

Effect of Antimicrobial Activity of Herbal Treated Cotton, Bamboo, and Tencel Socks

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Abstract:

*Eco-friendly environment plays a key role in the life of human beings to live in a better world with good hygiene and freshness. The environmental problems have led the textile manufacturer to produce eco-friendly textiles. Cotton is the King of fibres and it is the most ancient textile fibre. Bamboo fabric is breathable, cool, has fast water absorption and antibacterial properties. It is 100% biodegradable. In the textile market, tencel fabric plays an important position for fashion wear, bed linen and towels. Tencel fabric is an outstanding alternative to cotton. *Caesalpinia Sappan*, *Cassia Auriculata*, *Cassia Fistula*, *Mimosa Pudica*, and *Tinospora Cordifolia* were the five herbs used to dye the chosen yarns. Then, dyed yarns were wound into cone and knitted into socks. The dyes extracted from natural sources are non-allergic, non-toxic, eco-friendly and gain significant importance due to environmental awareness. The textile fabrics finished with antimicrobial agents have a great demand due to increase awareness in hygienic lifestyle. The antimicrobial activity of cotton, bamboo, tencel, bamboo/cotton and tencel/cotton are showed good resistance against selected microbes.*

Keywords: Antimicrobial, Eco- friendly, Herbs

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1. Introduction

The necessities of human beings are not only fulfilled with the provision of food, clothing and shelter alone, but it is important for the environment to be clean and liveable through pure, safe air and water (1). Herbal dyes are recognized as biodegradable, they do not cause any health hazards and they can be easily used without much environmental concerns (2). In the textile industry, cotton fibres are widely used for their outstanding properties of hygroscopicity, air permeability, biodegradability and non-static electricity (3). Cotton fabric is comfortable, wearable and breathable as it draws heat away from the skin, easily absorbs body moisture and evaporates in the air. The cotton fabric keeps the wearer cool and comfortable in the hot weather (4). Bamboo fabric is breathable, cool, has fast water absorption and antibacterial properties (5). Many apparel manufacturers claim that textiles made from bamboo fabric have antimicrobial properties (6). Tencel fibre has the advantages of both natural and synthetic fibres. The tencel fibre is also known as “green fibre” (7). The herbal cloth is organic and totally free from synthetic chemicals and is biodegradable (8). Socks are a vital element which helps to maintain the optimal conditions of warmth and moisture for the foot (9). The antimicrobial finish in textiles prevents the growth of bacteria, prevents diseases and protects the health of the wearer. Herbal antimicrobial finish finds wide prospects in the field of hygienic materials and has great prospects in medical textiles (10).

2. Materials and Methods

2.1 a. Procedure for Dyeing

The cotton, bamboo, tencel, bamboo/cotton and tencel/cotton yarns were selected for the study. The selected herbs namely *Caesalpinia sappan*, *Cassia Auriculata*, *Cassia Fistula*, *Mimosa Pudica* and *Tinospora Cordifolia* were powdered and boiled in distilled water for 1 hour. The selected yarns were immersed separately in prepared

kasayam/Concoction for absorption of herbs. Then dyed yarns were washed thoroughly with pure water and dried. Myrobalan mordant was used for the study. The selected herbs are given in Figure 1.

Recipe:

- Material liquor ratio - 1:50
- Dye source % - 15%
- Dye soaking time - 1 hour
- Dye extraction temperature - At boil
- Dye temperature - Room Temperature
- pH for dyeing and mordanting - 7
- Dye extraction medium - Aqueous medium

