

Technologies For Drying Melons and An Integrated Pest Management System Under the Conditions of Uzbekistan

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Abstract: This article analyzes the technologies for drying cucurbit crops, particularly melon, under the conditions of Uzbekistan, as well as their nutritional and pharmacological significance and methods for controlling major pests.

Key points: Melon varieties, Uzbekistan melon cultivation, Ripening period, Yield Organoleptic properties (taste, aroma), Storage duration, Nutritional value, Chemical composition, Water content, Vitamins (Vitamin C) fructose, candied fruits, cucurbit crops, leaf beetles, cultivated varieties.

Introduction

Currently, more than 150 cultivated varieties of melon are widely distributed in Uzbekistan. These varieties differ significantly in terms of ripening period, yield, organoleptic characteristics (taste and aroma), and storage duration. Most of these varieties are recognized not only nationally but also internationally due to their high quality. Melon fruit has high biological and nutritional value, and its chemical composition is characterized as follows: 85.0–92.0% water, 8.0–15.0% dry matter, 0.8% protein, 1.8% fiber, 6.2% carbohydrates, 0.9% fat, and 0.6% ash content. In addition, it contains 20.0–30.0 mg/% vitamin C, 0.03–0.07 mg/% other vitamins, as well as essential microelements such as Zn, Fe, Ca, Mg, K, and P, along with various organic and mineral compounds [1]. In Central Asian melon varieties, the total sugar content reaches 14.0–16.0%. The sweetness of melon mainly depends on the ratio of monosaccharides: a higher fructose content provides an intensely sweet taste, while a higher glucose content results in a mildly sweet flavor. These characteristics determine the importance of melon as a dietary food product, as well as its medicinal and traditional uses [2-3]. Melon is widely used in the food industry as a raw material for producing various processed products such as jams (syrops), preserves, candied fruits, pies, gingerbread, and cookies. Particularly noteworthy is “bekmes,” a traditional product obtained from melon, containing up to 60% sugar and distinguished by its unique color and taste. Bekmes is widely used in traditional Eastern confectionery, especially in the preparation of halva. Additionally, overripe melon fruits are processed into a traditional dried product known as “melon paste” (qovunqurt), prepared by mixing melon pulp with flour and drying it under sunlight [4]. This product can be stored for a long period (until spring), making it an important method for processing and preserving melon.

Methodology

Sun-dried melon slices become a natural product with a high concentration of sugars, exceeding 50%, and are widely consumed by the local population as well as exported, contributing

to economic value. Among modern drying technologies, vacuum freeze-drying (lyophilization) occupies a special place. Although this technology has been developing for more than a century, it still remains partly within the scope of experimental research. Many conventional drying technologies lack sufficiently developed fundamental scientific bases and optimized design methodologies. It is well known that during conventional hot-air drying, along with moisture evaporation, significant losses of biologically active substances, particularly vitamins and some microelements, occur. This reduces the nutritional and biological value of the dried product [5]. Thermal exposure accelerates oxidation processes, especially leading to the degradation of thermolabile vitamins such as vitamin C. In contrast, vacuum freeze-drying is based on a different physicochemical principle. In this process, raw materials are first frozen at low temperatures, and then, under vacuum conditions, the frozen water is removed through sublimation (direct transition from solid to vapor state) [6]. As a result, biologically active compounds, vitamins, and microelements are largely preserved.

The main advantages of this method include:

- preservation of natural taste, color, and aroma;
- reduction of degradation of oxidation-sensitive microelements;
- extended shelf life;
- high rehydration capacity of the product.

Thus, vacuum freeze-drying effectively solves one of the main problems in preserving fresh fruits and cucurbit crops—rapid spoilage—and allows consumers to access high-quality dried products throughout the year [7].

