



Review

Royal Jelly: An ancient remedy with remarkable antibacterial properties



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ABSTRACT

Royal Jelly (RJ), a honeybee hypopharyngeal gland secretion of young nurse and an exclusive nourishment for bee queen, has been used since ancient times for care and human health and it is still very important in traditional and folkloristic medicine, especially in Asia within the apitherapy.

Recently, RJ and its protein and lipid components have been subjected to several investigations on their antimicrobial activity due to extensive traditional uses and for a future application in medicine.

Antimicrobial activities of crude Royal Jelly, Royalisin, 10-hydroxy-2-decenoic acid, Jelleines, Major Royal Jelly Proteins against different bacteria have been reported. All these beehive products showed antimicrobial activities that lead their potential employment in several fields as natural additives. RJ and its derived compounds show a highest activity especially against Gram positive bacteria.

The purpose of this Review is to summarize the results of antimicrobial studies of Royal Jelly following the timescale of the researches. From the first scientific applications to the isolation of the single components in order to better understand its application in the past years and propose an employment in future studies as a natural antimicrobial agent.

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1. Introduction

Royal Jelly (RJ) is a glandular secretion white-yellowish (Fig. 1), gelatinous-viscous sour taste, with a slight characteristic smell of phenol (which gives it its characteristic flavour) produced from the hypopharyngeal and mandibular salivary glands of young nurse (bees aged between 5 and 14 days) (Chauvin, 1968; Fujita et al., 2013). RJ is the exclusive nourishment for all bee larvae, from hatching to the third day of life; those larvae which are selected

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to develop into queens are fed with RJ until the fifth day of larval life (the time at which the cell is operculated), and then RJ remains a dedicated feed for the queen bee alimentation for the duration of her life. Furthermore, RJ also has a significant impact on the life span: a worker bee lives around 45 days, while a queen bee could live up to five years during which is able to spawn in a day the equivalent of her weight in eggs (approximately 2000–3000 eggs per day for several years).

Storage conditions of RJ for its human employment is a critical point for maintain unchanged its properties; RJ is light and heat susceptible and undergoes oxidation to a direct contact with air (Bogdanov et al., 2004; Buttstedt et al., 2013; Kheyri et al., 2012; Sabatini et al., 2009; Scarselli et al., 2005; Zhang et al., 2012).

1.1. Historic background

The first historical notes about human employment of RJ date back to ancient Greece; Greeks thought that the “ambrosia”, the nectar which gave immortality to the gods of Olympus, was composed in part by RJ. At that time it was already consumed without knowing its specific effects, and historians reported that the honeycombs were shredded with inside honey, larvae, propolis, pollen and RJ and eaten fresh (Cassaignau, 1991; Mráz, 1995). Aristotle was the first to have discovered the function of RJ in the bees society and, by studying its effects in queen bee, he attributed to the consumption of RJ an increase of physical strength and, above all he supposed its role in an improvement of intellectual capacity; the breakfast of his school was exclusively made with honey and RJ (Domerego, 2001; Molan, 1999). In ancient Egypt, RJ was used like a cosmetic, which reached its zenith of notoriety with Cleopatra, as one of her personal beauty secrets. Furthermore, in that period RJ became a symbol of strength and majesty of the Pharaohs, which usually ate RJ (Emonet, 2001; Levet, 2008). In Asia, specifically in China, RJ is used in traditional medicine since ancient time. This product of bee-keeping, which was produced exclusively in the sovereign gardens, was correlated with the longevity and the sexual force, even in old

age, of ancient dynasties of China (Cherbuliez and Domerego, 2003; Contessi, 2010). Jan Swammerdam (1637–1680), a Dutch naturalist, microscopist and entomologist, was the first to described the compound of nourishment in the royal cell and discovered that the “beehive chief” is a queen and not a king as supposed until the seventeenth century (Contessi, 2010; Viel and Doré, 2003). The French scientist René Antoine de Réaumur (1683–1757) coined the term “Royal Jelly” to name the feed of queen bee and he related the assumption of RJ with the exceptional growth of the queen (Cherbuliez and Domerego, 2003; Molan, 1999). In 1852 Reverend Langstroth, known as the father of American beekeeping, was the first to analysed chemically RJ, however he used methods did not guarantee a scientifically significant information (Domerego, 2001; Levet, 2008). Langstroth also proposed during the fifties the use of RJ as a commercial product, especially in areas where the production of honey was not profitable (Contessi, 2010; Viel and Doré, 2003). The use of RJ as a functional product and health enhancer was investigated since the early 60s, with the development of the “Apitherapy”. From then on, particularities and properties of RJ were discovered and RJ reached a widely used in therapy for both men and bee itself (Contessi, 2010; Molan, 1999).

