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*Research Paper*

# Antimicrobial finishing of textiles for protection

■ Swapna Choudhury, Ava Rani Phukan **and** Pradip Kumar Borah

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■ **ABSTRACT :** The antibacterial materials such as fabrics, clothes are becoming important to avoid cross infection by pathogenic micro-organisms, especially bacteria such as *Aureimonas altamirensis*, *Bacillus clausii* and *Micrococcus yunnanensis*, to control the infestation by microbes, and to arrest metabolism in microbes in order to reduce the formation of odour. Textiles for medical and hygienic use have become important areas in the textile industry. Therefore, to reduce/prevent infections, various antibacterial compounds have been used for all types of textiles. The solutions of disinfectant used are generally active *in vitro*, but, it is also necessary to know the effectiveness of disinfecting cloths in conditions of use. In the current study, it was aimed to determine the antibacterial activity of fabrics functionalized with herbal extracts against *Aureimonas altamirensis*, *Bacillus clausii* and *Micrococcus yunnanensis*, and also after different wash cycles against these bacteria. The results of the present study showed that the most susceptible bacterium was *B. clausii* in all standard test methods for unwashed fabrics, antibacterial activity was continued even after washing cycles.

■ **KEY WORDS:** Antibacterial activity, *Aureimonas altamirensis*, *Bacillus clausii*, Herbal extract, *Micrococcus yunnanensis*, Textile fabrics

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See end of the paper for authors' affiliations →

**Swapna Choudhury**
Department of Textiles and Apparel Designing, College of Home Science, Assam Agricultural University, Jorhat (Assam) India
Email : spatgirichoudhury@gmail.com

Clothing is in close permanent contact with skin and thus provides an ideal basis for the attachment of bacteria transferred from human skin either by direct contact or sweat. The microbial ecology of human superficial skin is highly complex and that the bacterial species present on skin vary highly between individuals (Gao *et al.*, 2007). It is affected by environmental factors, such as temperature and humidity, and host factors, such as gender, immune status, and use of cosmetics (Roth and James, 1988). Skin bacteria pose neither odour problems nor problems with the loss of performance of textile materials under normal conditions. But under favourable growth conditions, bacteria rapidly multiply and cause odour generation (Rennie *et al.*, 1990, Ho¨fer 2006; McQueen *et al.*, 2007 and Obendorf *et al.*, 2007), loss of performance or discolouration of textiles, high humidity represents a favourable growth condition for bacteria. Thus, sweat is an ideal bacterial breeding ground. Many of the characteristic malodours associated with the human body are because of the presence of large populations of micro-organisms (Leyden *et al.*, 1981 and Rennie *et al.*, 1991).

Recognizing the importance of plant materials as antimicrobial agents, research has been initiated in the areas of producing bioactive textiles for the protection of wearer from common microbes causing cross

infections (Ramachandran *et al.*, 2004; Jantas and Gorna, 2006). Natural antimicrobial agents are non-toxic and non-allergenic and do not cause the problems of microbial resistance (Goldsmith *et al.*,1954 and Lin *et al.*, 2003). Usually, antimicrobial properties can be acquired to textile materials by chemically or physically incorporating functional agents onto fibres or fabrics (Gouda, 2006). The antimicrobial properties of such textile materials can be durable or temporary. Temporary biocidal properties of fabrics are easy to achieve in finishing, but easy to reduce in laundering. However, the antibacterial agents will vanish completely if they are impregnated in materials without covalent bond linkages (Seshadri and Bhat, 2005). The purpose of the present study was to determine the antibacterial activity of fabrics functionalized with herbal extract against *Aureimonas altamirensis*, *Bacillus clausii* and *Micrococcus yunnanensis* bacteria.

## ■ RESEARCH METHODS

### Preparation of fabric:

Cotton materials were scoured and bleached so that it easily penetrates the plant extract (Baruah, 2015).

### Preparation of plants extract:

The leave of *Bambusa tulda*, *Chromolaena odorata*, *Ageratum conyzoides*, *Adhatoca vasica* and root of *Achyranthes aspera*, free from disease were selected for extracting natural products to fabrics. The air dried leaves and roots of selected plants were made into fine powder by grinding and followed by mixing with methanol at room temperature in the ratio of 2:5 in a beaker. The beaker was left closed for 48 hours so that the methanol takes in the active components of the leaves and roots. After 2 days, the extracts were filtered through a Whatman No. 4 filter paper and then centrifuged at 10,000 rpm for separating the supernatant from the extract. Sterilized the extract and concentrated extracts were then stored at -20 ºC until further use.

