage as a result of impacts during handling.

Usually they are arranged in one or more layers of fruit of the same size in a corrugated cardboard box with perforations in the side walls and the lid, or in a wooden case allowing good ventilation.

The fruit may be wrapped separately in Paper and shall be protected, for example, by fibre within the package, to avoid contact with the sides of the package and between the individual fruits. The packages shall be sufficiently strong to protect the avocados, which cannot support pressure without deteriorating.

A.4 Optimum conditions of storage and transport

The storage and refrigerated transport of avocados consist of two phases — cooling and keeping at the storage temperature.

A.4.1 Cooling

The cooling of the avocados shall be carried out as quickly as possible, and this is achieved by means of:

- a refrigerated installation with a refrigeration power of 700 W to 930 W per tonne of avocados;
- a cooling air temperature of 7 to 12 °C, according to the temperature of storage (see A.4.2.1);
- an air circulation ratio of 80 to 100;
- homogeneous and regular packing or stacking, allowing uniform circulation of the cooling air through the contents of the store;
- an efficient air circulation (without short-circuits of external air).

A.4.2 Keeping at storage temperature

A.4.2.1 Temperature

After cooling, avocados shall be kept at the temperature of the atmosphere of the refrigerated enclosure, which depends on the variety and is indicated below.

Some varieties of the West Indies group, including Waldin, should be kept at 10 to 12.5 °C; however, Fuerte variety avocados (Mexican and Guatemalan hybrids group) may be kept at 4.5 °C for 3 weeks without deleterious effect.

The recommended temperature for storage of the other varieties is 7 °C; if the temperature is lower than 5 °C during storage, subsequent ripening becomes abnormal and avocados no longer have the desired eating qualities.

A higher temperature leads to a decrease in storage life.

The temperature shall be measured at the coldest point of the enclosure, i.e. at the outlet of the air from the cooler. If the stacks of packages are readily accessible in the store, it is recommended that the temperature be measured within the packages of avocados.

A.4.2.2 Relative humidity

The cold batteries of the air coolers shall be designed to obtain a relative humidity of 85 to 90 %. See CD/K/378:2010.

A.4.2.3 Air circulation

The recommended air circulation system is the vertical ventilation system with uniform air distribution on the suction surface and on the discharge surface, with an air circulation ratio of 80 to 100.

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A.4.2.4 Air change

The recommended rate of air change is one change per hour. The air change shall be carried out continuously because avocados have a high rate of respiration (see A.5).

A.4.2.5 Storage life

The storage life of the avocado depends on the cultivar and its degree of maturity at the start of storage. It is between 2 and 4 weeks.

A.4.3 Storage incompatibility

Vegetable foodstuffs which give off ethylene (tomatoes, etc.) may initiate or accelerate the ripening of the avocados. There is a storage incompatibility between avocados and these foodstuffs.

Conversely, avocados which have started to ripen release ethylene which may act on foodstuffs affected by ethylene (bananas, for example).

A.5 Wastage in storage

Wastage of avocados in storage may be caused by the following:

- too low a storage temperature, with abnormal ripening resulting in rubbery texture, browning of the pulp, bitter and disagreeable taste;
- ripening during the storage caused by the presence of ethylene in the atmosphere of the store, or by the presence of avocados which are too ripe at the beginning of storage;
- rotting at the base of the stalk (anthracnose);
- rotting arising from wounds;
- deterioration of avocados caused by too high a content of carbon dioxide in the store as a result of insufficient renewal of air. The carbon dioxide content should not exceed 3 %.

Annex B
(normative)**Method of determination of the dry extract in avocado using desiccation process in a microwave oven**

In order to determine the maturity index of Mexican and Guatemalan varieties of avocados and their hybrids, the oil or fat content appears to be the determining factor.

In California, the Hallowax method was developed and was applied for a certain number of years to determine the oil content.

The research conducted in California concluded that the total of the fat content and of the moisture, of the oil and water, is a constant for each variety so that to each minimum oil content required to obtain the appropriate organoleptic characteristics for consumption corresponds a maximum moisture content.

The moisture being the difference between 100 and the dry matter content and vice versa, it was thought preferable to set a minimum dry matter content for each variety, thus enabling to guarantee a post-harvest development of the avocado satisfactory for consumption.

Therefore the Hallowax method was replaced by the determination of the content of dry matter. In various producing and exporting countries of avocados the determination in a microwave oven is used, a method which has its merits due to its speed, simplicity, low cost, and repeatability.

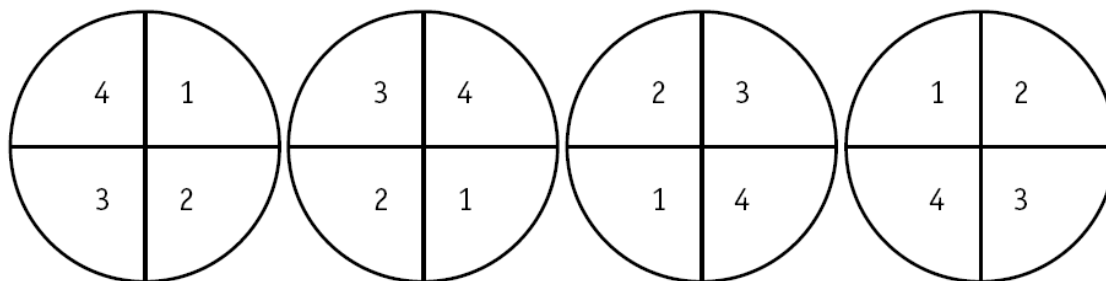
B.1 Application

This method allows to determine the loss of mass during the process of desiccation of the avocado.

B.2 Materials and instruments**B.2.1 Analytical scale with gradation of 0.010 mg****B.2.2 Microwave oven, capable of reaching a power of 800 W****B.2.3 Glass slides 8 cm in diameter****B.2.4 Pocket knife or knife****B.2.5 Slicer****B.3 Procedure**

Each time that samples are weighed, they must be controlled until the nearest centigram.

B.3.1 Weigh each glass slide and take note of the weight (P_0)**B.3.2** Cut the fruit longitudinally in two parts, eliminating the seed and the seminal tegument.**B.3.3** From one of the parts of the fruit, four 1.5 mm-thick slices must be cut with the help of the slicer.**B.3.4** Slices must be divided into four portions, cutting the diameters from largest to smallest. Then, deposit the four portions of the 4 slices without overlap, on four numbered glass-slides, according to the following schema of the slices divided in four and the number of the glass-slide where you are setting each quarter:



B.3.5 Weigh each glass-slide which contains the sample and record the weight (P_1).


