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Development of anti-microbial textiles using microencapsulated honey and turmeric

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Abstract

An attempt has been made to develop anti-microbial textiles using honey and turmeric. The concentration of honey and turmeric is optimised as 70:30 and it was applied on to the fabric using direct padding and microencapsulation technique. The antimicrobial activity of microencapsulated honey and turmeric treated fabric were tested against the infectious bacteria *Pseudomonas* and *Staphylococcus aureus.* Both the samples show better results against the bacteria before and after washing in Plate count method. Optical density values show that the microbial growth reduces with the application of honey and turmeric.

Key-Words: Textiles, Honey, Turmeric

Introduction

Anti-microbial textiles are the textiles which protect the human beings by inhibiting the growth of bacteria, fungi or any other micro-organisms on the surface of products by various means of application on to the fabric. Among the various antimicrobial agents available, natural anti-microbial agents plays a major role in many of the processes especially in wound dressings because of its properties of biodegradability, compatibility with the skin etc. Among the natural agents, honey and turmeric are easy available and well known natural anti microbial agents. Honey, which was used in the ancient days for the treatment of infected wounds, has recently been 'rediscovered' by the medical profession. Honey can be effectively used in wound healing process without any adverse effects and has better antimicrobial property against bacteria and fungi. It is mainly because of its high sugar content, low water content and presence of hydrogen peroxide which is unsuitable for the growth of micro-organisms.

Curcuma longa commonly known as turmeric, a yellow pigmented dried rhizome, is a powerful anti-oxidant, antiseptic, anti-microbial, anti-inflammatory effect, anti-carcinogenic, anti-mutagenic, anti-thrombotic, hepatoprotective, anti-microbial, anti-viral and anti-parasitic in nature. These materials can be encapsulated using microencapsulation technique to have controlled release of the agent in the specific site.

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Micro-encapsulation is a process in which tiny particles or droplets are surrounded by a coating to give small capsules. In a relatively simplistic form, a microcapsule is a small sphere with a uniform wall of diameter varying from micrometers to millimetres. The microencapsulation can be done to isolate the core from chemical attack, mask the taste or odor of the core, isolating a reactive core from chemical attack, have controlled release etc.

In this work, honey and turmeric concentration was optimised and applied on cotton fabric by means of direct padding and microencapsulation technique and compared its antimicrobial property before and after wash against two different bacteria *Pseudomonas* and *Staphylococcus aureus.*

Material and Methods

Fabric

The fabric selected for the development of anti-microbial textiles using honey and turmeric is knitted cotton fabric of following specification,

Structure	:	Single Jersey
Wales/inch	:	40
Course/inch	:	42
GSM	:	120

Finishing agents

The antimicrobial treatment on fabrics was done using honey and turmeric as core material and acacia gum as wall material.

Extraction of honey and turmeric

Turmeric is grinded in a mixer grinder and sun dried. Then, honey and turmeric powder were taken in 3 different concentrations of 50:50, 70:30 and 30:70. The

varying concentration mixtures of honey and turmeric was mixed with 10ml of methanol and kept it for overnight. Then the solution is stirred at boil, filtered and dried.

Microencapsulation technique

The micro-encapsulation was done using honey and turmeric as core material and acacia gum as a wall material. 10g of wall material was allowed to swell for half-an-hour in 100ml of hot water. The mixture was stirred for 15 minutes at the temperature between 40°C and 50°C by adding 50ml of hot water. 10ml of core material was added and stirred at 300 to 500 rpm for further 15 minutes followed by drop wise addition of 20% sodium sulphate solution(10ml) for 5-10 minutes. The stirrer speed was reduced and then 5ml of 17% v/v formaldehyde was added. The stirrer was stopped and the mixture was dried.

Finishing technique

Anti-microbial agent was applied on the fabric by pad-dry method. The finishing of anti-microbial agents includes the application of direct padding of turmeric and honey and micro-encapsulated turmeric and honey. The fabrics were dipped in the extracted solution, padded and dried at room temperature.