Result and discussion

Ensuring food security, meeting the growing demand for food products, and increasing export potential are among the most pressing issues today. In this regard, the introduction of scientifically based innovative technologies in the cultivation, storage, and processing of melon and other cucurbit crops is of great importance. The biochemical composition of melon also determines its dietary properties. It contains high levels of easily digestible monosaccharides (mainly fructose and glucose), making it a high-energy food product. However, due to this characteristic, consumption of melon should be limited for individuals prone to obesity or suffering from diabetes, as it may disrupt metabolic balance. Individuals with food allergies are also advised to exercise caution. Bioactive compounds in melon contribute to its pharmacological significance. In particular, carotenoids exhibit antioxidant properties, neutralizing free radicals and thereby reducing the risk of cancer development [8]. Adenosine has anticoagulant properties, regulating blood clotting and helping to prevent cardiovascular diseases, including stroke. Furthermore, potassium in melon supports heart function, regulates blood pressure, and plays an important role in preventing hypertension. Melon beetle (species belonging to the family Chrysomelidae) is one of the major pests causing significant damage to cucurbit crops such as cucumber (*Cucumis sativus*), melon (*Cucumis melo*), watermelon (*Citrullus lanatus*), and pumpkin (*Cucurbita* spp.). The adult beetle (imago) measures 7–9 mm in length, with a broadly oval body that is dorsoventrally flattened and slightly convex on the upper side [9]. Its coloration is reddish-brown, and each elytron (wing cover) typically has six black spots. The antennae are composed of 11 segments and have a filiform structure. The eggs are elongated-oval, approximately 1.7–1.8 mm in size, and yellow in color. The larval stage reaches up to 8–9 mm in length, with a yellowish body and five longitudinal rows of spiny projections on the dorsal side. The pupa is whitish-yellow, slightly smaller than the adult, with small black spots and fine hairs on the body. This pest overwinters mainly in the adult (imago) stage. Overwintering sites include plant residues, under leaves, beneath hay, in orchards, and near the soil surface. In early spring (March–April), beetles emerge from diapause and begin active feeding. They consume the parenchyma tissue from the underside of leaves, leaving only the veins, resulting in skeletonized leaves [10].

Female beetles lay eggs in clusters of 20–40 on the underside of leaves. A single female can lay approximately 120–150 eggs during its lifetime. Larvae hatch within 3–4 days and begin

feeding intensively, creating numerous holes in the leaves. In some cases, they also damage the fruit rind, significantly reducing product quality [11]. The larval development period lasts 15–20 days, after which pupation occurs on plants or near the soil surface. During the growing season, the melon beetle can produce 2–3 generations. At low temperatures (around -17°C), a large proportion of overwintering individuals perish. Click beetles (family Elateridae, order Coleoptera), particularly *Agriotes meticulosus*, are also dangerous pests of cucurbit crops [12]. The adult body is elongated and somewhat flattened, with the anterior part of the thorax extended into a pointed projection. A distinctive feature of these beetles is their ability to produce a “clicking” sound and jump into the air using the thoracic spine when they are flipped onto their backs. The larvae, known as wireworms, are elongated, cylindrical, yellowish in color, and covered with a thick chitinous exoskeleton [13]. Their head is flattened, and they possess three pairs of well-developed legs. Wireworms are polyphagous pests that develop in the soil and damage seeds, seedlings, young roots, and underground parts of stems. As a result, plant emergence and development are significantly reduced. Some species of click beetles overwinter in both adult and larval stages, while others overwinter only in the larval stage in the soil. Their life cycle may last several years, which complicates control measures [14].

Control measures (integrated pest management system):

1. Agrotechnical measures:

Early sowing of cucurbit crops at optimal times and the cultivation of healthy, vigorous seedlings play a crucial role in reducing pest damage. Crop rotation (including green manure practices) is also effective in reducing wireworm populations.

2. Preventive chemical treatments:

In early spring (March–April), it is recommended to treat weeds and surrounding areas where sucking pests (aphids, thrips, spider mites, whiteflies) develop. The following insecticides may be used:

- BI-58 (0.2%)
- Benzophosphate (0.3%)
- Karate (0.05%)
- Cyperphos (0.1%)

These measures not only limit the spread of major pests but also contribute to increasing beneficial entomofauna (natural enemies) [15].

3. Chemical control during the growing season:

In June, when pest populations increase and the ratio of pests to beneficial insects exceeds 1:15–20, chemical control becomes necessary. The following insecticides are recommended:

- Karbofos (0.1%)
- BI-58 (0.2%)
- Benzophosphate (0.25%)
- Mospilan (0.02%)
- Confidor (0.03%)

At the same time, to ensure environmental safety, all chemical treatments must be stopped at least 30 days before harvest.

Conclusion

In conclusion, melon cultivation and processing in Uzbekistan represent an important agricultural and economic sector, particularly due to the wide diversity of cultivated varieties and their high nutritional value. The application of modern drying technologies, especially vacuum freeze-drying, plays a significant role in preserving the quality, biological value, and shelf life of melon products, while also enhancing their export potential. At the same time, cucurbit crops are

highly susceptible to damage from major pests such as melon beetles (Chrysomelidae) and click beetles (Elateridae). These pests negatively affect plant growth, yield, and product quality throughout different stages of development. Therefore, the implementation of an integrated pest management system, including agrotechnical practices, preventive measures, and rational chemical control, is essential for sustainable production. Overall, the combined use of scientifically based drying technologies and effective pest control strategies ensures increased productivity, improved food security, and higher economic efficiency in melon production under the conditions of Uzbekistan.

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