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Mechanisation of the primary processing of watermelons without destroying the rind

Dinara TLEVLESSOVA[1*], Yevgeniy MEDVEDKOV[1,2], Ainura KAIRBAYEVA[1], Aigerim NAZYMBEKOVA[1]

Abstract

In the countries of the Commonwealth of Independent States (CIS), the sown area of watermelon in recent years does not exceed 85 thousand hectares, although in the early 90s it was almost 132 thousand hectares, 2/3 of these areas are located in the southern regions. One of the key problems of industrial cucurbit crops production is the transition of production from large-scale agricultural enterprises to small-scale private farms, the share of which today is more than 90%. At the same time, the transfer of production to the private sector provides additional profits for small producers and can be almost the only source of their income. The scientific originality of the paper is determined by the fact that the current situation indicates that the private farms have turned out to be more adapted to the specifics of market relations. Without considerable capital investments, using production technologies that are less dependent on the rise in the price of energy carriers and other material and technical resources, agricultural producers increase the output volume. The transition to the cultivation of cucurbit crops in households and small farms led to an increase in the separation of the real manufacturer from scientific achievements, the latest technologies, high-quality seeds, significantly limited the opportunities for the development of this industry.

Keywords: cucurbit crops; automation; food industry; bekmes; peeling machine.

Practical Application: The practical significance of the study is determined by the fact that the costs of watermelon production in households are 1.5 to 2 times higher than in agricultural enterprises. This is conditioned by the inefficient use of resource potential, the use of manual labour, the lack of innovative developments and low mechanisation of technological processes.

1 Introduction

Watermelon is a vitamin food product containing ascorbic acid, easily digestible sugar, vitamins, folic and malic acids, trace elements that provide a positive effect on the human body (Bhattacharjee et al., 2020; Artés-Hernández et al., 2021). The content of dry soluble substances in watermelons – 13.5%, sugars (glucose, fructose, sucrose) – 14%. In addition, fruits contain up to 0.5% fibre, 0.8% hemicellullose, from 0.7 to 4.2% pectin substances, about 0.7% protein, vitamins A (0.1 mg%), C (up to 13.7% mg%) and B1. Watermelon seeds usually contain up to 37% oil, which is not inferior to olive oil in terms of taste (Donchenko et al., 2020). Watermelons are used for the production of artificial honey, molasses, various confectionery products and jam (Larsen et al., 2020). Watermelon seeds are used to produce oil, which is used for technical and food premises. Given the above, this culture is promising for doing business with small and medium-sized forms of entrepreneurship (Nematollahi et al., 2020). Nowadays, the latest technologies for the long-term storage and processing of agricultural products are available (Rico et al., 2020; Zhidebayeva et al., 2020).

Each season, a certain amount of watermelon production remains unused (Yang et al., 2020). Some of the unsold goods are non-standard or substandard fruits that do not find demand in fresh form and cannot be sold on the market. The rest remains in the fields due to the low price of products, when at the height of the season the cost of selling watermelons does not even cover the cost of collecting them (Ahmar et al., 2020). In order for the production of watermelon to be profitable, the grown products should be used as much as possible. And here the revival of authentic recipes of watermelon dishes comes to the fore. Such products as watermelon honey – bekmes, or salted watermelon are not only delicious, but also useful, and most importantly – have a great added value (Babich et al., 2020). When processing 1 tonne of watermelons, 30 litres of the finished product are obtained, almost 30 thousand tourists tasted it for the first time in 2019. By the end of the summer of 2020, within the framework of the project, it was planned to put into operation a workshop for the production of watermelon honey (bekmes), where it was planned to produce the first tonne of craft products in the same year (Çınkır & Süfer, 2020).

