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HONEY: A SWEET SOLUTION?

Dr. Andrea K. Hubbard
 Associate Professor; Emeritus
 UCONN School of Pharmacy, Storrs, CT
 5000 ft in the Utah desert (Kanab, UT)


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Disclosure slide statement:

Dr. Hubbard has no actual or potential conflict of interest associated with this presentation.



<https://www.thesourceo2ways.com/about-us/apitherapy>



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Objectives

1. Describe medicinal history of honey
2. List composition and properties of honey
3. Identify diseases and conditions treated with honey
4. Recognize biologic activities of honey

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Outline

Apitherapy: alternative therapy that uses products that come directly from honeybees

Facts About the Bee and Honey	Conditions Treated	Biologic Properties
Medicinal History	<ul style="list-style-type: none"> • Wound healing • Anti-microbial • GI diseases • CVD • Diabetes • Asthma • Cancer 	<ul style="list-style-type: none"> • Anti Microbial • Anti oxidant • Anti inflammatory • Apoptosis • Prebiotic
Composition	Adverse Effects	Other Bee Products
Properties	<ul style="list-style-type: none"> • Infantile Botulism 	<ul style="list-style-type: none"> • Pollen • Bees wax • Propolis • Royal Jelly
OTC Products		Summary and Conclusions

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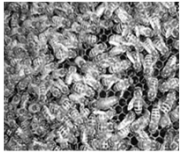

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Some Facts About...

The honeybee - highly socialized insect
Apis mellifera L.

Worker bees
 female

- Developed from a fertilized egg
- Cleaning cells, feeding young larva, building wax comb, etc.
- Gathers pollen and nectar
- Defends the hive and has a stinger
- May number as many as 60,000 in a colony
- The worker bee lives for a short period of time


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Pollen and Nectar

- Nectar from flowers; sweet liquid that entices the bees to the flower
- Suck up the nectar with their straw-like mouth
- Collect it in a little sac called a **crop**
- The nectar is for energy and becomes honey
- Collect pollen on their legs
- Leave a little bit of that pollen on each new flower
- Pollen needed for larva

Most bees collect just pollen or just nectar on any trip



Pollination



<https://www.thesourceo2ways.com/about-us/apitherapy>

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Some Facts About... The queen bee

- Develops from a fertilized egg
- Must mate with a drone to produce fertilized eggs
- Role in the hive is to produce eggs and to release pheromone signals within the hive
- May live for 5 years or more

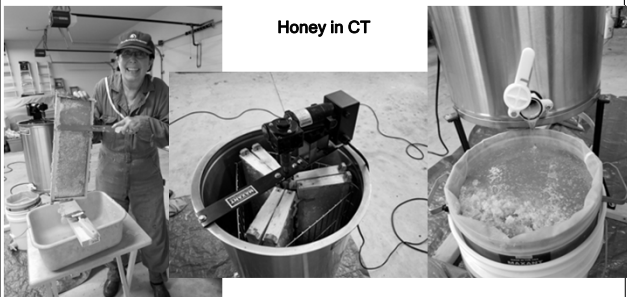
- **Royal jelly**, a white, viscous jelly-like substance
- Solely consumed by the queen bee
- Fed to queen bee throughout her entire life

- Consists of water (50%-60%), proteins (18%), carbohydrates (15%), lipids (3%-6%), mineral salts (1.5%), and vitamins



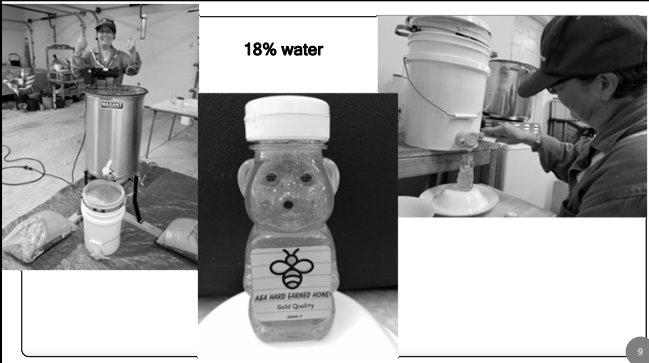
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Honey in CT



