

INTERNATIONAL
STANDARD

ISO
9719

First edition
1995-07-01

**Root vegetables — Cold storage and
refrigerated transport**

Légumes à racines — Entreposage à froid et transport réfrigéré



Reference number
ISO 9719:1995(E)

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9719 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*, Subcommittee SC 14, *Fresh fruits and vegetables*.

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Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Root vegetables — Cold storage and refrigerated transport

1 Scope

This International Standard gives guidance on conditions for cold storage and refrigerated transport of fresh root vegetables.

It applies only to stemless root vegetables intended for long-term storage in large-capacity warehouses, or refrigerated transport. Requirements for the storage of root vegetables with leaves are considerably different and are applicable only to short-term storage.

This International Standard applies to black radish (*Raphanus sativus*), blackroot (*Scorzonera hispanica*), carrot (*Daucus carota*), horseradish (*Armoracia rusticana*), parsley (*Petroselinum crispum* var. *tuberosum*), red beetroot (*Beta vulgaris* var. *cruenta*) and similar root crops.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2169:1981, *Fruits and vegetables — Physical conditions in cold stores — Definitions and measurement*.

3 Characteristics for storage

3.1 Vegetables intended for long-term storage should be intact and firm without any mechanical damage, and be free of frost damage, rot, mould,

parasites and disease. Excessive moisture on the surface of the roots and the presence of foreign odours or flavours should be avoided. Total removal of leaves is recommended. It is permitted to cut leaves smoothly with tops of roots of carrots, parsley, celeriac and beetroot.

3.2 The vegetables may be stored in warehouses without preliminary cleaning or washing, however, the soil naturally adhering to the roots or bulb should not exceed 2 % of the root weight.

3.3 Reference to standards for quality requirements valid for the individual types of root vegetable will minimize storage losses.

4 Putting into storage

4.1 Root vegetables may be stored in box pallets or individual wooden or plastic boxes, stacked on simple pallets to form handling units. Individual boxes on pallets may be formed into storage blocks suitable for fork-lift trucks.

4.2 The stacking height depends on the structure of the pallets and boxes but should conform to national standards for maximum loading. A common stacking height for individual boxes on pallets is 4 m, while that for box pallets is 6 m.

4.3 It is necessary to leave a minimum of 25 cm to 30 cm of free space between the stacks and the ceiling, and between the walls of the warehouse and the nearest stack.

4.4 In order to facilitate the use of a fork-lift truck, a space of 25 cm to 30 cm is recommended between the stacks.

4.5 Root vegetables may also be loose (or bulk) piled. The warehouse should be provided with interior bulkheads at least 1 m from the interior walls. Bulk piling may not be suitable for vegetables with long roots because of possible damage during mechanical filling and removal.

5 Method of storage

5.1 Root vegetables should be packed in wooden or plastic boxes for storage and transport.

The sides and possibly the bottom of the individual containers should be provided with a sufficient number of ventilation holes to allow air circulation through the package.

Ventilation in the horizontal direction is preferred.

An evaporator should be located near the ceiling so that the cooled air, circulated by the evaporation fans above the stored vegetables, falls and is returned to the evaporator.

5.2 The following conditions should be applied:

- high relative humidity may be provided by installation of a mechanical humidifier;
- air should be circulated within the room at a rate of 30 air changes per hour;

- the rate of ventilation with outside air should be 0,5 air changes per hour;

- if the mechanical refrigeration system is out of order, ventilation with outside air should be stopped so that the temperature within the room is maintained for as long as possible.

6 Optimum storage and transport conditions

For measurement of the physical quantities affecting storage, see ISO 2169.

6.1 Root vegetables should be stored at:

- a) temperature: 0 °C to 2 °C;
- b) relative humidity: 90 % to 95 %.

6.2 The storage room should be precooled to 0 °C to 1 °C prior to loading; product loading should be completed in less than 7 days.

6.3 When removed from storage, any moisture which may condense on the surface of the vegetables may be removed by holding the vegetables at 10 °C to 20 °C with adequate air circulation.

6.4 Root vegetables should always be shipped in refrigerated transport maintained at a uniform temperature between 0 °C and 5 °C.

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