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Assessment of Various Honey Varieties on Wound Complication in Four Selected Hospitals in F.C.T, Abuja, Nigeria

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Abstract **Original Research Article**

Honey has been used in wound dressing for thousands of years, but only in more recent times has a scientific explanation become available for its effectiveness. The principle aim and objectives of this current work on honey was to confirm this assertion on the usefulness and medicinal value of honey. It also probed the broad-spectrum of antibacterial activity of Honey however we observed that there was much variation in potencies between different honeys from diverse sources. In this context, Gelam, Tualang and Manuka honey is used on wound complication to assess their healing potentials in which each of the honeys are applied on dressing before put on the affected lesions on the skin. Statistical analysis such as chi- square (χ^2) test is used to compare association of diverse honey varieties which shows that the differences between honey varieties are not significant ($P<0.05$). Glucose oxidase is induced but regain its activity if the honey is diluted. It can be concluded from in vitro studies that honey has powerful antimicrobial and anti-inflammatory activities against dermatologically relevant microbes.

Keywords: medicinal value of honey, wound complication, dermatologically.

INTRODUCTION

Honey has been in use as a wound dressing for thousands of years. In the past few decades, there has been a large amount of clinical evidence has been accumulated that demonstrates the effectiveness of honey in this application [1]. However, it is only in more recent times that the science behind the efficacy has become available. It is now understood that honey is not just sugar syrup with certain physical properties that make it suitable as a wound dressing material, but that it is a biologic wound dressing with multiple bioactive components that can expedite the healing process.

The physical properties of honey alone will positively impact the wound healing environment and the healing process, specifically because honey is acidic and has a pH of around 3.2-4.5, and it is well known that topical acidification of wounds promotes healing by increasing the release of oxygen from hemoglobin [2]. In addition, this pH is less favorable for protease activity, thus reducing the destruction of the matrix needed for tissue repair. The high osmolality of honey due to its high sugar content is also beneficial to the healing process, as substantiated in reports showing sugar pastes to be effective as wound dressings [3]. The osmotic effect of the sugar draws water out of the wound bed and, although it could be thought that this may potentially harm and dehydrate the wound tissue, this is not the case. If the circulation of blood underneath the wound is sufficient to replace fluid lost from cells, then the osmotic effect of sugar on the surface simply creates an outflow of lymph [4]. This outflow is beneficial to the healing process, as demonstrated by negative pressure wound therapy.

Sugar also draws water out of bacterial cells and, as long as the sugar does not become too diluted by

the wound fluid, the growth of bacteria is inhibited. The lowest concentration of sugar known to prevent the growth of *Staphylococcus aureus* has a water activity of 0.86 [5]. Sucrose has this activity at a concentration of 67%; glucose at 55%; and fructose at 56%; however, it has been found that sucrose packed into an abdominal wound only maintains its activity for 4 hours before becoming sufficiently diluted by body fluids, allowing the water activity to increase to 0.897 and *S. aureus* to grow [6]. The additional bioactivity within the honey itself allows for continued inhibition of bacterial growth even when the osmolality has been diluted below the point where it should cease to be inhibitory [7, 8].

There has been only 1 clinical trial reported where honey was compared with sugar for its effectiveness, in which honey was found to be more effective than sugar in reducing bacterial contamination and promoting wound healing [9]. In addition to this 1 comparative clinical trial supporting the increased antimicrobial activity of honey, in vitro research has also been conducted which has provided good scientific evidence for the presence of bioactivity in honey [10]. This bioactivity would be expected to greatly augment the effects of the physical properties on healing of wounds [11]. The literature reporting MIC values for honey with a standardized level of antibacterial activity has been comprehensively reviewed by Molan and, in these studies, the honeys used were selected to have antibacterial activity near the median level, mostly at a level equivalent to the standard reference antiseptic phenol at a concentration of 13% to 18% (weight/volume) [12]. Honey used in most products registered with the US Food and Drug Administration (FDA) for wound care is typically standardized to be equivalent to 12% to 16% phenol. The various studies conducted with these standardized honeys reported MIC values for a range of species of bacteria present in infected wounds: *S. aureus*, various coagulase-negative *Staphylococci*, various species of *Streptococci*, various species of *Enterococci*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella oxytoca*, and a range of anaerobes [13].

METHODS

Before honey was used on the affected lesion or surface wound, the medical personnel usually washed his/her hand in order to avoid pathogens entering the wound and causing immune reaction towards the cell, then followed by clinical treatment such as First Aid in order to make the surface wound neat and clean. Then after all clinical precautions were taken, the honey was applied on a smooth dressing usually abrasive in order for the honey to clip on the affected area [16, 17]. The dressing is put on the affected area and left for about 3 to 4 days. After 3 to 4 days, the dressing is replaced by another dressing which enhances elimination of microbes, cell proliferation, regeneration and tissue modelling of the macrophage [18].

RESULTS

Each sample of honey were collected from vast varieties of honey such as Gelam, Tualang and Manuka and applied on surface wound among four selected hospital in F.C.T Abuja. Chi-square test (χ^2) were used to compare the association or mean differences of different honey varieties used on surface wound among selected hospital in F.C.T Abuja.