### Micro-organisms:

Three bacterial species, Gram-positive *Bacillus clausii* and gram-negative *Aureimonas altamirensis* and *Micrococcus yunnanensis*. These microbes were isolated from the infected clothes.

### Screening of antimicrobial activities :

Disc diffusion method (Jothi, 2009) was used to examine the antimicrobial activity. 15 ml of melted nutrient agar was poured in the Petri plates. After media were solidified, 250 µl of microbes cultures aged 48-72 hr were added to Petri plates and spread it by spreader evenly, dried it. After that holes were made by using 5mm cork borer. Each hole was filled with 150 µl of plant extract. Different concentrations were used *i.e.* 100%, 50%, 25%, 12.5%, 6.25% and 3.125%. The samples were slowly impregnated drop wise on the hole. Packed the Petri plates with paraffin. Plates were incubated at 28°C for 2-3 days. The zone of inhibition was recorded.

### Determination of minimum inhibitory concentrations (MIC) :

The antimicrobial activity of the potential plant extracts was determined by 2-fold dilution methods as described by (Omura, 2008) and MICs were read in µl/ml after overnight or 2-3 days incubation at 28°C. All experiments were made in replicates.

## ■ RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Effect of methanol herbal extracts against *Aureimonas altamirensis* :

Fig. 1 showed that the maximum inhibition of *Aureimonas altamirensis* with methanol herbal extract of *Bambusa tulda* was observed (23.93 mm) and minimum (17.28 mm) at 100% conc. and 25% conc., respectively followed by *Adhatoca vasica* (19.57 mm) and (15.23 mm) and *Achyranthes aspera* (16.93 mm) and (12.95 mm) at 100% conc. and 25% conc., respectively.

### Effect of methanol herbal extracts against *Bacillus clausii* :

From Fig. 1, it was observed that at 100% concentration the zone of inhibition of *Adhatoca vasica* extract was found to be maximum (22.78 mm) followed by *Ageratum conyzoides* (21.23 mm). *Chromolaena odorata* (21.03 mm), *Bambusa tulda* (20.03 mm) and *Achyranthes aspera* (15.33 mm. Again, the zone of inhibition at 50% concentration were found to be maximum (20.43 mm) in *Adhatoca vasica* and minimum

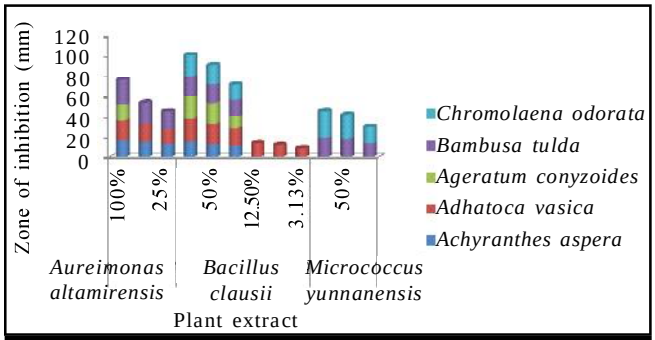



**Fig. 1 : Effect of methanol herbal extracts against bacteria**

(12.87 mm) in *Achyranthes aspera* extract. It is interesting to note that, *Adhatoca* extract showed remarkable effect on *Bacillus clausii* with methanol extract at very low concentration *i.e.* 3.125%.

**Effect of methanol herbal extracts against *Micrococcus yunnanensis* :**

From Fig. 1, it was observed that among the selected herbal plant tested against *Micrococcus yunnanensis* only *Chromolaena odorata* showed maximum inhibitory effect (27.22 mm) at 100% conc. and minimum (16.55 mm) at 25% conc. followed by *Bambusa tulda* (18.58 mm) and (13.58 mm), respectively. Rest of the herbal extracts were not found to be effective against *Micrococcus yunnanensis* at any concentrations.

**Evaluation of antimicrobial finished fabrics against bacteria :**

After application of extract, finished and control fabric samples were placed in intimate contact with AATCC bacteriostasis agar, which has been previously inoculated (Mat culture) with an innoculum of test organism. After incubation, a clear area of uninterrupted growth underneath and along the side of the test material indicated antibacterial effectiveness of the fabric (EN ISO 20645, 2004).

