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## CERTIFICATE

The research work embodied in the present Thesis entitled "**INVESTIGATIONS ON ODOUR RETENTION CHARACTERISTICS OF TEXTILES**" has been carried out in the Department of Textile Technology, PSG College of Technology, Coimbatore. The work reported herein is original and does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion or to any other scholar.

I understand the University's policy on plagiarism and declare that the thesis and publications are my own work, except where specifically acknowledged and has not been copied from other sources or been previously submitted for award or assessment.

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# ABSTRACT

The present study is designed to evaluate the influence of textiles on the odour retention characteristics. Commercially used textile fabrics made of cotton, viscose, linen, nylon, cotton/polyester (60/40) and 100 % polyester were sourced. Swatches of 12.5 cm length and 11.5 cm width were cut and fixed as a sweat absorbing material in axilla region of vests and T shirts and they were given for wear trial. The *in-vivo* wear analysis was carried out with sedentary and non-sedentary workers. The worn samples were collected and subjectively analysed for the odour intensity after 24 hour storage at normal atmosphere. The subjective analysis results revealed that, highest amount of odour intensity is in polyester. The intensity level observed were in the following order: polyester > nylon > cotton/polyester > linen > viscose > cotton. Cotton was found to be least odour forming material. Hence in the next phase, the effects of knitted structural parameters on the odour formation were also analysed using only cotton fabric. Cotton knitted fabrics made of three different thicknesses were selected based on their commercial importance. The knitted samples were cut into above mentioned size, firmly fixed in the axilla region of the vest and given for wear trial. The effect of different structures on odour formation was analysed through subjective and objective analysis. It was found that the structure with high thickness had the high odour intensity rating and the least value was observed for thinner structure. This is explained in terms of thickness and mass per square meter of the fabric. Sensory evolution test was performed by the expert team and it was confirmed that, higher the mass and loop density, higher was the odour retention in fabric. The thicker fabric enhances the optimum environment in the axilla region for better bacterial growth. This was confirmed by the bacterial isolation process and swab analysis, the thicker the structure (rib) higher was the presence (CFU/ml) of *Corynebacterium* Sp., *Bacillus* Sp. and

*Staphylococcus* Sp. groups than the thinner structure (single jersey). Higher amount of carboxylic acid was formed in the axilla region as a metabolic byproduct of bacteria. The formations of carboxylic acid in the textile material after wear trial was further confirmed objectively by PTR-MS and FTIR studies, where fragments of butyric, valeric and isobutryic acid along with acetates groups were identified

In the next phase, *Terminalia chebula* extract was characterized for its phytochemical components. The proximate analysis and phytochemical analysis revealed that *Terminalia chebula* had most of the important phyto-constituents like alkaloids, proteins, saponins, tannins, flavonoids, phenols, terpenoids, carbohydrates, triterpenoids, thiols, steroids and glycosides. They were analyzed qualitatively. High-performance liquid chromatography (HPLC) analysis was done to confirm the presence of these components objectively. The quantitative analysis revealed the presence of saponin, alkaloids, tannins and flavanoids, which in terms confirms their potential for medicinal use. The *in-vitro* antibacterial test by agar diffusion test was conducted for finished textile samples and it was observed that, the treated textiles material have the potential antibacterial property against wide spectrum of odour causing strains like *Staphylococcus aureus (MTCC 737), Escherichia coli (MTCC 1687 Klebsiella pneumoniae (MTCC 6644), Proteus vulgaris (MTCC 742), Salmonella typhi (MTCC 733), B. licheniformis (MTCC 429), M. luteus (ATCC 49732)* and *Pseudomonas Sp.,(MTCC 6628 ), Corynebacterium Sp (MTCC 8730 and ATCC 3021).* Minimum inhibitory concentration (MIC) values were determined and compared with the positive control (Tetracycline) used.

The effect of various parameters such as sonication processes, extraction timing and the temperature of the extraction were taken as key parameters to optimise. The Box and Behnken design was adopted to study the effects of these parameters on the effectiveness of extraction in terms of *in-vitro* antibacterial activity of treated textile (in Zone of inhibition) against odour causing bacterial strains. The response surface methodology results

showed that, higher the extraction time, higher was the antibacterial activity. The extraction temperature had very minimal effect on the efficacy against the selected strains. The increment in the temperature after $37^0$ reduces the activity considerably. Methanol was observed as very effective against all the odour causing strains. The influence of sonication process improved the extraction efficiency. The regression co-efficient values ($R^2$) of 45.11, 80.6, 77.51 and 82.27% were obtained for the bacterial strains like *Corynebacterium acnes, B. licheniformis*, *M. luteus, Corynebecteriurm Sp* respectively. The optimized extraction parameters for improved antibacterial properties were identified as, methanol extracts with 29 hours of immersion and $35^0$ C of extraction temperature with 30 minutes of sonication time. At optimized condition, the zone of inhibition value of 11, 32, 24, 40 mm were predicted for the strains *Corynebacterium acnes* (MTCC 8730)*, B. licheniformis* (MTCC 429), *M. luteus* (ATCC 49732)*, Corynebecteriurm Sp.,* respectively.

The optimized extraction conditions were taken for the next step to finish the different fabrics (cotton, viscose, linen, nylon, 60/40 cotton/polyester and 100 % polyester) and knit structure to evaluate the odour retention using simple pad-dry-cure method (direct application). Here the attempt has been made to reduce the axillary odour retention in textile material with the help of *Terminalia chebula* finish. Methanol extract of *Terminalia chebula* was applied and the subjective analysis for odour intensity measurement was performed. The results revealed that, the odour intensity in all the textile fabrics reduced significantly after *Terminalia chebula* finishing process in both sedentary and non sedentary cases. To confirm the odour reduction objectively, bacterial isolation studies were performed with the treated and untreated worn samples. The results revealed that, the amount of bacterial colony (CFU/mL) in the *Terminalia chebula* finished textile reduced considerably than in all the untreated samples except nylon. Further, FTIR studies confirmed the reduction of odour forming short chain volatile fatty acids (VFA) in the treated worn fabrics than the untreated.