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# Bacterial Resistance Finish on Cotton Fabric with Pomegranate and Onion Peel Extracts

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**A B S T R A C T**

The study was planned to assess the efficacy of pomegranate and onion peel extracts on cotton fabric with respect to bacterial resistance. Pomegranate and onion peel extract were extracted by soxhlet method and applied in two concentrations *i.e.* 3g/l and 5g/l. Desized and scoured cotton fabric was finished with these two pure extracts of pomegranate and onion peels and their three standardized combinations by exhaust method. SEM analysis was also done for visual analysis of extract absorbed by the fabric. To study the effect of finished on fabric with pure pomegranate and onion peel extracts and their combinations for bacteria resistance activity, quantitatively by AATCC-100 test method. In study it was found that percentage yield of extract was 17.27% from pomegranate peel and 7.46 % from onion peel. As the concentration of extract increased, bacterial reduction of all finished samples also increased. Among all the treatments, cotton fabric finished with combination of 50:50 was found to be more in bacterial reduction as compared to combination of 25:75 and 75:25 and pure pomegranate and onion peel extracts. It was 98.75% bacterial reduction in cotton fabric with 5g/l concentration of extract.

## Introduction

Microbial action is a dominant factor for limiting the service life of all textiles. Biodegradation of textiles is prevalent under tropical conditions. Textile materials and garments are susceptible to microbial attack, as these provide large surface area and absorb moisture required for microbial growth (Cardamone, 2002). Fabrics made from natural fibers are in demand due to their inherent properties like comfortability, good absorbency and being eco-friendly. These fibers are susceptible to microbial attack due to presence of waxes, pectin, cellulose and protein. Cotton fabrics are sensitive to bacterial attack and susceptible to micro-organisms growth due to their hydrophobic nature. Additionally, direct contact of textiles with human body provides warmth, humidity and nutrients; an excellent environment for micro-organism growth on textiles, resulting in unpleasant odor spread of diseases, discoloration, staining and degradation of cotton textiles. Understanding the importance of use of cotton fabric in our day to day life and considering the significance of antimicrobial finish on textiles, to overcome consumer

health problems faced by the consumers due to environment hazards like microbes, it is of great concerns to use of discarded underutilized parts of fruits and vegetables. Underutilized parts of plants means the parts used less than fully or below the potential and not used as much as it could be. The discarded or left over portions of the plant like seed, peels and skins can be reused for both environment and economic benefits. These parts can also be used to create value added products.

## Materials and Methods

Pure cotton fabric and two underutilized peels each from the exhaustive lists of fruits and vegetables *i.e.* pomegranate and onion were selected on the basis of survey and collected from the Hisar market. Use of these selected underutilized peels of pomegranate and onion for the preparation of extracts by soxhlet method. Exhaust method was used for the application of two pure extracts of pomegranate and onion peel and their standardized combinations *i.e.* 50:50, 25:75 and 75:25 on the desized and scoured cotton fabric in two concentrations *i.e.* 3g/l and 5g/l. The surface morphological structure and characteristic of all finished and controlled samples of cotton fabric were analyzed by Scanning Electron Microscope (Philips XL 30) with an accelerating voltage of 10 kv for magnification. To study the effect of finished cotton samples with pure pomegranate and onion peel extracts and their combinations for bacterial resistance activity, quantitatively by AATCC-100 test method.

## Results and Discussion

### Determination of yield percentage of pomegranate and onion peel extracts

The results it was found that the yield percent of pomegranate and onion peel extracts were obtained by soxhlet method from air dried powder of the peels for 8 hours was 17.27% and 7.46%, respectively and showed in table 1. Thus, yield percentage of pomegranate peel extract was found to be higher as compared to yield percentage of onion peel extracts. The air dried powder weight of the onion peel was less as compared to air dried powder weight of pomegranate peel. The difference in the yield percentage of extract may due to the variation of chemical composition and also due to the difference in the physical and chemical properties such as solubility of compound present in the peel of the pomegranate and onion.

