MECHANIZED APPARATUS FOR CUTTING MELON FRUIT INTO ANNULAR SLICES

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Abstract. *The article is devoted to the mathematical description of the process of cutting elastic-viscous materials on the example of a melon fruit. A method for deriving theoretically calculated equations for determining the critical cutting force and the destructive contact stress is given. A schematic diagram of an experimental laboratory installation for determining the elastic modulus and Poisson's ratio of plant raw materials and the principle of its operation are described.*

Keywords: *elastic-viscous material, cutting, process, force, contact stress, blade, deformation modulus, relative compression, coefficient of friction, installation, pressing, melon.*

INTRODUCTION

Melon production in the agricultural sector of Uzbekistan occupies one of the leading places. Highly sugary melon fruits are a good raw material for industrial processing to produce a wide range of food and technical products: melon jam, buckmeat, candied fruit, dried melon, etc.[1]. Currently, only the production of dried (dried) melon prevails from the products of processing melon fruits. Such production is concentrated mainly only in Uzbekistan and Turkmenistan, characterized by a hot climate and a variety of high-yielding varieties of melons [2]. It has been established that with waste-free processing from 1000 kg of fresh fruit, 75-80 kg of excellent dried melon can be obtained. Dried melon is a viscoelastic product of straw-yellow or yellow – pink color with a sickly sweet taste and a specific melon aroma

When processing any material, it is necessary to have information about their physical, mechanical and technological properties, that is, about the properties that promote or counteract this type of mechanical processing, especially when cutting elastic-viscous products with a blade, such as meat or vegetable products. When processing these materials, the interaction of the blade with the base of the material is characterized by complex physical phenomena that are difficult to describe analytically, in contrast to Hooke's law. Therefore, only when combining theoretical calculations with full-scale experimental studies, it is possible to understand the true physical essence of the process. Taking into account some assumptions and assumptions, it is possible to determine theoretically the main factors affecting the process under study, and subsequent experimental studies show the adequacy of the accepted judgments [1, 2].

Elastic-viscous materials can, with some assumptions, include the model of melon pulp, which consists of a solid skeleton (cellulose fiber) and a semi-liquid substance that fills the gaps between the solid elements. Being deformed by the action of the knife blade, the fibers will press on the liquid medium, forcing it to move to less stressed areas. In accordance with the laws of hydrodynamics, the resistance of the medium during such a movement depends on the speed of its movement, that is, it states the fact that in viscous bodies, the deformation is a function of the load and the time of its action. Generically, the model of plant material, from the point of view of rheology, can be considered as a model obeying the Hooke-Newton law [3-5].

The production of dried melon is mainly carried out by small farms and private farmsteads. The entire technological process is focused on the use of manual labor. Due to the growing demand for dried melon and the transition to an industrial scale of processing, there is a question of mechanization of some labor-intensive processes: peeling, cutting into slices and drying. One of the well-known and common methods of drying melons is cutting the fruit into ring-shaped slices, hanging them on poles and drying them in a stream of warm air [3]. Currently, the cutting of the fetus into rings was carried out manually, while the thickness of the rings was different, the work was monotonous and monotonous, which quickly tired the workers. In this regard, the development of a device for cutting melons into slices is in demand.

As the basis of our research, we chose the method of drying melons, which consists in cutting the fruit into ring-shaped slices perpendicular to its axis with a width of the resulting slices of 15-21 mm. When developing the device, the most common and recommended varieties of melons for drying were taken into account.

The shape, weight and overall dimensions of the fetus were taken into account. this is why the development of a device for cutting melons into slices is in demand. The mechanized chain conveyor developed by us with a discretely moving web is shown in Fig.1-3[4], which contains a chain conveyor 2 mounted on the frame 1 with a leading 3 and driven 4 sprockets and a drive 5. A load-bearing platform is fixed on the links of the roller chain, 6 on which a bed 7 with a cross–section is installed.but located through the slits 8, while needle spikes 9 are provided between the slits along the bottom of the bed. On the frame, pylons 10 are welded on both sides, on which a rotary lever 11 is attached, a cutting device mounted on it, made in the form of a package of disc knives of different diameters.

Fig. 1.