**Efficacy of antimicrobial activity of *Achyranthes aspera* treated fabrics :**

Table 1 revealed a decreasing trend of effective inhibition of *Aureimonas altamirensis* was observed when *Achyranthes aspera* treated cotton fabric tested as compared to herbal extract examined without fabric. Herbal extract of *Achyranthes aspera* alone showed effective inhibition of the tested bacterium (16.93 mm) at 100% conc. while treated fabric showed inhibition (16.77 mm) at 100% conc. It was followed by 50% conc. where inhibition was (15.25 mm) and (14.10 mm) and at 25% conc. (12.95 mm) and (12.40 mm), respectively. It was also observed from the Table that the effective inhibition of *Bacillus clausii* with the use of herbal extract without fabric and with fabric at 100% conc. (15.33 mm) and (15.26 mm), at 50% conc. (12.87 mm) and (12.63 mm) and at 25% conc. (11.62 mm) and (11.48 mm), respectively. This decreasing trend might be due to the pressure of the yarn and fabric structure (Plate 1 and 2).

**Efficacy of antimicrobial activity of *Adhatoca vasica* treated fabrics :**

It was observed from the Table 2, that methanol extract of *Adhatoca vasica* plant showed gradual decline of effective inhibition of *Aureimonas altamirensis* when tested with herbal extract without fabric compared to herbal extract used with fabric. At 100% conc. effective inhibition was (19.57 mm) and (15.87 mm), at 50% conc. (17.93 mm) and (15.77 mm), at 25% conc. (15.23 mm) and (14.00 mm), respectively. In case of *Bacillus clausii* effective inhibition was observed upto 3.125% conc. At 100% conc. herbal extract without fabric showed

**Table 1 : Efficacy of antimicrobial activity of *Achyranthes aspera* treated fabrics**

| Bacteria | % Plant extracts | Methanol extract | | | | | |
|---|---|---|---|---|---|---|---|
| | | Without fabrics (Control) | | | With fabrics | | |
| | | Mean (mm) | Std. deviation | Std. error | Mean (mm) | Std. deviation | Std. error |
| *Aureimonas altamirensis* | 100% | 16.9333 | 0.15275 | 0.08819 | 16.7667 | 0.05774 | 0.03333 |
| | 50% | 15.25 | 0.13229 | 0.07638 | 14.10 | 0.10 | 0.05774 |
| | 25% | 12.95 | 0.22913 | 0.13229 | 12.40 | 0.10 | 0.05774 |
| *Bacillus clausii* | 100% | 15.3333 | 0.15275 | 0.08819 | 15.2666 | 0.15275 | 0.08819 |
| | 50% | 12.8667 | 0.15275 | 0.08819 | 12.6333 | 0.15275 | 0.08819 |
| | 25% | 11.6167 | 0.20207 | 0.11667 | 11.4752 | 0.20207 | 0.11667 |

Data given are mean of five replicates

*Aureimonas clausii* *Bacillus clausii*

**Plate 1 and 2 : Antimicrobial activity of *Achyranthes aspera* extract and finished sample**

effective inhibition (22.78 mm) and with fabric (18.22 mm), followed by (20.43 mm) and (16.30 mm) at 50% conc. (17.63 mm) and (13.87 mm), respectively.

From the above results it was observed that all the treated samples (with fabric) showed less effective zone of inhibitions against tested pathogen as compared to control (without fabric) which might be due to constituent of the treated fabric which did not allow the proper absorption of phytochemical compounds present in the herbal extracts (Plate 3 and 4).

## Efficacy of antimicrobial activity of *Ageratum conyzoides* treated fabrics :

Table 3, revealed that methanol extract of *Ageratum conyzoides* was found effective against *Aureimonas altamirensis* only at 100% conc. both without fabric (15.38 mm) and with fabric treatment (12.57 mm), respectively. It might be due to phyto-chemical compound present in the extract was not much effective against the tested bacterium. However, it was found effective against *Bacillus clausii* upto 25% conc. both without