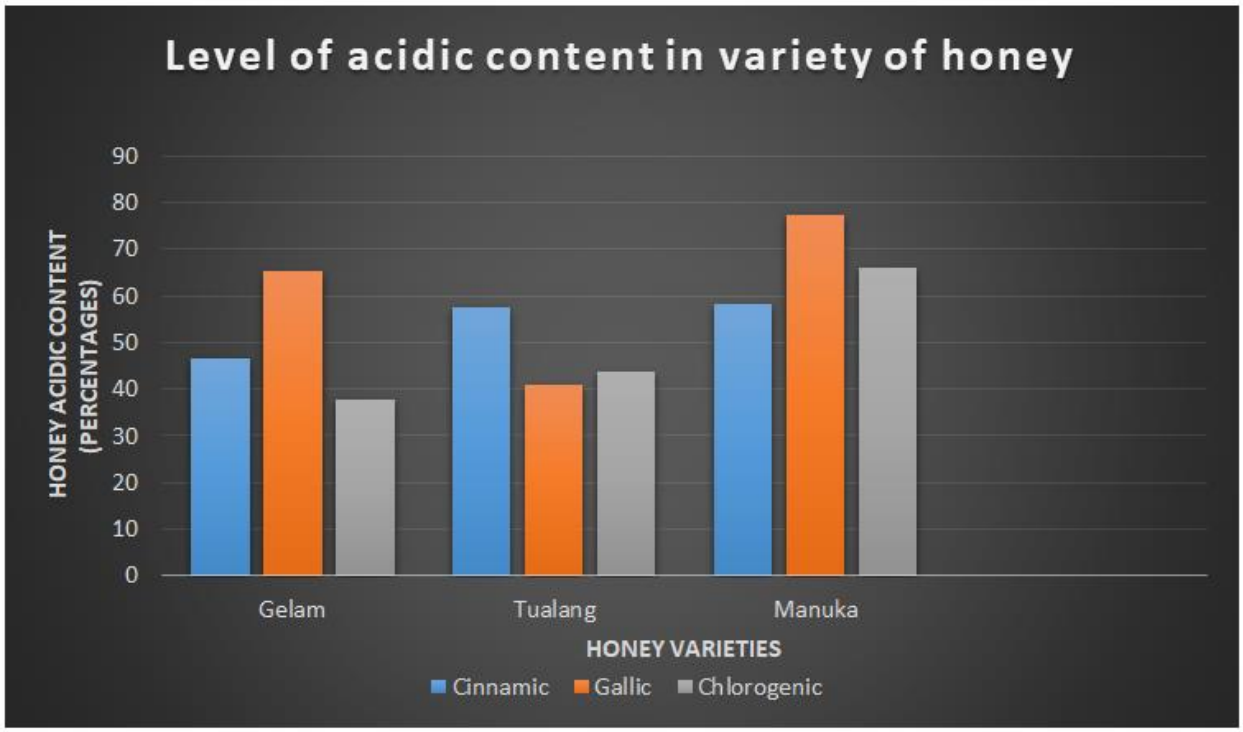

Figure 1: A chart that shows the level of various acidic content in different variety of honeys

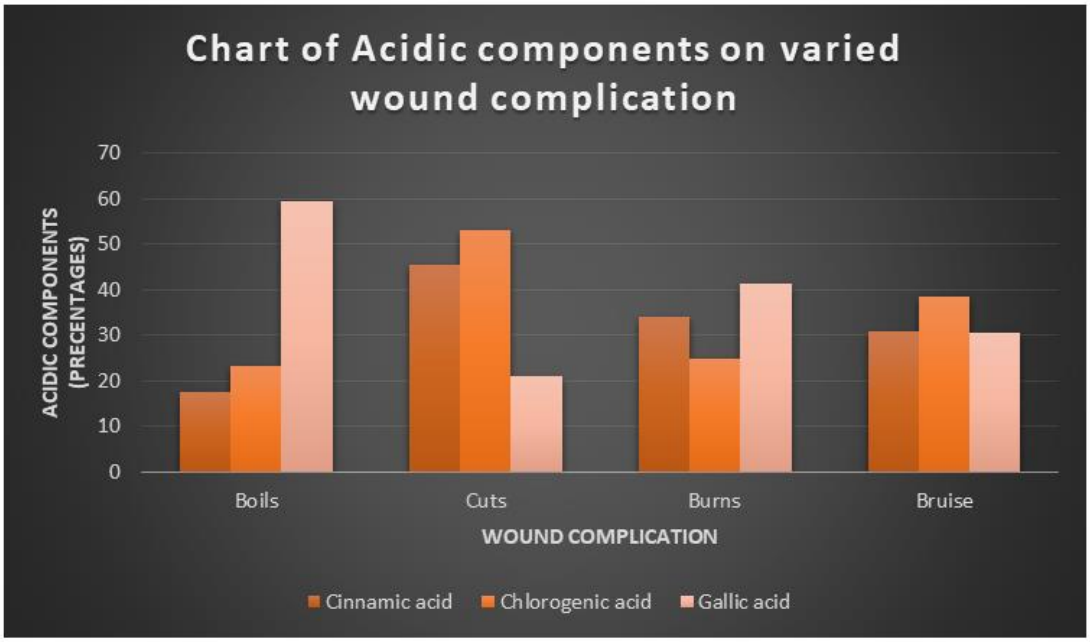

Figure 2: A chart which shows the acidic content of honey with different classes of wound complications (in percentages)