Testing Methods

Anti microbial testing

Anti-microbial activity of honey and turmeric can be assessed by using various techniques such as

- Agar Diffusion Method (AATCC 100-1982)
- Plate Count Method
- Estimation of Growth Curve

Agar diffusion method (AATCC 100-1982)

The agar diffusion method includes two different steps. One is the preparation of nutrient broth and another one is the preparation of nutrient agar. The prepared nutrient broth and nutrient agar were initially sterilized using autoclave. The *Pseudomonas* and *Staphylococcus aureus* bacteria were inoculated into the sterilized nutrient broth in the boiling tube which was kept for 24hrs inside the shaking incubator at 37°C. In the mean time, the nutrient agar was poured into the Petri dish. The inoculated bacteria was swapped on to the Petri dish containing nutrient agar and a well was made in it and it was then filled with different volumes say 25µl, 50µl, 75µl, 100µl and 150µl of honey and turmeric in the 50H:50T, 70H:30T, 30H:70T ratios. This was then kept for 24hrs in incubator at 37°C. The process was optimized by measuring the diameter of zone formed in centimetre which indicates the anti-microbial activity of honey and turmeric.

Plate count method

The washed and unwashed samples of directly padded honey and turmeric and micro-encapsulated honey and turmeric were immersed into the boiling tube containing the bacteria *Pseudomonas* and *Staphylococcus aureus* inoculated nutrient broth. It was kept inside the incubator chamber for 24 hrs at 37°C. Test tubes were taken and filled with NaCl of 4.5ml each for tri serial dilution. 0.5 ml of inoculated bacteria was transferred into the first tube and two similar dilutions were made. By doing this, the respective bacteria were diluted well inside the NaCl solution. Finally, the third series of solution was used for the further experimentation. The nutrient agar is then poured into the Petri dish on which diluted bacterial solution is swapped using L rod where the solution is uniformly distributed over the plate and it is kept inside the incubator at 37°C for 24 hrs. The percentage reduction of bacteria is counted by comparing it with control sample of 100% bacterial growth.

Estimation of growth curve

Initially, the nutrient broth was prepared and sterilised using autoclave. 2-5% of *Pseudomonas* and *S.aureus* bacteria were individually inoculated in 3 ml broth conical flask which was kept for 24 hrs inside the shaking incubator at 37^0C. This 3 ml broth was used to inoculate the working broth of 25 ml of each bacteria. The fabric padded with honey and turmeric of 4 mm diameter was put into the test tubes containing bacterial broth of 10 ml taken out from the 25 ml inoculated bacterial culture. Since it was kept for 24 hrs, it would have attained log phase, which has more bacterial growth. The existence of anti-microbial activity will reduce the bacterial growth, which can be evaluated using UV spectrophotometer at 600nm. The Optical Density (OD) values will give the growth of bacteria per unit volume. The graph was plotted for time against optical density values.

Results and Discussion

Agar diffusion tests

Table 1 shows the diameter of zone formed in cm for various concentrations of honey and turmeric say 50H: 50T, 70H: 30T and 30H: 70T for the two bacteria *Staphylococcus aureus* and *Pseudomonas*. From the table it is observed that 70H: 30T shows higher zone diameter when compared to the other concentrations. It is proved that the increase in the concentration of honey improves the anti microbial activity against *S.aureus* and *Pseudomonas* because of the presence of hydrogen peroxide which makes it unsuitable for the growth of microorganisms. While comparing the antimicrobial activity of turmeric and honey, better activity was found in *Staphylococcus aureus* than *Pseudomonas* bacteria. The formation of the zone is shown in the Figure 1 for various concentration against *Pseudomonas* and *Staphylococcus aureus*. While

comparing the different volumes of honey and turmeric, above 100µl shows decrease in antimicrobial activity. Hence the concentration of honey and turmeric is optimised as 70H:30T at 100µl.

Plate count method

From the Table 2 it is observed that the the anti-microbial activity of the two samples get reduced with respect to washing. This may be due to the washing off of the anti-microbial agent along with the detergent during washing and thereby reduces the anti-microbial activity of the samples. It is inferred form the Table 2 that the anti-microbial activity of the micro-encapsulated honey and turmeric show better activity against *Staphylococcus aureus* and direct padded samples show better activity against *Psedumonas* may be due to the resistance of the bacteria towards the specified antimicrobial agent. The anti-microbial activity of the micro-encapsulated honey and turmeric show better activity after wash may be due to the encapsulated structure and controlled release. Figures 2 (i) & (ii) show the bacterial reduction of the fabric samples after washing.

Estimation of Growth Curves

From Figure 3, it is observed that the OD value decreases with increase in time. This shows that the growth of the bacteria is reduced with the application of honey and turmeric. From the Table 3 it is also observed that the honey and turmeric has better resistance against *S.aureus* than *Pseudomonas* may be due to the resistance of the bacteria towards the honey and turmeric.

