

## Characterization of Colloidal Solution for Wound Dressing using Honey

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### Abstract:

The wound dressing are one of the critical products of medical textile. The wound management system includes wound dressings, bandages, pressure garments and tissue engineering etc. The main function of wound dressings is to heal the wound depending upon the severity of the wound, preventing from infections and providing appropriate condition for faster wound healing. The honey is well-known natural product used for medicated purpose in different medical problem. The technical research shows that the honey can be act as anti-microbial, anti-fungal, anti-biotic, anti-inflammatory and anti-dour. The result of studies shows that honey with silver Nano particles gives efficient wound healing performance. Further study required to get the standardized the wound dressing. In this present study, using honey and silver, the standardize colloidal solution has been prepared using honey by varying the concentration of honey and stock solution and it's characterization has been done which has been applied to prepared the spunlace wound dressing and antimicrobial activities has been checked

**Keywords — Spunlace, colloidal solution, Nano particles, wound dressing, honey**

### I. INTRODUCTION

Wound care management fall within dermatologist's scope of science. A wound is defined as a break in the epithelial integrity of the tissues [1]. This disruption can be deeper and involve sub epithelial tissues including dermis, fascia and muscle. They can be caused accidentally, intentionally or be a part of a disease process.

A wound is caused by physical trauma where the skin is torn, cut or punctured (an open wound), or where a blunt force trauma causes a contusion (a closed wound) [6]. Wounds can be classified according to their thickness, the involvement of skin or other tissues, the time elapsed from the point of trauma (breaking of skin continuity), the wound morphology and the method of wound closure. The wounds are also classified in terms of edges retract and tissue contracts. One of the essential characteristics of dressing is to protect the wound from pathogenic bacteria and other foreign material and prevent fluid loss from wound.

The use of topical honey used since long as effectively in the treatment of wounds, eczema and

inflammation [4]. Honey and silver are the two antimicrobial agents, which are used in various forms like gel, foam, solution to produce an antimicrobial dressing from textile base. In tropical honey some of its components act as antibacterial activity and some of their solution like hydrogen peroxide ( $H_2O_2$ ) acts as a cleansing agent for open wounds.

The present work had two-fold objective.

- 1) To prepare silver Nano colloidal (AgNPs) solution by formulating with Organic honey and Manuka honey. Further the characterization of AgNPs with both the honey was studied by varying the concentration of honey and the stock solution.
- 2) To coated different spunlace nonwoven fabrics with standardized solution and further the treated fabrics were tested against Escherichia coli (E.coli), Staphylococcus aureus (S. aureus).

The result shows that honey with silver nano particles gives efficient wound healing performance. Further study required to get the standardized wound dressing with the standardize solution to

achieve the antibacterial activity and to produce an effective dressing.

## II. MATERIALS AND METHODOLOGY

### A. Preparation of Standardized Solution

Silver nitrite ( $\text{AgNO}_3$ ) was procured from the LOBA, Organic honey (Forest honey) and manuka honey from the market. The concentration of silver nitrate was varied from 0.1, 0.5, 0.7g and Stock solution was also varies while preparing colloidal solution.

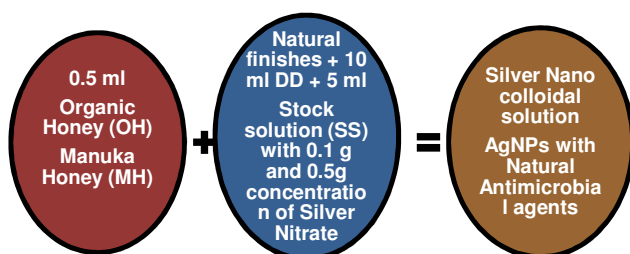


Figure 1: Preparation of AgNPs colloidal solution

The two different sets were prepared by changing the concentration of honey and stock solution to obtained the standardize AgNPs colloidal solution by taking stock solution of 0.1 g silver nitrate and 100ml doubled distilled water has been standardize by UV- spectrophotometer. After preparing the SS (stock solution) than two different sets are prepared for organic honey (OH).

- Changing the concentration of organic honey
- Changing the concentration of stock solution

### B Ultra-violet visible (UV-vis) spectroscopy

Different sets were prepared by changing the concentration of stock solution and honey were formed in colloidal solution was monitored using UV-vis spectral analysis. The spectra of the surface Plasmon resonances of AgNPs were recorded using a UV-vis spectrophotometer at wavelengths between 400nm and 700 nm.