**Table 2 : Efficacy of antimicrobial activity of *Adhatoca vasica* treated fabrics**

| Bacteria | % Plant extracts | Methanol Extract | | | | | |
|---|---|---|---|---|---|---|---|
| | | Without fabrics (Control) | | | With fabrics | | |
| | | Mean (mm) | Std. deviation | Std. error | Mean (mm) | Std. deviation | Std. error |
| *Aureimonas altamirensis* | 100% | 19.5667 | 0.07638 | 0.0441 | 15.8667 | 0.15275 | 0.08819 |
| | 50% | 17.9333 | 0.20817 | 0.12019 | 15.7667 | 0.25166 | 0.1453 |
| | 25% | 15.2333 | 0.05774 | 0.03333 | 14.0000 | 0.2000 | 0.11547 |
| *Bacillus clausii* | 100% | 22.7833 | 0.11547 | 0.06667 | 18.2167 | 0.10408 | 0.06009 |
| | 50% | 20.4333 | 0.10408 | 0.06009 | 16.3000 | 0.0866 | 0.0500 |
| | 25% | 17.6333 | 0.15275 | 0.08819 | 13.8667 | 0.15275 | 0.08819 |
| | 12.5% | 14.2333 | 0.05774 | 0.03333 | 12.5667 | 0.15275 | 0.08819 |
| | 6.25% | 12.3667 | 0.15275 | 0.08819 | 11.3667 | 0.15275 | 0.08819 |
| | 3.125% | 9.4333 | 0.15275 | 0.08819 | 8.7000 | 0.2000 | 0.11547 |

Data given are mean of five replicates

**Table 3 : Efficacy of antimicrobial activity of *Ageratum conyzoides* treated fabrics**

| Bacteria | % Plant extracts | Methanol extract | | | | | |
|---|---|---|---|---|---|---|---|
| | | Without fabrics (Control) | | | With fabrics | | |
| | | Mean (mm) | Std. deviation | Std. error | Mean (mm) | Std. deviation | Std. error |
| *Aureimonas altamirensis* | 100% | 15.3833 | 0.11547 | 0.06667 | 12.5667 | 0.15275 | 0.08819 |
| | 50% | - | - | - | - | - | - |
| | 25% | - | - | - | - | - | - |
| *Bacillus clausii* | 100% | 21.2167 | 0.12583 | 0.07265 | 16.3333 | 0.15275 | 0.08819 |
| | 50% | 19.70 | 0.13229 | 0.07638 | 14.3333 | 0.07638 | 0.0441 |
| | 25% | 11.1833 | 0.07638 | 0.0441 | 7.5667 | 0.20817 | 0.12019 |

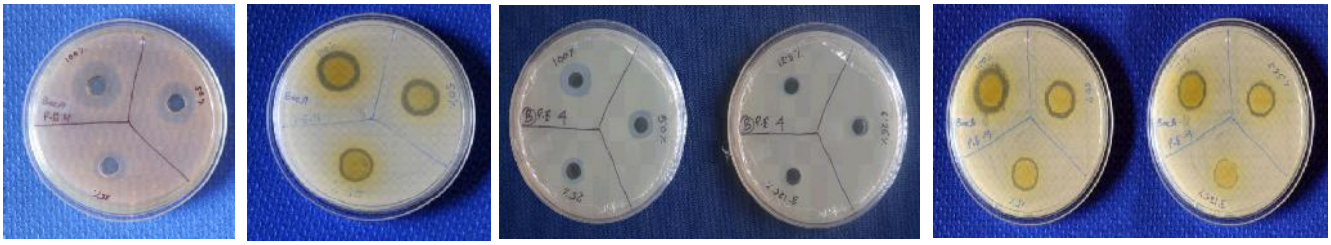
Data given are mean of five replicates

fabric and with fabric treatment. At 100% conc. without fabric showed effective inhibition (21.22 mm) and with fabric (16.33 mm), followed by (19.70 mm) and (14.33 mm) at 50% conc. (11.18 mm) and (7.57 mm) at 25% conc., respectively (Plate 5 and 6).

While Kunin (1993) found that the leaves of the *Ageratum conyzoides* plant possessed the most active principles against *Staphylococcus aureus* and *Escherichia coli* bacteria. Methanol extracts demonstrated considerable antimicrobial properties against the resistant strains of *Staphylococcus aureus*. However, it was weakly active against *E. coli* and was not active at all against *P. aeruginosa.*

**Efficacy of antimicrobial activity of *Bambusa tulda* treated fabrics :**

The Table 4 showed that methanol extract of *Bambusa tulda* could inhibit *Aureimonas altamirensis* without fabric (23.93 mm) at 100% conc. while it could inhibit the bacteria (14.47 mm) with treated fabric. It



