

HOW HONEY MIGHT HELP PROTECT PEOPLE FROM PATHOGENIC BACTERIA¹

HONEY FLORAL VARIETALS APPEAR TO DIFFER IN THEIR PROTECTION MECHANISMS INCLUDING PREBIOTIC FUNCTION

Study Overview: Honey made by honey bees using nectar from five (5) different legume crops were compared in terms of potential mechanisms that may help protect humans against pathogenic bacteria either directly or else indirectly as a prebiotic supporting beneficial probiotic microbes. This study compares honey varieties using *in-vitro* methods in order to test specific mechanisms of action. Pathogenic bacteria used in the experiments were selected due to their being food- and environmental-born bacteria known to be harmful to humans. Probiotics are commercially available to consumers in Italy, where the study was conducted.

Method in Brief: Five Italian honey products (alfalfa, astragalus, carob, indigo and sainfoin) were compared for their role supporting five (5) beneficial probiotic lactic acid microbes (*Lactocaseibacillus casei*, *Lactobacillus gasseri*, *Lactocaseibacillus paracasei* subsp. *paracasei*, *Lactiplantibacillus plantarum*, and *Lactocaseibacillus rhamnosus*). *In-vitro* testing compared the effect for each honey relative to glucose controls in terms of probiotic specific mechanisms: 1) probiotic growth 2) ability of intact probiotic cells to adhere 3) the probiotic's antioxidant activity potential. All three mechanisms provide the potential to support digestive health. In addition, the honey varieties were compared to glucose in terms of their capacity to directly inhibit biofilm production by the pathogenic bacteria strains that affect human health either from food or environmental contaminants (*Acinetobacter baumannii*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Listeria monocytogenes*, and *Staphylococcus aureus*). Biofilms of pathogenic bacteria are associated with increased virulence and can form before food is consumed in food processing environments, as well as within gastrointestinal systems in people.

Findings: As this study tested multiple potential mechanisms of action, it is encouraged that those interested in specific honey varieties for each mechanism of action refer to the original publication. The following are generalized summary findings excerpted from the publication:

Honey probiotic mechanisms of action: When exposed to honey, “[m]ost probiotics increased their growth or the *in vitro* adhesion ability to 84.13% and 48.67%, respectively. Overall, alfalfa honey best influenced the probiotic strains’ growth and *in vitro* adhesion properties. ... All types of honey increased the antioxidant activity of the probiotic cells, except for the less sensitive *L. plantarum*.”

Honey's direct effect on pathogenic bacteria biofilms: "Except for a few cases, we observed a bio-film-inhibitory action of all legumes' honey, with percentages up to 81.71%. Carob honey was the most effective in inhibiting the biofilm of *Escherichia coli*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*... On the other hand, alfalfa and astragalus honey exhibited greater efficacy in acting against the biofilm of *Acinetobacter baumannii*. Indigo honey, whose biofilm-inhibitory action was fragile per se, was very effective when we added it to the culture broth of *L. casei*, whose supernatant exhibited an anti-biofilm activity against all the pathogenic strains tested."

Conclusions: Within this study, there are multiple potential mechanisms, both direct and indirect as a prebiotic, by which honey helps protect against food and environmental pathogenic bacteria. Honey varieties appear to differ in terms of mechanisms of action, which means that results from a single study would be most generalizable to the research study conditions specifically tested in terms of honey floral varietal, probiotic enabler, and potential effect directly on pathogenic bacteria.