

# Application of Herbal Extracts for Antimicrobial Property



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## **Abstract**

Application of herbals on cotton opens up new avenues for herbal as well as Textile industry i.e. clean room fabrics, as herbal treated garments can be used in medical gown, operation theater fabric etc. Application of wound healing herbals on cotton has a scope in wound healing / wound dressing manufacturing. In order to analyze and explore the possibility of herbal medicine for bandages and wound dressing, various extracts of the colouring / medicinal substances from the different herbals like Amla, Myrobolan, Garlic, Turmeric, Neem, Tulsi, Aloe vera, Henna, Peepal and Banyan leaves were applied on the cotton fabric and their evaluation for the antimicrobial property was carried out.

## **Keywords**

Anti microbial property, Herbal, Medical textile, Wound dressing.

## **1. Introduction**

The use of herbs to treat disease is almost universal among non-industrialized societies. A number of traditions came to dominate the practice of herbal medicine at the end of the twentieth century such as;

- The herbal medicine system, based on Greek and Roman sources
- The Siddha and Ayurvedic medicine systems from various South Asian Countries
- Chinese herbal medicine (Chinese herbology)
- Unani-Tibb medicine
- Shamanic Herbalism [1]

Among the 120 active compounds currently isolated from the higher plants and widely used in modern medicine today, 80 percent show a positive correlation between their modern therapeutic use and the traditional use of the plants from which they are derived.

More than two thirds of the world's plant species - at least 35,000 of which are estimated to have medicinal value - come from the developing countries.

Herbalists tend to use extracts from parts of plants, such as the roots or leaves but not isolate particular phytochemicals. They argue that the different phytochemicals present in many herbs will interact to enhance the therapeutic effects of the herb and dilute toxicity. Herbalists deny that herbal synergism can be duplicated with synthetic chemicals. In specific cases the claims of synergy and multifunctionality have been supported by science [2].

The healing value of herbal treated textile (or herbal garment) and its usage is based on the principle of touch. By coming in contact with herbal cloth, the body loses toxins and its metabolism is enhanced.

Herbal garments helps in fighting many common and prevalent diseases such as hypertension, heart ailments, asthma, diabetes and skin diseases. For diabetes, Mimosa pudica (touch-me-not), cumon/cumin seeds, *Magnolia champaca* (*champa*) flower and Hibiscus rosa-sinensis or shoe flower (*ghudahal*) are combined in the herbal dye. The main herbs used in the herbal dye for arthritis are curry leaves and apocynceae. Whereas, for skin diseases, the herbs used are turmeric, neem, indigo and sandalwood. Cuscus grass is good for asthma patients, sandalwood; with its mild fragrance has a soothing effect that helps in fighting stress. Rubia cordifolia, *majith* are known to be effective against diseases like leprosy. *Katha*, catechu is used for treatment of parasitic infestation and itching.

Some of the other herbal dyes used are catechu, pomegranate rind, madder, castor oil, sweet basil, lime, wild turmeric, henna leaves, curry leaf tree, aloe vera, certain herbal fruits, etc, each having their own healing effects.

Textiles treated with medicinal herbals can be used in medical gown, operation room theater fabric etc. Also by application of wound healing herbals on cotton have a scope in wound healing / wound dressing manufacturing.

## 2. Materials and Methods

Cotton Fabric used in this investigation was received from Premier mills, Mumbai.

### 2.1 Herbal Drugs

- |                     |                                            |
|---------------------|--------------------------------------------|
| 1. Amla Powder      | Local shop, Mumbai                         |
| 2. Myrobalan Powder | Local shop, Mumbai                         |
| 3. Tulsi            | Fresh Leaves from ICT Garden               |
| 4. Neem             | Fresh Leaves from ICT Garden               |
| 5. Garlic           | Local Vegetable Market                     |
| 6. Turmeric         | Lijjat, Sahakari Bahandar, Matunga, Mumbai |
| 7. Henna Powder     | Local shop, Mumbai                         |

- |                  |                              |
|------------------|------------------------------|
| 8. Peepal Leaves | Fresh Leaves from ICT Garden |
| 9. Banyan Leaves | Fresh Leaves from ICT Garden |
| 10. Aloe Vera    | Fresh Leaves from ICT Garden |

## 2.2 Extraction of herbals

Extraction of herbal for 2 % was carried out by taking 2 gms of it in 100 ml water and then boiled for 1 hr. It was then kept overnight and filtered out. The volume of filtrate was adjusted to 100 ml and extract was considered to be of 2% concentration.

