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Avocados — Guide for storage and transport

Avocats — Guide pour l'entreposage et le transport

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2295 was drawn up by Technical Committee ISO/TC 34, *Agricultural food products*, and circulated to the Member Bodies in April 1971.

It has been approved by the Member Bodies of the following countries :

Australia	Hungary	Romania
Austria	India	South Africa, Rep. of
Brazil	Iran	Spain
Chile	Netherlands	Sweden
Czechoslovakia	New Zealand	Thailand
Egypt, Arab Rep. of	Poland	Turkey
France	Portugal	United Kingdom

No Member Body expressed disapproval of the document.

Avocados — Guide for storage and transport

0 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.

1 SCOPE AND FIELD OF APPLICATION

This International Standard lays down the conditions for successful storage of avocados, *Persea americana* Miller (*Persea gratissima* Gartner), 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).

2 REFERENCE

ISO 2169, *Fruits and vegetables — Testing of physical conditions in cold stores.*¹⁾

3 CONDITIONS OF HARVESTING AND PUTTING INTO STORAGE

3.1 Varieties

The products covered by this International Standard are fresh fruits intended for storage and belonging to the following cultivars:

Antilles group	Peterson — Fuchs — Pollock — Waldin — Simmonds — Black Prince
Guatemalan group	Anaheim — Benick — Chica — Dickinson — Itzanna — Edranol — Linda — Nabal — Taylor — Trapp-Schmidt — Wagner
Antilles and Guatemalan hybrids group	Bonita — Booth 1 — Booth 3 — Booth 7 — Booth 8 — Choquette — Collinson — Fairchild — Hickson — Lula — Hall
Mexican and Guatemalan hybrids group	Fuerte — Mac Arthur
Mexican group	Duxe — Ettinger — Taft — Topa Topa — Zutano

This list is not restrictive.

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.

1) At present of the stage of draft.

3.2.1 Criteria of maturity

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

- 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.

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).

3.3 Quality characteristics for storage

Avocados shall have a stalk 1 to 2 cm long.

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.

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.

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.

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.

4.1 Cooling

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

- a refrigerated installation with a refrigeration power of 700 to 930 W¹⁾ per tonne of avocados;
- a cooling air temperature of 7 to 12 °C, according to the the temperature of storage (see 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 system (without short-circuits of external air).

1) 600 to 800 kcal/h.

4.2 Keeping at storage temperature

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 Antilles 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.

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 ISO 2169.

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.

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 annex).

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.

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).

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ANNEX

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 %.

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