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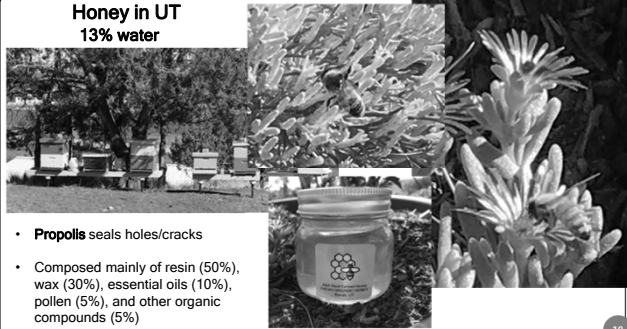
18% water



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Honey in UT 13% water

- Propolis seals holes/cracks
- Composed mainly of resin (50%), wax (30%), essential oils (10%), pollen (5%), and other organic compounds (5%)



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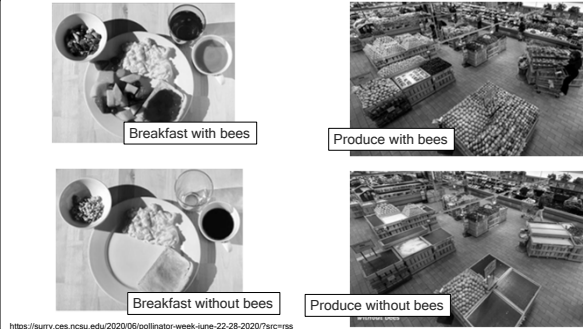
Single most important pollinator

Honey Bee

- Nut crops
- Fruit trees
- Berries
- Row crops
- Depend 80% to 100% on honeybee pollination.

Insects 2019, 10, 356

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Breakfast with bees

Produce with bees

Breakfast without bees

Produce without bees

<https://surry.ces.ncsu.edu/2020/06/pollinator-week-june-22-28-2020/?sr=rs>

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Multiple Choice Question #1

Which of the following is a correct statement? :

- a. Honeybees have minimal importance in the propagation of crops.
- a. Propolis helps in the maturation of the queen bee.
- b. Royal jelly helps in the development of the king bee.
- c. Honeybees collect nectar and pollen in separate flights.

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Medicinal History of Honey

Ancient Egyptians, Assyrians, Chinese, Greeks and Romans: honey for wounds and intestinal diseases

Ancient Egypt

- o In 900 remedies; mixed with wine and milk
- o Offered honey to their deities as a sacrifice
- o Used honey for embalming the dead
- o Antibacterial properties that helped heal infected wounds

Ancient Greece

- o Honey and vinegar. Used for gout and certain nervous disorders
- o Hippocrates prescribed this combination for pain, water and honey for thirst, and a mixture of honey, water and various medicinal substances for acute fevers

- Roman Empire
 - o Gift to the gods; widely used in cooking
- Christianity
 - o Production of honey and beeswax increased to meet demand for candles for the church
- Islamic Medicine
 - o Mohammad treatment of diarrhea, treatment of tuberculosis
- Ayurveda - digestion, cough, teeth and gums, insomnia, skin, cardiac

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Mesolithic cave paintings from Spain from 7000 B.C. shows the first records of beekeeping, but bee honey fossils date back about 150 million years!

Beeswax was used for

- plugging mummies' orifices
- glue
- hair styling
- model making and painting

The picture is of the hair and hair extensions on the head of the mummy of Nefertari





<https://www.petbutcher.com/the-uses-of-honey-and-wax-in-ancient-egypt/>


<https://www.apicultural.co.uk/bees-of-re-beekeeping-in-ancient-egypt/>

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26th Dynasty hieroglyph depicting a beekeeper with their hives of bees





<https://www.loe.org/shows/segments.html?programID=15-P13-00046&segmentID=7>

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An ancient Greek amphora depicting four men being stung by bees after attempting to steal honey from the hives that nourished the infant Zeus.