B.3.6 Put the glass-slides into the microwave oven. It must be checked beforehand, for this thickness of the sample slice, that the desiccation is constant and that no brown coloration due to burning will appear. Establish a power of 800 W and after 4 minutes, weigh the sample directly, without allowing it to cool in the desiccator. Return the sample into the microwave for 1 minute and weigh it again. Repeat the process until the weight is constant or the difference of the mass between two consecutive weighings is not greater than 0.5 mg. The total time of desiccation ranges between 4 and 7 minutes. The final weight will be P_2 .

B.3.7 Calculate the dried extract as following:

$$\% \text{ Dried extract} = \frac{P_2 - P_0}{P_1 - P_0} \times 100$$

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 ⁽¹⁾	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>EAS 19:2010, Fresh avocado — 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;"> Signature Seal of competent authority </div>				
13. Observations:				
<small>(1) Where the goods are being re-exported, indicate the origin in box 9.</small>				

Annex D (informative)

Avocado (*Persea Americana*) species — Fact sheet

The avocado, unflatteringly known in the past as alligator pear, midshipman's butter, vegetable butter, or sometimes as butter pear, and called by Spanish-speaking people *aguacate*, *cara*, *cupandra*, or *palta*; in Portuguese, *abacate*; in French, *avocatier*, is the only important edible fruit of the laurel family, Lauraceae. It is botanically classified in three groups: A), *Persea americana* Mill. var. *americana* (P. *gratissima* Gaertn.), West Indian Avocado; B) P. *americana* Mill. var. *drymifolia* Blake (P. *drymifolia* Schlecht. & Cham.), the Mexican Avocado; C) P. *nubigena* var. *guatemalensis* L. Wms., the Guatemalan Avocado.

D.1 Description

The avocado tree may be erect, usually to 9 m but sometimes 18 m or more, with a trunk 30-60 cm in diameter, (greater in very old trees) or it may be short and spreading with branches beginning close to the ground. Almost evergreen, being shed briefly in dry seasons at blooming time, the leaves are alternate, dark-green and glossy on the upper surface, whitish on the underside; variable in shape (lanceolate, elliptic, oval, ovate or obovate), 7.5-40 cm long. Those of the Mexican race are strongly anise-scented. Small, pale-green or yellow-green flowers are borne profusely in racemes near the branch tips. They lack petals but have 2 whorls of 3 perianth lobes, more or less pubescent, and 9 stamens with 2 basal orange nectar glands. The fruit, pear-shaped, often more or less necked, oval, or nearly round, may be 7.5-33 cm long and up to 15 cm wide. The skin may be yellow-green, deep-green or very dark-green, reddish-purple, or so dark a purple as to appear almost black, and is sometimes speckled with tiny yellow dots, it may be smooth or pebbled, glossy or dull, thin or leathery and up to 6 mm thick, pliable or granular and brittle. In some fruits, immediately beneath the skin there is a thin layer of soft, bright-green flesh, but generally the flesh is entirely pale to rich-yellow, buttery and bland or nutlike in flavour. The single seed is oblate, round, conical or ovoid, 5-6.4 cm long, hard and heavy, ivory in colour but enclosed in two brown, thin, papery seedcoats often adhering to the flesh cavity, while the seed slips out readily. Some fruits are seedless because of lack of pollination or other factors.

D.2 Origin and distribution

The avocado may have originated in southern Mexico but was cultivated from the Rio Grande to central Peru long before the arrival of Europeans. Thereafter, it was carried not only to the West Indies, but to nearly all parts of the tropical and subtropical world with suitable environmental conditions.

D.3 Varieties

D.3.1 WEST INDIAN race

'Butler', pear shaped; medium-large; skin smooth; seed of medium size, tight in the cavity.

'Fuchs' ('Fuchsia'), pear shaped to oblong, sometimes with a neck; of medium size; skin smooth; flesh pale greenish-yellow; 4 to 6% oil; seed loose. A poor shipper.

'Maosz' (a seedling selected from a plot near Maoz, Israel); pear-shaped; of medium size; skin rough, leathery, violet-purple when ripe; flesh sweetish and very low in oil. Tree is an alternate bearer but is fairly small, highly salt-tolerant; used in Israel as rootstock on either saline or calcareous soils.

'Pollock'; oblong to pear shaped; very large, up to 2.27 kg; skin smooth; flesh green near skin, contains 3 to 5% oil; seed large, frequently loose in cavity. Shy-bearing and too large but of superior quality.

'**Ruchle**'; pear-shaped; of medium size, 280-560 g; flesh low in oil (2-5%).

'**Russell**'; pear-shaped at apex with long neck giving it a total length up to 32.5 cm; skin, smooth, glossy, thin, leathery; flesh of excellent quality; seed small. Tree bears well and is recommended for home gardens.

'**Simmonds**'; oblong-oval to pear-shaped; large; skin smooth, light green; flesh of good flavour, 3 to 6% oil; seed of medium size, usually tight. Tree bears more regularly than Pollock but is less vigorous; sometimes sheds many of its fruits.

'**Trapp**'; round to pear-shaped; medium to large; skin smooth; flesh golden-yellow, green near skin, of excellent quality, 3 to 6% oil; seed large, loose in cavity. A good shipper.

'**Waldin**'; oblong to oval; medium to large; skin smooth; flesh pale to greenish-yellow, of good flavour, 5 to 10% oil; seed medium to large, tight. Tree tends to overbear and die back; is hardy.

D.3.2 GUATEMALAN race (skin varies from thin to very thick and is granular or gritty)

'**Anaheim**'; oval to elliptical; large; skin glossy, rough, thick; flesh of fair to good flavour, up to 22% oil, but inferior to 'Fuerte', 'Nabal' and 'Benik'. Tree slender, erect, tall, cold-sensitive; bears regularly, up to 100 kg annually in Israel.

'**Benik**'; pear-shaped; medium to large; skin rough, purple, medium-thick; flesh of good quality, 15 to 24% oil; seed nearly round, medium. The tree begins to bear late and yields only about 53 kg per year. Colour is not popular on the market.

'**Dickinson**'; oval to obovate; small to medium; skin dark-purple with large maroon dots, rough, very thick, granular, brittle; flesh of good quality; seed small to medium, tight. Tree is a moderate but regular bearer.