### Scanning Electron Microscopic (SEM) analysis of finished and controlled fabrics

The surface morphological structure of controlled (unfinished) and finished samples of cotton fabrics were analyzed by Scanning Electron Microscope (Philips XL 30) and are showed in the plate 2. It was showed that unfinished cotton fabric depicted the smooth surface of fiber with striation while slight deposition of extracts of pomegranate and onion peel on the surface of finished cotton fabric. It can be clearly seen that extract of pomegranate and onion peel were deposited unevenly in the form of granule on the surface of the fabric and it was not found on the surface of unfinished cotton fabric.

Surface morphology features of the cotton fabric finished with combinations extract of pomegranate and onion peel were analyzed and these were showed in plate 1. It was found that cotton fabric finished with 50:50, 25:75 and 75:25 combinations showed more granules on the surface of fabric, as compared to unfinished and finished fabric with pure pomegranate and onion peel extracts. Fibers of cotton fabric depicted the puckering effect. The may be due to the acidic reaction of the extract on the fiber.

## Determination of bacterial resistance of the finished fabrics

To determine the bacterial resistance of the fabrics finished with pomegranate and onion peel extracts and their combinations in two different concentrations *i.e.* 3g/l and 5g/l by exhaust method, the growth of *E. coli* bacteria was counted quantitatively by AATCC-100 test method. The efficacy of pomegranate and onion peel extracts and their combinations was compared against the control sample and also among themselves. Bacterial reductions of finished cotton fabric are given in table 2**.**

It is evident from the data that there was confluent lawn of growth of bacteria on the control sample. After finishing the cotton fabric by exhaust method with 3g/l and 5g/l concentrations of pomegranate peel extract separately, percentage reduction values were 97.08 % and 97.92 %, respectively. Data also revealed that when onion peel extract was applied by exhaust method with 3g/l and 5g/l concentrations, the percent reduction values were 97.00% and 97.58%, respectively.

Data also depicted the bacterial reduction against various combinations of pomegranate and onion peel extracts. It was found that 50:50 combination of pomegranate and onion peel extract exhibited maximum bacterial reduction *i.e.* 98.58% with 3g/l concentration by exhaust method followed by 75:25 and 25:75 combinations with 97.83% and 97.42 % bacterial reduction, respectively. With 5g/l concentration of the same extract *i.e.* pomegranate and onion peel extracts, the bacterial reduction values increased to 98.75%, 98.16% and 98.00% using 50:50, 75:25 and 25:75 standardized combinations on cotton fabric.

**Plate.1** SEM analysis of finished and controlled fabric

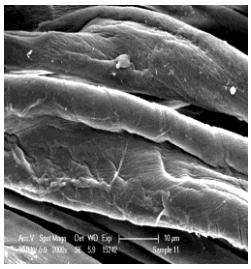
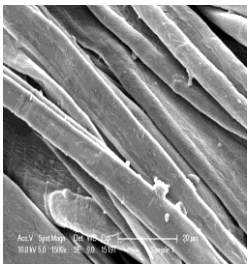
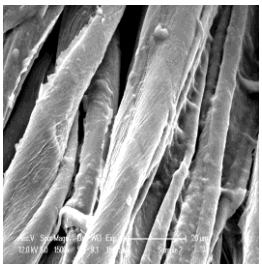
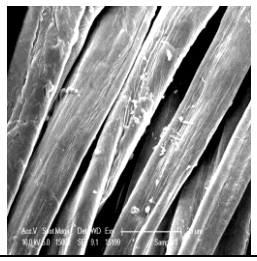
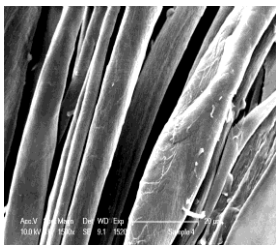
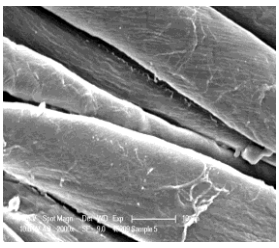
| | | |
|---|---|---|
|  |  |  |
| **Controlled Cotton Fabric (Unfinished)** | **Cotton Finished with Pomegranate Peel Extract** | **Cotton Finished with Onion Peel Extract** |
|  |  |  |
| **Cotton Finished with Combination of 50:50** | **Cotton Finished with Combination of 25:75** | **Cotton Finished with Combination of 75:25** |

