

Royal jelly:

A boon of nature

Sudeepa Kumari Jha*, Md Monobrullah, Anjani Kumar and Milan Kumar Chakravarty

Birsa Agricultural University, Kanke, Ranchi, Jharkhand 834 006

Royal jelly is a bee product secreted by worker bees. It is responsible for morphological characteristics of queen bee. It is a rich source of protein and has high medicinal importance. It is also used in food industries as dietary supplement and in cosmetic industries. But, it is not considered as a bee product in traditional bee keeping because after secretion, it is immediately consumed by bees and is not stored. Harvesting of royal jelly becomes feasible only in the case of queen rearing. The most common method of mass rearing of queen bee is grafting of larvae in artificial queen cup. The royal jelly is extracted with aspirator or water vacuum pump and is stored in jar after filtering with nylon net. The shelf life of fresh royal jelly is very small. A small beekeeper may also harvest royal jelly along with honey.

Keywords: Grafting, Honey bee, Queen cell cup, Royal jelly

ROYAL jelly is a milky white viscous and jelly like substance secreted by hypopharyngeal gland of worker bees in bee colony. The bee colony consists of one queen, few hundred drones and thousands of worker bees. The queen bee is the longest bee in the colony and its wing covers the abdomen partially. While in drone and worker bees, wing fully covers the abdomen. The drone is larger in size than worker bee and their abdominal tip is blunt, while that of worker is pointed. Queen is fertilized female which lays eggs, worker is sterile female which performs all the functions of the colony like foraging and nursing the brood and queen bee. Drone is haploid male and its function is to fertilize the newly emerged queen bee during nuptial flight. Both queen and worker are developed from fertilized egg, while drone develops from unfertilized egg. The brood cell of worker and drone bees are hexagonal with flat cap and convex cap. The difference between queen and worker bee is only related to

feeding during larval stage. For the first three days, larvae of all caste are fed on royal jelly, hence, it is also called as bee milk or brood food. After three days, the drone and worker larvae are no longer fed with royal jelly, they feed on mixture of nectar and honey. But queen larvae are continuously fed with royal jelly throughout their life. It is believed that royal jelly is mainly responsible for fertility and long life span of queen bee. Royal actin is the main compound in royal jelly that triggers development of morphological character in queen bee, viz. large in size. Mandibular gland of queen bee secretes queen substance (9-oxo-2-decenoic acid) which inhibits ovary development of worker bees and makes it sterile.

The commercial production of royal jelly is mainly related to mass rearing of queen bee, because queen larvae can not consume the royal jelly at a rate at which it is supplied to them and there is always surplus royal jelly which can be extracted at the cost of queen larvae. The most

popular method of mass queen bee rearing is grafting method given by Doolittle in 1951. Other methods like cup kit method may also be used. The most suitable time for royal jelly production is during honey flow period, when pollen and nectar are sufficiently available, i.e. November–March. The production of royal jelly is suitable for both large as well as small apiarists, having only 15–20 bee boxes.

Mass production of queen bee by grafting method

One day old larvae are grafted in artificial queen cell cup, attached in frame with the help of grafting needle. After that, the frame containing queen cell cup is placed in a queen less bee hive or in super chamber having queen excluder where queen bee cannot move.

Preparation of queen cell cup: To prepare queen cell cup, a solid wooden stick about 10–15 cm long with its one tip of pencil thickness (9–10 mm diameter) and other slightly broader is used. Pure bee



Queen bee



Queen cell cap



Grafting needle



Queen cage

Different tools required in royal jelly production

wax and one table spoon honey are required. For bee wax, old wax sheet or extra wax comb made in a bee box may be used. The bee wax is kept in a bowl and is melted by putting hot water. A dilute solution is prepared by mixing honey in one glass of water. The tip of stick is dipped in honey water solution and excess liquid is shaken off and then the stick is dipped in molten wax to a depth of 8–9 mm. Then, it is held in open air until the wax solidifies and this process is repeated 5–6 times. Every successive dip in wax should be 1 mm lesser, so that cup is obtained with good base and thin walls. After cooling, the wax is removed from the cup with slight twist. The queen cell cup can be used repeatedly for queen bee rearing. The farmers can easily purchase readymade queen cell cups from the market.

Attachment of cup cell: Horizontally, 2–3 wooden bars at equal distance between top and bottom in a wooden frame are used to fix wax sheet. These queen cup cells are glued at the bar with 10 cm distance from each other. Before grafting, the cup cells may be kept in a colony overnight to make them more acceptable. The cells may be primed with royal jelly before grafting.

Larval grafting: For grafting, one day old larvae are selected and placed one by one in queen cup with the help of grafting needle. The young larvae are very delicate, so grafting should be done very carefully. Four days before grafting, a blank wax sheet in a hive should be placed so that eggs laid on the same day hatch three days before grafting. The frame with grafted larvae is then given to queenless colony. If the queens are present, then grafted

frame should be placed in upper chamber of two storey colonies with queen excluder, so that the queen cannot move into this chamber.

