The antimicrobial effects of royal jelly, propolis and honey against bacteria of clinical significance in comparison to three antibiotics

Monica Mierzejewski
College of Arts & Sciences/Biology

Abstract

In recent years a marked increase in antibiotic resistance by certain pathogenic bacteria has been seen. This increase is due to the overuse and misuse of antibiotics and has resulted in several highly resistant strains of bacteria such as MRSA—a strain of *Staphylococcus aureus* frequently causing nosocomial infections, against which only the antibiotic Vancomycin is currently effective. In order to assist in combating bacterial infections, alternative methods to traditional ato have inhibitory effects on ba

The primary causes of this increased resistance are suggested to be the overuse and misuse of antibiotics in situations where antibiotics are either unnecessarily prescribed or when medical directives for their proper use are not followed [1,3]. Attentions should therefore be placed on exploring alternatives to antibiotic treatments in order to have substitutes available and to potentially stall the further progression of antibiotic resistance.

Honey has historically been used as a therapeutic agent [4]. In addition, propolis and royal jelly—also products of the common honeybee (*Apis mellifera*)—have become available as supplements as new research has emerged suggesting their curative properties.

Despite the lack of a lymphatic-based immune system, many insects, including *A. mellifera*, are able to ward off bacterial infections [5, 6], which suggests a mechanism for the production of potent antimicrobials by these insects [7]. Three of the major known mechanisms of microbial control used by honey bees are: honey, propolis and royal jelly [8].

Since bees neither migrate nor hibernate, honey is produced by bees as an alternative food source during winter months when their primary food supply, nectar, is not available [9]. The properties of honey that prevent its spoiling are its low pH, hydrogen peroxide content, flavonoids and high sugar content, which results in high osmotic pressure [8]

failed and showed impressive chemical debridement action [10]. While many characteristics of honey are constant, the exact composition of honey varies, however, due to variations in pollen content, the taxa of which indicates the floral source used by that hive to produce the honey [11,12].

Royal jelly is a spe a food source ity is wards harmful

emergence and spread of drug-resistant pathogens has accelerated. More and more essential medicines are failing. The therapeutic arsenal is shrinking. The speed with which these drugs are being lost far outpaces the development of replacement drugs" [20].

Materials and Methods

Samples of *Staphylococcus aureus, Escherichia coli, Staphylococcus epidermidis* and *Bacillus cereus* were obtained from Becton Dickinson Baltimore Biological Labs (BD BBL) and were maintained as stock cultures on slants of Tryptic Soy Agar, with weekly transfers to new tubes. Sock cultures were used to inoculate Tryptic Soy broth cultures which served as "working cultures" in the experiments. Cultures were initially incubated for 24 hours at 37°C and then refrigerated to stall growth.

The bacteria selected were chosen based on their frequent occurrence in infections.

Honey and Royal Jelly

The bacterium to be tested was swabbed from a broth culture onto a Muller Hinton agar plate and a well was made within the agar. For each trial 0.05 mL of either honey or royal jelly, which had been warming in a 35-40°C water bath, was pipetted into the well. The plate was incubated for 24 hours at 37°C. After incubation the zone of inhibition surrounding each well was measured. (Figure 1)

Wells were made in the agar after it was inoculated by inverting a glass 5mL pipette and inserting the tip into the plunger. The agar was pierced, forming a circle, and the agar was drawn up by the plunger.

Figure 1: Graphical representation of a treatment disk/well in agar and zone of inhibition produced.

Propolis

A tincture (61 wt/wt%) using an ethanol solvent was made and infused into sterile 6mm disks which were then dried to remove the ethanol. The disks were placed onto inoculated Muller Hinton agar plates and were also incubated for 24 hours at 37°C.

To determine the possible effects of the ethanol solvent, disks saturated with ethanol were added to inoculated agar after 24 hours of drying and an additional control using black sterile disks was similarly run.

Antibiotics

Antibiotic comparison tests were run, using a purchased set of antibiotic infused disks—Kanamycin (30µg), Penicillin (10 units) and Tetracycline (30µg)—from Fischer Scientific. The 6mm disks were placed onto inoculated Mueller Hinton Agar plates, which were subsequently incubated for 24 hours at 37°C. After incubation the zones of inhibition were measured.

Results

Honey and Royal Jelly

Honey and royal jelly displayed a varying degree of bacterial inhibition. Zones of inhibition produced after honey treatment were over 25mm for *S. aureus*, *E.coli* and *B. cereus* while the effectiveness was drastically reduced against *S. epidermidis* (Figure 2a). The rims of the produced zones were graduated rather than distinct, with the zone fading into the area of normal growth.

S. epidermidis was the bacterium most a24 46( )2 [(om 0.003 Tw

in the spectrum of effectiveness (Table 1). Of the natural products the honey and royal jelly were most inhibitory and were in certain instances, comparable to Tetracycline and Kanamycin.

Kanamycin and Tetracycline were the most effective treatments overall; however, for *Staphylococcus epidermidis* and *Escherichia coli*, honey and royal jelly, respectively, were the most effective products tested.

These and other natural products may have the potential to serve as complementary methods of bacterial inhibition to those already in use by traditional medicine.

The bacteria chosen~~7~~– *7* *fod[i t-s 00he7(act)3(er)-2] 31.. 001.J 6.988 0*

When examining the issue of an individual product producing a zone of enhanced growth surrounding the area of inhibition it can be theorized that the product became diluted as it spread through the agar, thereby decreasing its effectiveness. The spread resulted in the loss of its inhibitory effects and bacteria in the area with certain metabolic capabilities used the component parts as nutrient sources. Honey enlists several properties to induce bacterial inhibition such as low osmotic pressure, H2O2, etc. However, honey also contains several sugars and bacteria which can digest carbohydrates and may have been able to do so after the product had been diluted.

While more research is required to examine the antimicrobial spectrum of bee products, this research demonstrates that honey, royal jelly, and propolis contain antibacterial derivatives, which could plausibly be prescribed to treat mild bacterial infections and be adopted as standard first-

6(d)-7(e-2)-19(n)5(d

[20] Chan, Margaret. "World Health Day 2011." World Health Organization. N.p., 6 Apr. 2011. Web. <http://www.who.int/mediacentre/news/statements/2011/whd_20110407/en/index.html>.
[21] "Staphylococcal Infections." MedLine Plus. U.S. National Library of Medicine, 30 Aug. 2013. Web. <http://www.nlm.nih.gov/medlineplus/staphylococcalin