Table 1: Shows the various kinds of honey varieties on wound complication in four selected hospitals in F.C.T Abuja

Items	**Gelam**				**Tualang**				**Manuka**			
Selected hospitals	A	B	C	D	A	B	C	D	A	B	C	D
Total no of subjects taken or patients	51	34	45	29	43	30	36	41	40	32	37	25
Boils (%)	19.4	8	12.2	4.6	16.9	10	18.8	17.1	13	6.7	11.2	5.4
Cuts (%)	31.6	16	15.3	6.1	9.4	9.5	10.3	14.5	9.7	11.3	10.7	8.8
Burns (%)	8.0	7	10.6	8.6	11.5	4.7	3.6	5.7	11	6.7	8.4	5.6
Bruises (%)	7.8	3	7.1	9.7	5.2	5.8	3.3	3.7	6.3	7.3	6.7	4.7
No examined	26	19	20	10	22	17	21	25	22	18	16	12
No of positive cases	15	10	10	9	12	3	10	7	14	6	18	13
No of negative cases	10	5	15	10	9	10	14	9	4	8	3	0

DISCUSSION

The antimicrobial property of honey has been attributed to its multiple components, including high sugar concentration, low pH, hydrogen peroxide (H_2O_2), and methylglyoxal. (MGO), antimicrobial peptide bee defensin-1, and other compounds such as polyphenols that have not been fully elucidated [19]. The high sugar concentration and low moisture content of honey cause osmotic stress to microbial cells, and low pH is unfavorable for the growth of many micro-organisms. However, if a sugar solution with identical sugar components and pH to that of honey is prepared, the antimicrobial activity of the sugar solution is often considerably lower than that of honey, suggesting that other factors in the honey are responsible for its antimicrobial activity [20]. Honey bees add an enzyme, called glucose oxidase, to the collected nectar during the honey-making process, which converts the glucose in the honey into hydrogen peroxide H_2O_2, gluconic acid. Toxic to many microbes. During the ripening of honey, glucose oxidase is in activated but regains its activity if the honey is diluted [21]. Revamil honey produced 3.47 0.25 mm H_2O_2 40% (v/v) honey after 24 hours, but no H_2O_2 detectable in the Manuka honey they tested, suggesting that non peroxide factors are responsible for the antimicrobial activity of Manuka honey. Manuka honey has been shown to contain high levels of MGO, 44-fold higher than Revamil honey. MGO in Manuka honey is produced by the non-enzymatic conversion of di-hydroxyacetone present at high concentrations in the nectar of *L. scoparium* flowers. The change occurs slowly during honey storage [22-24]. A report shows that neutralization of MGO in Manuka honey abolished the antimicrobial activity of the honey against *S. aureus*, but did not abolish the antimicrobial activity against *E. coli* and *P. aeruginosa*. The authors concluded that MGO is not fully responsible for Manuka honey's non peroxide antimicrobial activity and that other components, possibly polyphenols, may be responsible [25]. Bee defensin-1 is an antimicrobial peptide that is part of the

honey bee innate immune system. It is secreted by the hypo pharyngeal gland of honey bees and can enter honey via bee saliva during the regurgitation process of honey making. Bee defensin-1 has a strong activity against Gram-positive bacteria including *S. aureus* [26].

CONCLUSION

Despite these optimistic findings in vitro, the use of honey in clinical practice today as an antimicrobial agent does not appear to have yet reached its full potential. Innovative research that can maximally exploit the antimicrobial properties of this natural sub-stance and overcome obstacles associated with in vivo use may, in the future, lead to the production of an antimicrobial agent that is highly valued in clinical practice. Interestingly, no honey-resistant microbial strains have emerged to date, and this may be unlikely because of the multifactorial nature of the antimicrobial property of honey [27]. As honeys from diverse floral origins have been shown to have antimicrobial activity against a range of skin relevant microbes, research should continue to investigate the efficacy of honey in the treatment of other types of skin disorders where microbes have been implicated in the pathophysiology of the disease. There are countless varieties of honeys being produced worldwide, and some may have superior antimicrobial activities that are yet to be discovered [28, 29]. It can be concluded from in vitro studies that honey has powerful antimicrobial activity against dermatologically relevant microbes. These findings are particularly promising in current times when the problem of antimicrobial drug resistance is considered a global crisis and the World Health Organization (2014) has acknowledged the possibility of a post antibiotic era in which common infections can kill [30]. Even more exciting are the in vitro findings that honey can reverse antimicrobial resistance and reduce microbial pathogenicity.

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