The process of making bekmes or watermelon honey is very simple. It is made from watermelon juice, which is drained in a roaster and evaporated over a fire for 12 hours (Jayakumar et al., 2020). In traditional medicine, bekmes is used to treat colds. It is used to make a mixture for use in combination with onion juice or apple cider vinegar or is added into a solution for gargling (Ren et al., 2021; Ivanova et al., 2021). When coughing, the product is mixed with radish juice and two teaspoons are used every half hour. This honey is effective for the cardiovascular diseases. Mixed with rosehip juice, bekmes increases haemoglobin and strengthens the immune system. The product is useful in the

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[1] *Department of Mechanization and Automation of Production Processes, Almaty Technological University, Almaty, Republic of Kazakhstan*
[2] *The Center for Innovative Educational Technologies, Almaty Technological University, Almaty, Republic of Kazakhstan*
*Corresponding author: dinusina@mail.ru

fight against pathologies of liver cells, normalises their condition (Wen et al., 2020; Zhanabayeva et al., 2021). In addition to traditional medicine, it is used for culinary purposes as ordinary honey or thick syrup, as a dessert or component for other dishes, in the manufacture of candied fruits and for filling various delicacies or cheesecakes (Ayatusaadah et al., 2020; Gutyj et al., 2017).

Watermelon honey is not useful for everyone, it is not recommended to consume it for people suffering from diabetes and those who are struggling with excess weight (Chawgien & Kiattisin, 2021). There is also an individual intolerance to the components of bekmes. It is also worth limiting the use of such honey for those who have reduced kidney function or urolithiasis, and when using such honey in large quantities, symptoms of acute gastritis occur (Sun et al., 2020). In addition to the listed application, bekmes can also be part of various cosmetics (Kizatova et al., 2017).

2 Materials and methods

Currently, there are a lot of new approaches to the technology of production of watermelons, but important factors determining the yield of table watermelon and the quality of its fruits are the choice of a variety or hybrid, methods of basic tillage, sowing dates taking into account the biological characteristics of the variety (hybrid), nutrition conditions and moisture availability (Hwang et al., 2021; Baiysbayeva et al., 2021). Notably, watermelon fruits are an important food product. The nutritional value of watermelon fruits lies primarily in the high content of carbohydrates, mainly sugars, that are well absorbed by the human body (Raviv, 2020). The watermelon fruits are dominated by sucrose, glucose, fructose, a lot of vitamins, especially ascorbic acid (Li et al., 2020). In addition, watermelons contain: carotene, vitamins B1 (thiamine), B2 (riboflavin), PP (nicotinic acid), folic acid. There are not many proteins in fruits, but they are very valuable for nutrition. The pulp of watermelons contains all the essential amino acids (Nazulan et al., 2020). Their number in the rind is even greater than in the pulp. The fruits are rich in mineral constituents and contain potassium – 0.22%, sodium – 0.016%, calcium – 0.028%, magnesium – 0.084%, iron – 0.037%, sulphur – 0.016%. Watermelon fruits also contain organic acids: malic, amber, citric.

Along with fresh consumption, watermelons are used in the food industry for technological processing: preparation of thickened watermelon juice, kvass, beer, wine, and various confectionery products are prepared from the juice – candied fruits, jam, marmalade, sweets, etc. Watermelon cultivation is an important branch of agriculture, which, unfortunately, is currently experiencing certain difficulties. Modern melon cultivation requires solving many problems, among which the increase in yield and the commercial yield of environmentally friendly products is of decisive importance, while reducing the total costs of growing and harvesting melons. Along with fresh consumption, watermelons are used in the food industry for technological processing: preparation of thickened watermelon juice, kvass, beer, wine, and various confectionery products are prepared from the juice – candied fruits, jam, marmalade, sweets, etc.

3 Results and discussion

During the cultivation of watermelons in non-irrigated conditions of the southern regions, the main factor limiting the size and marketability of the crop is moisture. The water content in watermelon leaves varies significantly during the day and during the growing season of the crop. In watermelon, the amount of water used by plants depends on the conditions of soil moisture. The greatest amount of water is consumed during the period of increased growth of vegetative and generative organs. The lack of water during this period leads to a decrease in the early harvest. As the plant finishes forming the crop, water consumption decreases.

The optimal soil moisture for the normal growth and development of watermelon plants in different periods is characterised by the following indicator: seed swelling – 80-85% of the seeding rate (SR), flowering – 70-80, fruit development– 70-80, the beginning of fruit ripening – 60-70% SR. The study determined the soil moisture on the crops of watermelon hybrids in the main phases of growth and development of the crop. The soil moisture on the crops of watermelon hybrids in the main phases of growth and development changed significantly, which is associated with the weather conditions of the year of study and the biological characteristics of the hybrids under consideration. During the sowing-germination period, the average soil moisture in all variants of the experiment was 73% SR, which is explained by the same requirements of watermelon seeds for germination. In the subsequent phases of growth and development, the plants of watermelon hybrids had sufficient moisture that meets the requirements of watermelons for soil moisture.