## 2.3 Herbal Treatment

Cotton fabrics were treated by extract of different concentrations (5%, 10%, & 15%) of Amla, Myrobalan and Garlic for mordanting at 90<sup>0</sup>C for 1 hr. Samples were then washed with cold water and were air dried. After mordanting the samples were treated by 2% extract of the different herbals like Turmeric, Neem, Tulsi, Aloe vera gel, Peepal Leaves, Banyan Leaves and Henna Powder with different concentrations (2%, 5%, 10%, 15%, 20%, and 30% owf) at 90<sup>0</sup>C, then it was given cold wash and dried in air.

## 2.4 Antimicrobial Test

The herbal treated cotton fabric were tested for the antimicrobial properties against gram positive as well as gram negative bacteria according to the AATCC 100-2004 method.

## 3. Results and Discussion

In order to analyze and explore the possibility of using fibres as carrier of herbal medicine for bandages and wound dressing, a set of experiments was carried out to extract the colouring / medicinal substances from the different herbals like Amla, Myrobolan, Garlic, Turmeric, Neem, Tulsi, Aloe vera, Henna, Peepal and Banyan leaves. The herbal dye extracted from these herbals having the botanical name *Phyllanthus emblica* (Amla), *Terminalia chebula* (Myrobolan), *Allium sativum* L. (Garlic), were used as mordants while, *Curcuma longa* (Turmeric), *Azadirachta indica* (Neem), *Ocimum tenuiflorum* (Tulsi), *Aloe-Vera* (Aloe Vera), *Ficus religiosa* (Peepal), *Ficus benghalensis* (Banyan) and *Lawsonia inermis* (Henna) were used as herbal medicines and were applied on cotton fabric. Cotton fabric was used as carrier material to evaluate the preliminary performance properties of the herbals to be used as a medicine in bandages or wound healing medical textiles.

Initially treatment with 5 %, 10%, 15% & 20% on the weight of fabric of amla, myrobolan and garlic was given with 2% extract of the herbal. Depending upon the % owf to be applied, the required quantity of this extract was taken, MLR was maintained to 1:30 and treatment was carried out as per the method described in the experimental part. These mordanted fabrics were

then treated with different percentages such as 2%, 5%, 10%, 15%, 20% & 30% of 2% herbal extract of turmeric, neem, tulsi, aloe-vera, henna, peepal leaves and banyan leaves. These herbal treated fabrics then were evaluated for their antimicrobial properties against the Gram positive and Gram negative bacteria by AATCC 100 test method. Antimicrobial activity of the herbals can give the preliminary idea about the application of the herbal treated textile as wound healing bandage or wound dressing. Also if these herbals show good antimicrobial properties after applying on to the textile fibres or fabrics, they can be used in treatment of absorbent layer of diaper or sanitary napkin so that it will help in retarding or stopping the growth of microbes which in turn can take care of the undesired rashes in some cases to the wearer's skin.

These herbals may act as medicament by killing the microbes around the skin / wound resulting in unhindered, desired, faster wound healing. Hence the evaluation of these herbal treated textiles for the antimicrobial properties was undertaken.[3]

<b>Table I : Antimicrobial activity of herbals used as mordant against the Gram +ve bacteria &amp; Gram -ve bacteria</b>			
<b>Sr. No.</b>	<b>Samples</b>	<b>% reduction of Gram +ve bacteria</b>	<b>% reduction of Gram -ve bacteria</b>
1	Amla 5%	78	72
2	Amla 10%	90	85
3	Amla 15%	98	93
4	Amla 20%	99	98
5	Myrobolan 5%	78	68
6	Myrobolan 10%	90	75
7	Myrobolan 15%	95	85
8	Myrobolan 20%	99	95
9	Garlic 5%	75	65
10	Garlic 10%	88	80
11	Garlic 15%	94	85
12	Garlic 20%	98	92