**Table.1** Determination of yield percentage of pomegranate and onion peel extract

| Underutilized peels | Weight of air dry powder (g) | Method of extraction | Time period of extraction (hours) | Weight of the extract (g) | Percentage yield |
|---|---|---|---|---|---|
| Pomegranate Peel | 134 | Soxhlet | 8 | 23.14 | 17.27 |
| Onion Peel | 134 | Soxhlet | 8 | 10.00 | 7.46 |

**Table.2** Determination of bacterial reduction of cotton fabric finished with pomegranate and onion peel extracts by quantitative method

| Application Method | Concentration of extracts (g/l) | Bacterial count (CFU/ml) (% Reduction) *(Escherichia coli)* | | | | |
|---|---|---|---|---|---|---|
| | | Pomegranate peel extract | Onion peel extract | Combinations of pomegranate and onion peel extracts | | |
| | | | | (50:50) | (25:75) | (75:25) |
| Exhaust Method | 3 | $3.5 \times 10^6$ (97.08 %) | $3.6 \times 10^6$ (97.00 %) | $1.7 \times 10^6$ (98.58 %) | $3.1 \times 10^6$ (97.42 %) | $2.6 \times 10^6$ (97.83 %) |
| | 5 | $2.5 \times 10^6$ (97.92 %) | $2.9 \times 10^6$ (97.58 %) | $1.5 \times 10^6$ (98.75 %) | $2.4 \times 10^6$ (98.00 %) | $2.2 \times 10^6$ (98.16%) |
| Control (Unfinished) | Confluent growth | | | | | |

On comparing the efficacy of all cotton finished samples among themselves and with control sample with pure extracts of pomegranate and onion peel, their combinations, different concentrations, it can be concluded that cotton fabrics finished with different combinations of pomegranate and onion peel extracts *i.e.* 50:50, 25:75 and 75:25 showed better efficacy against bacterial growth as compared to pure pomegranate and onion peel extracts in both concentrations in exhaust methods. As the concentration of pure extracts and their standardized combinations increased, bacterial reduction also increased. This is supported by the study of Jothi (2009), Rathinamoorthy *et al.,* (2012) and Fadhel *et al.,* (2012).

The efficacy of 50:50 combinations of pomegranate and onion peel extracts was maximum than efficacy of the extract in 25:75 and 75:25 combination of the pomegranate and onion peel extract. This is may be due to cumulative effect and different chemical composition of pomegranate and onion peel extracts. Further the efficacy of pure pomegranate peel extract in all treatments against bacterial reduction was determined higher than pure onion peel extract and this is may be due the chemical composition of pomegranate peel extracts *i.e.* presence of hydrolysable tannins class compound and flavonoids which are known to exhibit a remarkable degree of antibacterial activity.

These results are supported by the study conducted by Khurshid *et al.,* (2015) who stated that bleached cotton samples were treated with 5, 7, and 10% concentrations of aloe gel and neem separately and also with a hybrid combination of aloe gel and neem (HCAN) extracts in same concentrations. These finished samples were subjected to an antibacterial activity test against *E. co*li and *S. aureus* and an antifungal activity test against *Aspergillus niger*. It was found that the hybrid combination of aloe gel and neem (HCAN) was an effective antibacterial and antifungal agent as compared to aloe gel and neem separately. These results are in accordance with Al Laham *et al.,* (2014) and Mahajan *et al.,* (2014) who studied antimicrobial activity

of various parts of *Punica granatum* against antibiotics resistance *E. coli*, *S. aureus*, *Shigella flexneri* and *Candida albicans* and found that a combination of promising antibacterial extracts has exerted synergistic effect against *E. coli*. Bakarnga *et al.*, (2016) also stated that extracts from different plant parts might be used in combination to achieve improved antibacterial potency.

Thus, yield percentage of pomegranate peel extract was found to be higher as compared to yield percentage of onion peel extract. It can also be concluded that cotton fabrics finished with different combinations of pomegranate and onion peel extracts *i.e.* 50:50, 25:75 and 75:25 showed better efficacy against bacterial growth as compared to pure pomegranate and onion peel extracts in both concentrations in exhaust methods. As the concentration of pure extracts and their standardized combinations increased, bacterial reduction also increased.

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