***Aureimonas altamirensis*** ***Bacillus clausii***

**Plate 3 and 4 : Antimicrobial activity of *Adhatoca vasica* extract and finished sample**

***Aureimonas altamirensis*** ***Bacillus clausii***

**Plate 5 and 6 : Antimicrobial efficacy of *Ageratum conyzoides* extract and finished samples**

**Table 4 : Efficacy of antimicrobial activity of *Bambusa tulda* treated fabrics**

| Bacteria | % Plant extracts | Methanol extract | | | | | |
|---|---|---|---|---|---|---|---|
| | | Without fabrics (Control) | | | With fabrics | | |
| | | Mean (mm) | Std. deviation | Std. error | Mean (mm) | Std. deviation | Std. error |
| *Aureimonas altamirensis* | 100% | 23.9333 | 0.11547 | 0.06667 | 14.4667 | 0.30551 | 0.17638 |
| | 50% | 20.25 | 0.22913 | 0.13229 | 12.6133 | 0.01528 | 0.00882 |
| | 25% | 17.2833 | 0.16073 | 0.0928 | 0.00 | 0 | 0 |
| *Bacillus clausii* | 100% | 20.0333 | 0.05774 | 0.03333 | 15.8333 | 0.15275 | 0.08819 |
| | 50% | 18.3833 | 0.10408 | 0.06009 | 14.2667 | 0.02887 | 0.01667 |
| | 25% | 15.65 | 0.05 | 0.02887 | 13.6 | 0.1 | 0.05774 |
| *Micrococcus yunnanensis* | 100% | 18.5833 | 0.10408 | 0.06009 | 13.4333 | 0.15275 | 0.08819 |
| | 50% | 17.7833 | 0.07638 | 0.0441 | 12.9167 | 0.07638 | 0.0441 |
| | 25% | 13.5833 | 0.05774 | 0.03333 | 9.8167 | 0.10408 | 0.06009 |

Data given are mean of five replicates

was followed by (20.25 mm) and (12.61 mm) at 50% conc. and (17.28 mm) without fabric at 25% conc., respectively. Similarly, *Bambusa tulda* extract also exhibited effective inhibition of *Bacillus clausii* at 100% conc. without fabric (20.03 mm) and with treated fabric (15.83 mm), followed by 50% conc. (18.38 mm) and (14.27 mm), 25% conc. (15.65 mm) and (13.60 mm), respectively. Effective inhibition of *Micrococcus yunnanensis* at 100% conc. was observed without fabric (18.58 mm) and with fabric treated (13.43 mm), followed by (17.78 mm) and (12.92 mm) at 50% conc. and (13.58 mm) and (9.82 mm) at 25% conc., respectively (Plate 7 and 8).

*Aureimonas altamirensis* and *Micrococcus yunnanensis* (gram negative) and *Bacillus clausii* (gram positive) organisms showed that the activity of *Bambusa tulda* extracts with disc diffusion method (without fabric) were stronger for *Aureimonas altamirensis* than *Bacillus clausii* and *Micrococcus yunnanensis*. Whereas treated samples showed more inhibitory effect against *Bacillus clausii* than *Aureimonas altamirensis* and *Micrococcus yunnanensis*.

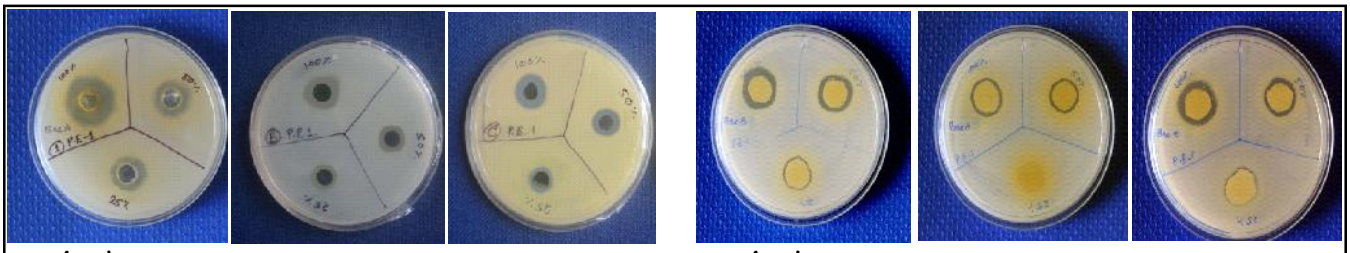
It has also been observed from the study that the antimicrobial activity of extracts (without fabric) were more than the finish fabrics. This might be due to the slow release of active substances from the fabric surface.