Thus, on the crops of the Krissby hybrid, the soil moisture during the germination-flowering period was 71% SR. However, starting from the flowering phase and until the end of fruiting, this indicator remained at the level of 75% SR, which is explained by the large vegetative mass of plants, which prevented the evaporation of water from the soil during the growing season. The soil moisture on the crops of the Redstar hybrid during the germination-flowering period was 75% SR, during the flowering-first fruit harvest, it increased to 82% SR, and then decreased to 75% SR. On the crops of hybrids Lady and Victoria, this indicator in the main periods of vegetation was, respectively, 76-80-80% SR and 70-74-75% SR. The formation of economically useful organs by a plant and the organism as a whole, passes through stages, according to which it is possible to judge the age of the culture with a sufficient degree of reliability. At the same time, it is possible to determine in time the complex of necessary conditions for normal growth and development, depending on the formative processes of organogenesis. This principle is the main one in the development of technologies and is carried out with the aim of directed regulation of the main factors of plant life, taking into account the fullest use of climatic resources, soil fertility, fertilisers and the material and technical capabilities of the economy in combination with the requirements of environmental protection.

In cucurbit crops, which are characterised by a high degree of sensitivity to changes in external conditions, there is a discrepancy between the phenophases and the differentiation of the fruiting organs. In this situation, the data of phenological observations for the accurate determination of the state of the plant must be supplemented with an analysis of the differentiation of the growth cone and germinal flowers. It is believed that watermelons have 12 stages of organogenesis. I-III stages of organogenesis (the stage of vernalisation) – normally pass at a daily temperature of 16-18^{0}C and last for a watermelon – 18-22 days. The process of vernalisation takes place during the germination of seeds at the age of cotyledons – before the appearance of the first real leaf.

Under favourable conditions, watermelon seeds germinate for 7-10 days. The appearance of the first real leaf occurs 5-6 days after the emergence of seedlings. At the stage of vernalisation, the corcles in the sprouted seed are especially sensitive to external factors of moisture and temperature. A sharp drop in temperature and insufficient moisture to the optimal level in the seed layer at the beginning of this stage (I-II) greatly disrupts the normal course of development: the emergence of seedlings is restrained for up to 20 or more days, and in some cases, the death of seeds or the formation of small fruits in the future is noted. IV-V stages of organogenesis (light stages) – a good harvest can be obtained only by creating lighting conditions for melon plants that they need for normal development and due to the timely formation of density and weed eradication.

VI-VII stages of organogenesis (the stage of development of generative organs) – normally pass at a daily temperature of 22-25^{0}C and last 10-15 days. During this period, the branching of plants and the formation of buds occurs. The temperature regime is of particular importance during this period. At an average daily temperature of 18 °C with a range from 7 to 25 °C the development of plants stops, and at a temperature of 23-24 °C with a range from 13-22 °C buds develop normally. VIII-IX stages of organogenesis (stage of embryonic development). The processes of embryonic development cover the period from the beginning of flowering to the maturation of seeds, that is, until the XII stage of organogenesis. The duration of the time from setting to the ripening of the fruit depends on the weather, agrotechnical and soil conditions, on variety, and this period lasts 20-45 days. The embryonic period of seed development ends in a normally developed and fully mature fruit. X-XII stages of organogenesis – fruiting-the end of the growing season. In the year of the research, the average daily air temperature in May was 25% higher than the average annual temperature, which contributed to the friendly germination of watermelon seeds. As already noted, watermelon is a heat-resistant and light-loving plant. Therefore, it requires a lot of heat and sunlight for its growth and development. In dry, hot weather, the fruits accumulate more sugar, taste better and more fragrant. Therefore, its growth and development are closely related to the conditions of the external environment.