'**Edranol**'; pear-shaped; of medium size; skin olive-green, slightly rough, thin leathery; flesh of high quality and nutty flavour, 15 to 18% oil; seed small, tight. Disease resistant. Rated as excellent.

'**Hazzard**'; pear-shaped; of medium size; skin rough, fairly thin; flesh of good quality, 15 to 34% oil; seed small. Rated as excellent and free of external and internal diseases and discolorations in storage. The tree grows slowly, reaches only 3.5-4.5 m, begins bearing early and is a dependable producer. Some fruits may crack if left on tree too long. More than 100 trees can be planted per acre.

'**Itzamna**'; oblong pear-shaped; medium large; skin rough; flesh yellow, 11% oil; seed small, tight.

'**Linda**'; elliptical; very large; skin rough, dull-purple when ripe; flesh yellow, 10 to 14% oil; seed small, tight. A good shipper but not popular because of size and colour. Tree low, spreading, vigorous and bears regularly.

'**Lyon**'; broad-pear-shaped; beyond medium to large; skin somewhat rough to rough; bright-green with many small yellowish or red-brown dots; medium-thick, granular and brittle; flesh greenish near skin, of high quality; seed medium-small to medium, tight. Tree comes into bearing early and bears heavily, so much so as to weaken the tree.

'**Macarthur**'; pear-shaped; large; skin thin, pliable; flesh has sweet, nutty but watery flavour, contains 13 to 16.7% oil; seed medium to large. Very cold-hardy.

'**Nabal**'; nearly round; medium to large; skin nearly smooth, thick, granular; flesh of high quality, green near skin; 10 to 22 % oil; seed small, tight. Tree bears alternate years very heavily, but is rated as of medium quality and disease-prone during prolonged ripening.

'**Nimlioh**'; elliptical; large; skin slightly rough; flesh thick; seed fairly small, tight. Tree bears moderate crops.

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'Panchoy'; pear-shaped to almost elliptical; medium to large; skin rough, very thick; seed of medium size, tight. Subject to die-back

'Pinkerton'; early crop roundish; later, pear shaped with neck; of medium size, 227-397 g; skin medium-leathery, pliable; flesh thick, up to 10% more than in 'Hass' or 'Fuerte'; smooth textured, of good flavour, high in oil, rated as of good quality but inferior to 'Hass' and 'Fuerte'; tends to darken in the latter part of the season; seed small, separates readily from the flesh with the coat adhering to the seed. Fruit ships well and has good shelf life, but the neck is a disadvantage on the fresh fruit market; accordingly, the late-season fruits are sent to processing plants. The tree is of low, spreading habit; bears early and heavily; is as cold-sensitive as 'Hass'.

'Reed'; round; medium to large, 227-510 g; skin slightly rough, medium-thick, pliable; flesh cream-colored with rich, faintly nutty flavour; doesn't darken when cut; rated as excellent quality; seed small to medium, tight; coat adheres to seed. Tree erect, can be spaced 4.6x4.6 m; bears early and regularly; about as cold-sensitive as 'Hass'.

'Schmidt'; pear-shaped; medium to large; skin rough; flesh pale-yellow, 12 to 16% oil; seed of medium size, tight. The tree is a poor bearer and cold-sensitive and the fruit of poor keeping quality.

'Sharpless'; slender-pear-shaped, sometimes with long neck; large to very large; skin slightly rough, greenish-purple to dark-purple with many yellowish dots, thick, granular; flesh of superior quality and flavour; seed small, tight.

'Solano'; obovate to oval; beyond medium to large; skin nearly smooth, bright-green with many yellowish dots, medium-thick, granular; flesh greenish near skin, of fair quality; seed small, tight. A good bearer.

'Spinks'; broad-obovate; very large; skin rough, dark-purple, thick, granular, brittle; flesh of very good quality and flavour; seed small, tight.

'Taft'; broad pear-shaped; medium to very large; skin faintly rough, more so at base; many yellowish dots, thick, granular but somewhat pliable; flesh of excellent quality and flavour; seed of medium size, tight.

'Taylor'; obovate to pear-shaped, occasionally with neck; small to medium size—340 to 510 g; skin rough, with many small yellow dots; fairly thin; flesh of excellent quality and flavour, 12 to 17% oil; seed of medium size, tight. The tree is cold-hardy but excessively tall and slender.

'Tonnage'; pear-shaped, medium large; skin dark green, rough, thick; flesh green near skin, rich in flavour, 8 to 15% oil; seed medium, fairly tight. Tree erect, fairly slender, requiring less distance between trees; is a heavy bearer.

'Wagner'; rounded to obovate; small to medium; skin slightly rough; flesh light yellow, 16 to 20% oil; seed large, tight. Tree lower growing than 'Taylor', a heavy bearer, but fruit more subject to black spot than 'Taylor'.

'Wurtz'; pear-shaped, small to medium; 226-240 g; seed large. Tree is small and slow growing, bears moderately but regularly. More than 100 trees may be planted per acre (240 per ha).

D.3.3 GUATEMALAN X WEST INDIAN hybrids

'Bonita'; obovate, slightly flattened on one side; of medium size; skin slightly rough; flesh contains 8 to 10% oil; seed of medium size. Hardy.

'Booth 1'; round-obovate; medium-large; skin almost smooth, medium thick, brittle; flesh pale, 8 to 12% oil; seed large and loose. The tree is a heavy bearer but the fruit is of poor quality and the seed is too big.

'Booth 7'; round obovate; of medium size; skin slightly rough, thick, brittle; flesh contains 7 to 14% oil; seed of medium size, tight. The fruit is commercially popular and the tree is a good bearer.

'Booth 8'; oblong-obovate; medium-large; skin slightly rough, fairly thick, brittle; flesh contains 6 to 12% oil; seed medium large, tight. Popular commercially and the tree is a heavy bearer.

'Chequette'; oval; large; skin glossy, smooth, slightly leathery; flesh of good quality, 13% oil; seed medium, tight. Tree bears heavily in alternate years.

'Collinson'; broad-obovoid to elliptical; large; skin smooth; flesh of excellent flavour, 10 to 16% oil; seed of medium size, tight. The flesh is apt to blacken around the seed in cold storage.

'Fuchs-20'; ellipsoid; medium to large; skin smooth, speckled with yellowish lenticels when ripe; flesh flavor is excellent. Tree is vigorous but a poor bearer; seedlings vary in salt-tolerance but cuttings of resistant selections perform well in saline conditions.