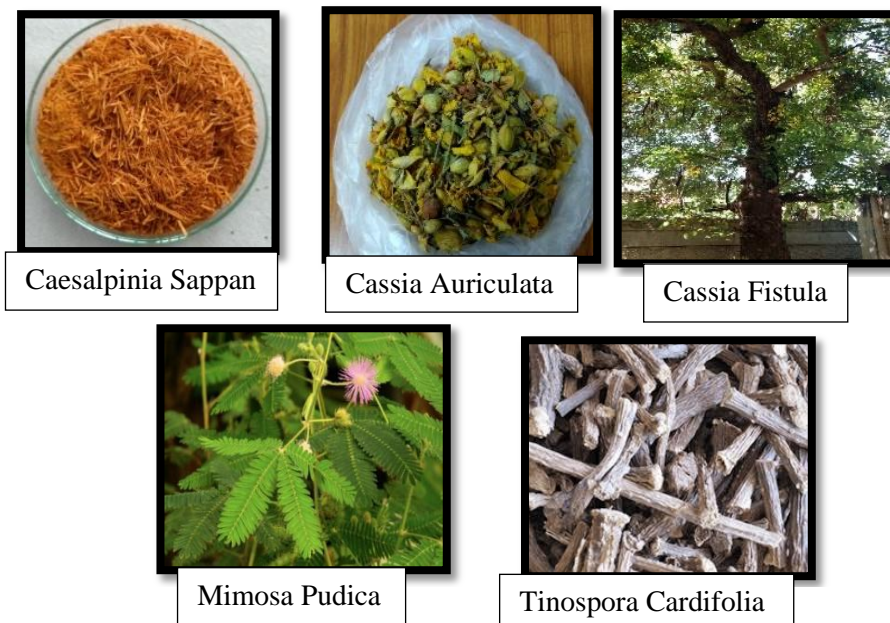


Figure 1- Herbs

2.1 b. Socks knitting

The dyed cotton, bamboo, tencel, bamboo/cotton and tencel/cotton yarns were knitted into socks. The knitted socks were shown in Figure 2 and details were given in Table I.

Table I - Particulars for knitting procedure

S.No		Particulars used for Knitting				
		Cotton	Bamboo	Tencel	Bamboo/Cotton	Tencel/Cotton
1.	Count	40s				
2.	Knitting Structure	Single Jersey				
3.	Machine	Soko knit				
4.	Wales/inch	26	26	25	25	26
5.	Course/inch	40	41	34	37	42





Figure 2 - Dyed Socks

2.2 Antimicrobial Activity

2.2.a. Antibacterial Activity

The finished socks (Cotton, Bamboo, Tencel, Bamboo/Cotton and Tencel/Cotton) were analyzed for their antibacterial activity using the standard AATCC - 147 test methods (Parallel streak method). The results were shown in Figure 3 and 4.

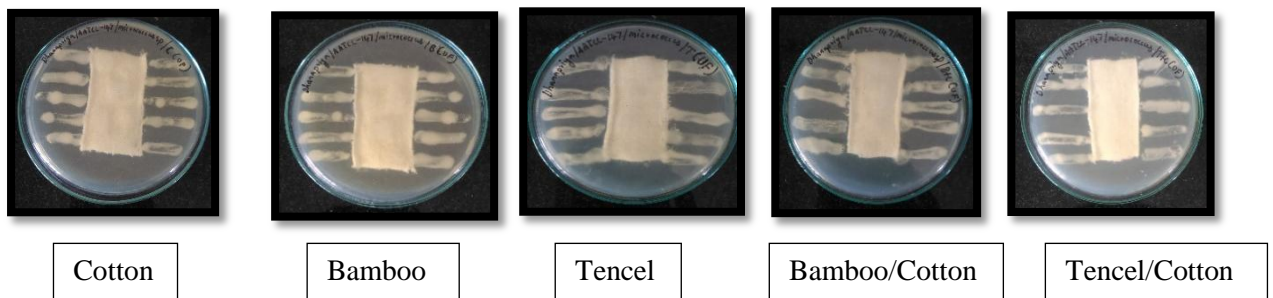


Figure 3 - Antibacterial Activity for Untreated

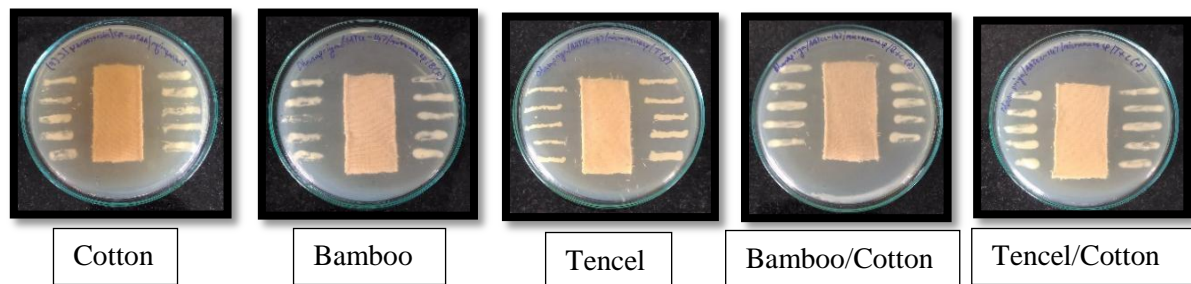


Figure 4 - Antibacterial Activity for treated

2.2.b. Antifungal Activity

The finished socks (Cotton, Bamboo, Tencel, Bamboo/Cotton and Tencel/Cotton) were analyzed for their antifungal property using the standard AATCC-30 test method. The results were shown in Figure 5 and 6.

