Antibacterial Activity of Indonesian Local Honey Against Strains of P. Aeruginosa, S. Aureus and MRSA

Jakarta, Indonesia.

**Background:** Honey has been used in wound care since ancient times. Many publications attest antibacterial activity of manuka honey against Pseudomonas aeruginosa, S. aureus, and Methicillin-resistant S. aureus (MRSA). However, antibacterial effect of local honey from Indonesia has never been studied and compared to medical grade honey before. This study aims to compare antibacterial activity of local honey and manuka honey against P. aeruginosa, S. aureus and MRSA.

**Methods:** The honeys were tested for their antimicrobial activities with broth dilution method. Different concentrations of honey were prepared in reaction tubes. Strains of P. aeruginosa, S. aureus, and MRSA were grown in nutrient broth. These strains of bacteria then added to the different concentrations of honey. Minimum Inhibitory Concentrations (MIC) is the lowest concentration of the honey that yielded no growth of bacteria.

**Results:** MIC of local honey for P. aeruginosa is 50%, for S. aureus is 100% and for MRSA is 100%. MIC of manuka honey for P. aeruginosa is 12.5%, for S. aureus is 25%, and for MRSA is 12.5%.

**Conclusion:** Nusantara Manuka have the similar antibacterial activity spectrum against P. aeruginosa, MRSA and S. aureus, but it must be given in greater concentration to exert the same level of antibacterial activity with Manuka honey.

**Keywords:** honey, wound care, antibacterial activity

Honey, according to WHO definition, is a natural sweetener produced by Apis mellifera bee extracted from plants, collected, deposited, dehydrated inside the bee hive 1, 2. Honey has been used in wound care since ancient times 3,4,5. In the 1970’s, its use in wound care has been reintroduced to the medical world once again, mainly for infected operative wound, burns, and pressure ulcer 6,7,8.

Honey has several important characteristics for wound care, such as anti-inflammatory activity, antibacterial activity, aid in debridement, odor reducing agent, maintaining moisture in wound, thus enhanced wound healing activity 9,10,11,12,13,14. Antibacterial activity in

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honey is one of the main characteristics in honey for wound treatment. Its antibacterial activity is due to the low osmolarity, low acidity level (pH) and it produces hydrogen peroxide. Honey also has other unidentified components with antibacterial effect. Many publications attest to the antibacterial activity of honey against Pseudomonas aeruginosa, Staphylococcus aureus, and Methicillin-resistant Staphylococcus Aureus (MRSA). Unfortunately, medical grade honey has not yet available nationwide and the cost of it are still very high for most of Indonesian people.

In Indonesia, local honey has been used by the non-medical society for various purposes. Despite many kinds of local honey produced in Indonesia, none of them had ever been proven for its efficacy in wound treatment. Antibacterial effect of local honey from Indonesia has never been studied and compared to medical grade honey before.

In this study, we want to compare antibacterial activity of local honey and manuka honey against P. aeruginosa, S. aureus and MRSA.

### METHODS

This study is an analytical descriptive study to compare antibacterial effect of Indonesian local honey and Manuka honey against P. aeruginosa, S. aureus and MRSA. The study was being conducted at the microbiology laboratory in the Medical Faculty of the Universitas Indonesia from March – April 2010. We used 3 bottles of “Manuka Honey MGO 400 (500 gram)” produced by Manuka Health New Zealand Ltd, compared to 3 bottles of Indonesian...
local honey "Madu Murni Nusantara" produced by PT Madu Murni Nusantara. Both honeys have been certified by BPOM (Madu Nusantara - DEPKES RI 137611001072; Madu Manuka - BPOM RI 237606001074). Honey samples were taken with consecutive sampling from all the honey in the DKI Jakarta area on March 2010.

Antibacterial activity of these honeys was tested against P. aeruginosa, Staphylococcus aureus and MRSA, obtained from bacteria isolation of patients' wounds in Cipto Mangunkusumo hospital Jakarta.

Dilution method was used to obtain antibacterial effect of each honey. Honey was diluted with sterile Mueller Hinton broth to have various concentration of honey, from 1% to 100%. A broth jelly media without honey was used as a control for the bacterial growth. Phenol was also used against these strains of bacteria as a control. P. aeruginosa, S. aureus and MRSA were cultured each in broth jelly at 37°C for 4 hours, to then be added to the various honey concentration media. These media then incubated at 37°C for 24 hours and afterward examined for bacterial growth. Minimum Inhibitory Concentration (MIC) is the lowest concentration of honey which can prevent the growth of bacteria in the media. MIC was obtained by comparing the clarity level of various media concentration to control.