'Grande'; pear-shaped; large; skin rough, green to purplish; seed of medium size, tight. Tree is a heavy bearer.

'Hall'; pear-shaped; large; skin smooth, fairly thick; flesh deep-yellow, 12 to 16% oil; seed medium large, tight. Heavy bearer and cold-hardy but subject to scab.

'Herman'; obovate; skin smooth, fairly thin, flexible; flesh yellow, 10 to 14% oil; seed small. Tree a heavy bearer and hardy.

'Hickson'; obovate; medium to small; skin slightly rough, thick, brittle; flesh of fair to good quality, 8 to 10% oil; seed small, tight. Tree bears heavily every other year; is cold-sensitive.

'Simpson'; obovate-elliptical; rather large; skin slightly rough and thick but not brittle; flesh pale, 10 to 14% oil; seed medium-large, tight. The tree is a good bearer.

'Winslowson'; round-oblate; large; skin smooth; flesh pale, 9 to 15% oil; seed of medium size, loose. This hybrid is closer to the West Indian race than the Guatemalan. Not popular because of loose seed, overblooming, tendency to shed crop, and tree and fruit are susceptible to anthracnose.

D.3.4 MEXICAN race

Skin thin and tender, clings to the flesh; flesh of high oil content, up to 30%. The foliage has a pronounced anise-like odour; the tree is more cold resistant than those of the other races or hybrids, thriving near Puebla, Mexico, at 500 ft (1,800 m) above sea-level.

'Duke'; elongated; rather small 150 - 200 g; flesh of good quality, 14.5% oil. Tree is large, symmetrical and wind and cold-resistant, and also highly resistant to root rot, especially when grown from cuttings. Bears 78 kg annually from the 6th to the 15th year.

'Ganter'; small, about 150 g; of good quality, 18% oil; seed small to medium, usually loose. Tree is small, yields no more than 20 kg per year. Poor shipper.

'Gottfried'; pear shaped; medium size; skin smooth, purple; flesh of excellent quality, 9 to 13% oil; seed medium. Tree prolific and subject to anthracnose, but hardy and desirable for home.

'Mexicola'; very small; skin black; flesh of excellent flavour; seed large. Bears early and regularly; very heat- and cold-resistant. **'Northrop'**; small, 100-150 g; skin nearly black; flesh of good quality, 26% oil; seed medium. Fruit does not keep well; flavour disagreeable when overripe. Tree bears regularly but has lower yield than 'Duke'.

'Puebla'; medium size; skin smooth, purple; flesh of good flavour; oil content nearly 20%; seed medium to large. Tree does not set fruit regularly. Has been recommended for home gardens because of hardiness.

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'Zutano'; pear shaped; medium-small, skin light green, very thin, leathery; flesh watery, 15 to 22% oil; seed medium. Poor quality, delicate to handle, and prone to disease during ripening. Tree is a good bearer. Grown where it is too cold for 'Hass'.

D.3.5 GUATEMALAN X MEXICAN hybrids

'Bacon' Quality of flesh slightly better than 'Zutano'. Season: slightly later than 'Zutano'. Tends to be affected with end spot, an external blemish. 'Bacon' is a good choice for tropical highlands about 1600 m.

'Fuerte'; pear shaped; small to medium or a little larger; skin slightly rough to rough, with many small yellow dots, thin, not adherent to flesh; flesh green near skin, 12 to 17% oil; seed small, tight. Tree is broad, very productive, but tends to bear biennially. Subject to scab and anthracnose. Has long been the leading avocado on the European market.

'Hass'; pear shaped to ovoid; of medium size; has a tendency to be undersized; skin tough, leathery, dark-purple or nearly black when ripe; pebbled; fairly thin; flesh of good flavour, 18 to 35% oil; seed small. Tree bears better than 'Nabal' in cool areas, but grows tall and requires topping.

'Hayes'; fruit resembles 'Hass' but is larger; skin is glossier, is pebbled, rough, thick and becomes brown-purple. Tree is erect with drooping branches and the fruit is largely sheltered by the foliage.

'Lula'; pear-shaped, sometimes with neck; medium large; skin almost smooth; flesh pale-to greenish-yellow, 12 to 16% oil; seed large, tight. Tree tall, bears early and heavily; cold resistant.

'Rincon'; pear-shaped; small to medium; skin fairly thin, smooth, leathery; flesh buttery, contains 15 to 26.5% oil; fibres in flesh near base turn black when fruit is cut; seed of medium size. Tree has a low spreading habit.

'Ryan'; pear-shaped; of medium size, 226-340 g; skin medium-rough; flesh of fair quality; seed rather large. Tree large and bears regularly but not as heavily as 'Fuerte' or 'Hass'.

'Sharwil'; similar to 'Fuerte' in shape but a little more oval; of medium size, skin rather rough, fairly thin; flesh rich in flavour, of high quality, 15 to 26% oil. Tree bears regularly but not heavily. Disease-free during ripening.

'Susan'; pear-shaped; of medium size, averaging 227-283 g; skin light-green smooth, thin, peels well; flesh pale cream-colour, of bland flavour; ripens unevenly with darkening spots; has slight tendency to turn dark when cut; not attractive; of only fair quality; seed large, loose; coat adheres to seed. Tree of medium size.

D.3.6 In general, small to medium-sized fruits are best for commercial production and especially for metropolitan markets. Large fruits are suitable for local use especially by large families. Smooth, thin or fairly thin, pliable, green skin is preferred by the consumer. The flesh should be virtually fibreless and of agreeable flavour and, for the dieter, of low oil content. The seed must be small and tight so as not to bruise the flesh during handling and shipping. The seed coats ought to adhere to the seed and not to the cavity. The fruit should ship well and stand cold storage. The tree should be of moderate height, slender enough to permit judiciously close planting without crowding. It should bear at an early age and regularly but not so heavily as to suffer die back, and, of course, should be disease-, insect-, and, in subtropical areas, cold-resistant. Cold-resistant cultivars stand cold-storage better than cold-sensitive cultivars.

D.4 Pollination

Many isolated avocado trees fail to fruit from lack of pollination. Commercial growers are careful to match Class A cultivars whose flowers will receive pollen in the morning with Class B cultivars that release pollen in the morning and every grower must be sure to include compatible pollinators in his grove.