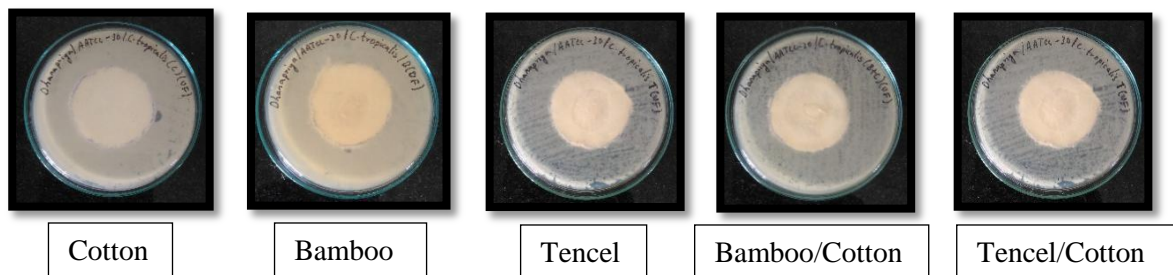


Figure 5 - Antifungal Activity for Untreated

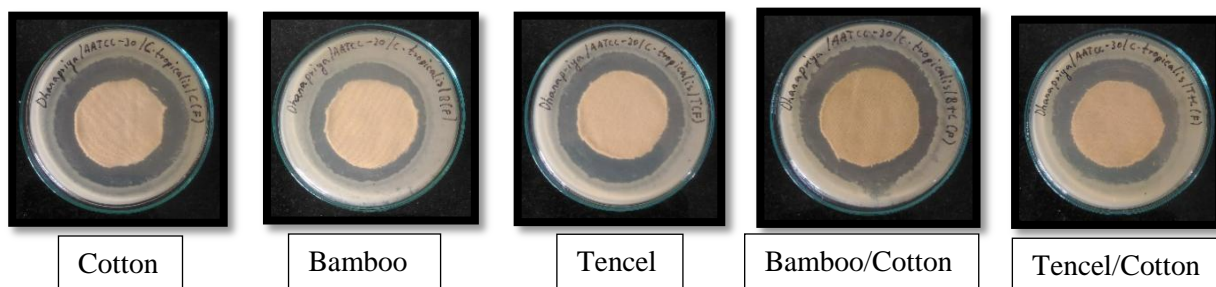


Figure 6 - Antifungal Activity for Untreated

3. Result and Discussion

3.1.a Assessment of Antimicrobial Activity

3.1.a.a Antibacterial Activity

The assessment of qualitative antibacterial activity of untreated and treated cotton, bamboo, tencel, bamboo/cotton and tencel/cotton fabrics are presented in Table 2 and Figure 7.

Table 2 - Assessment of Qualitative Antibacterial Activity of Finished Fabric

S. No	Samples	Zone of Inhibition (mm)			
		S. aureus		Micrococcus Sp	
		Control	Before Wash	Control	Before Wash
1	Cotton	0	39	0	36
2	Bamboo	0	35	0	37
3	Tencel	0	38	0	39
4	Bamboo/Cotton	0	37	0	38
5	Tencel/Cotton	0	36	0	35

0* No Antibacterial Activity

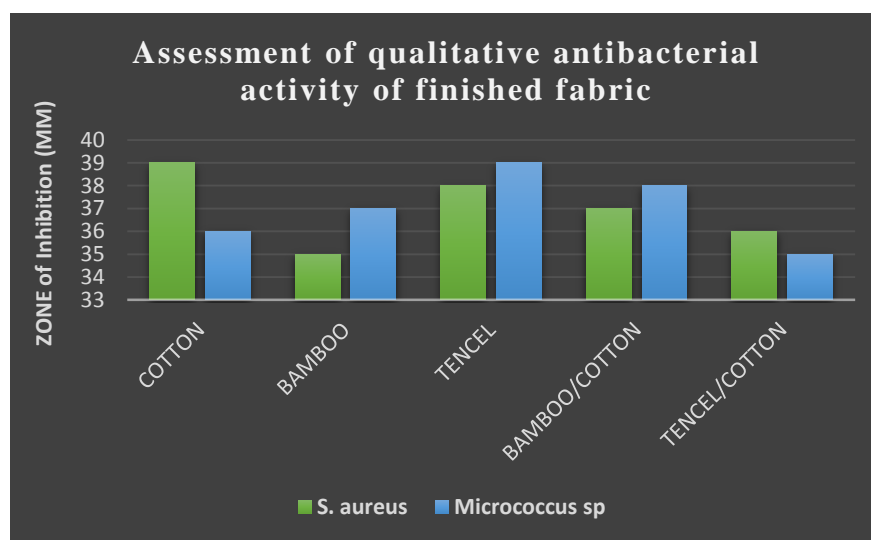


Figure 7 - Antibacterial Activity

From the above Table 2 and Figure 7, it is evident that the untreated cotton, bamboo, tencel, bamboo/cotton and tencel/cotton fabric does not possess any antibacterial activity against *S. aureus* and *Micrococcus Sp*. All treated fabrics have an inhibition zone against *S. aureus* with Cotton (39 mm), Tencel (38 mm), Bamboo/Cotton (37 mm), Bamboo (35 mm), and Tencel/Cotton (38 mm) (36 mm).