### C SEM-EDX

Standardize solution was further analyze for SEM-EDS of AgNPs. The SEM-EDS of both solution was examined using Scanning Electron

Microscope (SEM), Model JSM-5610 LV, Version 1.0, Jeol. Using SEM instrument equipped with energy dispersive X-ray (EDX) used for analyzing the composition of solution.

### D Particle size analysis

The average particle size along with its PdI (Polydispersity index) and the ZP (Zeta paricle) of the nanoparticles were analyzed by dynamic light scattering (DLS) using a Zetasizer Nano ZS (Malvern Instruments, UK). Particle size and PdI measurements were performed at a scattering angle of  $90^\circ$  at  $25^\circ\text{C}$ . The samples for ZP were placed in a disposable zeta cell at  $25^\circ\text{C}$ .

## III RESULTS AND DISCUSSION

### A Characterization of Colloidal Solution

Preparation of AgNPs colloidal solution (silver nanoparticles colloidal sol.) has been done by using green synthesis by taking natural antimicrobial agents like organic honey and manuka honey. Firstly, two sets has been prepared of colloidal solution using organic honey, doubled distilled water by changing the concentration of honey and stock solution.

TABLE 1  
CHANGING CONCENTRATION OF HONEY

| Code | Concentration of honey (ml) | Distilled water (ml) | Stock solution (ml) |
|------|-----------------------------|----------------------|---------------------|
| S-01 | 1                           | 10                   | -                   |
| S-02 | 1                           | 10                   | 5                   |
| S-03 | 2.5                         | 10                   | 5                   |
| S-04 | 0.5                         | 10                   | 5                   |
| S-05 | 5                           | 10                   | 5                   |

TABLE 2  
CHANGING STOCK SOLUTION

| Code | Concentration of honey (ml) | Distilled water (ml) | Stock solution (ml) |
|------|-----------------------------|----------------------|---------------------|
| H-01 | 0.5                         | 10                   | 1                   |
| H-02 | 0.5                         | 10                   | 2                   |
| H-03 | 0.5                         | 10                   | 3                   |
| H-04 | 0.5                         | 10                   | 4                   |
| H-05 | 0.5                         | 10                   | 6                   |

The Table 1 and Table 2 respectively shows the step involves in the formulation of colloidal solution. The solution has been analyzed to check

its stability, composition and particle size. The result has been discussed.

#### A FTIR Analysis of Honey

The first broad spectra indicate the (Figure 2) presence of alcohol/ phenol having O-H stretch bond between the compound and a molecule. The range of first broad spectra between  $3373.61\text{ cm}^{-1}$  to  $3244.38\text{ cm}^{-1}$  in organic honey where as in manuka honey the first spectra range between  $3524.06\text{ cm}^{-1}$  to  $3238.59\text{ cm}^{-1}$ .

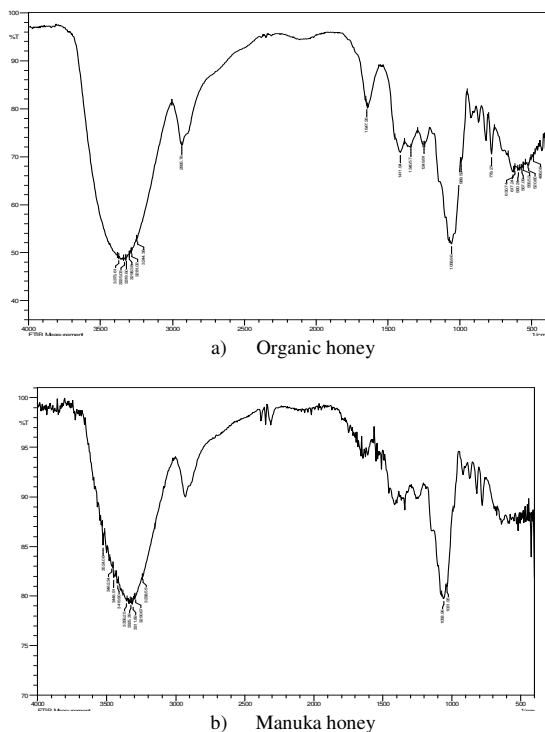


Figure 2: FTIR spectrum

In first peak of both the honey shows the alcohol and phenolic group having O-H stretch bonds. The second peak in both the honey have same value which is  $1058.96\text{ cm}^{-1}$  shows the presence of C-H bonds due to the presence of water in the colloidal solution. The spectra pattern obtained through analysis has been shown in Figure 2 (a), (b) of both the honey

The second peak in Figure 2 (a) shows the peak value band is  $2935.76\text{ cm}^{-1}$  which shows the presence of alkyl group having C-H stretch bond between the compound or a molecules but in manuka honey peak Figure 2 (b) is found but no

value has been recorded. C-H bond present in most of the organic compounds. Both the honey shows the similar pattern of spectra but in manuka honey more fluctuating may be due to different composition in both the honey. Both the honey also contains aromatic C-H bending bonds. In manuka honey, the centre portion of the Figure 2 a) and b) shows the presence of ketone and aldehyde group in both the honey.