The results with respect to Gram +ve & Gram -ve bacteria namely; *Staphylococcus aureus* & *Escherichia Coli* are given in **Table I**. From the table it can be said that all the three herbals used as mordants showed good antimicrobial properties against both type of bacteria. In all the cases it is evident that as the concentration of herbals increases, % reduction of bacteria also increases. In other words, higher was the concentration of these herbal extract on the fabric, higher was the possibility of its diffusion in the nutrient and thus more was its resistance to the growth of microorganisms. This was true in all the three different herbals. The control sample i.e

untreated sample, did not show any reduction and on the contrary has shown increase in the number of bacterial colonies. This clearly indicates that the fabric used here typically acts as a vehicle or carrier for the medicinal extract and it does not interfere in any way in the reduction of microbial growth. From the table it is seen that practically 100 % reduction in growth is given by amla, myrobolan and garlic at 20% concentration. Overall it ranges from 78% to 99% for Gram +ve bacteria while for Gram –ve bacteria it ranges from 72% to 98%.

Among the three herbal extracts amla and myrobolan gave the maximum % reduction of microorganism followed by garlic. These three are known to be wound healing medicine in Ayurved. [4]

**Table II : Antimicrobial activity of different herbals against the Gram +ve & Gram -ve bacteria**

Sr. No.	Samples	% reduction of Gram +ve bacteria	% reduction of Gram –ve bacteria
1	Turmaric 2%	73	72
2	Turmaric 15%	88	85
3	Turmaric 30%	95	93
4	Neem 2%	70	46
5	Neem 15%	95	80
6	Neem 30 %	98	93
7	Tulasi 2%	75	38
8	Tulasi 15%	95	83
9	Tulasi 30 %	98	94
10	Aloe-vera 2%	45	35
11	Aloe-vera 15%	60	65
12	Aloe-vera 30 %	75	80
13	Banyan 2%	35	15
14	Banyan 15%	55	34
15	Banyan 30 %	70	48
16	Peepal 2%	49	10
17	Peepal 15%	68	45
18	Peepal 30 %	78	70
19	Henna 2%	10	10
20	Henna 15%	40	40
21	Henna 30 %	75	70

Similarly the results in **Table II** show the extent of reduction in the growth of Gram +ve & Gram –ve bacteria by different herbals. In this case too, higher was the extract concentration; higher was the reduction in microbial growth, irrespective of the type of microbes. With regards to the

ability of seven different medicinal herbal extracts on their application on cotton fabric in offering antimicrobial property, the order is as follows;

Tulsi ≥ Neem > Turmeric > Aloe-vera > Peepal > Banyan > Henna

Highest concentration (30%) under study of neem & tulsi showed 98% reduction in bacterial growth while highest concentration (30%) of turmeric has shown 95% reduction. The other herbals did not give more than 75% reduction even at highest concentration of 30%. Hence it was though appropriate to study the combination of these herbal extracts with the so called mordants as described earlier to get increased reduction in bacterial growth.

The further sets of experiments were devoted to study the effect of seven herbal extracts on application on pretreated (mordanted) cotton fabric with Amla, myrobolan and garlic as a mordant in exhibiting synergetic effect on antimicrobial property with less concentration of application of the herbal extract if possible.

**Table III : Antimicrobial activity of Turmeric mordanted with Amla, Myrobolan and Garlic against the Gram +ve & Gram -ve bacteria**

Sr. No.	Samples		% reduction of Gram +ve bacteria	% reduction of Gram -ve bacteria
1	Turmeric 2%		73	72
2	Turmeric 15%		88	85
3	Turmeric 30%		95	93
4	Amla 5% +	Turmeric 2%	80	78
5		Turmeric 15%	90	85
6		Turmeric 30%	97	92
7	Amla 20%	Turmeric 2%	85	80
8		Turmeric 15%	97	92
9		Turmeric 30%	99	98
10	Myrobolan 5%	Turmeric 2%	78	75
11		Turmeric 15%	89	80
12		Turmeric 30%	96	93
13	Myrobolan 20%	Turmeric 2%	85	85
14		Turmeric 15%	96	95
15		Turmeric 30%	99	98
16	Garlic 5%	Turmeric 2%	75	70
17		Turmeric 15%	85	82
18		Turmeric 30%	93	90
19	Garlic 20%	Turmeric 2%	83	80
20		Turmeric 15%	85	80
21		Turmeric 30%	97	92

