Treating *Cutibacterium acnes*-Related Acne Conditions Using Manuka Honey Available in Commercial Markets

Ana Malo [1], Eden Olguin [1], Ferhat Ozturk*[1],

1. The University of Texas at San Antonio, San Antonio TX, 78249

Abstract

Manuka honey is a rare monofloral honey cultivated from the pollen of the Manuka tree (Leptospermum scoparium), native to the country of New Zealand. This honey is known for its various health benefits and antimicrobial properties; largely attributed to its high phenolic content. Apart from phenolic content, bioactive compounds such as methylglyoxal contribute to honey's role in antibiotic effects. For this reason, manuka honey is often used as a natural antibiotic substance to treat specific conditions, such as dermal blemishes and acne. As a result, skin products like Manuka honey infused moisturizer, etc. have been introduced to the commercial beauty market.

The primary focus of this study will be methylglyoxal compounds within manuka honey and be tested and observed to see its potential effects on bacterial acne. The microbe that will be targeted in this experiment will the opportunistic *Cutibacterium acnes* (bacteria known to cause facial acne) to provide an understanding on how Manuka honey affects prevalent acne-causing microorganisms. The potency of Manuka honey is measured by the Unique Manuka Factor (UMF) grading system. It evaluates four key compounds that contribute to the health factors of the honey; methylglyoxal, leptosperin, dihydroxyacetone, and hydroxymethylfurfural. The numeral range of the scale starts from 5+ to 25+, which refers to the Manuka honey's antimicrobial potency and quality.

Introduction and Research Hypothesis

Manuka honey is renowned for its strong antimicrobial properties, largely due to its high concentration of methylglyoxal (MGO), a glycolytic byproduct with potent antibacterial activity. MGO disrupts the structural integrity of gram-positive bacteria such as *Staphylococcus aureus*.

Given that *Cutibacterium acnes*—a gram-positive bacterium and part of the natural skin microbiota—is a major contributor to acne (acne vulgaris), MGO may exert similar antibacterial effects against *C. acnes*. Therefore, Manuka honey presents a promising natural alternative for the treatment of bacterial-induced skin conditions such as acne.

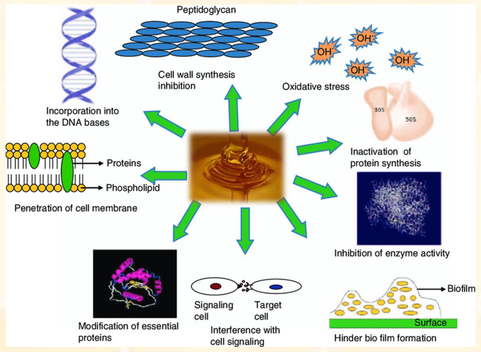

Figure 1. Infographic demonstrating the antibacterial strategies of honey

Objective

- The main goal of this thesis is to observe the antimicrobial activity of MGO in Manuka honey and how the results of *in-vitro* trials can be used
- To use a non-invasive clinical trial with IRB to prove that Manuka honey is a safe and natural alternative treatment for bacterial-related acne with little to no side effects on normal or sensitive skin
- The investigation will hopefully involve the future development of Manuka honey infused dermal skin patches as medical device with the approval of the FDA.

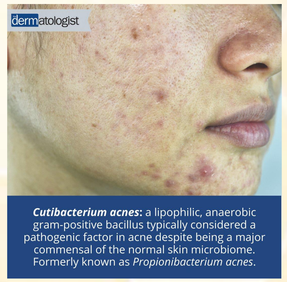

Figure 3. Photograph of *C. acnes* induced acne condition on a patient

Cutibacterium acnes

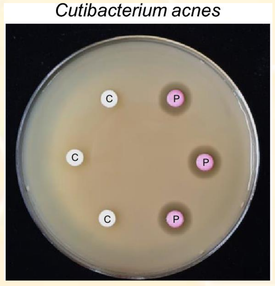

Figure 4. *C. acnes* cultured on a Petri dish with antibiotic zone of inhibition test

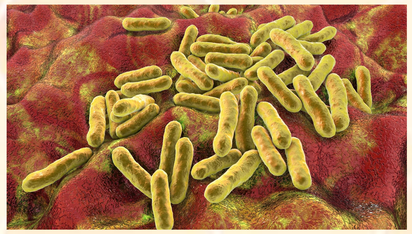

Figure 5. 3D model of *C. acnes*

Figure 2. A European honeybee pollinating a Manuka tree blossom

Materials and Methods

- Manuka honey samples (UMF 5+, 10+, 15+, 20+, 25+)
- *Cutibacterium acnes* culture
- Petri dishes (blood agar media)
- Anaerobic chamber
- Incubator
- Hydrocolloid patches