Similarly, the treated fabrics exhibited a zone of inhibition against *micrococcus Sp* with tencel (39 mm), bamboo/cotton (38 mm), bamboo (37 mm), cotton (36 mm), and tencel/cotton (35 mm). As a result, it can be stated that herbal-treated fabrics can inhibit the growth of microbes such as *S. aureus* and *Micrococcus Sp*.

3.1.b. Antifungal Activity

The assessment of antifungal activity of untreated and treated cotton, bamboo, tencel, bamboo/cotton and tencel/cotton fabrics analysis are presented in Table 3 and Figure 8.

Table 3 - Assessment of Qualitative Antifungal Activity of Finished Fabric

S. No	Samples	Zone of Inhibition (mm)			
		<i>C.albicans</i>		<i>C.tropicalis</i>	
		Control	Before Wash	Control	Before Wash
1	Cotton	0	64	0	60
2	Bamboo	0	63	0	62
3	Tencel	0	60	0	64
4	Bamboo/Cotton	0	65	0	63
5	Tencel/Cotton	0	61	0	65

0* No Antifungal Activity

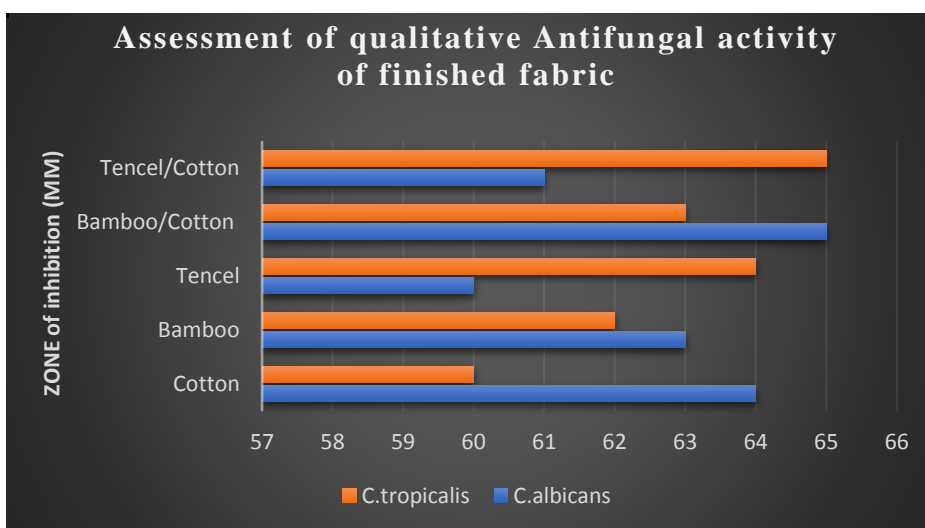


Figure 8 - Antifungal Activity

From Table 3 and Figure 8, it is revealed that the untreated cotton, bamboo, tencel, bamboo/cotton and tencel/cotton fabrics have no antifungal activity against *C. albicans* and *C. tropicalis*.

There was a zone of inhibition against *C. albicans* on cotton (64 mm), bamboo (63 mm), tencel (60 mm), bamboo/cotton (65 mm), and tencel/cotton (61 mm). In the same way, the zone of inhibition against *C. tropicalis* was cotton (60 mm), bamboo (62 mm), and tencel (64 mm), bamboo/cotton (63 mm) and cotton/tencel (65 mm). The results showed that cotton, bamboo, and bamboo/cotton demonstrated greater antifungal action against *C. albicans* than tencel and tencel/cotton whereas the antifungal efficacy against *C. tropicalis* demonstrated that bamboo, tencel, bamboo/cotton and tencel/cotton treated fabrics showed the highest zone of inhibition when compared to cotton fabrics.

4. Conclusion

Herbal textiles have medicinal properties which are beneficial for the skin. Plant-based medicines have been in use since time immemorial. India is a repository of medicinal plants. The herbal textiles, or Ayurveda, have been used to maintain good health and help lead a healthy life. This research study was conducted to evaluate the antibacterial activity of herbal treated socks knitted with cotton, bamboo, bamboo/cotton, tencel and tencel/cotton. The study has proved that the herbal treated socks reduced bacterial growth when compared to untreated socks. The treated socks; namely cotton, bamboo, tencel, bamboo/cotton and tencel/cotton are showed good resistance against selected microbes. The developed socks were cool and comfortable to wear. It can be recommended for long wear hours for both indoor and outdoor usage irrespective of climate. It can also be suggested for people with sensitive skin and skin allergies.

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