**Table III** shows the results of application of Turmeric extract on mordanted cotton with three different mordants namely amla, myrobolan and garlic. The concentrations of mordants taken were 5% and 20% while those of turmeric extracts were 2%, 15% and 30%. From the table it is clear that mordanting shows definite increase though marginal in reduction of growth of both types of microorganisms. As the concentration of turmeric was increased keeping mordant concentration same, the reduction in bacterial growth was increased in all the cases. The trend as seen earlier remained same, that the myrobolan gave almost comparable results as of Amla while garlic giving slightly inferior results. In case of combination of Amla and turmeric as well as Myrobolan and turmeric the % reduction of almost 90% and more was observed in combination of 5% + 15%, 5% + 30%, 20% + 15% and 20% + 30% where first value is for mordant while second value is for herbal extract. In case of Garlic + turmeric more than 90% reduction was observed in combination of 5% + 30% and 20% + 30% only..

<b>Table IV: Antimicrobial activity of Neem mordanted with Amla, Myrobolan and Garlic against the Gram +ve &amp; Gram -ve bacteria</b>				
<b>Sr. No.</b>	<b>Samples</b>		<b>% reduction of Gram +ve bacteria</b>	<b>% reduction of Gram -ve bacteria</b>
1	Neem 2%		70	46
2	Neem 15%		95	80
3	Neem 30 %		98	93
4	Amla 5% +	Neem 2%	85	75
5		Neem 15%	97	85
6		Neem 30%	98	96
7	Amla 20%	Neem 2%	98	93
8		Neem 15%	99	97
9		Neem 30%	99	99
10	Myrobolan 5%	Neem 2%	83	75
11		Neem 15%	91	83
12		Neem 30%	98	94
13	Myrobolan 20%	Neem 2%	97	91
14		Neem 15%	99	95
15		Neem 30%	99	99
16	Garlic 5%	Neem 2%	80	75
17		Neem 15%	88	88
18		Neem 30%	98	98
19	Garlic 20%	Neem 2%	95	86
20		Neem 15%	99	94
21		Neem 30%	99	99



Thus at different combination of the herbal concentrations as seen from the table, more than 90% reduction in bacterial growth could be achieved which as per norms is quite enough to be used as medicament for wound healing or in diaper absorbent layer to reduce the microbial growth on skin

In the similar set of experiments neem extract treatment was given to mordanted cotton fabric and then treated fabrics were evaluated for the antimicrobial properties and the results are shown in **Table IV**. From the table it can be observed that neem is showing excellent antimicrobial activity against both type of bacteria and giving almost 100% reduction in microbial growth. Even 5% Amla and 2% neem have given 85% reduction in microbial growth, which is clearly the synergetic effect of the combination as 5% amla has shown only 78% reduction in microbial growth while 2% neem has shown 70% reduction in microbial growth.

<b>Table V : Antimicrobial activity of Tulasi mordanted with Amla, Myrobolan and Garlic against the Gram +ve &amp; Gram -ve bacteria</b>				
<b>Sr. No.</b>	<b>Samples</b>		<b>% reduction of Gram +ve bacteria</b>	<b>% reduction of Gram -ve bacteria</b>
1	Tulasi 2%		75	38
2	Tulasi 15%		95	83
3	Tulasi 30 %		98	94
4	Amla 5% +	Tulasi 2%	80	75
5		Tulasi 15%	96	90
6		Tulasi 30%	98	96
7	Amla 20%	Tulasi 2%	97	87
8		Tulasi 15%	99	95
9		Tulasi 30%	99	99
10	Myrobolan 5%	Tulasi 2%	80	73
11		Tulasi 15%	90	88
12		Tulasi 30%	98	95
13	Myrobolan 20%	Tulasi 2%	85	85
14		Tulasi 15%	94	88
15		Tulasi 30%	98	96
16	Garlic 5%	Tulasi 2%	75	70
17		Tulasi 15%	85	85
18		Tulasi 30%	92	90
19	Garlic 20%	Tulasi 2%	85	81
20		Tulasi 15%	92	91
21		Tulasi 30%	97	95

From the table it can also be observed that as the concentration of application of the herbal extract and mordant increases, % reduction in microbial growth also increases which is but obvious.