Conclusion

It is observed from the present work that the honey and turmeric has very good antimicrobial activity against *Pseudomonas and Staphylococcus aureus*. Micro-encapsulated honey and Turmeric treated sample shows better anti- microbial activity than direct padded sample. The percentage reduction of bacterial growth of microencapsulated honey and turmeric before and after washing is 30 and 20 for *Pseudomonas* and 100 and 70 for *Staphylococcus aureus* respectively. It is also observed that the antimicrobial activity of the samples reduces with washing specifically with direct padded sample.

References

1. Badmaev et. al, (1993), "Honey Impregnated Gauze Versus Polyurethane Film in the Treatment of Burns – a Prospective Randomized Study", Br J. Plastic Surgery, Vol. 46, pp. 322-323.
2. Subrahmanyam M., 1991, "Topical Application of Honey in Treatment of Burns", Br J. Plastic Surgery, Vol. 78(4), pp. 496-8.
3. Gescher et al, 2005, "Honey as a Natural Resistor for the Wounds",J.Food Prot., Vol. 47, pp.815-817.
4. Thilagavathi G. et al., 2007, "Microencapsulation of Herbal Extracts for Microbial Resistance in Healthcare Textiles", Indian Journal of Fibre and Textile Research, Vol. 32, pp.351-354.
5. Huhtanen C N et al., 1981, "Incidence of Clostridium Botulinum Spores in Honey", J. Food Prot., Vol. 44, pp.812-814.
6. Thomas, A. W., & Frieden, A., 1923, "The gelatin-tannin reaction", Industrial and Engineering Chemistry, 15, 839-41.
7. White JW., 1975, "Composition of honey Honey: A comprehensive survey", London: Heineman, pp.157-220.

Table 1: Diameter of Zone formed for different concentrations of honey and turmeric

S. No.	Concentration of mix with indication of specific bacteria (H:T)	Diameter of inhibition zone (cm)				
		25µl	50 µl	75 µl	100 µl	150 µl
1	50:50 S	Nil	2.5	2.7	3	1.2
2	50:50 P	Nil	1.2	3	3.5	1.5
3	70:30 S	Nil	2.3	2.6	3	2.7
4	70:30 P	Nil	2.5	3	3.1	3.2
5	30:70S	Nil	1.8	2.7	3	2.5
6	30:70 P	Nil	Nil	1.1	1.7	1.6

S - *Staphylococcus aureus* **P - *Pseudomonas*** **H- Honey** **T- Turmeric**

Table 2: Bacterial Reduction Percentage Before and After Washing

Bacteria	Control (%)	Direct padding (H&T)		Micro-encapsulated Padding (H&T)	
		Before	After (15)	Before	After (15)
Pseudomonas	0	40	20	30	20
S.aureus	0	30	0	100	70

Table 3 Estimation of Growth Curves for Bacteria (AATCC 99-1989)

S.No	Time in min	*Pseudomonas (nm)*	*Staphylococcus aureus (nm)*
1.	30	1.515	1.796
2.	60	1.489	1.534
3.	90	1.482	1.517
4.	120	1.477	1.491
5.	150	1.471	1.484
6.	180	1.465	1.466
7.	210	1.454	1.477

