INTERNATIONAL STANDARD

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Round-headed cabbage — Guide to cold storage and refrigerated transport

Choux pommés — Guide pour l'entreposage et le transport réfrigérés

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 2167 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*.

This second edition cancels and replaces the first edition (ISO 2167:1981), the scope of which has been technically revised to include recommendations for refrigerated transport.

Annex A of this International Standard is for information only.

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Introduction

This International Standard gives general recommendations for the cold storage and refrigerated transport of round-headed cabbages.

These recommendations may need to be modified to suit particular cultivars of round-headed cabbage, local climatic conditions, cultivation practices and market requirements, distances of transportation, etc. Experts will be able to establish those recommendations most appropriate for particular market requirements, and ecological and agrotechnical factors. In addition, the quality of the harvest and the storage conditions attainable in particular transport vehicles and cold stores may necessitate modifications to these recommendations.

Subject to local conditions and the fact that cabbages are living matter, the application of the recommendations made in this International Standard should enable much wastage during refrigerated transport and cold storage to be avoided.

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Round-headed cabbage — Guide to cold storage and refrigerated transport

1 Scope

This International Standard gives guidance on the operations to be carried out before and the conditions to be met during the cold storage and refrigerated transport of round-headed cabbages (*Brassica oleracea* L. var. *capitata* L., and *Brassica oleracea* L. var. *sabauda* L.), for maintaining quality and avoiding deterioration.

This International Standard is applicable to round-headed cabbages intended for human consumption.

2 Conditions of harvesting and storage

2.1 Harvesting

Cabbages should be harvested when ripe (firm "head"), i.e. when the size and form of the head of the cabbage is characteristic of the cultivar in question, and during a period of dry weather.

NOTE 1 Premature harvesting may lead to an excessive tendency of the cabbages to wither and, conversely, delayed harvesting may induce bursting of the cabbages.

The best period for harvesting is early in the morning, in dry weather, in the absence of dew and, in the case of irrigated cultivation, 10 days to 15 days after the last irrigation (in order to avoid excessive turgidity of the tissues, cracks in the heads and rotting leaves).

Cabbages harvested in wet weather should be allowed to dry before being stored and transported.

Cabbages damaged or frozen, even partially, should be rejected.

The butt should be cut off slightly below the point from which the outer leaves originate, the latter remaining firmly attached. The cut should be made cleanly and the butt should have a maximum length of 3 cm, in order to avoid cabbages being damaged by mechanical action during handling.

2.2 Characteristics for storage

Late varieties of cabbage are recommended for storage.

Cabbages intended for storage should be sound, of good quality, not run to seed and, depending on the cultivar, of mass 1,6 kg to 3 kg for white cabbage, and 1 kg to 2 kg for red cabbage.

Cabbages should be free from disease and physiological defects.

The heads should be well covered and free from parasites, bruises and damage or injuries due to frost. They should be clean and free from earth fragments or other foreign materials. Their content of agrochemical product residues should not exceed the limits established by the relevant producing or importing country.

The heads should be free from abnormal surface moisture. They should be covered by at least one layer of outer leaves.

2.3 Place of storage

Cabbages should be stored in refrigerated cells of maximum capacity 500 t; the cells should be previously disinfected, free from insects and vermin, aerated and cooled.

The storage of cabbages in the vicinity of products which emit ethylene should be avoided since this may affect the quality of the cabbage by inducing cracks in the head of the cabbage and yellowing and abscission of the leaves.

The time taken to fill a cell should be no longer than 7 days.

2.4 Method of storage

Cabbages may be stored in bulk or in standardized containers.

Cabbages stored in bulk should be ventilated in the vertical direction, and the depth of cabbages in any stack should not exceed 3 m.

Cabbages stored in standardized containers should be ventilated in the vertical or in the horizontal direction or in top-ventilated cells. The height of stacks should not exceed 6 m, and a minimum free space of 80 cm should be left between the top row of containers and the ceiling of the cell. The cabbages should be arranged in rows with their butts facing upwards.

The storage system should ensure good air circulation; it is therefore necessary to leave a space of 5 cm to 10 cm between stacks, and a space of about 65 cm between stacks and the wall.

3 Optimum storage conditions[1)]

3.1 Air temperature

The average air temperature in the cold store should be maintained between 0 °C and 1 °C.

The temperature at the centre of a stack should also be between 0 °C and 1 °C, although white cabbage is able to tolerate a temperature of −0,8 °C.

NOTE 2 Reducing the temperature to below −0,8 °C may cause decomposition of leaf tissue.

Owing to the respiration of cabbages, the temperature at the centre of a stack will increase rapidly if the stacking pattern is incorrect and the ventilation inadequate, and therefore the product temperature should be monitored within representative stacks.

3.2 Relative humidity

The relative humidity should be maintained between 90 % and 98 %.

3.3 Air circulation

The air circulation during storage and transportation should be such (0,25 m/s to 0,40 m/s) that the temperature and relative humidity specified in 3.1 and 3.2 are maintained constant and uniform.

3.4 Storage life and quality control

The storage life of cabbages depends on the cultivar, the quality and the storage conditions (see annex A). The storage life of most cultivars falls into one of three categories: short term (3 months to 5 months), mid term (4 months to 6 months) and long term (5 months to 7 months).

During the storage period, regular quality control of the product should be carried out.

4 Operations at the end of storage

Before marketing, it is necessary to examine cabbages and to discard yellowed or diseased outer leaves, to retrim the butt if necessary, and to discard split or rotten heads.

5 Refrigerated transport

To maintain their quality during transportation, cabbages should be packed in containers standardized in the country concerned.

The duration of transport may be 2 days to 3 days at a temperature of 0 °C to 15 °C, or 8 days to 10 days at a temperature of 0 °C to 1 °C.

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

Annex A
(informative)

Influence of horticultural factors on storage life, and defects arising during storage

A.1 Influence of horticultural factors on storage life

Certain ecological or agrotechnical factors have an adverse effect on the storage life of cabbages. These factors may be summarized as follows:

a) cabbages which are harvested too early or too late (e.g. cabbages which have burst or run to seed);

b) cabbages (particularly spring, summer and autumn varieties) having leaves which are excessively curled and which do not adhere tightly to the head;

c) cabbages from land which has been over-treated with nitrogenous fertilizer;

d) cabbages harvested in wet weather;

e) cabbage heads damaged by lesions caused by frost (see note 3), or which have lost most of their leaves or which have had too much of their tops knocked off.

NOTE 3 Certains cultivars of green cabbage which are resistant to cold are able to withstand temperatures slightly below 0 °C but not freezing.

A.2 Defects arising during storage

In general, a distinction is made between damage of physiological origin and damage of biological origin.

A.2.1 Physiological damage

Physiological damage may be characterized by

a) desiccation of the outer leaves, owing to insufficient relative humidity during storage;

b) a glassy appearance of the leaves when the storage temperature has been too low (freezing); the leaves will turn brown on warming;

c) the appearance of small brown specks, owing to lack of oxygen during storage (lack of oxygen occurs when the cabbage or its container is covered with plastic film);

d) loss of the outer leaves or bursting, due to physiological disorders.

A.2.2 Biological damage

Biological damage may be due to bacterial decomposition such as blackening of the veins, caused by *Pseudomonas campestris*, or fungal deterioration.

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