#### B UV Analysis

The Figure 3 (a) shows the UV-vis absorption spectroscopy of AgNPs colloidal solution by changing the concentration of organic honey.

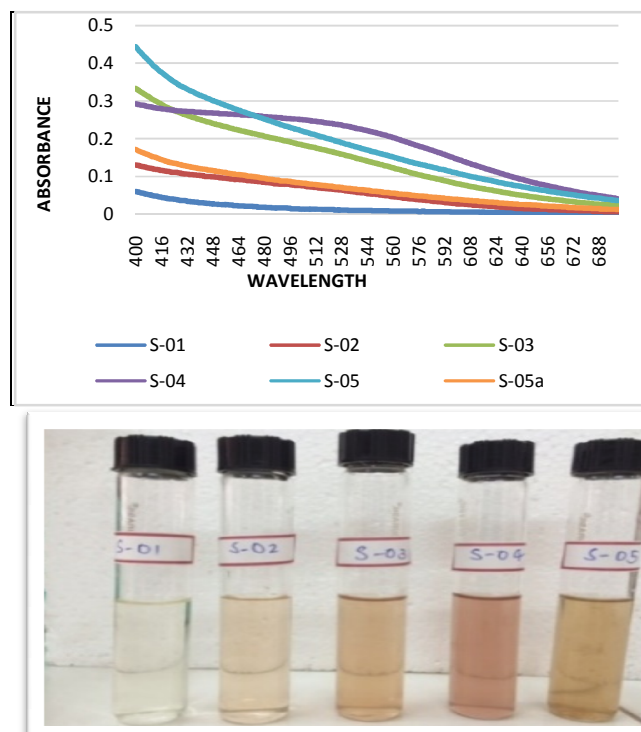


Figure 3 (a): UV-vis spectroscopy of AgNPs solution of organic honey

After doing the UV analysis, it has been observed that sample S-04 concentration gives high absorbency in required range of wavelength of 400 to 700 nm and give more stability at 0.3 absorbency level. It means at 0.3 level the effectiveness of AgNPs shows more hence expected to give better performance in the end product. So S-04 solution has been taken further to compare with manuka honey and also as a standardize solution for application in wound dressing.

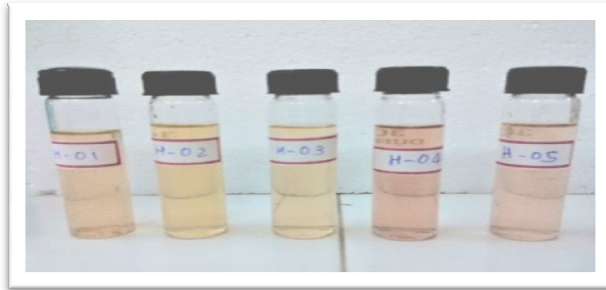
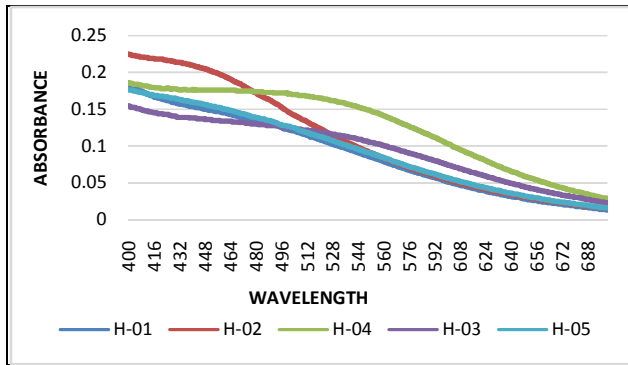