Heat requirements. The best conditions for the growth and development of watermelon are created in those areas where the sum of active temperatures (over 10 °C) during the growing season is 3200-3400 °C. Its seeds begin to germinate at a temperature of 16-18 °C. At a lower temperature, they germinate slowly, part of it loses its germination, becomes mouldy and dies. Seedlings that have appeared on the soil surface, as a rule, are weakened and in the future their growth is slowed down, and the productivity of plants decreases and the quality worsens. The optimal temperature for seed germination is in the range of 20-25 °C, and at a higher temperature (over 35 °C) this process also slows down. The optimal temperature for the growth and development of plants is from 25 to 30 °C. The higher temperature begins to slow down the growth and development of plants, and at 44°C, protein coagulation begins in cells. In the heat resistance of watermelon plants, a considerable role is played by the covering tissue and pubescence of the leaves, a waxy coating on them and the ability to increase water transpiration during the heat period, which contributes to their cooling. Due to the rapid movement of water by vessels, the temperature of plants decreases by 6-7 °C. Reducing the air temperature to minus 1 °C has a detrimental effect on plants, and 5-10 °C sharply restrains their growth. Especially negative long-term temperature drop below 15 °C during the flowering of plants. This leads to the fall of buds and flowers, and the pollen and pistil do not mature, which significantly worsens the pollination process. The root system of a watermelon is more sensitive to a decrease in temperature than the vegetative one. If it decreases for a long time below 15 °C, the roots are damaged by microorganisms, they begin to die faster than the leaves and stems. High air temperature (over 40 °C) and low relative humidity during the flowering period of plants also negatively affects the pollination of flowers. For pollination of flowers, the best air temperature in the morning is 18-20 °C, and in the afternoon – 20-25 °C.

Light requirements Watermelon belongs to the cultures of a neutral (or short) day, it is quite demanding to the light. For its normal growth and development, light of a certain spectrum, sufficient intensity and duration of the day is required. The light stage is better for a 12-hour light day and ends before the formation of 4-5 real leaves. Reducing it to 10-12 hours within two weeks after the emergence of seedlings accelerates the formation of female flowers, fruiting, and fruit maturation. The reduction of daylight hours to 8 hours and a decrease in solar insolation and air temperature during the growing period worsens the growth and development of watermelon plants. Its plants also do not withstand shading and weed infestation. At the same time, not only the yield decreases, but also the size of the fruits decreases and their quality worsens. In cloudy weather, with the thickening of plants and excessive moisture, the accumulation of dry matter and sugars in the fruits decreases.

Requirements for soil and air humidity. Due to the fact that the water moves quickly and quite well through the vessels of watermelon plants, despite the large surface of the leaf apparatus, which evaporates a large amount of moisture, dry winds do not cause much harm to them. At the same time, watermelon plants are quite moisture-loving. The flow of water to the leaf apparatus is largely influenced by the soil temperature. With a decrease in its root system weakly absorbs water from the soil and plants suffer from its lack. At high air temperatures and dry winds, due to the presence of a large leaf apparatus, plants also lack moisture and wither. The optimal soil moisture in the layer of 0-70 cm for watermelon is in the range of 75-80% SR, and the relative humidity of the air is 40-60%. Reduction in soil moisture to 45% SR can be critical. When the relative humidity of the air decreases, pollination of flowers worsens, growth slows down, the duration of the growing season increases and plant productivity decreases. In the southern regions, watermelon plants need to be watered in certain phases of growth and development if there is insufficient precipitation. However, the increased relative humidity also negatively affects watermelon plants – they are affected by fungal diseases.

Nutrient requirements. Watermelon plants respond well to the application of organic and mineral fertilisers. However, when applying organic fertilisers at increased rates, especially fresh manure, the growth and development of plants is delayed, their resistance to diseases decreases, the quality of fruits worsens. Watermelon reacts well to the introduction of black mould humus. From mineral fertilisers, watermelon reacts best to phosphorus, less to nitrogen and potassium, especially in the first half of the growing season. With a good supply of readily available forms of phosphorus, plants better absorb nitrogen and potassium. For 10 tonnes of watermelon crop, 23.0 kg of nitrogen, 8.0 of phosphorus and 25.0 kg of potassium are removed from the soil. Watermelon plants react poorly to chlorine forms of potash fertilisers and to soil salinisation. The best soils for growing watermelon are chernozems, dark grey podzolic and alluvial of light mechanical composition, as well as sandy loam with a pH of 6.5-7.5. At the same time, the root system of plants is able to absorb nutrients even from poor soils. Therefore, watermelon can be grown even on sandy soils. Loam and waterlogged soils with a close occurrence of groundwater are not suitable for cultivation. It is characteristic that the factor of the mechanical composition of the soil is more significant than its fertility.