D.5 Climate

The West Indian race requires a tropical or near tropical climate and high atmospheric humidity especially during flowering and fruit-setting. The Guatemalan race is somewhat hardier, having arisen in subtropical highlands of tropical America. The Mexican race is the hardiest. Temperatures as low as -4 °C do it little harm. In areas of strong winds, wind-breaks are necessary. Wind reduces humidity, dehydrates the flowers and interferes with pollination, and also causes many fruits to fall prematurely.

D.6 Soil

The avocado tree is remarkably versatile as to soil adaptability, doing well on such diverse types as red clay, sand, volcanic loam, lateritic soils, or limestone. The desirable pH level is generally considered to be between 6 and 7, but avocados are grown on limestone soils ranging from 7.2 to 8.3. Mexican and Guatemalan cultivars have shown chlorosis on calcareous soils in Israel. The tree's primary requirement is good drainage. It cannot stand excessive soil moisture or even temporary water-logging. Sites with underlying hardpan must be avoided. The water table should be at least 0.9 m below the surface. Salinity is prejudicial but certain cultivars (see 'Fuchs-20' and 'Maoz') have shown considerable salt-tolerance. Avocados grafted onto 'Fuch-20' rootstocks and irrigated with water containing 380 to 400 ppm Cl performed well in a commercial orchard.

D.7 Propagation

Normally, avocado seeds lose viability within a month. 'Lula' seeds can be stored up to 5 months if placed in non-perforated polyethylene bags and kept at 4.4 °C, thus indicating that it may be possible to successfully store seeds of other cultivars ripening at different seasons for later simultaneous planting. Fresh seeds germinate in 4 to 6 weeks. Seedlings will begin to bear in 4 or 5 years and the avocado tree will continue to bear for 50 years or more. Some bearing trees have been judged to be more than 100 years old.

While many important selections have originated from seeds, vegetative propagation is essential to early fruiting and the perpetuation of desirable cultivars. However, seedlings are grown for rootstocks. At times, mature avocado groves are top worked to change from an unsatisfactory cultivar, or one declining in popularity, to a more profitable one, or an assortment of cultivars for different markets.

Inasmuch as avocado roots are sensitive to transplanting, it is now considered advisable to raise planting material in plastic bags which can be slit and set in the field without disturbing the root system.

D.8 Spacing

Spacing is determined by the habit of the cultivar and the character of the soil. In light soil, 7.5×7.5 m may be sufficient. In deep, rich soil, the tree makes its maximum growth and a spacing of 9.1 or 10.7 m may be necessary. If trees are planted so close that they will ultimately touch each other, the branches will die back. Some growers plant 3-4.5 m apart initially and remove every other tree at 7 to 8 years of age.

Holes at least 0.6 m deep and wide are prepared well in advance with enriched soil formed into a mound. After the young plant is put in place a mulch is beneficial, weeds should be controlled, and watering is necessary until the roots are well established. Generally small amounts of fertilizer are given every 2 months with the amount gradually increasing until fruiting begins. Bearing trees need, on the average, 1.5 – 2 kg 3 times a year, beginning when the tree is making vegetative growth. No fertilizer should be given at blooming time; one must wait until the fruits are firmly set. Nitrogen has the greatest influence on tree growth, its resistance to cold temperatures, and on fruit size and yield. Fertilizer mixes vary greatly with the type of soil. Mineral deficiencies determined by leaf analysis, are usually remedied by foliar spraying. Magnesium deficiency was formerly a serious handicap to avocado growers in Florida and Kenya. In California, zinc deficiency has been corrected by applying zinc chelates or zinc sulfate to the soil instead of spraying the foliage.

Keeping the upper soil moist has been greatly facilitated by drip irrigation, which also may carry 80% of the fertilizer requirement.

Because some cultivars tend to grow too tall for practical purposes, commercial growers cut trees back to 4.8-5.4 m, let them grow back to 9.1 m and top them again. But decapitation is not a perfect remedy because the tendency of the avocado tree is to grow a new top very quickly. Recently it has been found that the growth-inhibiting chemical, TIBA (triiodobenzoic acid) slows down terminal growth and encourages lateral shoots.

Avocado branches frequently need propping to avoid breaking with the weight of the developing fruits. Some growers find it profitable to interplant bananas until the avocado trees reach bearing age.

D.9 Maturity and harvesting

Avocados will not ripen while they are still attached to the tree, apparently because of an inhibitor in the fruit stem. Homeowners usually consider the entire crop pickable when a few mature (full grown) fruits have fallen. This is not a dependable guide because the prolonged flowering of the avocado results in fruits in varying stages of development on the tree at the same time. The largest fruits, of course, should be picked first but the problem is to determine when the largest are full grown (perfectly mature for later perfect ripening). If picked when full grown and firm, avocados will ripen in 1 to 2 weeks at room temperature. If allowed to remain too long on the tree, the fruits may be blown down by wind and they will be bruised or broken by the fall.

Immature fruits do not ripen but become rubbery, shrivelled and discoloured. Most West Indian cultivars will ripen properly if picked when the specific gravity becomes 0.96 or lower, but 'Waldin' is fully mature when the specific gravity is still above 0.98. Guatemalan and Guatemalan X West Indian cultivars generally are harvest-mature when the specific gravity is 0.98 or lower. In California, physiological maturity of 'Bacon', 'Fuerte', 'Hass' and 'Zutano' has been determined by measurement of length, diameter and volume, but dry weight, correlating with oil content, is considered a better maturity index. California law has, since 1925, required a minimum of 8% oil, but oil content varies greatly among cultivars and also the climatic region where the fruit is grown. Some people complain that the 8% standard is too low for some cultivars. Maximum flavor of 'Fuerte' develops when the fruit is harvested at an oil content of 16%. Therefore, a minimum dry weight standard of 21% has been recommended.

Formerly, avocados were detached by means of a forked stick and allowed to fall, but this causes much damage and loss. Nowadays harvesters usually use clippers for lowhanging fruits and for those higher up a long handled picking pole with a sharp "V" on the metal rim to cut the stem and a strong cloth bag to catch the fruit. Gloves are worn to avoid fingernail scratches on the fruit. All methods of picking are acceptable if the stem scar is waxed on stemless fruits to avoid weight loss before ripening at which time the stem detaches naturally.

Avocados must be handled with care and are packed and padded in single or double-layer boxes or cartons for shipment.

It will be seen that the yield varies greatly with the cultivar, age of tree, the locale, weather and other conditions.