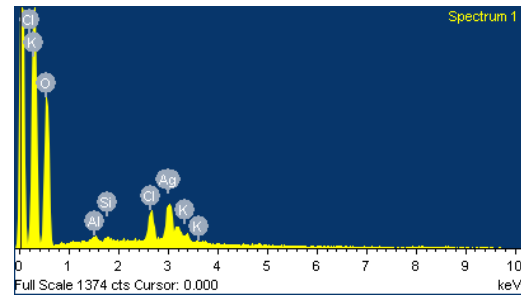
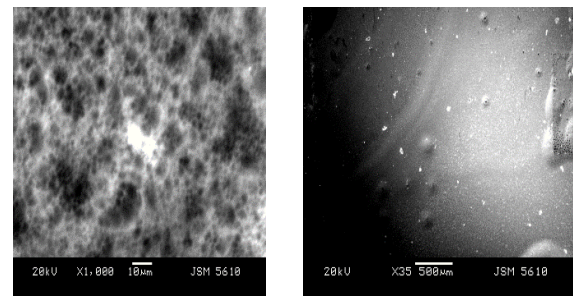
Fig. 3 (b): UV-vis spectroscopy of solution S-04 by changing stock solution

The Fig. 3 (b) shows the UV-vis spectroscopy has been carried out by taking concentration of honey of S-04 by varying the content of stock solution. It shows that H-04 sample shows stability as compared to S-04 but the absorbency of S-04 is higher than H-04, so S-04 has been selected as a standardize solution for preparing the product

### C SEM-EDX Analysis

The further analysis of solution has been done using SEM-EDX to find the presence of AgNPs particles and its % content of Ag in solution. It is observed that AgNPs with varying diameters exist within the concentration of standardize colloidal solution. Fig. 4 (a) and (b) shows the SEM-EDX images of AgNPs in colloidal solution as appeared are not spherical, but are irregularly shaped and their diameter size varied due to aggregation of AgNPs in both solution by taking organic honey and manuka honey

The presence of the silver peak is also confirmed by energy dispersive X-ray spectroscopy as shown in the Fig.4(a) and 4(b) of the silver colloidal solution having the standardize concentration with organic honey and manuka honey. The proportion



Figur. 4 (a): SEM and EDX of S-04 of organic honey

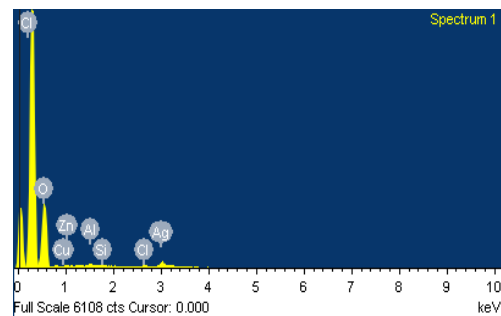
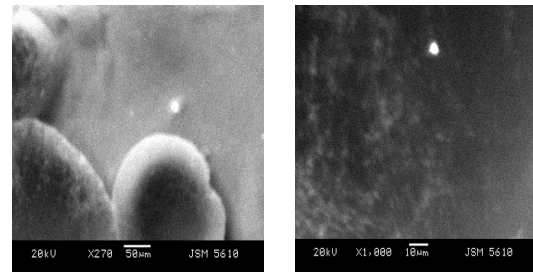


Fig. 4 (b): SEM and EDX of standardize concentration with manuka honey

of Ag in colloidal solution has been found 18 % and 9% respectively. In manuka honey, the Ag content was reduced to half due to the highly viscosity of honey and also due to formation of large clusters of rings as shown in Fig. 4(b).Energy dispersive X-ray (EDX) spectrum of colloidal solution has indicated Cl and O peaks, which could be due to organic honey content and distilled water.

### D Particle Size Analysis

The particle size analysis done by Zeta Particle size analyzer (Malvern Particle size analyzer). The Fig.5 a) and b) shows the results of zeta potential particle size analyzer and PdI (Polydispersity Index) of AgNPs colloidal solution with standardize concentration using organic honey. Results of the particle size and Polydispersity feature that the majority of particle size acquire a value at 5.50 nm with a lower PdI 0.224 for organic honey and at 4.65 nm position with 0.233 PdI for manuka honey which indicates the good uniformity of AgNPs solution.