Extraction, storage and processing: After 72 hours of grafting, the cells are cut at the level of royal jelly with sharp blade. The larvae are thrown out and royal jelly may be extracted with a spatula/aspirator/water vacuum pump. The extracted royal jelly is filtered by using fine nylon net and is immediately stored in a glass or food grade plastic. It has a limited shelf life and can be stored in household under deep freezer. Freeze dried royal jelly is found in powder form. It is obtained by evaporating the water content from the frozen product in a vacuum, for which some special equipment are required ranging from a simple laboratory freezer drier to large industrial plants. The freeze dried royal jelly must be stored in air tight container to protect it from the humidity. If the royal jelly is not harvested from these artificial queen cells and these frames remain in hive for 10 days, then queen cell will be sealed and queen will emerge after 4–5 days. The queen cell can be used for requeening of queen less colonies or in colony where queen bee has become old and replacement of queen is required. In this case, the recipient colony should have sufficient number of worker bees of all ages, mature drone and sufficient quantity of food reservoir so that queen is treated well in the colony. If the colony has old queen, the colony is made queenless at least 24 hours prior to transplantation. The individual queen cell is cut at the base with sharp knife and placed in recipient colony just adjacent to brood area. For requeening, new

queen should be caged in queen cage and plugged with muslin cloth to avoid damage by worker bees due to intolerance. After few hours, workers gather around the cage indicating acceptance of queen bee in the colony. After that, the queen bee is released from the queen cage. Another method is dipping the queen in honey of recipient colony and released it in new queenless colony.

Composition

Royal jelly is a nutrient rich substance and is strongly acidic in nature. It contains roughly 50–70% water, 17–45% protein, 18–52% sugar (about 90% fructose and glucose), 3.5–19% lipid and 2–3% mineral of dry weight. In protein, all the essential amino acid for humans are present. Besides, it also contains trace minerals, antibacterial and antibiotic components, all vitamin B, trace amounts of vitamin C but none of the fat soluble vitamins, viz. vit A, D, E or K are found.

Utility

Number of researches suggest that many nutrients present in royal jelly are beneficial to human health. It should be taken daily in very small dose around 250–500 mg as dietary supplement. But the taste of royal jelly is not very pleasant. Therefore, many consumers use it as ingredient in food products. Mixture of honey and royal jelly (1.3%) is tasty and most popular way to consume royal jelly as food. One teaspoon mixture contains about 100–300 mg of royal jelly. In Asia, it is widely used in beverage industry. Some vitamin supplements and fruit juices are also enriched with freeze dried royal jelly.

In India, royal jelly is used in treating diseases since ancient time. The major health benefits are its anti-inflammatory effects, reduction of heart disease risk by impacting cholesterol level, wound healing and skin repair, lowers the blood pressure, regulates blood sugar by reducing oxidative stress and inflammation, antioxidant properties support healthy brain function, provide anti-aging effects, enhance healthy immune system, hair growth, treats certain symptoms of menopause etc. But, it should not be used by asthma or allergic patient, pregnant or breast-feeding women without any medical advice. In medicine industry, it is mainly used for stimulatory purposes. It is also used in cosmetic industry to prepare creams.

Market

Studies conducted at Central Bee Research and Training Institute (CBRTI), Pune, College of Pharmacy and CSIR-National Chemical Laboratory, Pune confirm that royal jelly produced by honey bees that gather pollen from flowers of mustard, coconut and multi-flora variants are of top international

quality. The quality of Indian royal jelly is better than the royal jelly produced in Thailand and China and almost equal to Italian royal jelly which is considered as the best quality in the world. China is the world largest producer and exporter of royal jelly and is supplying more than 90% of the global market. Japan imports over 400 metric tonnes royal jelly and holds first rank amongst importers. In India, number of apiarists is more than 2 lakhs but not even 5% are trained in royal jelly production. Even the Indian brands are not using domestically produced royal jelly, they import and repack it (Table 1).

Table 1. Food Safety and Standards Authority of India (FSSAI) imposed International Organization for Standardization (ISO) standard for royal jelly in India (2019)

Parameter (% by mass)	ISO permissible limit
Moisture	62–68.5
10 hydroxy-2-decenoic acid	1.4
Protein	11–18
Total sugar	7–18
Glucose	2–9
Total lipid	2–8



Queen rearing by grafting method

Source: <https://www.dadant.com/learn/queen-rearing-methods-and-equipment/>

Though people of developed countries are more conscious about health from a longer period but from last few decades health awareness has increased among people of developing countries like India. So, Indian bee-keeper has large market domestically and globally for royal jelly. A large amount of royal jelly is sold from the apiary in natural state because purchaser prefers unaltered naturalness. In local market, it is sold approximately at ₹50,000/kg.

SUMMARY

Royal jelly is a secretion of 5–12 days old worker bee. It is rich source of protein which contains all the essential amino acid for humans. Under normal conditions, the produced royal jelly is directly consumed by new born larvae and adult queen bee. Technology of commercial royal jelly production is similar to mass rearing of queen bee. Harvested royal jelly can be easily stored in household under deep freezer. Freeze dried form obtained by evaporating the water content from royal jelly is in powdery form and it retains the characteristics of the product, but this should be stored in air-tight containers. Market demand of royal jelly is increasing day by day, as people are becoming more aware towards health benefits due to its nutritional and medicinal importance. Hence, Indian beekeeper has large market for royal jelly. A new entrepreneur or small beekeeper may also start royal jelly production with minimum investment.

*Corresponding author's e-mail: sudeepak.jha@gmail.com

FEW FACTS

All manufacturers claim their own cooking oil is the best! Canola oil, olive oil, sunflower oil, butter, margarine, and virgin coconut oil all have their supporters. But the fact is that all liquid oils are about the same. They all provide about 120 calories per tablespoon. Unless you drink your cooking oil, or deep-fry every day, your choice of cooking oil doesn't make a huge difference. It's good that we pay attention to our oil. But the fact is, the major source of oil in our diets isn't home cooking – it's packaged foods and fast-food meals! If we're concerned about GMO (Genetically Modified Cooking Oils), it's likely that corn, soy, and canola oils are genetically-modified. There're non-GMO, organic kinds of these oils available. So check the label. Choose sunflower oil or canola oil if you wish to fry foods, as these oils have a higher smoke point. It is best not to fry with extra-virgin olive oil, as its smoke point is only about 190°C/375°F.