D.10 Yield

It will be seen that the yield varies greatly with the cultivar, age of tree, the locale, weather and other conditions.

D.11 Storage

Storage conditions are elaborated in Annex A.

D.12 Pests and diseases

Migrating cedar waxwings feed on leaves, flowers and very young fruits and the fruits are commonly attacked by squirrels, rats and mice. The avocado red mite, *Oligonychus yothersi*; is the most common predator on the leaves in some groves and not in others. Red-banded thrips, *Selenothrips rubrocinctus*, the greenhouse thrips, *Heliothrips haemorrhoidalis*, and red-spider, *Tetranychus mytilaspidis*, may feed on avocado leaves and blemish the fruits from time to time. There are several scales also which may feed on foliage, especially the wax scale, *Ceroplastes floridensis*, the pyriform, or soft white, scale, *Protospulvinaria pyriformis*, Dictyospermum scale, *Chrysomphalus dictyospermi*, and the black scale, *Saissetia oleae*. Among two dozen other minor pests are the citrus mealybug, *Pseudococcus citri* and avocado mealybug, *P. nipae*. Stinkbugs may prick the fruits leaving little dents in the skin coupled with gritty areas at the same locations inside.

2 lepidopterous pests, *Amorbia cuneana* and the omnivorous looper, *Sabulodes aegrotata*, when present in large numbers, cause severe defoliation and fruit-scarring. Biological control is being

achieved by release of the egg parasite, *Trichogramma platneri*; which is now commercially available to growers. The orange tortrix (a leaf roller), *Argyrotaenia citrana*, has been increasing as a menace to the avocado, the larvae feeding on twigs, terminal buds and foliage, flowers, and fruits. Since the pest requires shaded areas, it is best controlled by thinning out a close-planted grove or top-working to less susceptible cultivars.

Root-rot caused by the fungus, *Phytophthora cinnamomi*, which is being combated by the use of strict sanitary procedures and resistant rootstocks, especially 'Duke'.

Mushroom root-rot from *Clitocybe tabescens* may occasionally occur. Cercospora spot (brown spots on the leaves and fruits), caused by the fungus, *Cercospora purpurea*, may cause cracks in affected areas of the skin and thus allow entrance of the anthracnose fungus, *Colletotrichum gloeosporioides*, which invades and spoils the flesh. *Glomerella cingulata* is an important source of anthracnose. Some cultivars are subject to scab which is readily controlled by copper sprays.

More than 30 other pathogens are variously responsible for wood rot, collar rot, dieback, leafspot, stem-and rot of fruit, branch canker, and powdery mildew. Stems of young trees may be affected by sunburn, and hot, dry winds cause tipburn of leaves. The avocado tree may show copper or zinc deficiency or tipburn from an excess of mineral salts.

D.13 Food uses

Indians in tropical America break avocados in half, add salt and eat with tortillas and a cup of coffee—as a complete meal. Ripe avocados are consumed in a variety of ways depending on consumers. Because of its tannin content, the flesh becomes bitter if cooked.

D.15 Avocado oil

Oil expressed from the flesh is rich in vitamins A, B, G and E. It has a digestibility coefficient of 93.8% but has remained too costly to be utilized extensively as salad oil. The amino acid content has been reported as: palmitic, 7.0; stearic, 1.0; oleic, 79.0; linoleic, 13.0.

The oil has excellent keeping quality. Samples kept in a laboratory in Los Angeles at 4.4 °C showed only slight rancidity after 12 years. There is much interest in the oil in Italy and France. The Institut Francais de Recherches Fruitières Outre Mer has studied the yield of oil in 25 cultivars. Joint Italian/Venezuelan studies of 5 prominent cultivars indicated that the fatty acid composition and tryglyceride structure was not influenced by variety. The oil is used as hair-dressing and is employed in making facial creams, hand lotions and fine soap. It is said to filter out the tanning rays of the sun, is non-allergenic and is similar to lanolin in its penetrating and skinsoftening action. In Brazil, 30% of the avocado crop is processed for oil, 66 % of which is utilized in soap, 33 % in cosmetics. The pulp residue after oil extraction is usable as stockfeed.

Table D.1 — Food value per 100 g of edible portion (flesh)*

Moisture	65.7 — 87.7 g
Ether Extract	5.13 — 19.80 g
Fiber	1.0 — 2.1 g
Nitrogen	0.130 — 3.82 g
Ash	0.46 — 1.68 g
Calcium	3.6 — 20.4 mg
Phosphorus	20.7 — 64.1 mg
Iron	0.38 — 1.28 mg
Carotene	0.025 — 0.475 mg
Thiamine	0.033 — 0.117 mg
Riboflavin	0.065 — 0.176 mg
Niacin	0.999 — 2.220 mg
Ascorbic Acid	4.5 — 21.3 mg
*Analyses of West Indian, Guatemalen and Mexican avocados marketed in Central America.	

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Browning of the flesh of freshly cut avocado fruits is caused by polyphenol oxidase isoenzymes. Avocado halves average only 136 to 150 calories.

The avocado has a high lipid content—from 5 to 25% depending on the cultivar. Among the saturated fatty acids, myristic level may be .1%, palmitic, 7.2, 14.1 or 22.1%; stearic, 0.2, 0.6 or 1.7%. Of the unsaturated fatty acids, palmitoleic may range from 5.5 to 11.0%; oleic may be 51.9, 70.7 or 80.97%, linoleic, 9.3, 11.2 or 14.3%. Non saponifiable represents 1.6 to 2.4%. Iodine number is 94.4. In feeding experiments which excluded animal fat, 16 patients were given ½ to 1½ avocados per day. Total serum cholesterol and phospholipid values in the blood began to fall in one week. Body weight did not increase. Cholesterol values did not rise and 8 patients showed decreases in total serum cholesterol and phospholipids.

Amino acids of the pulp (N = 16 p. 100) are recorded as: arginine, 3.4; cystine, 0; histidine, 1.8; isoleucine, 3.4; leucine, 5.5; lysine, 4.3; methionine, 2.1; phenylalanine, 3.5; threonine, 2.9; tryptophan, 0; tyrosine, 2.3; valine, 4.6; aspartic acid, 22.6; glutamic acid, 12.3; alanine, 6.0; glycine, 4.0; proline, 3.9; serine, 4.1.