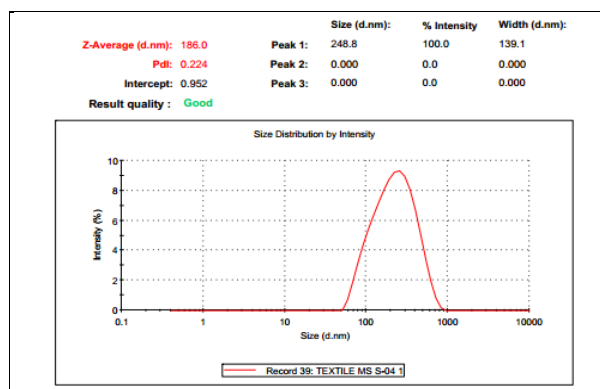


Fig. 5: a) Particle size analyzer of organic honey solution with 0.1g Ag

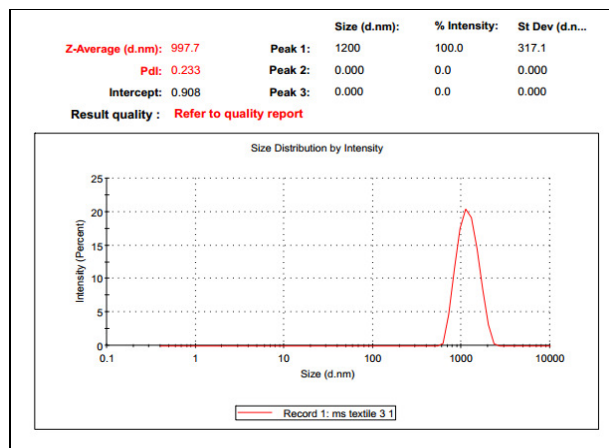


Fig. 5: b) Particle size analyzer of manuka honey solution with 0.1g Ag

The Figure 5 c) and d) shows the results of zeta potential particle size analyser and PdI (Polydispersity Index) of AgNPs colloidal solution with standardize concentration using honey with 0.5g Ag content in stock solution.

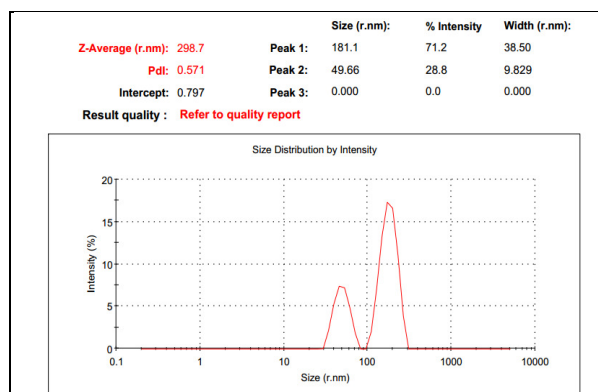


Figure 5: c) Particle size analyzer of manuka honey solution with 0.5g Ag

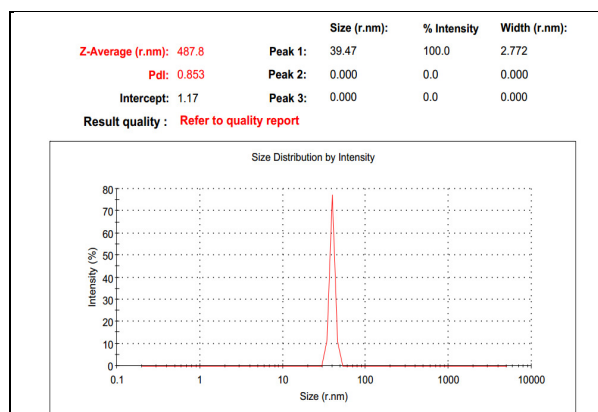


Figure 5: d) Particle size analyzer of manuka honey solution with 0.5g Ag

Results of the particle size and Polydispersity feature that the majority of particle size acquire a value at 5.50 nm with a lower PdI 0.571 for organic honey and at 4.65 nm position with 0.853 PdI for manuka honey which indicates the good uniformity of AgNPs solution.

### IV CONCLUSION

The characterization the colloidal solution has been done and following observation has been taken

- FTIR analysis shows the presence of alcohol and phenolic group having stretch O-H bonds and the aromatic C-H bonds at the end portion of spectra in honey. In the center portion of spectra pattern in both the honey shows the presence of ketone and aldehyde group. Ketone group is also present in methylglyoxal (C<sub>3</sub>H<sub>4</sub>O<sub>2</sub>) compound which gives

the good antibacterial activity depend upon the content of methylglyoxal in honey.

- UV visible spectroscopy of manuka honey shows the lowest absorbance level whereas organic honey shows the highest absorbance among all prepared solution. Also with the increase in concentration level of silver in colloidal solution shows the decrease in absorbance level of solution.
- SEM-EDX of colloidal solution morphology were found not in spherical in shape and varied in diameter due to aggregation of AgNPs in both the honey solution. In manuka honey the content of silver is reduced to half from 18% (of organic honey) to 9 % (of manuka honey).
- Particle size analyzer results of colloidal solution shows that by increasing the silver content in colloidal solution from 0.1g to 0.5g, the size distribution peak become narrower and also has been shifted in between 10 to 100 d nm. Results of the particle size for manuka honey which indicates the good uniformity of AgNPs solution.

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