The best precursors for watermelon are laylands, perennial grasses, winter wheat and corn for silage. Tillage is the same as for cucumber. Favourable conditions for sowing watermelon come when the soil warms up at the depth of seed embedding to a temperature of 16-18 °C. When sowing seeds in cold soil, part of it becomes mouldy and loses germination. The delay in sowing also leads to the liquefaction of seedlings, the delay in harvesting – a decrease in fruit yield and their quality. Seeds of precocious varieties and hybrids are sown according to the scheme 140 × 70 cm, 140 × 140, 140 + 70 × 70 cm, mid- and late-maturing – 210 × 140, 210 × 210, 280 × 210, 210 + 70 × 70 cm. The seeding rate depends on the plant density and their size. In small-seeded varieties and hybrids, the seeding rate is 3-4 kg/ha of seeds, in large-seeded varieties – 5-6 kg/ha. Precision seeders allow reducing it by half. The sowing depth is up to 5 cm, and on light soils and at low humidity – up to 7 cm. When seedlings appear, the row spacing is loosened to a depth of 4-6 cm. In the phase of 2-3 leaves, the plants break through, leaving one or two best developed in the nest. Before the stems, 2-3 loosening of the row spacing is carried out. On irrigated lands, the plants are watered during the period of mass fruit formation. At the beginning of flowering, for better pollination of flowers, bee colonies are taken out at the rate of 1-2 hives per 1 ha. To obtain an earlier harvest, watermelon is grown in seedlings. Seedlings are grown in pots measuring 10 × 10 cm and planted at the age of 25-30 days, when the threat of spring frosts has passed.

The crops are harvested in biological ripeness, when the fruits acquire the appropriate colour and shine and the peduncles and tendrils in the leaf axils begin to dry out. The yield of watermelon fruits on average is 15.0-20.0, and on irrigated lands – up to 60.0-80.0 t/ha. Watermelon is grown in winter and film greenhouses, greenhouses and under a small-sized film coating. For this purpose, early-maturing varieties and hybrids are used. The agricultural technique of cultivation is the same as for cucumber, with some features. The age of seedlings is 25-30 days. In winter greenhouses, seedlings are planted in late January – early February, in plastic greenhouses – from mid-March to April 10-15, depending on the method of heating the structures, when the soil warms up to a temperature of 20-22 °C. Planting scheme 70 × 70 cm, 140 × 70, 100 × 100, 160 × 50-60 cm. At the beginning of flowering, hives with bee colonies are installed in or near greenhouses. 2-3 fruits are left on the plant. If two fruits are left on the sprout, then the last one develops poorly. Before the formation of fruits, the temperature on sunny days is maintained at 25-27 °C, on cloudy days-22-25 °C and at night 18-20 °C, soil – 22-24 °C, and during the period of fruit filling and before their ripening-27-30 °C, 24-27 °C, 20-22 °C and 24-26 °C, respectively, relative humidity – 70%. Plants are rarely watered when the soil moisture (substrate) decreases to 60% SR. Immediately after watering, the structures are ventilated. Excessive humidity during this period leads to plant diseases, delays the ripening of fruits and a decrease in the sugar content in them. The fruits that have begun to ripen are placed in nets and tied to a trellis. In greenhouses, watermelon seedlings begin to be planted from the middle of March at the rate of 1-2 plants under the greenhouse frame. Under a small-sized film coating, it is planted 15-20 days earlier than in the open ground. The yield of watermelon fruits in winter greenhouses is 8-10 kg/m, in film.