**Efficacy of antimicrobial activity of *Chromolaena odorata* treated fabrics :**

From the Table 5, it was observed that methanol extract of *Chromolaena odorata* showed effective inhibition of *Bacillus clausii* without fabric (20.03 mm) at 100% conc., with fabric treatment (19.22 mm) followed by (18.73 mm) and (18.30 mm) at 50% conc. (15.07 mm) and (13.87 mm) at 25% conc., respectively. *Chromolaena odorata* extract was also found effective against *Micrococcus yunnanensis* without fabric at 100% conc. (27.22 mm) and with fabric treatment (24.23 mm) followed by 50% conc. (24.33 mm) and (17.82 mm) and 25% conc. (16.55 mm) and (13.73 mm), respectively (Plate 9 and 10).

**Evaluation of antimicrobial finished fabrics against bacteria after washing :**

Tests were performed to evaluate the durability and effectiveness of the antimicrobial herbs used on cotton material. All the results were evaluated and compared their results whether the fabric was right for its proposed end use. To test the durability of the antimicrobial finish, treated samples were examined for antimicrobial efficacy from 1 to 10 home launderings.



***Aureimonas altamirensis*** ***Bacillus clausii*** ***Micrococcus yunnanensis*** ***Aureimonas altamirensis*** ***Bacillus clausii*** ***Micrococcus yunnanensis***

**Plate 7 and 8 : Antimicrobial efficacy of *Bambusa tulda* treated samples**

**Table 5 : Efficacy of antimicrobial activity of *Chromolaena odorata* treated fabrics**

| Bacteria | % Plant extracts | Methanol extract | | | | | |
|---|---|---|---|---|---|---|---|
| | | Without fabric (Control) | | | With fabric | | |
| | | Mean (mm) | Std. deviation | Std. error | Mean (mm) | Std. deviation | Std. error |
| *Bacillus clausii* | 100% | 21.0333 | 0.05774 | 0.03333 | 19.2167 | 0.10408 | 0.06009 |
| | 50% | 18.7333 | 0.15275 | 0.08819 | 18.3 | 0.0866 | 0.05 |
| | 25% | 15.0667 | 0.15275 | 0.08819 | 13.8667 | 0.15275 | 0.08819 |
| *Micrococcus yunnanensis* | 100% | 27.2167 | 0.10408 | 0.06009 | 24.2333 | 0.15275 | 0.08819 |
| | 50% | 24.3333 | 0.15275 | 0.08819 | 17.8167 | 0.07638 | 0.0441 |
| | 25% | 16.55 | 0.15 | 0.0866 | 13.7333 | 0.15275 | 0.08819 |

Data given are mean of five replicates

*Bacillus clausii* *Micrococcus yunnanensis*

**Plate 9 and 10 : Antimicrobial efficacy of *Chromolaena odorata* treated samples**

**Effect of laundering on antimicrobial finish of *Achyranthes aspera* extract :**

Fig. 2, revealed that *Achyranthes aspera* treated fabric showed effective inhibition of *Aureimonas altamirensis* upto 7 wash (1.08) as compared to control (16.77) at 100% conc. indicating long antimicrobial activity of the treated fabric. It was followed by (2.57) upto 6th wash at 50% conc. and (5.22) upto 4th wash at 25% conc., respectively. However, the efficacy of the finish fabric was reduced in each laundering gradually. It was also evident from the results that finish fabric was less effective against *Bacillus clausii* after laundering. Finish fabric showed effective inhibition of bacteria upto 6th wash at 100% conc. (2.77) as compared to control (15.27), followed by 5th wash (0.87) at 50% conc. and 4th wash (2.62) at 25% conc.

