

Get Buzzed on Honey: Consuming Honey May Positively Affect the Diversity of the Gut Microbiome

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Introduction

The human microbiome is comprised of the 10-100 trillion symbiotic microorganisms that reside in the gastrointestinal tract along with their genetic constituents (12). Current medical research is attempting to identify and characterize these bacterial communities in order to see how they interact with and benefit their human hosts. *Lactobacillus* and *Bifidobacteria* are amongst many that reside in this microbiome, and have been identified as beneficial probiotic bacteria (9). They are thought to aid in digestion, protect against enteropathogens, reduce the risk of disease or cancer, and even boost mood (8). The diversity and function of these microorganisms are heavily affected by what people consume in their diets, as food later becomes a source of essential nutrients amongst an intensely competitive group of microbes. This has led to a closer examination of non-Western dietary habits, like seasonal foraging observed in the Hadza people, and food supplements like ginger, garlic, and honey used in folk medicine. The oligosaccharides, the low pH value, various peroxides, specialized proteins, and acids found in honey are thought to play a role in the development of beneficial microorganisms and the destruction of pathogenic bacteria in the microbiome (5). Additionally, the incredibly diverse and large amount of beneficial bacteria found in the Hadza people (1), whom commonly consume honey, supports the idea that honey may have a positive effect on the human microbiome.

