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Technology for extraction of bee-bread from the honeycomb

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Abstract

Different methods of extraction of perga from a honeycomb are observed. A number of extraction technologies which allow obtaining a high nutritional quality product with preserved vitamins for further production of medicines or alternative foodstuffs which are based on bee-keeping products are studied. A detailed analysis of the technologies and main technical characteristics of various units is given. It is concluded, that the highest productivity is reached by the technologies which are based on convective method and modern non-destructing methods, such as acoustic drying.

Keywords: Extraction, bee bread, drying, scarification;

1. Main text

As known, technology for extraction of bee-bread consists of gathering of honeycombs, drying, cooling, segmentation, separation into bee-bread granules and wax.

During gathering of honey combs it is necessary to have them completely void of honey to provide for smooth segmentation process and less sticking to the segmentation apparatus, lower wax traces in obtained bee-bread. Honeycombs with mildew are not accepted.

There are several known technologies for separation of the bee-bread from the honeycomb: soaking in water, manual extraction through vibration, drying; drying and separation of granules through vacuum drying; drying, freezing, segmentation and filtering of the wax particles.

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However, all the mentioned methods have serious disadvantages: soaking in water causes considerable losses of the nutrients; other methods are very inefficient and require significant manual labour. Therefore mentioned methods cannot be applied in industrial production of bee-bread [1, 2].

In article efficiency of existing ways of beekeeping products processing was investigated. Defining criteria for an assessment of efficiency of existing technologies was their productivity, and also conservation of nutrients and vitamins in a final product - amino acids, proteins, folic acid, vitamins B and C.

Technology [3] that allows for complete mechanization of the bee-bread separation includes four major operations: drying, segmentation, filtering and disinfection. Prepared material is dried at 40°C for 8-10 hours until humidity reaches 14-15%. For rapid drying top layer of bee-bread covered with honey which slows drying is removed. Vacuum drying for 5-7 hours at 40°C humidity falls to 10%. Bee bread becomes more rigid, which during grinding process decreases amount of waste. Dried substance is cooled until –1°C and then is grinded in the machine with grinding intervals 4.9-5mm, which allows for complete fraction. Fragmented substance is then filtered in the seed cleaning machine at the air flow of 7.5-8 m/s, with the filter cell diameter of 2.6 mm. All wax particles are removed in the process. Obtained bee-bread is disinfected with gamma rays and a gas mixture including ethylene oxide and methylene.

Before honeycombs can be partitioned they must be cooled to 0±2°C and kept at that temperature for 30-50 min. After that wax becomes brittle which allows for easier break down. It is also important to remove the wax covering the bee bread granules, keeping the latter intact to preserve the nutrients.

Most appropriate equipment for this task is a segmentation machine with cylindrical pins. Dried at airflow of 7.8-8.1 m/s allows for extraction of at least 97% of bee-bread with traces of wax of no more than 2% and 80% of bee bread granules left intact [4]. This technology allows to extract bee-bread and store it separately from the wax. Most important operation in the separation technology is drying, because the quality of the product mainly depends on it. Drying must be carried out carefully preventing the substance to lose its nutritional properties. Those properties are lost due to protein demodulation and enzymes inactivation caused by excessive heating. Maximum allowed temperature is **40°C** which is considered natural temperature inside the bee-hive.

Several methods for drying pollen pellets are known, each of them having several disadvantages. During the sublimation drying (at freezing temperatures in deep vacuum) various biologically active components are lost. Conductive method does not heat the substance equally at all layers. Drying under the sunlight destroys many biological properties. Infra red drying causes sugars to form caramel and loss of nutritional values.

For industrial production a convection method is most appropriate. Used equipment is relatively simple and cheap. Convenience of the method is also important – it allows to dry the substance in the bee-hives placed at the top of each other and forming the drying channels.

The convection drying machine includes the drying channel, formed by the horizontal air shaft, and vertically placed bee hives, electric heater and ventilator.

Quality of the substance during the drying process and its intensity are defined by the heating agent properties: temperature, speed and relative humidity [5]. Optimal settings research showed that at humidity levels of 14-15% bee bread granules become almost non adhesive and very rigid. This allows obtaining large quantity of unbroken granules and less waste due to sticking of the substance to the machine parts.

The process of drying mainly depends on the temperature of the drying agent which must not exceed 40–42°C.

Dependence on the airflow speed is crucial in the range up to 1.8-2.0 m/s. Further increase in the speed of airflow has almost no effect.

Under described conditions bee bread does not lose its nutritional properties and vitamins. Adhesiveness of the bee bread decreases proportionally to its humidity. Drying to less than 14-15% is not cost effective.

Another relevant factor to the drying process is the size of the object and its surface. Bee bread has a form of granules covered with wax of the honeycomb. The surface facing the atmosphere is often covered with honey preventing air contact. Therefore surface scraping is necessary to aid the drying process. Effective scraping includes double scratching in perpendicular directions. This allows shortening the drying process by more than 30% and scraping in one direction by only 16% [6].

Scraping machine includes metal frame, onto which two ball bearing supports are attached. On the supports is the scraping roller which is moved by the drive. The roller has left and right threads, the scraping levers are attached to it, which are placed on the outer surfaces of the main plates, on the inner surfaces of which are the pins. The pins are directed through the perforated plate, which is necessary for their cleaning. The opposing rows of pins on the left and right plates are dislocated relative to each other in the horizontal dimension. On the frame there are two end switches and on to which scraping lever is bound.

A prepared honeycomb is manually placed between plates, where it is held in the vertical position, after which the drive is switched on. The levers are directing the plates towards each other through the roller. Passing through the plate punctures the pins perforate the outer layer of the bee-bread granules. The depth of penetration is regulated by the switch. At the extreme position the lever is held by the switch and directed by the drive in the reverse. Plates move apart. Wax and bee bread particles that are stuck on the pins are cleaned away by the perforated plate. After the lever activates the switch the drive stops, the honeycomb is then extracted.