Different manuka honey concentrations will be tested to see which is most effective in treating acne formation on facial skin. The concentrations; all UMF scores of 5+, 10+, and a 15+, 20+, and 25+ representing the MGO content of the honey, will be used to test which factor level is most efficient in delivering antibacterial results, minimal/absence of irritation on skin, and has shown reduced/absent scarring within the treatment period. The time it takes for the acne to clear will also be recorded; with ideal results being the ones that took the less time to show results.

A trial with volunteers will be conducted, estimating that 12 participants with *C. acnes* related acne will be needed. A control and experimental group will be assigned to observe the key differences in using Manuka honey by applying it directly on the skin. The experimental groups would consist of 1-2 participants for each of the 5 UMF categories, as well as 2 participants for the "blank" (control) group.

The trials will be conducted within a timeframe of around 6-7 weeks; the participants are to apply the Manuka honey (either directly or on the dermal patches) onto the skin with the affected acne areas and leave it on the skin for 30 minutes-1 hour. Warm water will be used to wash off the residual Manuka honey off the face. The participants' skin will be swabbed onto Petri dishes to cultivate possible *C. acnes* cultures, which will also be put through an anaerobic chamber to imitate its ideal environment. This is to observe the direct skin flora's changes in the pathogen, which will reflect the Manuka honey antibacterial activities and potency.

Figure 6. Manuka honey product (UMF 10+) pictured at popular grocery store chain Trader Joe's©

Expected Results

The key outcomes that are expected to be seen is that Manuka honey will be successful in inhibiting the growth of *Cutibacterium acnes* and does not pose any side effects on normal or sensitive skin. The use of hydrocolloid patches will most likely be more effective than the direct application of Manuka honey alone, as the hydrocolloid ingredient will enhance the activity of Manuka honey as it simultaneously diminishes any visible blemishes and acne spots. The higher the UMF score (such as a 25+ sample), the more likely the respective Petri dish culture will reflect antibiotic activity of that sample. This type of result would demonstrate a linear relationship between MGO content and antibacterial activity.

Conclusions

- Manuka honey exhibits strong antimicrobial activity due to its high methylglyoxal (MGO) content.
- MGO effectively targets gram-positive bacterial structures, contributing to bacterial inhibition.
- Manuka honey may inhibit the growth of *Cutibacterium acnes* in anaerobic conditions, both on skin and in vitro.
- These findings support the potential use of Manuka honey as a natural treatment for acne and related skin blemishes.

References

- Weston, R., Mitchell, K., Allen, K., Antibacterial phenolic components of New Zealand manuka honey, *Food Chemistry*, Volume 64, Issue 3, 1999, Pages 295-301, ISSN 0308-8146,
- Patel, S., Cichello, S. Manuka honey: an emerging natural food with medicinal use. *Nat. Prod. Bioprospect.* Volume 3, 2013, Pages 121–128.
- Zheng, J., Guo, H., Benefits, deleterious effects and mitigation of methylglyoxal in foods: A critical review, *Trends in Food Science & Technology*, Volume 107, 2021, Pages 201-212,
- Rabie E, Serem JC, Oberholzer HM, Gaspar AR, Bester MJ. How methylglyoxal kills bacteria: An ultrastructural study. *Ultrastructural Pathology*. Volume 40, Issue 2, 2016, Pages 107-111. DOI: 10.3109/01913123.2016.1154914
- Juliano, C., & Magrini, G. A. Methylglyoxal, the Major Antibacterial Factor in Manuka Honey: An Alternative to Preserve Natural Cosmetics? *Cosmetics*, Volume 6, Issue 1, 2019,
- Mayslich, C., Grange, P. A., & Dupin, N. *Cutibacterium acnes* as an Opportunistic Pathogen: An Update of Its Virulence-Associated Factors. *Microorganisms*, Volume 9, Issue 2, 2021, Page 303.

Acknowledgements

We would like to thank the UTSA Honey Pathway, Dr. Ozturk, and the UTSA Honors College for making this Honors class possible and creating this wonderful opportunity to explore the possibilities of Manuka honey.