Methods

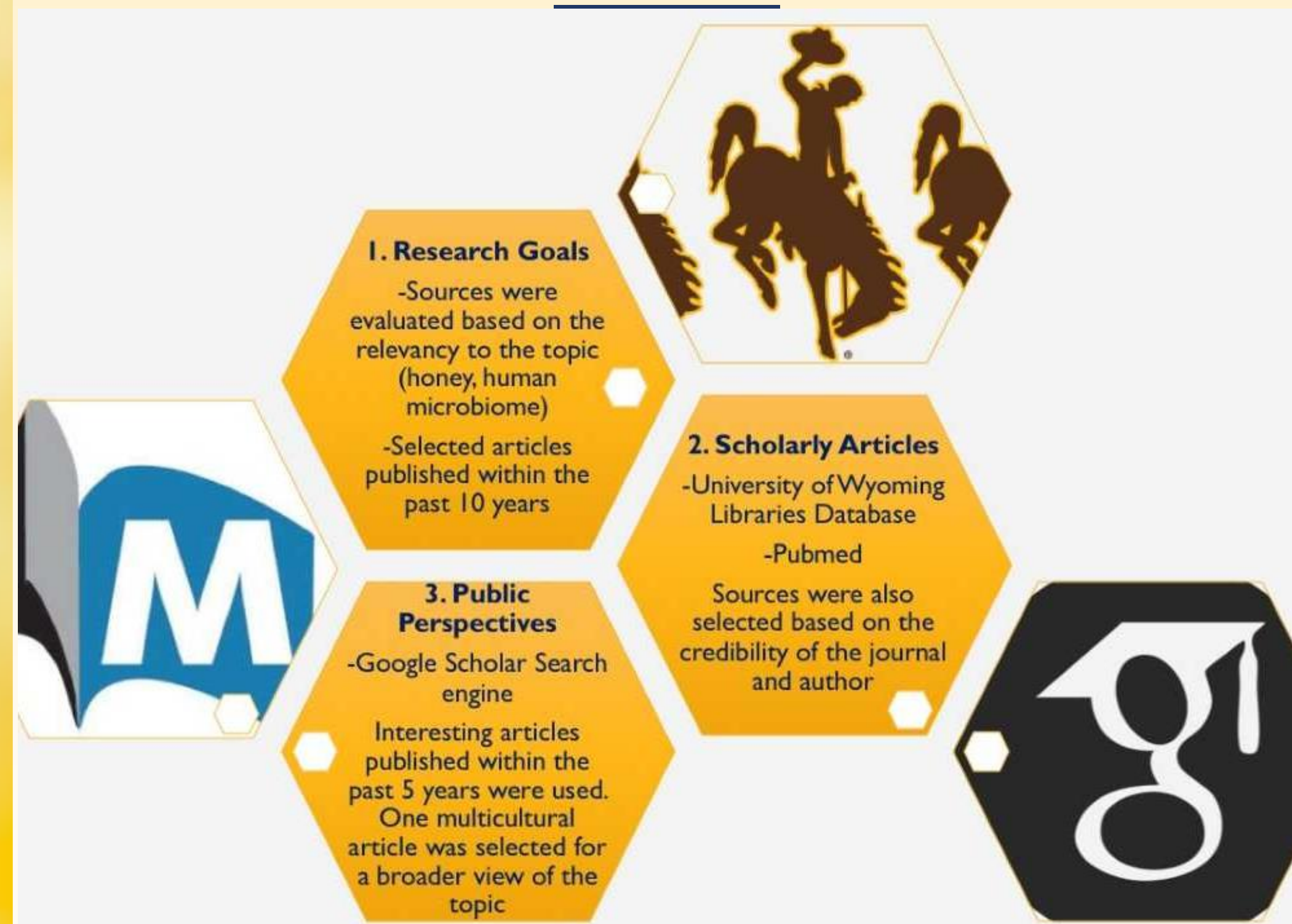


Fig 1. Honey bees collect nectar from flowers in order to produce honey. "Honey Bees - Facts, Information & Pictures." *Animal Corner*,



Fig 2. Honey is one of many types of food the Hadza people gather and consume. Possibly assisting in their larger diversity of gut microbes (1)

Hypothesis

Honey, which has been consumed since the time of Aristotle as a form of medicine, is comprised of more than 180 substances including amino acids, vitamins, minerals, enzymes and oligosaccharides. These oligosaccharides may be used by beneficial, probiotic bacteria residing in the human gastrointestinal tract such as *Bifidobacterium* and *Lactobacillus* (9). These two genera of microorganisms are reported to colonize the gut in unusually high numbers and in great diversity amongst an isolated group of hunter-gatherer Hadza people who consume honey consistently throughout the summer months (1). Additionally, honey has been used as an antibiotic for centuries. It is thought that the low pH, peroxides, and specialized proteins and acids found in honey play a role in disrupting biofilm formation and quorum sensing processes in certain species of pathogenic bacteria to reduce infection (5). Although previous case studies have only demonstrated the medicinal effects of topical honey or the relationships between the consumption of certain foods and the types of microbial populations existing in the gut, we hypothesized that if consumed in controlled human trials, honey will directly improve the diversity and health of the human microbiome.

	Nectar honey	Honeydew honey
Monosaccharides		
Fructose	38.2	31.8
Glucose	31.3	26.1
Disaccharides		
Sucrose	0.7-1.31	0.5-0.8
Maltose and others	5-7.31	4-8.8
Trisaccharides		
Melezitose	<0.1	4.0
Erllose and others	1-1.5	4-4.7
Undetermined		
Oligosaccharides	3.1	10.1
Total sugars	79.7	80.5

Source: *Doner (1977)* and *Bogdanov et al. (2008)*.

Fig. 3. Average sugar composition of honey (10)

Discussion

Our findings failed to support our hypothesis due to the lack of relevant human trials and the fact that the quality and effectiveness of honey varies widely. No research was able to demonstrate how effective honey is at diversifying the gut microbiome and improving health and wellness in consumers. However, we are unable to reject our hypothesis as a growing body of research is demonstrating the specific effects of honey as an antibiotic and prebiotic which may become relevant in current human trials. In almost every study reviewed, researchers noted that not all honey is created equal. Honey can be classified as either nectar honey from floral sources or honeydew honey from plant and insect secretions (10). The chemical composition of their honey varied depending on the floral or plant source and the geographic origin of the honey as shown in Figure 3. Honey from different sources was shown to have different effects on various communities of intestinal bacteria (6). Manuka honey, a single-origin honey from New Zealand, was frequently used in research due to its purported medical benefits and unique chemical composition. In the real world, the exclusive use of Manuka honey is not practical for most consumers as it comes at a cost of £7 (approximately \$9.50) per teaspoon (3).