Sensitivity test was also conducted against these strains of bacteria, to obtain level of resistance against antibiotics of these bacteria.

**RESULTS**

P. aeruginosa used in this study have resistance towards amoxycillin, amoxycillin clavulanat, sulbenicillin, carbenicillin, cefotiam, ceftazidim dan tigecyclin. MRSA only have sensitivity against clindamycin, vancomycin, tigecyclin, levofloxacin, linezolid dan moxifloxacin. S. aureus are resistant towards amoxycillin, amoxycillin clavulanat, sulbenicillin, gentamycin, chloramphenicol, ampicillin sulbactam, ofloxacin, azithromycin. (Table 1).

From the dilution method, MIC of P. aeruginosa from manuka honey was 12.5%. The MIC for Indonesian local honey was 50%. (Table 2). The result for MRSA also available (Table 3).

<table>
<thead>
<tr>
<th>Bacteria strains</th>
<th>MIC for Manuka honey</th>
<th>MIC for local honey</th>
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<tbody>
<tr>
<td>P. aeruginosa</td>
<td>12.5%</td>
<td>50%</td>
</tr>
<tr>
<td>S. aureus</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>MRSA</td>
<td>12.5%</td>
<td>100%</td>
</tr>
</tbody>
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From the dilution method, MIC of S. Aureus from manuka honey was 25% (Table 4). The MIC for Indonesian local honey was 100% (Table 5).

In this study, we found that the clarity level of P. aeruginosa for the local honey was uncertain. Thus, we cultured the bacteria from the local honey media to a blood jelly media. From this media, we can see that in 50% concentration of local honey, bacteria can not grow (Figure 1-2).

**DISCUSSION**

Antibacterial activity of honey is due to its low osmolarity, low pH, its hydrogen peroxide and other unidentified components\(^{12,15}\). In this study, from the sensitivity test against 3 bacteria, we can see most of antibiotics commonly used have already been resistant. This is probably due to the unreasonable use of antibiotics in Cipto Mangunkusumo hospital causing resistance of bacteria towards these antibiotics. The high resistance of antibiotics will make wound healing in infected wound even harder to be achieved.

From the dilution method, MIC of Indonesian local honey was highest achieved against P. aeruginosa which is 50%. This means even by diluting local honey to 1:2, it will still have antibacterial activity against P. aeruginosa. This bacteria can not live in acid condition. Honey has a pH of 3.5 – 4.5 causing an acid condition, and if this acidity can be maintain, then P. aeruginosa can not live in this condition \(^{6,8,9}\).

Even if bacteria can live in acid condition, honey will cause plasmolisis due to its low osmolarity level. The high level of glucose in honey make a low osmolarity level, and may cause osmosis between intracellular liquid with extracellular liquid. If bacteria cell is suspended in high concentrate of glucose, water will come out of the intracellular, thus plasmolisis occurred. In this study, MIC for local honey against P. aeruginosa has more effectiveness than against MRSA nor S. aureus. This is probably because honey antibacterial activity against P. Aeruginosa is achieved not only because of the low osmolarity level but also due to its acid condition.

From all MIC results, manuka honey has the MIC lower than local honey. In several literatures, it was found that there is methy-
lglioxil substance in manuka honey. This substance is said to be the main cause of manuka’s great antibacterial effect. Our Indonesian local honey has never been tested for the availability of methylglioxil.

MIC indicates that honey has antibacterial activity against these bacteria, and this effect can be used to treat infection, including wound infection. The high concentration of local honey MIC means that to obtain its antibacterial effect, honey cannot be diluted less than its MIC. This has correlation especially in wounds with high level of exudation. Exudation can dilute honey, causing honey to lose its antibacterial effect if diluted under the MIC concentration. Thus, for highly exudative wound, frequent change of dressing using honey is important to prevent dilution of honey, and to achieve its optimal antibacterial effect.

**CONCLUSION**

This study concluded that Manuka honey has MIC lower than Indonesian local honey (madu lokal nusantara). Indonesian local honey (madu lokal nusantara) has antibacterial activity against P. aeruginosa, MRSA and S. aureus. This effect has been tested against bacteria cultured from Cipto Mangunkusumo hospital.

Antibacterial effect of local honey can be used in treatment for infected wound, especially wounds infected by P. aeruginosa, MRSA and S. aureus. Furthermore, to obtain its antibacterial effect in infected wounds, honey needs to be applied as wound dressing according to the wound condition itself, especially the amount of exudation which can dilute honey concentration.

**REFERENCES**