Short Communication

CHANGES IN THE CHEMICAL CONTENTS OF VEGETABLE TANNED SOLE LEATHER OF BUFF DUE TO FUNGAL INFESTATION UNDER VARYING ENVIRONMENTAL CONDITIONS

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ABSTRACT

Finished leather and leather goods, stored under varying environmental conditions in warehouses, frequently become mouldy. The relative humidity plays an important role. The most common spoilage are formation of coloured inbleachable spots, mildewing and perforations due to degradation of leather components like fat and oils, causing loss of durability, rendering them unfit for commercial purpose. It is, therefore, necessary to evaluate the extent of damage which is brought about by the fungi and their biochemical activities in relation to microclimatic conditions of storage. Many workers have discussed the role of fungi which brings the changes in physical and chemical properties of finished leather due to infestation but they were concentrated around the optimum mildew growing conditions (95-100% Relative Humidity and 30°C temperature). During the present study the role of fungi on vegetable tanned sole leather of Buff, at different level of relative humidity and duration of storage at optimum temperature (28°C) has been investigated. Thus, during the present study three basic attempts were taken under considerations –(i) Qualitatively – what kind, (ii) Quantitatively – how many fungi inhabit the vegetable tanned sole leather of Buff and (iii) Estimation of changes in the quantity of fat and oils due to infestation by fungi.

Key Words: Fungal infestation, Sole leather, Mildewing, Buff, Chemical changes, Inbleachable

INTRODUCTION

Leather is utilized in making a large number of commercial commodities and it has gained a status symbol as one of the topmost foreign exchange earner and belongs to the elite of society. India is fortunate in having a good raw hide base but the biodeterioration of leather and leather goods includes undesirable and aggressive activities of fungi during leather manufacture, finishing, storage and in use. Infestation caused by fungi reduce durability and commercial value of finished leather due utilization of chemicals as a nutrients which incorporated during finishing. Different workers estimated the loss in leather quality due to fungal infestation.1,8

MATERIAL AND METHODS

Vegetable tanned sole leather (Buff) was collected from leather factories and tanneries, inoculated with isolated fungi prior to storage. The exposed leather samples were stored at varying levels of relative humidity at suitable temperature to determine the changes in the fat and oils contents of leather.

Maintenance of Relative Humidity

The Relative Humidity (R.H.) was maintained in desiccators (8” diam.) using salt saturated solutions.2 The different salts viz. chromium trioxide (CrO3), magnesium acetate (Mg(C2H3O2)2.4H2O), sodium chlorate (NaClO3) and zinc sulphate (ZnSO4.7H2O) were used to control 30, 60, 80 and 95 percent relative humidity, respectively.

Determination of oil and fats3

Isolated fungi were allowed to infest vegetable tanned sole leather (Buff) to determine the loss of oil and fat contents under varying environmental conditions. Vegetable tanned sole finished leather of Buff was stored in
laboratory at 60, 80 and 95 percent relative humidity and 28 ± 1°C temperature to determine the effect of storage conditions (R.H., temperature and duration) in relation to deterioration of finished leathers. A control set was also maintained. A strip was removed from uncut and untrimmed edge of the sample. The samples were then cut into approximately 2 mm pieces separately, which were put into glass stopper bottles for chemical analysis. The oils and fats were estimated by Soxhlet extraction method with petroleum ether. The extraction flask was dried with 2 or 3 glass beads in it by heating for half an hour at 102 ± 2°C and weighed after cooling in a desiccators. 10.0 ± 0.005 gm of prepared leather sample was weighed accurately. It was placed in thumb of Soxhelt extractor attached to a previously weighed flask. The extraction was made for 4-6 hours with petroleum ether (B.P. 40-60°C). After extraction the solvent was distilled off and fatty residue was dried at 102 ± 2°C temperature in a hot air oven for four hours. The flask was cooled in desiccators and weighed until constant weigh was obtained. From the weight of residue the percent of the fat was calculated.

\[
\text{Oil and fat percent by weight} = \frac{W_2}{W_1} \times 100
\]

where,

\( W_2 = \) Weight of leather sample taken.
\( W_1 = \) Constant weight of dry residue.

RESULTS AND DISCUSSION

Total 24 fungi were isolated from all the sites are listed in Table 1. Maximum loss of fat and oils was reported at 95 percent in comparison to 80 and 60 percent R.H. Result were compared with their control set and percent difference was calculated. At 95 percent R.H. these were 3.90, 2.20 and 1.15 after 60, 80 and 120 days, respectively. At 80 percent R.H., the loss was 4.25, 3.20 and 2.20 after 60, 80 and 120 days, respectively. Comparatively, no loss was recorded at 60 percent R.H. after 60 and 120 days, but loss after 180 days was 5.1, as shown in Table 1 and Fig. 1.