D.16 Toxicity

Unripe avocados are said to be toxic. Two resins derived from the skin of the fruit are toxic to guinea pigs by subcutaneous and peritoneal injection. Dopamine has been found in the leaves. The leaf oil contains methyl chavicol. Not all varieties are equally toxic. Rabbits fed on leaves of 'Fuerte' and 'Nabal' died within 24 hours. Those fed on leaves of 'Mexicola' showed no adverse reactions. Ingestion of avocado leaves and/or bark has caused mastitis in cattle, horses, rabbits and goats. Large doses have been fatal to goats. Craigmill *et al.* at Davis, California, have confirmed deleterious effects on lactating goats which were allowed to graze on leaves of 'Anaheim' avocado an hour each day for 2 days. Milk was curdled and not milkable, the animals ground their teeth, necks were swollen and they coughed, but the animals would still accept the leaves on the 4th day of the experiment. By the 10th day, all but one goat were on the road to recovery. All abnormal signs had disappeared 20 days later. In another test, leaves of a Guatemalan variety were stored for 2 weeks in plastic bags and then given to 2 Nubian goats in addition to regular feed over a period of 2 days. Both suffered mastitis for 48 hours. Avocado leaves in a pool have killed the fish. Canaries have died from eating the ripe fruit. The seeds, ground and mixed with cheese or cornmeal, have been used to poison rodents. However, tests in Hawaii did not show any ill effect on a mouse even at the rate of 1/4 oz (7 g) per each 2.2 lbs (1 kg) of body weight, though the mouse refused to eat the dried, grated seed material until it was blended with cornmeal. Avocado seed extracts injected into guinea pigs have caused only a few days of hyperexcitability and anorexia. At Davis, mice given 10 to 14 g of half-and-half normal ration and either fresh or dried avocado seed died in 2 or 3 days, though one mouse given 4 times the dose of the others survived for 2 weeks.

The seed contains 13.6% tannin, 13.25% starch. Amino acids in the seed oil are reported as: capric acid, 0.6; myristic, 1.7; X, 13.5; palmitic, 23.4; X, 10.4; stearic, 8.7; oleic, 15.1; linoleic, 24.1; linolenic, 2.5%. The dried seed contains 1.33% of a yellow wax containing sterol and organic acid. The seed and the roots contain an antibiotic which prevents bacterial spoilage of food. It is the subject of two United States patents.

The bark contains 3.5% of an essential oil which has an anise odour and is made up largely of methyl chavicol with a little anethole.

D.17 Other uses

The seed yields a milky fluid with the odour and taste of almond. Because of its tannin content, it turns red on exposure, providing an indelible red-brown or blackish ink which was used to write many documents in the days of the Spanish Conquest. These are now preserved in the archives of Popayan. The ink has also been used to mark cotton and linen textiles. In Guatemala, the bark is boiled with dyes to set the colour.

Much avocado wood is available when groves are thinned out or tall trees are topped. The sapwood is cream-colored or beige; the heartwood is pale red-brown, mottled, and dotted with small drops of gummy red sap; fine-grained; light — 560-640 kg/m³ m; moderately soft but brittle; not durable;

susceptible to drywood termites and fungi. The wood has been utilized for construction, boards and turnery.

Honeybees gather a moderate amount of pollen from avocado flowers. The nectar is abundant when the weather is favourable. When unmixed by that from other sources it produces a dark, thick honey favoured by those who like buckwheat honey or sugarcane syrup.

D.18 Medicinal uses

The fruit skin is antibiotic; is employed as a vermifuge and remedy for dysentery. The leaves are chewed as a remedy for pyorrhoea. Leaf poultices are applied on wounds. Heated leaves are applied on the forehead to relieve neuralgia. The leaf juice has antibiotic activity. The aqueous extract of the leaves has a prolonged hypertensive effect. The leaf decoction is taken as a remedy for diarrhoea, sore throat and haemorrhage; it allegedly stimulates and regulates menstruation. It is also drunk as a stomachic. In Cuba, a decoction of the new shoots is a cough remedy. If leaves, or shoots of the purple-skinned type, are boiled, the decoction serves as an abortifacient. Sometimes a piece of the seed is boiled with the leaves to make the decoction.

The seed is cut in pieces, roasted and pulverized and given to overcome diarrhoea and dysentery. The powdered seed is believed to cure dandruff. A piece of the seed, or a bit of the decoction, put into a tooth cavity may relieve toothache. An ointment made of the pulverized seed is rubbed on the face as a rubefacient—to redden the cheeks. An oil extracted from the seed has been applied on skin eruptions.

D.19 Related Species

Persea schiedeana Nees, called *coyo*, *coyocte*, *chalte*, *chinini*; *chucte*, *chupte*, *cotyó*, *aguacate de monte*, *aguacaton*, wild pear, and *yas*, grows wild in mountain forests from southern Mexico to Panama at altitudes 1,400-1,900 m. The tree is usually 15-20 m tall, occasionally to 50 m. Young branches are densely brown-hairy. The leaves are deciduous, obovate to oval, often cordate at the base; 12.5-30 cm long, 7-15 cm wide, white-hairy on the underside. Downy flowers, borne in densely grayish-hairy panicles, are light greenish-yellow, the perianth and stamens turning red with age. The fruit, resembling that of the avocado and equally variable, is generally pear-shaped, weighing 227-397 g, with thick, leathery, flexible skin. Various descriptions are given: brownish-white, light-brown, pale-green, greenish-brown or dark-brown, the flesh is oily with a milky juice, few to many coarse fibres, but a very appealing, avocado-coconut flavour. The seed is very large. The cotyledons, unlike those of the avocado, are pink internally.

The tree is left standing when forests are cleared and is cultivated in Veracruz and on some farms in Guatemala. The fruits from the best of the wild and cultivated trees are marketed locally. The timber is used in construction and carpentry. This species was introduced into the USA from Guatemala and Honduras in 1948 as a wilt-resistant rootstock for the avocado. It is very sensitive to frost. In 1974 it was reported to be a poor bearer in Puerto Rico.

A more distant relative is *Beilschmiedia anay* Kosterm. (*Huielandia anay* Blake), called *anay*, *payta*, *escalalan* or *excalan*, which is native to moist, relatively low altitudes, 300 to 700 m in southern Mexico, Guatemala, Costa Rica and Colombia.