The primary processing of watermelon consists of the following technological operations: cleaning the fruit from the skin, cutting in half, separating the seeds. During peeling, as already noted above, there is a high degree of injury to the pulp, which affects the quality of the final product. The analysis of known means for peeling watermelon fruits revealed that the main methods of peeling are: mechanical, physical, chemical, combined. The mechanical method is carried out by rubbing the rind on the rough surface of the working element, to which the fruit should be pressed tightly. The quality of the cleaning process depends on the size of the contact surface of the working surface and the fruit, the pressing force and the type of relative movement of the surface and the watermelon itself. Disadvantages of the mechanical method, which are most often manifested by damage to the pulp and incomplete cleaning, which is explained by the imperfection of the designs of mechanical means. The physical method of cleaning is carried out by the influence of steam, which is supplied under considerable pressure and relaxes the surface layer of the fruit. The steamed layer is then cleaned and washed off in washing and cleaning machines. In addition to steam exposure, the peel is fired in thermal units at a temperature above 800 °C, which is then cleaned with brushes in washing and cleaning machines. This method is energy-consuming and does not provide high-quality cleaning and has not been widely used in industry.

The chemical method of peeling is based on the use of alkalis. After processing with a warm alkaline solution, the peel is cleaned with rollers, and the fruits are washed from the alkaline solution. The combined method involves processing with steam and alkalis. Chemical and combined methods also require significant water costs for washing the fruit after treatment with alkalis. In addition, the implementation of these methods requires significant energy costs for heating water and steam. With this in mind, the most promising is a mechanical method of peeling watermelon fruits. Next, the study analyses the existing mechanical means for implementing this method. Well-known is the equipment for cleaning the watermelon fruits. The authors solve the problem of improving the quality of fruit cleaning, reducing energy consumption and, as a result, the cost of production. The equipment for cleaning melon fruits contains a frame, a hopper, a drive drum with brushes on the inner surface and an additional brush installed in the drum cavity. Due to the fact that the additional brush is provided with a reciprocating vertical movement, high quality of peeling is achieved (Figure 1).

Notably, the structural disadvantage of this design is the sequential installation of brush drums. In addition, the ends of the brushes cannot provide high efficiency of exposure to the peel of fruits of various shapes and sizes. A technical solution is aimed at eliminating these shortcomings. The proposed device (Figure 2) contains brush drums formed by a hollow roller with a leading and driven trunnions at the ends. Radially oriented corrugated blades are placed on the surface of the roller with an even pitch, between which parts of a multi-stranded metal rope are placed. Each part of the rope branches are laid in corrugations and connected to the blades with a pair of slats and fasteners. The multi-stranded rope in the equipment enters the peel of the fruit, while the hard part is removed, and the fruits acquire a rotational movement and the drums remove the layer of peel that remains from the fruits.

The study suggests that this technical solution provides cleaning of fruits of different sizes due to the fact that the fruits move along an inclined plane during the impact of the drums, as well as by adjusting the retaining brush. At the same time, the use of a multi-core rope is a disadvantage of this device, which is explained by its rapid wear and the complexity of the replacement process. To peel the watermelon, it was proposed to use a device containing a milling drum (Figure 3). The machine developed by the authors provides processing of pre-cut pieces of watermelon (11), which are fed along the tray (2) into the space between the support roll (3) and the needle roll (4), which move them in the direction of the milling drum (5), which cuts the peel.

The proposed equipment arrangement does not solve the problem of excluding manual labour from the process of peeling the watermelon. The pieces need to be placed manually in the machine. Chinese-made ZH-XP1 watermelon peeling machines have appeared on the market (Figure 4).

This machine has a capacity of 50 pcs/hour. The installation and removal of the fruit is carried out manually. The machine is narrowly functional, designed for cleaning watermelon of certain varieties. Cleaning is carried out with rotating knives. The Titan FXP-99 machine and the watermelon cleaning machine (Russia) were created according to the same principle (Figure 5).

These machines are designed for cleaning elongated fruits. The productivity of the machines is 500 pcs/hour (Titan FXP-99)

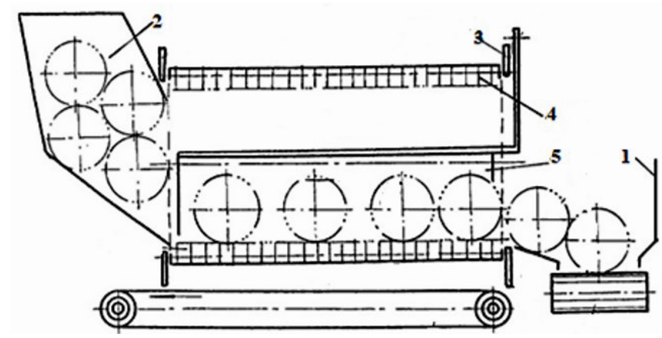

Figure 1. Arrangement of equipment for cleaning cucurbit crops: 1 – frame, 2 – hopper, 3 – drum, 4 – brushes, 5 – additional brush.