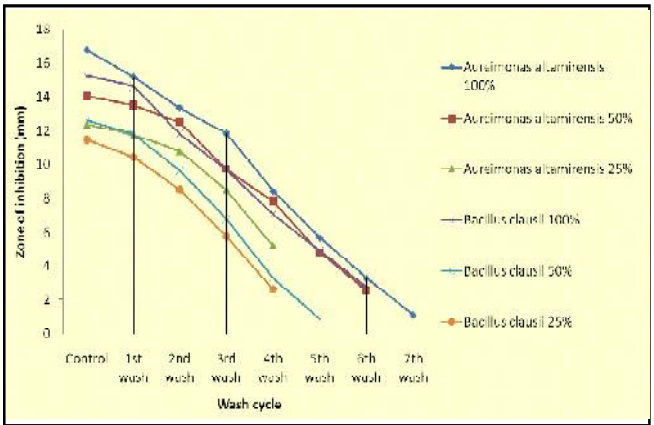



**Fig. 2 : Laundering effect of *Achyranthes aspera* extract**

**Effect of laundering on antimicrobial finish of *Adhatoca vasica aspera* extract :**

From Fig. 3 it was observed *Adhatoca vasica* treated fabric showed effective inhibition of *Aureimonas altamirensis* upto 6th wash (3.82) as compared to without wash (15.87) at 100% conc. It was followed by (3.25) upto 6th wash at 50% conc. (5.42) upto 4th wash at 25% conc., respectively. The results also indicated that finish fabric was effective against *Bacillus clausii* bacteria upto 7th wash (4.88) at 100% conc. compared to fabric without wash (18.22). It was followed by 7th wash (3.18) at 50% conc., 5th wash (3.75) at 25% conc., 5th wash (3.17) at 12.5% conc., 4th wash (2.90) at 6.25% conc. and 3rd wash (2.67) at 3.125% concentrations.

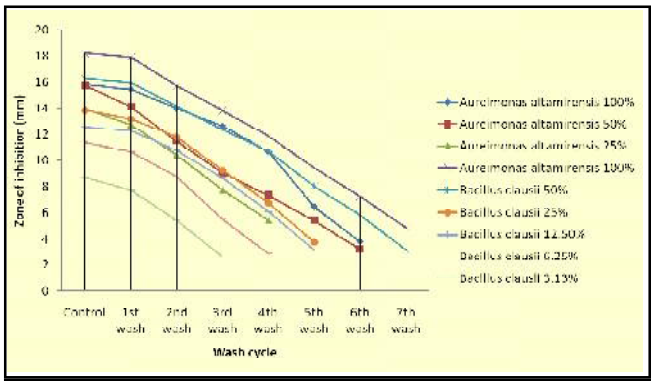



**Fig. 3 : Laundering effect of *Adhatoca vasica* extract**

**Effect of laundering on antimicrobial finish of *Ageratum conyzoides* extract :**

Fig. 4 revealed that *Ageratum conyzoides* treated fabric was less effective against *Aureimonas altamirensis* after laundering as it showed inhibition of bacteria upto 3rd wash only (3.05) at 100% conc. as compared to control (12.57). Whereas it was found effective against *Bacillus clausii* upto 7th wash (4.52) at 100% conc. as compared to fabric without wash

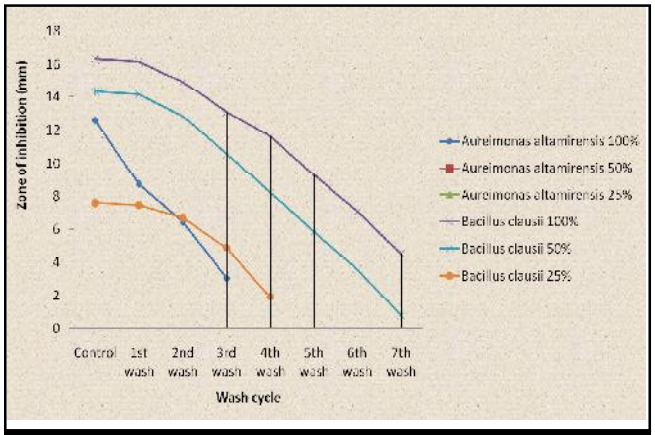



**Fig. 4 : Laundering effect of *Ageratum conyzoides* extract**

(16.33), followed by 7th wash (0.78) at 50% conc., 4th wash (1.90) at 25% conc., respectively.

**Effect of laundering on antimicrobial finish of *Bambusa tulda* extract :**

Fig. 5 revealed that *Bambusa tulda* treated fabric was effective against *Aureimonas altamirensis* bacteria after laundering upto 6th wash both at 100% conc. (2.67) and 50% conc. (2.43), respectively. On the other hand it was found effective upto 7th wash against *Bacillus clausii* both at 100% conc. (1.88) and 50% conc. (0.98), followed by 6th wash at 25% conc. (1.60), respectively. It was also evident from the results that fabric finish was effective against *Micrococcus yunnanensis* upto 5th wash both at 100% (2.95) and 50% conc. (3.05) followed by 4th wash at 25% conc. (2.85), respectively.