2. Composition

RJ is an acid colloid (3.6–4.2 pH) composed mainly by water, sugar, proteins, lipids, vitamins and some mineral salts (Melliou and Chinou, 2005; Ramadan and Al-Ghamdi, 2012; Vecchi et al., 1993).

The major component is water, ranged from 60% to 70% (Caboni et al., 2004; Melliou and Chinou, 2005), followed by carbohydrates from 11% to 23% (Sabatini et al., 2009; Sesta, 2006), proteins from 9% to 18%, (Melliou and Chinou, 2005; Ramadan and Al-Ghamdi, 2012; Simuth, 2001), lipids from 4% to 8%, (Malka et al., 2009; Nagai and Inoue, 2005; Sabatini et al., 2009) and there are present in low amount vitamins and mineral salts with other unknown substances present in traces and all together could range from 0.8–3%

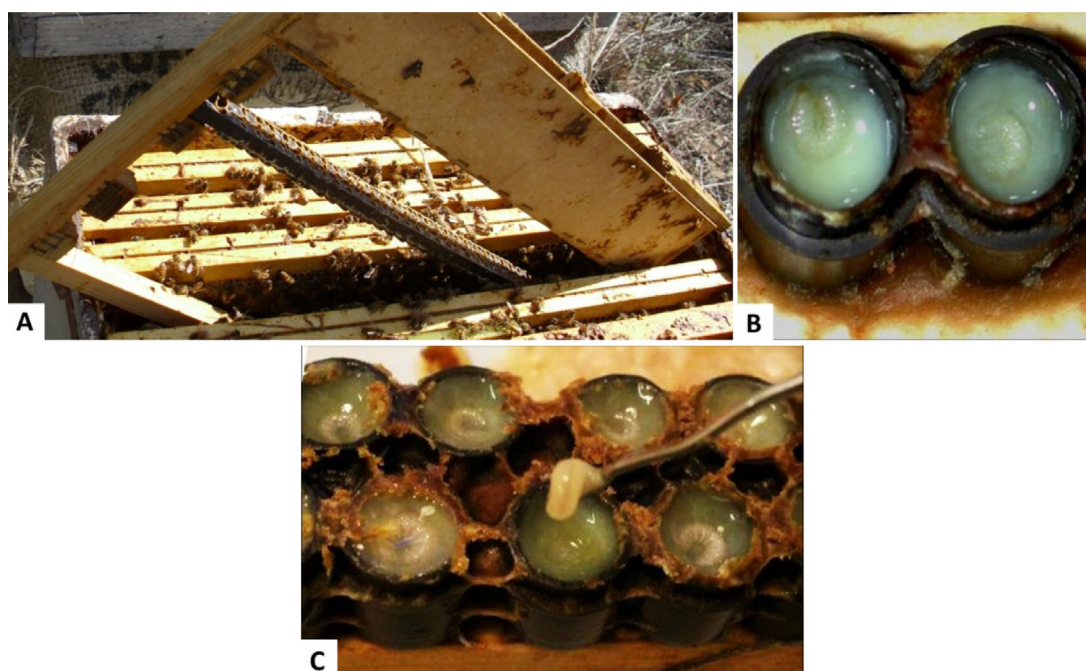


Fig. 1. Hive and royal cells with Royal Jelly and queen bee larvae.

A. Hive for breeding queen bees and Royal Jelly production, constituted by only royal cells. **B.** Queen bee larvae during development in royal cells filled with Royal Jelly. **C.** Queen bee larvae removed by royal cells for the Royal Jelly collection.

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