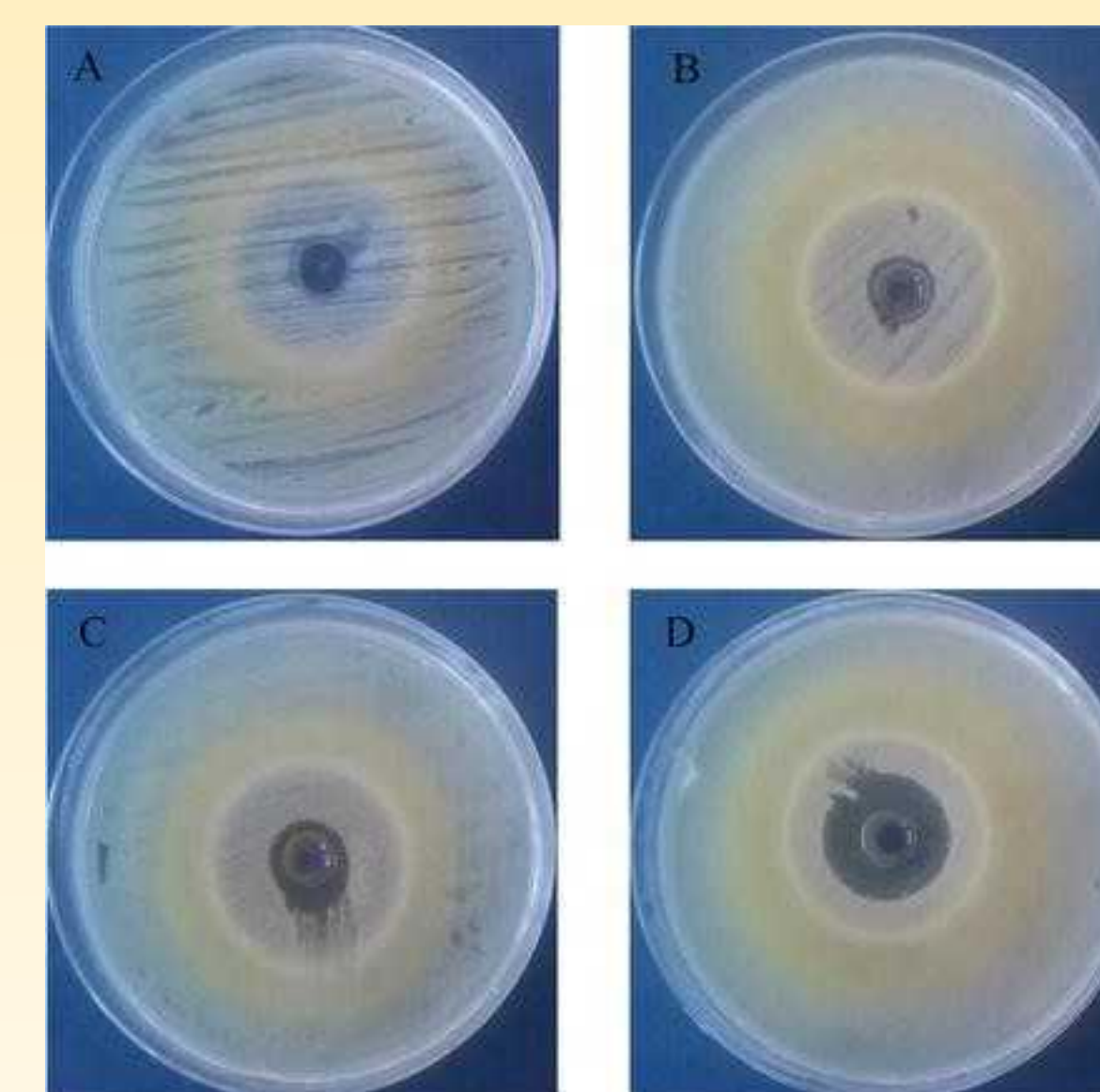


Fig. 4: Plates showing the zones of inhibition around a combination of bacteria when exposed to different types of honey.

One study was able to effectively characterize the antibacterial activity of honey, and attributed this to oligosaccharides, hydrogen peroxide, methylglyoxal and the antimicrobial peptide bee defensin-1 (10). A range of medically significant bacteria, such as extended-spectrum beta-lactamase producing *Escherichia coli* and vancomycin-resistant *Enterococcus faecium*, responded to a 40% honey solution in a laboratory setting even when pH was adjusted in a range from 3.3-7.0 (7). In later experiments, the oligosaccharides were able to withstand simulated digestion and demonstrate antimicrobial activity or serve as a prebiotic for *Bifidobacteria* and *Lactobacillus* (5). Surprisingly, honey also exhibited antigenotoxic effects which protect these beneficial colonic bacteria against antimicrobial compounds in their environment (2). This indicates that the components in honey may be able to affect bacteria in the intestine after digestion, but no human trials have been published to show any significant effect this has on the microbiome (9). It is difficult to determine whether honey will demonstrate a significant prebiotic effect when beneficial bacteria are competing with other dominant gut bacteria in a human system (10).