<https://www.planetbee.org/planet-bee-blog/the-sacred-bee-ancient-greece-and-rome>

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Because bees were considered to have special powers, they were often used as **emblems**:

- In the third century BC, used on coins in the Greek city of Ephesus
- Emblem of Eros / Cupid, god of love and sexual desire

Cupid the Honey Thief by Albrecht Durer, 1514

<https://meli-feli.com/en/the-history-of-honey/>

<https://www.planetbee.org/planet-bee-blog/the-sacred-bee-ancient-greece-and-rome>

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Multiple Choice Question #2

Honey or products of bees have been used in the following ways for centuries:

- Treatment of infected wounds
- Element in marriage ritual
- Food for livestock
- Treatment for loss of hair

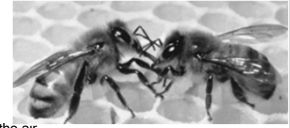
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Honey's Eternal Shelf Life, Explained

That honey found stored in an ancient Egyptian tomb? Yeah, it's still good to eat.

Honey stands out for one remarkable reason:

- It never spoils
- No need to refrigerate
- Store unopened at room temperature
- May come out of solution to crystallize



Honey is hygroscopic, draws and holds water out of the air

- Trophallaxis
- Enzymes in crop
- Stored honeycomb, evaporation occurs (high temperature & fanning of wings)
- Once water content is 18% or lower, capped with beeswax
- Use honey in winter to stay alive

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Outline

Facts About the Bee and Honey

Medicinal History

- Egypt
- Greece
- Roman
- Christian
- Islam
- Aryurveda

Composition

Properties

OTC Products

Conditions Treated

- Wound healing
- Anti-microbial
- GI diseases
- CVD
- Diabetes
- Asthma
- Cancer

Adverse Effects

- Infantile Botulism

Biologic Properties

- Anti Microbial
- Anti oxidant
- Anti-inflammatory
- Apoptosis
- Prebiotic

Other Bee Products

- Pollen
- Bees wax
- Propolis
- Royal Jelly

Summary and Conclusions

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Composition of Honey
180 different compounds

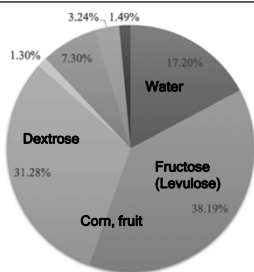
- Composed of sugars (about 80%)
- Water (approximately 17%)
- Other constituents (approximately 3%)
 - Enzymes: glucose oxidase (oxidation of glucose)
 - Oxidants: H₂O₂; MGO
 - Gluconic acid (mild organic acid)
 - pH: 3.9
 - acidity and taste
 - antioxidant activity
 - Formic acid (strong organic acid)
 - Amino acids: Proline
 - Vitamins: B complex (pollen); vitamin C
 - Minerals: potassium
 - Phytochemicals: pigments; clear to dark amber; suspended pollen
 - Flavonoids; phenolic acids
 - Taste/color in honey: floral origin; geographical area, climate, species of bee
 - within 2 miles of hive

<https://foodstruct.com/food/honey>

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Nectar broken down to fructose and glucose

Many of these sugars are formed during the honey ripening and maturation time



Ranneh et al. BMC Complementary Medicine and Therapies (2021) 21:30

■ water 17.20% ■ Levulose 38.19% ■ Dextrose 31.28% ■ Sucrose 1.30%
■ Maltose 7.30% ■ Others 3.24% ■ High sugars 1.49%