One of the industrial technologies for extraction of bee bread consists of the following: the outer layer of the bee bread granules 1 (Fig. 1) is destroyed in the scraping machine 2. Then honeycombs are dried by the convection method. The ventilator 3 is sucking in the air, which passes the heater 4, and at 42° C is passed into the bee hives 5 with the frames. It is passed out of the construction with the excessive humidity. Bee bread is dried until 14-15%.

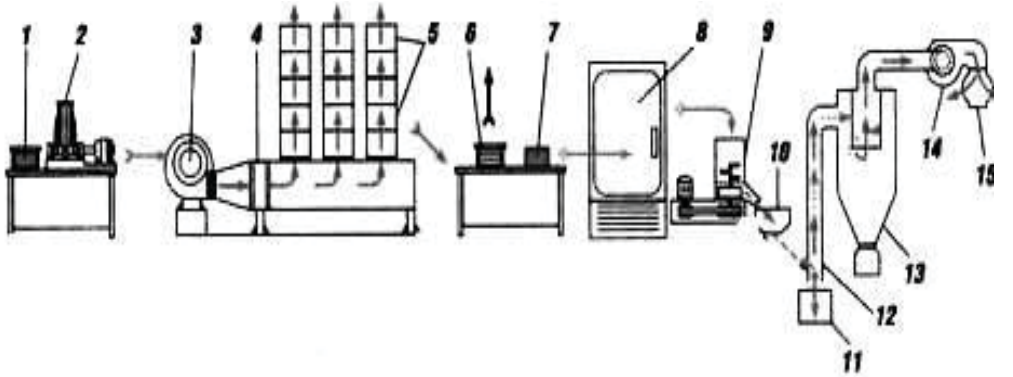

Fig. 1. Bee bread granules extraction: (1) outer layer of the bee bread granules, (2) scraping machine, (3) ventilator, (4) heater, (5) bee hives, (6) frames, (7) wax and bee bread, (8) freezer, (9) segmentation machine, (10) dosage machine, (11) container, (12) ventilation shaft, (13) cyclone, (14)ventilator, (15) dust container

Dried substance 7 is separated from the frames 6 and placed in the freezer 8, where it is held for 50-60 minutes at 0-2 °C. Then it is broken down at the segmentation machine 9 and through the dosage machine 10 is taken into pneumo-separation in the ventilation shaft 12. Through it the granules fall into container 11, wax is taken into cyclone 13 and dust particles into the dust container 15.

The drying apparatus consists of electric heater, placed on the frame. With the upper part of the frame, where twelve framed hives are placed the heater is connected via a tent. Under the hives a dense metal net is placed to prevent wax falling on the electric elements. The heater is supplied with the temperature regulator.

Before the drying process the equipment is checked and the heating parameters are set. Then 12 bee bread frames are placed into each bee hive.

Separated bee bread and wax substance is frozen for 30 minutes at -5 °C.

Segmentation machine 9, dosage machine 10 and pneumatic separation equipment 12-15 compose a single line. It consists of a frame where the segmentation machine is placed. Above it is the loading bunker, ventilation shaft, and cyclone and control panel. Ventilation shaft, cyclone and dust container are connected.

The equipment is operated in the following way: The segmentation and ventilation is switched on at the control panel. Then honeycombs are loaded into the bunker where they are broken into smaller pieces by the rods. After that granules are moved into the ventilation shaft where wax and small bee bread particles are transferred into the cyclone and bee bread granules fall into the container. Smallest particles are caught in the dust container.

The inventors proposed a method of extraction of the bee bread granules, that is very productive, economically efficient, and ecologically clean, allows for preservation of products properties. The extraction equipment includes the grinder of the honeycombs, pitcher that throws the grinded mass on the air separation module. The air flow is provided by the horizontally placed on the cyclone ventilator. Cyclone catches bee bread particles. The grinder is a sideways placed cylinder inside which is a roller with protracted rods. On the lower end of the grinder is a grid. The pitcher is a disk with shovels placed on a roller drive. Separator includes several shovels and gaps for the creation of the separated flow.

Also known is the technological line for the processing of bee bread with the acoustic dryer [7]. The equipment works the following way: Honeycombs are loaded into the dryer. Low frequency acoustic wave source is switched on. Equipment operates for several hours. Humid air is removed from the dryer. Frequency is held at 25 hertz. The infrasound spreads in the container with minor absorption. Harmonic waves of equal frequency and amplitude running towards each other from the source and reflected from the container walls form standing waves, which act in the process of drying more effectively. Almost 98% of bee bread is extracted, containing less than 5% of wax traces. Undamaged bee bread granules in the finished product compose 87% of total mass [7].

Proposed method for acoustic drying [8] allows raising productivity and lowering the price of the drying equipment. Acoustic dryer includes drying container with soundproof walls, loading-unloading equipment, a source of acoustic waves, and hot air inflow equipment. The source of acoustic waves is a membrane, connected to a drive. Acoustic source is outfitted with the reverse valve and the membrane has a form of a rolling diaphragm. The outgoing pipe of the heater is placed coaxially with the pipe of the acoustic source and is placed parallel to the drying container at its flank. Simultaneous effect by the hot air and the acoustic vibrations from the same source increases productivity, simplifies engineering and is cheaper than for example Hartmann generator.

Thus, the highest productivity is reached by the technologies which are based on convective method and modern non-destructing methods, such as acoustic drying. These technological inventions allow preserving nutritional properties and vitamins in the substance, which can then be used in production of medical and food products.

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