Discussion (cont.)

Nural Cokcetin, a researcher at the University of New South Wales, is currently conducting a human trial focused on the effects of honey on the human microbiome. Her research is expected to be completed by 2019 and will give more insight into the long-term effects of honey consumption on the human microbiome and required dosages needed to observe therapeutic effects (13).

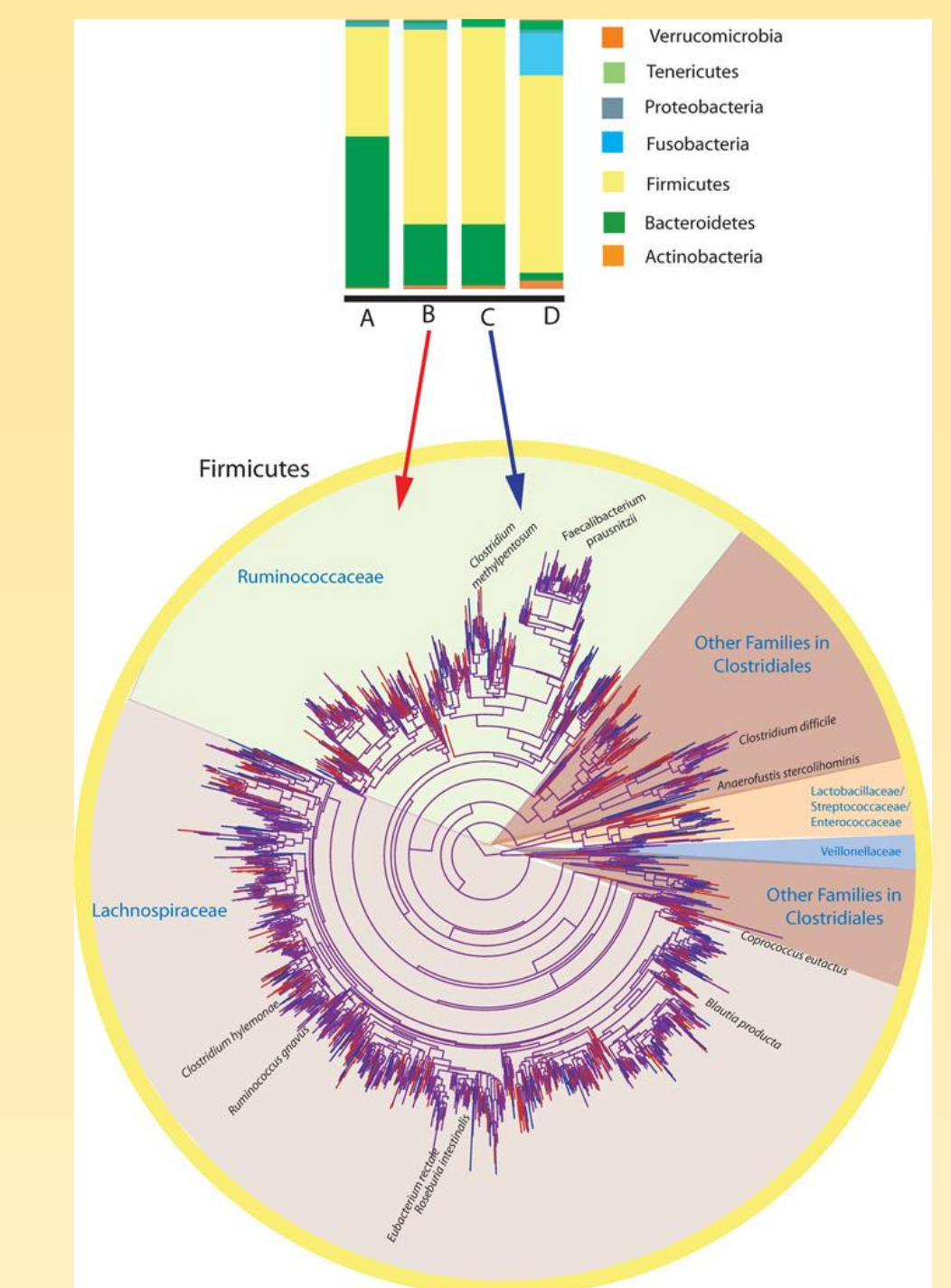


Fig. 5: A phylogenetic look showing the diversity of the human microbiota (8).

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