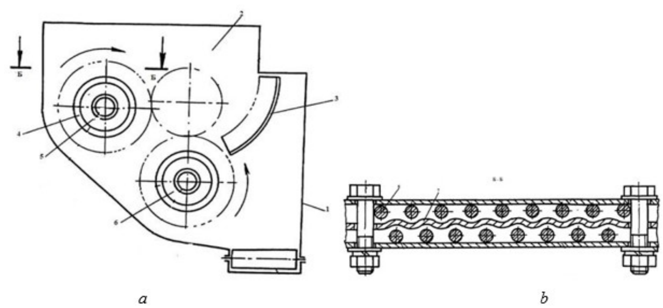

Figure 2. Arrangement of equipment for cleaning cucurbit crops: a – vertical section of the equipment; b: 1 – frame, 2 – hopper, 3 – retaining brush, 4 – hollow roll, 5,6 – drums, 7,8 – rope.

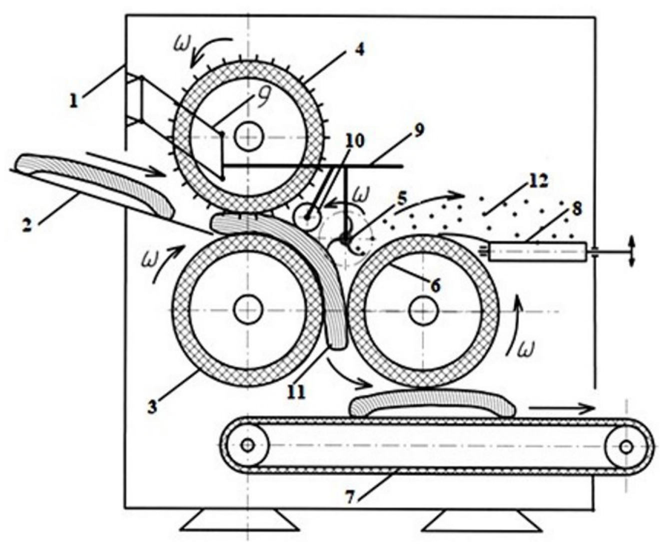

Figure 3. Equipment for cleaning cucurbit crops: 1 – frame, 2 – tray, 3 – support roll, 4 – needle roller, 5 – milling drum, 6 – clamping roll, 7 – conveyor of peeled slices, 8 – peel conveyor, 9 – holder 10 – copying wheel, 11 – fruits, 12 – peel.

Figure 4. Watermelon peeling machine (China).

a *b*

Figure 5. Watermelon cleaning machine (Russia): a – Titan FXP-99 (Dolgoprudny, Russia); b – machine manufactured by Voploscheniye LLC (Podolsk, Russia).

and 50 pcs/hour. Loading and removing the fruit is carried out manually, which increases the cost of the finished product.

4 Conclusions

Many years of experience shows that watermelons are of important food and fodder value. The refined tastes of consumers push manufacturers to search for new business ideas. One of the directions of such a search is not just the cultivation of crop products, but the creation of new products with greater added value on its basis. The most promising is a mechanical method of peeling the watermelon fruits. As a result of the analysis of the available design solutions, it was found that almost all devices and machines remained only experimental developments. They have not been introduced into industrial-scale production. The machines produced by the industry require the use of manual labour and cannot be included in the production lines of modern automated production.

To obtain food products from watermelon, it is necessary to remove the peel, which gives the finished product a bitter taste. The existing technologies for peeling fruits are mainly based on the use of manual labour, which leads to an increase in the cost of production, a decrease in the productivity of the cleaning process. In this regard, the task of developing a machine for peeling watermelon fruits remains relevant and requires a solution. The main tasks that need to be solved during the development of mechanical means for peeling watermelon fruits are: complete elimination of manual labour; prevention of damage to the pulp of the fruit; ensuring the versatility of processing (processing fruits of any shape); simplicity of design; low energy consumption of the processing.

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