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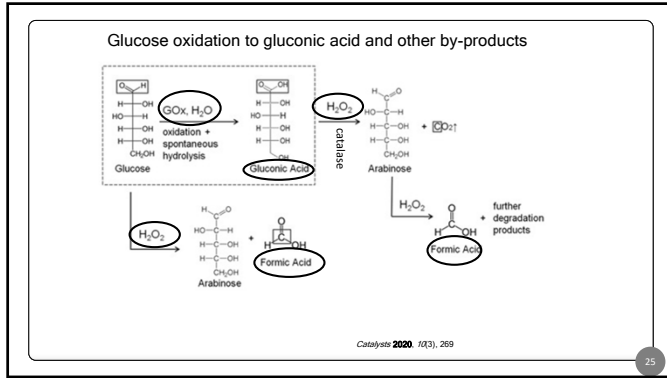
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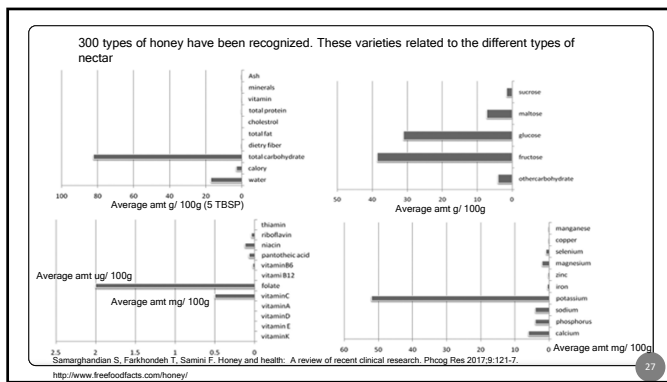
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- ### Composition of Honey
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- ### Methylglyoxal (MGO)
- Mānuka honey
- dark, rich and creamy
 - Is darker in color, richer flavor profile and a thicker texture.
 - Unique antioxidants, prebiotics and an antibacterial
- Generated during glucose and fructose metabolism in the crop of bee*
- Antibacterial properties :
- H₂O₂ – oxygen and water due to catalase
 - MGO - non-peroxide activity
 - Low pH
 - Phenolic acids
-
- *also found in bread, wine, soya, beer

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Composition: Over the Counter

The US Food and Drug Administration (FDA) has approved several honey-based products (human and animal). Manuka honey from nectar of tree flowers Leptospermum (Australia and New Zealand)

Honey based

- gels
- dressings
- ointments
- creams
- lozenges
- syrups
- eye drops

Wound treatment, digestive problems, cough, sore throat and acne

MGO - dihydroxyacetone conversion, is in high concentration in nectar of Manuka flowers' nectar

Appl. Sci. 2021, 11, 5159

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Multiple Choice Question #3

The low pH and antioxidant activity of honey is primarily due to:

- Potassium
- Proline
- Dextrose
- Gluconic acid

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Outline

<p>Facts About the Bee and Honey</p> <p>Medicinal History</p> <ul style="list-style-type: none"> • Egypt • Greece • Roman • Christian • Islam • Aryurveda <p>Composition</p> <p>Properties</p> <p>OTC Products</p>	<p>Conditions Treated</p> <ul style="list-style-type: none"> • Wound healing • Anti-microbial • GI diseases • CVD • Diabetes • Asthma • Cancer <p>Adverse Effects</p> <ul style="list-style-type: none"> • Infantile Botulism 	<p>Biologic Properties</p> <ul style="list-style-type: none"> • Anti Microbial • Anti oxidant • Anti inflammatory • Apoptosis • Prebiotic <p>Other Bee Products</p> <ul style="list-style-type: none"> • Pollen • Bees wax • Propolis • Royal Jelly <p>Summary and Conclusions</p>
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Efficacy of Honey in Diseases and Conditions*

HONEY

↓ Treatment

Asthma Wound Diabetes Neurological diseases Gastrointestinal diseases Cancer Cardiovascular diseases

***results primarily from In vivo animal models and In vitro cell culture studies**

Samarghandian S, Farkhondeh T, Samini F. Honey and health: A review of recent clinical research. Phcog Res 2017;9:121-7.