The tree attains a height of 20 m; the young branches are brown-hairy. Leathery leaves, broad-elliptic or broad-ovate, are 12-30 cm long and 7.5-19 cm wide, white-hairy only on the veins. The flowers (in December and January) are fragrant, greenish, in slender panicles to 13 cm long. The fruit is ellipsoid-pyriform, 7-15 cm long, with very thin, glossy, purplish-black skin and sparse green, oily flesh similar to that of the avocado in texture and flavour. The seed is obovoid, up to 7 cm long, with thick, purplish-yellow, red spotted coat, and strong almond odour. In Guatemala, the fruit matures in August and September, falls while hard, and ripens in 2 or 3 days. Analyses in Guatemala show (per 100 g/flesh): moisture, 73.86 g; protein, 1.62-1.80 g; carbohydrates, 3.32-3.90 g; fat, 12.98-17.44 g; cellulose, 2.12 g; ash, 1.38 g. See Table D.2.

Table D.2 — Food value per 100 g of edible portion (*flesh*)*

Moisture	76.5 — 77.6 g
Ether Extract	5.55 — 7.59 g
Fiber	1.0 — 1.8 g
Nitrogen	0.191 — 0.204 g
Ash	0.72 — 0.91 g
Calcium	11.4 — 12.5mg
Phosphorus	35.5 — 36.2 mg
Iron	0.31 — 0.35 mg
Carotene	0.003 — 0.033 mg
Thiamine	0.048 — 0.070 mg
Riboflavin	0.067 — 0.089 mg
Niacin	0.598 — 0.718 mg
Ascorbic Acid	5.7 — 16.4 mg
*Analyses by Munsell <i>et al.</i>	

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

Annex E (informative)

Avocado — 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
Abamectin	0.02	---	<i>{0.01}</i>
Azoxystrobin	2	---	<i>{0.05}</i>
Boscalid	1.5	---	<i>{0.05}</i>
Buprofezin	0.3	---	<i>{0.05}</i>
Carfentrazone-ethyl	0.1	---	EU 1 <i>{0.01}</i>
	1. European Union does not maintain a specific MRL for the Carfentrazone-ethyl/Avocado combination, but does maintain an MRL of 0.01 PPM for its "Fruit Fresh or Frozen; Nuts" group.		
Cyprodinil	1.2	---	EU 2 <i>{0.05}</i>
	2. European Union does not maintain a specific MRL for the Cyprodinil/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Miscellaneous fruit" group.		
Fenpropathrin	1	---	EU 3 <i>{0.01}</i>
	3. European Union does not maintain a specific MRL for the Fenpropathrin/Avocado combination, but does maintain an MRL of 0.01 PPM for its "Miscellaneous fruit" group.		
Fludioxonil	0.45	---	<i>{0.05}</i>
Folpet	25	---	EU 4 <i>{0.02}</i>
	4. European Union does not maintain a specific MRL for the Folpet/Avocado combination, but does maintain an MRL of 0.02 PPM for its "Miscellaneous fruit" group.		
Fosetyl-AI	25	---	50
Glyphosate	0.2	---	EU 5 <i>{0.1}</i>
	5. European Union does not maintain a specific MRL for the Glyphosate/Avocado combination, but does maintain an MRL of 0.1 PPM for its "Inedible peel, large" group.		
Imidacloprid	1	---	1
Inorganic bromide resulting from fumigation	75	75	<i>{50}</i>
Malathion	8	---	EU 6 <i>{0.02}</i>
	6. European Union does not maintain a specific MRL for the Malathion/Avocado combination, but does maintain an MRL of 0.02 PPM for its "Miscellaneous fruit" group.		
Metalaxyl	4	<i>{0.2}</i>	EU 7 <i>{0.05}</i>
	7. European Union does not maintain a specific MRL for the Metalaxyl/Avocado		

	combination, but does maintain an MRL of 0.05 PPM for its "Miscellaneous fruit" group.		
	US	Cod	EU 8
Methomyl	2	---	{0.05}
	8. Methomyl and Thiodicarb (sum of methomyl and thiodicarb expressed as methomyl) European Union does not maintain a specific MRL for the Methomyl/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Miscellaneous fruit" group.		
	US	Cod	EU 9
Methoxyfenozide	0.6	---	{0.02}
	9. European Union does not maintain a specific MRL for the Methoxyfenozide/Avocado combination, but does maintain an MRL of 0.02 PPM for its "Inedible peel, large" group.		
	US	Cod	EU
Norflurazon	0.2	---	---
	US	Cod	EU 10
Oryzalin	0.05	---	{0.01}
	10. European Union does not maintain a specific MRL for the Oryzalin/Avocado combination, but does maintain an MRL of 0.01 PPM for its "Miscellaneous fruit" group.		
	US	Cod	EU 11
Oxyfluorfen	0.05	---	0.05
	11. European Union does not maintain a specific MRL for the Oxyfluorfen/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Inedible peel, large" group.		
	US	Cod 12	EU 13
Paraquat dichloride	0.05	{0.01}	{0.02}
	12. Codex does not maintain a specific MRL for the Paraquat dichloride/Avocado combination, but does maintain an MRL of 0.01 PPM for its "Assorted tropical and sub-tropical fruits - inedible peel" group.		
	13. European Union does not maintain a specific MRL for the Paraquat dichloride/Avocado combination, but does maintain an MRL of 0.02 PPM for its "Fruit Fresh or Frozen; Nuts" group.		
	US	Cod	EU 14
Permethrin	1	---	{0.05}
	14. European Union does not maintain a specific MRL for the Permethrin/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Fruit Fresh or Frozen; Nuts" group.		
	US	Cod	EU 15
Phosphine	0.01	---	0.05
	15. European Union does not maintain a specific MRL for the Phosphine/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Fruit Fresh or Frozen; Nuts" group.		
	US	Cod	EU
Pyraclostrobin	0.6	---	{0.02}
	US	Cod	EU 16
Pyriproxyfen	1	---	{0.05}
	16. European Union does not maintain a specific MRL for the Pyriproxyfen/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Miscellaneous fruit" group.		
	US	Cod	EU 17
Simazine	0.2	---	{0.1}
	17. European Union does not maintain a specific MRL for the Simazine/Avocado combination, but does maintain an MRL of 0.1 PPM for its "Fruit Fresh or Frozen; Nuts" group.		
	US	Cod	EU 18
Spinetoram	0.3	---	{0.05}
	18. European Union does not maintain a specific MRL for the Spinetoram/Avocado combination, but does maintain an MRL of 0.05 PPM for its "Miscellaneous fruit" group.		
	US	Cod	EU
Spinosad	0.3	---	{0.02}

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