Abstract
We examined more than 100 local Texas honey samples for their antimicrobial and anti-oxidant potential. We identified some honeys with greater antioxidant potential, presented higher antimicrobial capacity comparable with current medical-grade honeys. Although several studies have analyzed honey’s antimicrobial activity against numerous gram-positive and gram-negative bacteria, the effect on Cutibacterium acnes remains unknown. This study analyzed the antimicrobial capacity of local Texas honeys against C. acnes in terms of bactericidal and bacteriostatic activity.

Introduction (Background)
Honey’s extensive benefits for skin care have been recognized for centuries, owing to its high biological activity. It regulates bacterial growth and aids skin homeostasis, while also functioning as an antibacterial, anti-inflammatory, and anti-aging, and antioxidant agent [1], thus reducing the development of clogged pores. Acne, an inflammatory skin disorder, occurs when sebaceous glands become clogged due to acne’s invading skin’s surface, leading to increased Cutibacterium acnes (C. acnes) colonies and resulting in pimples and blackheads on the face, back, and chest [2]. Despite various available acne treatment modalities, such as topical and oral antibiotic therapy, which are recommended to combat acne pathogenesis, they can lead to adverse side effects, including bacterial resistance. The emergence of multidrug-resistant bacteria (MDR) has become a global problem, prompting significant efforts to find alternative therapies. Studies indicate that honey has a low emergence of bacterial resistance due to variations in composition arising from nectar sources, climate conditions, storage duration, diverse floral origins, and preservation conditions [3]. While honey is renowned for its antimicrobial properties and wound-healing effects, its application to inflammatory acne remains insufficiently studied. Thus, exploring the dermatological application of honey could pave the way for developing effective, low-cost treatments for acne vulgaris without adverse side effects.

Methods
We collected 117 honey samples between 2021 and 2022 from beekeepers of various geographical locations throughout Texas. The biological activity levels (BALs) of the honey samples were determined through antioxidant, antimicrobial, and physicochemical analyses by the biochemistry and microbiological techniques at the UTSA HONEY Analysis Lab. The honey samples with the highest BAL values (r=15) were selected for this study of C. acnes inhibition. The antimicrobial activity of these high BAL honey was analyzed using the agar well-diffusion method for their ability to inhibit C. acnes proliferation. Zone of inhibition was measured after 7 days of anaerobic incubation at 37°C.

Results
The agar well-diffusion test results showed that certain honey varieties have strong antimicrobial properties against C. acnes, making them promising for treating acne. However, the size of the clear zones of inhibition varies among different honey samples tested. The honey samples ranged in color from white to dark amber, which was determined using a spectrophotometer measuring the absorbance at 560mm and multiplying by a factor of 3.15. The H2O2-based antimicrobial activity of honey can be affected by storage and processing conditions that affect glucose oxidation (an enzyme introduced into nectar by worker bees), which is vulnerable to damage from heat and light making it highly variable.

Conclusions
• C. acnes is an anaerobic gram-positive pathogen that took 7 days to grow in an aerobic chamber; thus, antimicrobial activity is crucial to the outcome
• C. acnes growth curve was optimized with different concentrations of starting bacteria using the OD600 measurements.
• The top 5 honey samples with the largest ZOI were SA-5, 19, 37, 16, and 33, which is originated from South-Central and Texas Hill country regions
• Dark amber and Amber honeys have superior antimicrobial properties
• Lighter color honey like SA-36 and SA-27 had a low pFOV value with high hydrogen peroxide activity
• Honey samples that had a large ZOI (>16 mm) will be tested for Minimum Inhibitory Concentration (MIC) and Maximum Bactericidal Concentration (MBC).

Broader Impacts
• Natural non-invasive approach can create a platform to establish new dermatological treatment plans for acne using local medical-grade honeys
• Formulation of medical-grade honey-based products and their application in human clinical trials will help with dryness, redness, scarring, and skin irritation. As changes in the management of acne treatment.
• Honey-based acne treatment provides a cost-effective alternative to conventional treatments such as topical retinoids and hormonal regimens
• Advanced honey-derived skin products may decrease skin sensitivity for acne treatment
• Chemical and biological components of the medical-grade honey can be identified using biochemical tools such as GCMS, LCMS, HPLC etc.

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References

Figure 1: Biological Activity of Honey

Figure 2: Honey Samples Origin

Figure 3: Agar well-diffusion Assay

Figure 4: Plate 1. SA samples: 20, 32, 30, 37, 53. Plate 2: SA samples: 8, 33, 16, 37, 4. Plate 3: SA samples: 19, 36, 17, 27, 5.

List of Considerations
- The total 5 honey samples with the largest ZOI were SA-5, 19, 37, 16, and 33, which is originated from South-Central and Texas Hill country regions
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