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Conditions and Diseases treated

Wound healing/management

- rapid clearance of infections
- debridement of wounds
- suppression of inflammation
- minimization of scarring
- stimulation of angiogenesis
- tissue granulation and epithelium growth

- insect bites, burns, skin disorders, sores, boils
- radical surgery for cancers

Pediatric Care

- skin damage near stomas

Gastrointestinal diseases

- Bacterial and rotavirus infection
- Diarrhea and gastroenteritis
- Constipation
- Peptic ulcer
- Oral health

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Diabetes type I and type II

- adjunct to standard antidiabetic drugs
- dramatically lower glycemic index than with sucrose or glucose
- reduces postprandial glycemic response
- lowering the glucose serum concentration

Neurological diseases

- Polyphenol ingredients of honey quench biological ROS that lead to neurotoxicity, aging, and the pathological deposition of misfolded proteins, including amyloid beta.

Cancer

- Apoptosis, antimutagenic, antiproliferative, and anti-inflammatory pathways.

CVD

- Scavenging radical species, suppressing lipid peroxidation, strengthening enzymatic and non-enzymatic antioxidant systems and stimulating/inhibiting proinflammatory markers.
- Atherosclerosis

Asthma

- Coughing sedative
- Pharyngitis/cough

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Asthma and Allergy Foundation of America

Does eating honey desensitize your body to pollen and improve allergy symptoms?

Need eat honey found in local area?

- Honey does not help with allergies. Bees eat nectar/gather pollen from annuals/perennials/vegetables/fruit trees
- Not the same pollen responsible for allergies (trees, grasses, and weeds)
- Very little of these common pollen allergens would make it into honey

- Pollen loses its immunogenicity
- Pollen digested by bees and humans; pasteurization
- Don't ingest enough intact pollen for desensitization

<https://community.aaifa.org/blog/taifa-explains-can-honey-help-my-seasonal-allergies>

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Adverse effects: relatively free except for:

DO NOT FEED HONEY TO CHILDREN YOUNGER THAN 1 YEAR OF AGE.

Infant botulism

- Acute condition that affects infants (<1 year).
- Clostridium botulinum, an anaerobic Gram positive bacillus
- Microbial spores ingested, ideal conditions for germination in the colon
- Spores germinate into the vegetative form to produce toxins

Vehicle for infant botulism

- Contamination in a beehive, or stages of processing
- Considered one of the safest foods due to low pH, presence of organic acids, low Aw.
- Spores can survive this environment

The American Academy of Pediatrics (AAP) recommends:

- Do not give children under the age of 2 any added sugars
- Associated with higher risk of insulin resistance, prediabetes, and type 2 diabetes.

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Multiple Choice Question #4

Honey can be given to children:

- Younger than 1 year of age
- Younger than 2 years of age
- Over two years of age
- Once they are weaned

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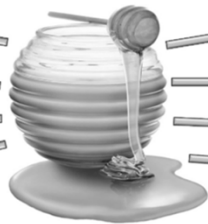
Biologic activity: role in disease treatment

ACTIVITIES:

- ANTIOXIDANT
- ANTIMICROBIAL, ANTIVIRAL AND ANTIPARASITIC
- ANTICANCER (Apoptosis)
- ANTI-DIABETIC

PROTECTION OF:

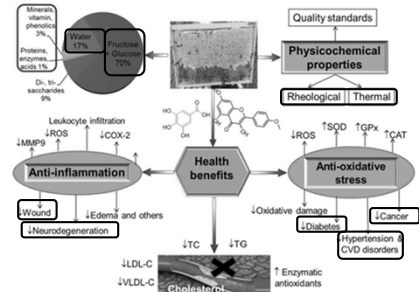
- CARDIOVASCULAR SYSTEM
- NERVOUS SYSTEM
- RESPIRATORY SYSTEM
- GASTROINTESTINAL SYSTEM



Molecules 2018, 23, 2322

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Mechanisms of Biologic Activities



Nutrients 2019, 11, 167

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Biologic Properties of Honey*

