

# Storage of fruits, potatoes and onions

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## Diseases during fruit storage

Fruit storage depends on the species and varietal composition, as well as on the conditions under which they are stored. Late apple and pear varieties and quince can be stored under ordinary conditions for up to 2–3 months, and in a refrigerator – for up to 4–6 months. Under household conditions, storage is best carried out in cellar premises, where temperatures are lower and air humidity is higher. Storage is best achieved in refrigerated fruit stores, where a constant temperature is maintained, from minus 1°C to about 3–5°C for the different species, and a relative air humidity of 85–90%. Under these conditions the fruits can be stored throughout the winter, until spring.

The temperature and air humidity must be controlled throughout the entire storage period. Fruits of different varieties should be stored separately.

Under improper storage regime, diseases of an **infectious or non-infectious** nature develop on the stored fruits.

## Infectious diseases:

**Soft rot** – manifests itself in the form of yellow to light brown spots around mechanical injuries on the fruits, with watery and soft tissues, with an unpleasant moldy odor and alcoholic taste. The decay encompasses the entire fruit, which softens and is easily crushed under pressure, and under high humidity a dense blue-green mold growth is formed.

**Gray mold rot** – on the fruits, under high humidity, a grayish-white fluffy growth of the mycelium and spores of the fungus develops. The spots quickly spread to neighboring fruits and foci of infection are formed in a short time. Stored fruits should be checked regularly and, upon manifestation of the disease, they must be quickly removed and destroyed.

**Bitter rot** – appears as brown rot on the surface of the fruits or as internal decay around the seed cavity, which is filled with cotton-like mycelium speckled with clusters of pink sporulation. The fruits have a bitter taste and an unpleasant odor.

**Brown rot** – the pathogen penetrates the fruits through injuries caused by pests, diseases and hail. The surface of infected fruits becomes glossy, dark – brown or black. The disease spreads rapidly to neighboring fruits, especially at low temperatures and high air humidity.

## Non-infectious diseases:

**Fruit scald** – light brown spots on the surface of the fruits, which enlarge and gradually penetrate to a depth of up to 1 cm into the fruit. The disease is due to an impaired temperature regime and poor gas exchange, under which toxic substances such as acetic acid, methyl alcohol, acetaldehydes, etc. accumulate around the fruit.

**Jonathan spots** – development of necrotic, light brown surface spots located around the lenticels of the fruit. The cause of the disease is impaired gas exchange. In case of attack by secondary microorganisms, soft rot develops.

**Bitter pit** – under the fruit skin small brown cores of dead cells with a spongy consistency and bitter taste are formed, reaching a depth of 1–2 cm. The disease is due to calcium deficiency.

## Potato diseases during storage

For storage of healthy and edible potatoes, the tubers must be well matured, without mechanical damage and free from disease attacks. Potato stores must be cleaned and disinfected with a 3% solution of copper sulfate. Potatoes should be stored at a temperature of 2–4°C, relative humidity of 80–90% and good ventilation of the store. Periodic inspections should be carried out for timely removal of rotten tubers.

Under unsuitable storage conditions, infectious and non-infectious diseases develop on potatoes.

### Infectious diseases:

**Dry (*Fusarium*) rot** – a fungal disease which appears as a light brown, sunken, dry spot around an injured place on the tuber. The spot enlarges slowly and encompasses the entire tuber, which mummifies. Under the spot, the interior of the tuber acquires a loose structure. Under moist conditions a pale pink or cream growth develops. The optimal storage temperature is between 2–5°C.

**Soft rot** – caused by bacteria and within 5–6 days the tuber softens, rots and turns into a slimy mass with an unpleasant odor. The disease is transmitted from one tuber to another and foci of decay are formed. Rotting tubers must be removed, ventilation must be increased and a temperature of 2–5°C must be maintained.

**Phomosis dry rot (*phomosis*)** – the disease appears on the surface of the tuber in the form of large, rounded, 2–5 cm, sunken and well delimited from the healthy tissue, brown spots with a net-like structure. Under the spots the tissues are dry and spongy, and later cavities covered with a gray growth are formed. Temperatures below 4°C and above 10°C are unfavorable for the development of phomosis. Light hardening of the tubers for 3–4 days is recommended before placing them in storage.

## Non-infectious diseases:

**Blackheart** – in the center of the tuber the tissues are necrotic and blackened, gradually harden, dry up and cavities are formed. The cause of the disease is oxygen deficiency. To prevent the disease, it is recommended to store the tubers in layers not higher than 1–1.5 m, with ensured ventilation by means of grates and fans.

**Freezing injury of tubers** – in mild freezing, the damage appears as darkening of the vascular bundles. At minus 1°C to 3°C the tubers freeze and become hard. After thawing the tissues soften and macerate (disintegrate) – the process is irreversible.

**Sweetening of tubers** – this disorder is observed when the temperature remains around 0°C for a prolonged period. Then excess sugars accumulate in the tubers due to reduced respiration. When such tubers are placed in warmth (around 10°C), respiration increases and their sweet taste disappears.

## Diseases of bulb crops during storage

During storage, onion and garlic bulbs must be healthy, clean, without mechanical damage and covered with scales. They should be stored in well-ventilated stores, in bulk or in shallow layers, maintaining a temperature of 0–2°C and up to 65% air humidity. Under improper storage regime the following diseases develop:

**Black mold rot of onion and garlic** – the bulbs soften, their scales dry out and mummify, and a black powdery mass forms between them.

**Soft, crumbly rot of onion** – the tissues around the neck soften and sink. When cut, it can be seen that some of the inner scales have rotted, look boiled and emit an unpleasant odor.

**Neck rot of onion** – the rot starts from the neck, with the diseased scales being watery and separated from the healthy ones by a narrow ring. Later they mummify and under moist conditions are covered with a gray growth.

**Gray rot of garlic** – yellowish-brown, slightly sunken, small spots develop, which gradually enlarge during storage. When harvesting the bulbs, they should be well dried and stored in cool and well-ventilated premises.

***Blue-green mold rot of onion and garlic*** – the outer scales and the base of the bulbs are covered with brown watery spots, gradually mummify and only the outer scales remain. In garlic, the head darkens and breaks into individual cloves. Diseased bulbs smell strongly and are covered with a blue-green growth. Only mechanically sound bulbs should be stored, under maintenance of optimal conditions.

***Fusarium rot of onion and leek*** – the onion bulbs, the roots and the pseudostem of leek soften, turn brown and rot. A pink mycelium develops between the scales and leaves.