Results of similar experiments with tulsi are shown in **Table V**. Tulsi has also shown similar results rather slightly better as compared to neem. As it is well a known herb having very good antimicrobial properties and here also it is giving good antimicrobial activity on application to the cotton fabric. It is giving practically 100% reduction in microbial growth in most of the combinations. It is difficult to distinguish the better one however, both Neem and Tulsi seems to be offering desired antibacterial property.

**Table VI : Antimicrobial activity of Aloe vera mordanted with Amla, Myrobolan and Garlic against the Gram +ve & Gram -ve bacteria**

Sr. No.	Samples	% reduction of Gram +ve bacteria	% reduction of Gram -ve bacteria
1	Aloe-vera 2%	45	35
2	Aloe-vera 15%	70	65
3	Aloe-vera 30 %	80	78
4	Amla 5%	Aloe-vera 2%	69
5		Aloe-vera 15%	78
6		Aloe-vera 30%	89
7	Amla 20%	Aloe-vera 2%	73
8		Aloe-vera 15%	85
9		Aloe-vera 30%	94
10	Myrobolan 5%	Aloe-vera 2%	68
11		Aloe-vera 15%	80
12		Aloe-vera 30%	89
13	Myrobolan 20%	Aloe-vera 2%	70
14		Aloe-vera 15%	84
15		Aloe-vera 30%	91
16	Garlic 5%	Aloe-vera 2%	65
17		Aloe-vera 15%	75
18		Aloe-vera 30%	85
19	Garlic 20%	Aloe-vera 2%	69
20		Aloe-vera 15%	83
21		Aloe-vera 30%	90

**Table VII :** Antimicrobial activity of Banyan leaves mordanted with Amla, Myrobolan and Garlic against the Gram +ve & Gram -ve bacteria

Sr. No.	Samples	% reduction of Gram +ve bacteria	% reduction of Gram -ve bacteria
1	Banyan 2%	35	15
2	Banyan 15%	55	34
3	Banyan 30 %	70	48
4	Amla 5%	Banyan 2%	65
5		Banyan 15%	70
6		Banyan 30 %	80
7	Amla 20%	Banyan 2%	65
8		Banyan 15%	80
9		Banyan 30 %	91
10	Myrobolan 5%	Banyan 2%	60
11		Banyan 15%	70
12		Banyan 30 %	80
13	Myrobolan 20%	Banyan 2%	63
14		Banyan 15%	78
15		Banyan 30 %	89
16	Garlic 5%	Banyan 2%	60
17		Banyan 15%	65
18		Banyan 30 %	80
19	Garlic 20%	Banyan 2%	62
20		Banyan 15%	76
21		Banyan 30 %	87

**Table VIII : Antimicrobial activity of Peepal mordanted with Amla, Myrobolan and Garlic against the Gram +ve & Gram -ve bacteria**

Sr. No.	Samples	% reduction of Gram +ve bacteria	% reduction of Gram -ve bacteria	
1	Peepal 2%	49	10	
2	Peepal 15%	68	45	
3	Peepal 30 %	78	70	
4	Amla 5%	Peepal 2%	70	60
5		Peepal 15%	85	70
6		Peepal 30 %	90	80
7	Amla 20%	Peepal 2%	76	65
8		Peepal 15%	90	75
9		Peepal 30 %	96	88
10	Myrobolan 5%	Peepal 2%	60	58
11		Peepal 15%	75	68
12		Peepal 30 %	85	79
13	Myrobolan 20%	Peepal 2%	66	63
14		Peepal 15%	81	71
15		Peepal 30 %	90	85
16	Garlic 5%	Peepal 2%	58	55
17		Peepal 15%	75	65
18		Peepal 30 %	85	75
19	Garlic 20%	Peepal 2%	61	60
20		Peepal 15%	83	70
21		Peepal 30 %	91	81