***General view of the machine for cutting the melon fruit into ring* slices**

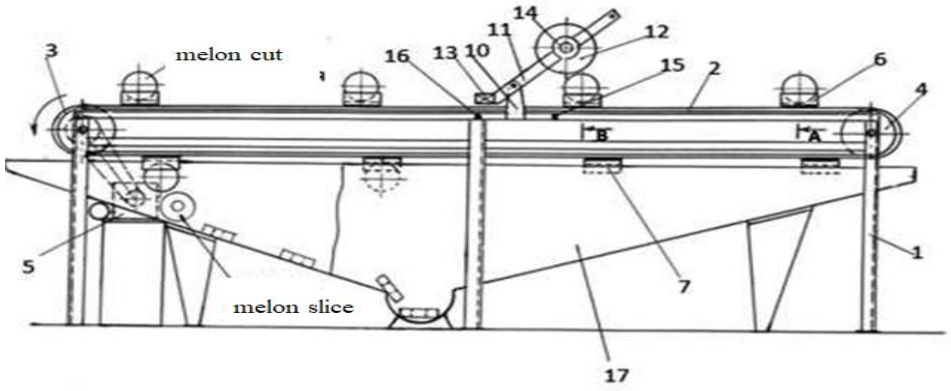
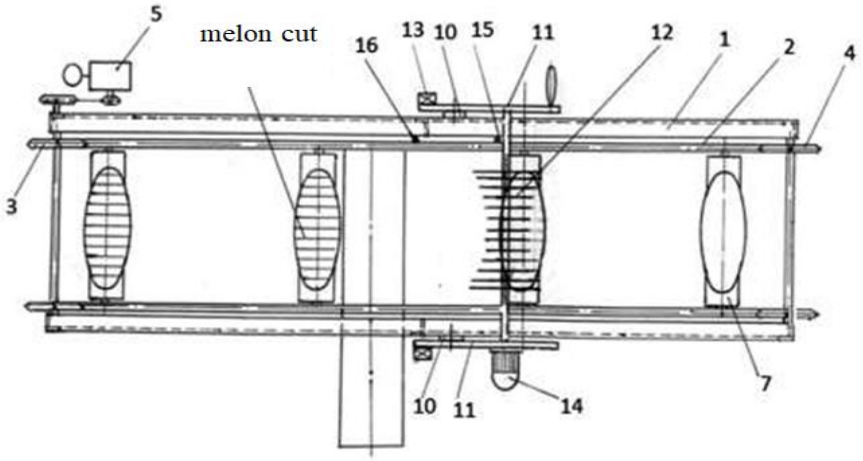


Fig. 2.

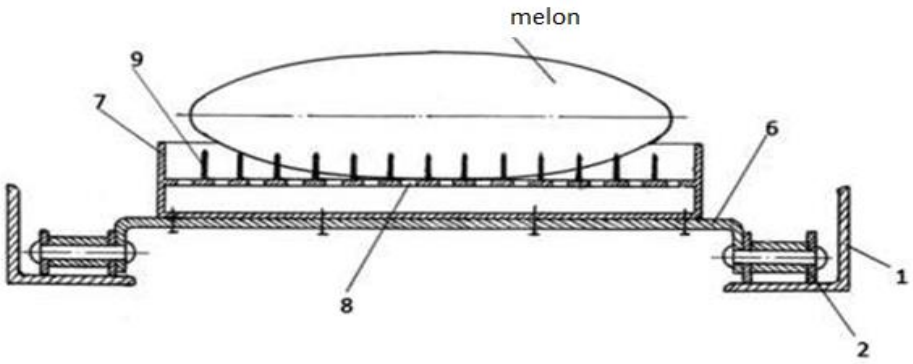
General view of the machine in the plan



The lever 11 is balanced by a counterweight 13, and the knives are driven by a flanged electric motor 14. Two electromechanical plungers are installed on the frame in the cutting zone: one 15 – for remote disconnection of the conveyor drive, the second 16-for switching on the electric motor of the cutting device. Under the frame there is a hopper 17 for collecting sliced melon slices and collecting placentas with seeds.

Fig.3.

A fragment of fixing a melon fruit on a bed.



The device works as follows. Sorted melons by size and shape (preferably spindle-shaped) are peeled according to the method described [2].Then the conveyor drive 2 is started and the peeled melon fruit is placed on the bed 7, while the fruit is impaled on needle spikes and fixed motionless. As you move forward, in the cutting area, the lodgment contacts the plunger 15, which turns off the conveyor drive and turns on the drive of the cutting device 12. The operator lowers the rotary lever 11 on the melon fruit located under the package of disc knives. At the same time, since the knives are mounted on a curve corresponding to the outer surface of the melon, they simultaneously pierce into its flesh and cut it into annular slices. The width of the lobules is determined by the technological requirements of the melon drying process and depends on the density of the pulp of its structure, sweetness, varietal characteristics and other differences. For many varieties of melons, the cutting thickness ranges from 15 to 21 mm.

At the end of the cutting process, the rotary lever 11 goes up, the second plunger 16 is triggered, which turns off the electric motor 14 and turns on the chain conveyor drive. The bed with cut melon slices with discrete intermittent movement of the conveyor removes the leading sprocket 3 and, when inverted, is freed from the slices that slip off the spikes and fall into the

hopper 17. When the lobules fall, the placentas with the seeds come off, from the pulp and all this mass is sent along the discharge chute for separation

Thus, the proposed device makes it possible to mechanize the cutting of melon fruits into ring slices and provides automatic removal of cut slices from the beds, which reduces processing time, increases machine productivity and facilitates the work of employees of farms specializing in the production of dried melons. The device has a relatively simple design and does not require large material and monetary costs.on separation. .

For the manufacture of an experimental model of the machine, a single-row roller chain PR-19.05-3180 (GOST 13568-75) and a worm gearbox RFU-100-40 were used.

Disc knives and lodgements are made of 1.2mm thick non-rusting steel sheet. A positional electric switch is used as an electric contact plunger. Experimental studies have shown that the machine has shown good reliability of action and provided high-quality cutting of melons in a wide range of fruit sizes and lobule thickness.

CONCLUSIONS

The determined values of the elastic modulus and the Poisson's ratio provide a basis for the theoretical determination of the critical cutting force, but to determine the exact value of the local modulus of deformation corresponding to the moment of compression of the material by the edge of the cutting tool blade, laboratory studies are required.International Journal of Modern Agriculture, Volume 10, No.2, 2021 ISSN: 2305-7246

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