Antimicrobial

- ~60 species of bacteria: aerobes and anaerobes, gram-positives and gram-negatives
- MIC range from 1.8% to 10.8% (v/v), i.e. sufficient antibacterial potency
- Does not lead to development of antibiotic-resistant bacteria
- Used continuously
- Anti bacterial activity due to
 - Dehydration of bacteria
 - Acidity (pH 3.2 - 4.5)
 - H₂O₂
 - Phytochemicals

Antioxidant

- Sterilize the wounds, stimulate tissue re-growth, reduce edema, scar formation
- Simple wounds, burns, diabetic foot ulcers, pressure ulcers.
- Darker honey (e.g., Manuka) has higher value of antioxidant
 - antioxidant enzymes
 - phenolic compounds

*results primarily from in vivo animal models and in vitro cell culture studies

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Apoptotic activity

Indicated to prevent cell proliferation, induce apoptosis, modify cell cycle progression, cause mitochondrial membrane depolarization in several types of cancer cell lines

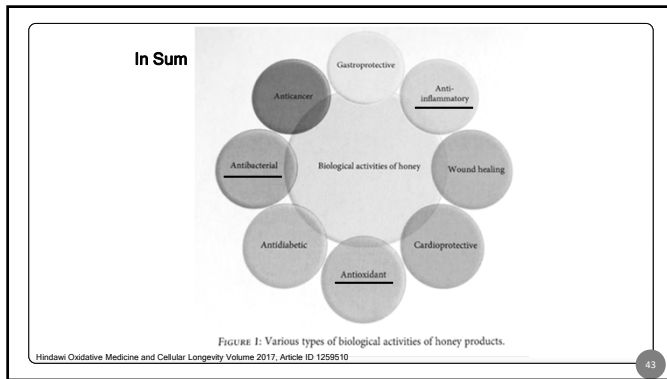
Prebiotic

High content of oligosaccharides - substrate for the growth of prebiotic microorganisms

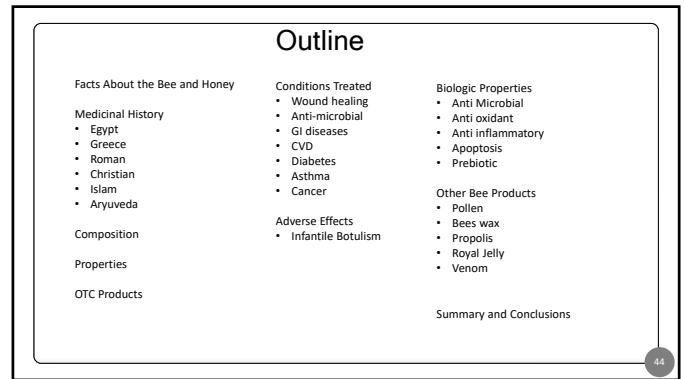
Anti-inflammatory

Phenolic content in honey - anti-inflammatory effect
Suppress cyclooxygenase - 2 and/or inducible nitric oxide synthase

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Apitherapy from other Bee Products*:

Pollen: protein; antifungal, antimicrobial, antiviral, anti-inflammatory, immunostimulating, and local analgesic

Bees Wax: lowering cholesterol and for relieving pain. Used for swelling, ulcers, diarrhea, hiccups

Propolis: resins, wax; gastrointestinal disorders, allergies, and gynecological, oral, dermatological conditions

Royal Jelly: water, protein, sugars: reproductive health, neurodegenerative disorders, wound healing, aging

Venom: protein; injected at traditional acupuncture point. anti-inflammatory properties, skin health, rheumatoid arthritis and chronic pain

Allergic reactions to bee products

*results primarily from in vivo animal models and in vitro cell culture studies

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Multiple Choice Question #5

Apitherapy from _____ has been approved by the FDA:

- Propolis
- Royal jelly
- Pollen
- Honey

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Summary and Conclusions

- Natural product
- Bioactive compounds
- Oxidative Stress, low pH leading to antibacterial activity
- Food and/or a sweetener
- Medicinal use in stimulating healing of wound
- Treat other diseases and conditions
- Potential use for other bee products

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