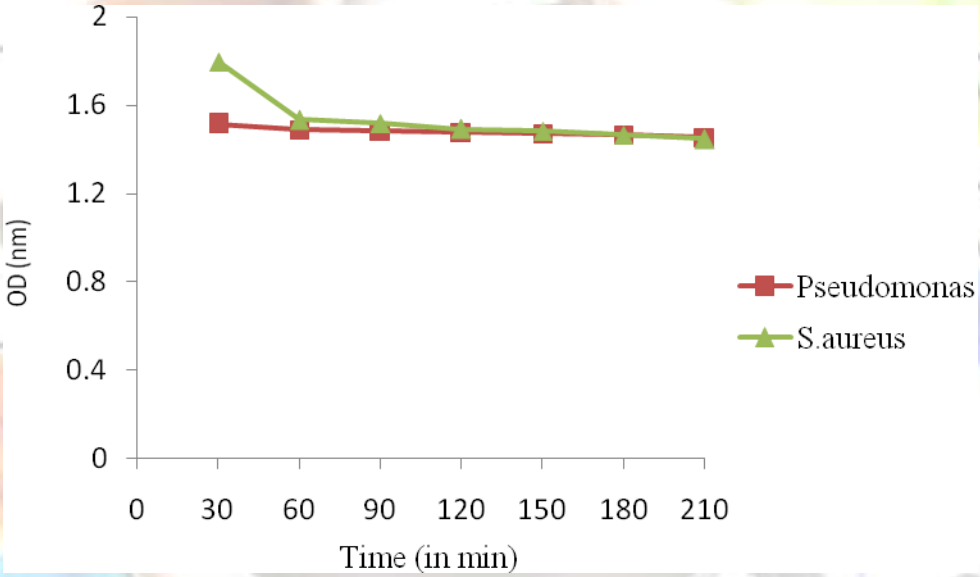


Fig. 3: Growth curve for bacteria *S.aureus* and *Pseudomonas*

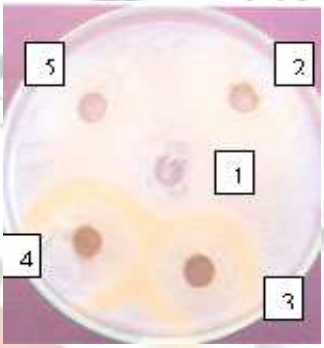
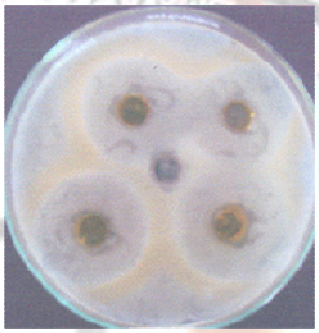
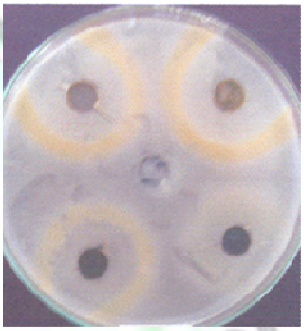
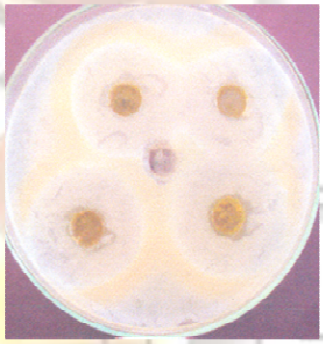
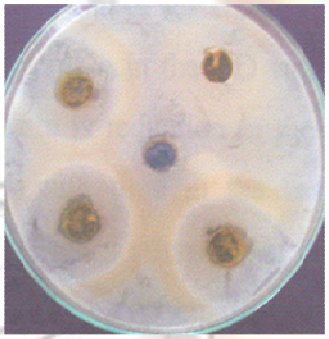
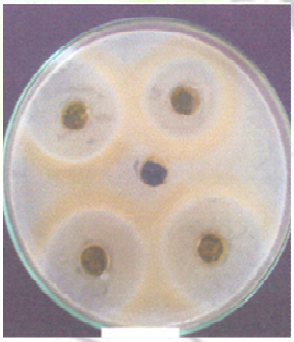
Concentration / Bacteria	50:50	70:30	30:70
Staphylococcus Aureus			
Pseudomonas			
	1. 25 µl 2. 50 µl 3. 75 µl 4. 100 µl 5. 150 µl		

Fig. 1: Diameter of Zone formed for different concentrations of honey and turmeric

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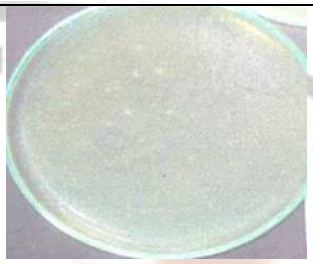
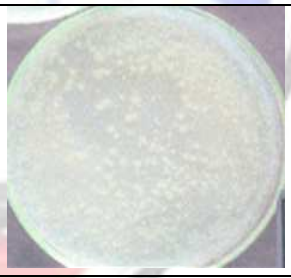
Wash levels / Techniques	Control	Before Wash	After wash
Direct Padding of Turmeric and Honey			
Microencapsulated Turmeric and Honey			

(i)

Wash levels / Techniques	Control	Before Wash	After wash
Direct Padding of Turmeric and Honey			
Encapsulated Turmeric and Honey			

(ii)

Fig. 2: Bacterial reduction of treated and untreated samples before and after washing against (i) *Pseudomonas* (ii) *Staphylococcus aureus*