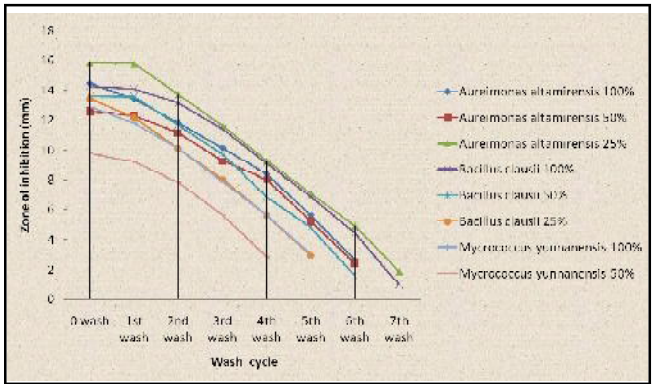



**Fig. 5 : Laundering effect of *Bambusa tulda* extract**

**Effect of laundering on antimicrobial finish of *Chromolaena odorata* extract :**

From the Fig. 6, it was evident that *Chromolaena odorata* treated fabric showed effective inhibition of *Bacillus clausii* after laundering upto 7th wash both at 100% (5.72) and 50% conc.(2.43), followed by 6th wash (2.00) at 25% conc., respectively. Similarly, it was found effective against *Micrococcus yunnanensis* upto 7th wash both at 100% (3.08) and 50% conc. (1.05), followed by 6th wash at 25% conc. (0.90), respectively.

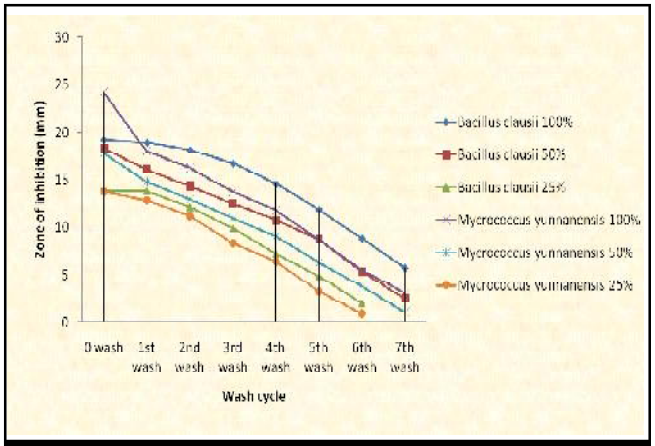



**Fig. 6 : Laundering effect of *Chromolaena odorata* extract**

The results of the antimicrobial determinations for all the organic extracts of the root of *Achyranthes aspera* and leaves of *Adhatoca vasica*, *Ageratum conyzoides*, *Bambusa tulda* and *Chromolaena odorata* against the three bacterial species were investigated by disc-diffusion assay. The disc-diffusion method for antibacterial activity showed significant reduction in bacterial growth in terms of zone of inhibition. The antimicrobial activity of the finished samples was evaluated for fastness to washing after different wash cycles. The antimicrobial activity was assessed after each wash by challenge test. It was observed that the activity diminished gradually as the number of wash frequencies increased (Payne and Kudner, 1996). From this it was clear that only hydrogen bonds and weak Vander Val's forces existed between the cellulose and active principle of extract and thus resulting in poor wash durability.

**Conclusion :**

Bio-deterioration of textile materials, mainly natural origin is a serious global economic problem. It requires long-term protection of these materials against destructive activity of micro-organisms. At the same time the high standards of hygiene in some areas, primarily

medicine, at the work places and others, requires the use of textile materials with antimicrobial properties. Most research has been focused on the searching for the new agent - biocides with high efficiency, which are not only effective but also safe, which don't cause the skin irritation, respiratory allergy. Future application will be concentrated on the natural origin substances. The attention also should be done on the biodegradability and environmental protection.

Authors' affiliations:
**Ava Rani Phukan,** Department of Textiles and Apparel Designing, College of Home Science, Assam Agricultural University, Jorhat (Assam) India (Email : avaphukan@gmail.com)

**Pradip Kumar Borah,** Department of Plant Pathology, College of Agriculture, Assam Agricultural University, Jorhat (Assam) India (Email : pradipkrborah@gmail.com)

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