<b>Table IX:</b> Antimicrobial activity of Henna mordanted with Amla, Myrobolan and Garlic against the Gram +ve & Gram -ve bacteria				
<b>Sr. No.</b>	<b>Samples</b>		<b>% reduction of Gram +ve bacteria</b>	<b>% reduction of Gram -ve bacteria</b>
1	Henna 2%		10	10
2	Henna 15%		40	40
3	Henna 30 %		75	70
4	Amla 5%	Henna 2%	60	57
5		Henna 15%	74	66
6		Henna 30 %	87	79
7	Amla 20%	Henna 2%	65	60
8		Henna 15%	80	72
9		Henna 30 %	93	85
10	Myrobolan 5%	Henna 2%	57	51
11		Henna 15%	66	61
12		Henna 30 %	84	76
13	Myrobolan 20%	Henna 2%	62	58
14		Henna 15%	72	70
15		Henna 30 %	89	81
16	Garlic 5%	Henna 2%	56	50
17		Henna 15%	64	61
18		Henna 30 %	84	71
19	Garlic 20%	Henna 2%	60	55
20		Henna 15%	70	68
21		Henna 30 %	88	78

Similarly remaining herbals; Aloe-Vera, Banyan leaves, Peepal leaves and Henna extract were used for treating the cotton fabric after mordanting with amla, myrobolan and garlic extract. The results are shown in **Table VI – Table IX**. From these tables it can be confidently said that mordanting has positive effect on the antimicrobial properties. In other words, herbal treatment on the mordanted cotton fabric has better antimicrobial properties than the non mordanted cotton fabric especially at lower concentration of application. This effect is more conspicuous here as compared to the previous herbals, turmeric, neem and tulsi as alone aloe – vera, banyan leaves, peepal leaves and henna are less effective in imparting antimicrobial property. Among these herbals aloe-vera is more effective in imparting antimicrobial property than the banyan leaves, peepal leaves and henna.

From these experiments it can be said that amla, myrobolan, garlic, turmeric, neem and tulsi has shown excellent antimicrobial activity when applied on to the textile when used alone as well as

in combination. So in other words, these herbal extracts can be used in wound dressing bandages. Generally wound heals naturally on its own and the process become faster when one provides better condition for healing like cleanliness, moist environment and microbe free environment. Thus in conclusion it could be said that;

1. Extracts of Amla, Myrobolan, Garlic, Tulsi, Neem and Turmeric impart excellent antimicrobial property alone as well as in combination.
2. Amla, Myrobolan and Garlic when tried as mordant, Amla and Myrobolan showed better results compared to garlic extract.
3. Tulsi, Neem and Turmeric extract when evaluated in combination with amla, myrobolan and garlic, imparts excellent antimicrobial property.
4. Other herbal extracts like aloe-vera, Henna, Banyan leaves and Peepal leaves are not very much promising in imparting antimicrobial property by this type of exhaust application on fabrics which can be seen from the results. Hence one can not recommend the use of these herbals for imparting antimicrobial property with these parameters of the application.

It is to be noted that these experiments are quite preliminary and require additional data to clearly come out with the product, which can in fact offer capacity of wound healing comparable to the products available in the market based on the allopathic medicine.

## **Conclusion**

In order to analyze and explore the possibility of herbal medicine for bandages and wound dressing by extracts of the colouring / medicinal substances from the different herbals like Amla, Myrobolan, Garlic, Turmeric, Neem, Tulasi, Aloe – vera, Henna, Peepal and Banyan leaves, study was done on the cotton fabric and evaluation for the antimicrobial property was done. The results show that extracts of Amla, Myrobolan, Garlic, Tulsi, Neem and Turmeric impart excellent antimicrobial property when applied alone as well as in combination. Amla, Myrobolan and Garlic when tried as mordant, Amla and Myrobolan showed better results compared to garlic extract. Other herbal extracts like aloe vera, Henna, Banyan leaves and Peepal leaves are not much promising in imparting the antimicrobial property by the type of exhaust application on fabrics, hence, cannot be recommended the use of these herbals for imparting antimicrobial property with researched parameters of the application.

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