The grain and flesh surface of leather showed profuse fungal growth when the samples were stored at higher R.H. (80 and 95 percent). The control set were maintained at 60 percent R.H. because at this R.H., the slow growth pattern of fungi observed and confined to grain surface only. Settlement of air fungi on leather is also depends upon season. 4 Formations of coloured inbleachable spots on different leather during storage period are phenomenon of common occurrence. Coloured spots on polished surface are considered more harmful because they lower down the commercial value as in such cases finish of leather is not possible. Three different types of coloured leather were due to secretion of water soluble pigments by fungi, hydrolysis of fats and oils, degradation of proteinaceous and hide substances. As a result of these changes not only the spots appeared but it also gave the leather a mouldy to musty odour. These spots developed on both, grain as well as on flesh side but these were more pronounced and frequently observed on the grain surface. Infested leather samples were found to decrease their oil and fat contents. The total reduction was found more at 95% R.H. in comparison to 80 and 60 % R.H. Various oils viz. castor oil, spindle oil, turkey red oil, coconut oil, linseed oil, sunflower oil, waxes, are incorporated during finishing operation of leather to make them attractive and durable. These oils are triglycerides obtained from plants, marine and animals. The oil used as nutrient by the fungi for their growth and multiplication, for this purpose, they produced lipolytic enzyme, which hydrolyzed their oil into glycerol and fatty acids. Nwuche Charles Oguigu and James Chukwuma Ogonna reported that Aspergillus Sp are more efficient producer of enzyme lipase. 5 Moulds on tanned leather will spoil their appearance. Mould growth is greatly influenced by the kind of treatment that the leather has received during its manufacture, i.e. it depends on the tanning agent, oil, oil emulsion, greases and other auxiliaries used. The mould growing on leather feed on the water soluble and different oils, greases and finishes that are present in it. Many workers have supported the chemical degradation of the constituent’s triglycerides by the fungi. Mould can bring bout hydrolysis of any triglycerides that may be present in the leather. These changes are caused at least in part by the removal of greases. These cause an increase in
stiffness and a loss in both tensile strength and stretches at the breaking point. The grain is also weakened and tends to crack. Mildew does not cause any appreciable deterioration or hide substances in the leather. The growth of mildew on leather is supported by the greases present on it, which act as nutrients. The above findings supported by Sharma and Chauhan when studying the utilization of different oils by fungi exhibiting extracellular lipase production. The stiffness, crackiness of the grain and loss of tensile strength were concerned with the destruction of fats, greases and organics acids due to metabolic activities of the fungi. A close examinations of results revealed that all changes in properties and loss of different constituents took place at 95 % R.H. in suitable limits of temperature as compared to 60 and 80 % R.H. This was because, at higher R.H., the leather samples gained considerable moisture which allowed the fungi to grow and multiply very fast. As a result of this, the leather samples allowed to deteriorate very fast which brought the changes in physicals and chemicals properties considerably. Sweet and Henrickson stated that water is essential for the growth of micro organisms, germination of spores and enzymatic activity. The skin acts as a reservoir both in receiving excess water and in making water available according to the physiological needs of the organisms. Sharma et al. isolated fungi from spoiled areca nuts which contained tannins and they found reduction in total water soluble, carbohydrates and sugar. Rathore et. al. studied the relative capacity of fungi causes infestation and also changes in the fat and oil contents of vegetable tanned finished leather of sheep due to aeromycoflora under varying environmental conditions. It was also noted during the present work that the vegetable tanned sole leather of Buff absorbed maximum moisture in comparison to the chrome tanned leather in the same conditions. This capacity is related to the compactness of leather fibers and presence of relative amount of fat and water soluble. All these observations support emphatically the result obtained in the present study, dealing the role of fungi during the deterioration of leather causing the changes in physical and chemical properties of finished leather. Such studies provide sufficient information regarding the extent of damage at different duration of storage and R.H. at optimum temperature. Fungi isolated from vegetable tanned sole leather (Buff) are given below:

1. **Aspergillus niger** Van Tieghem.
2. **A. chevalieri** (Maugin) Thom and Church.
3. **A. Fumigatus** Fresenius.
4. **A. Flavus** Link.
5. **A. terreus** Thom.
6. **A. tamari** Kita.
7. **A. amstelodami** (Maugin) Thom and Church.
8. **A. sydowii** (Bainier and Sartory) Thom and Church.
9. **Penicillium purpurogenum** Stoll
10. **P. Oxalicum** Thom.
11. **P. funiculosum** Thom.
12. **P. citrinum** Thom.
13. **Alternaria geophila** Daszewska
14. **A. alternata** (Fr.) Keissel
15. **Fusarium neoceras** Wollenweber and Reinking
17. **Curvularia lunata** (Walker) Boedijn
18. **Mucor ambiguous** Vuillemin.
19. **Botryoderma** sp. Papendorf and Upadhyay.
20. **Cunninghamella** sp. Matruchot
21. **Cladosporium herbarum** (Persoon) Link
22. **Chaetomium globosum** Kunze.
23. **Drechslera papendorfii** (Vander Aa) Ellis
24. **Paecilomyces varioti** Bainier

**Table 1 : Changes in the oils and fats of vegetable sole leather (buff) due to fungal infestation during storage**

<table>
<thead>
<tr>
<th>RH/Days</th>
<th>60</th>
<th>120</th>
<th>180</th>
<th>Control</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>5.2</td>
<td>5.2</td>
<td>5.1</td>
<td>5.2</td>
<td>0.1</td>
</tr>
<tr>
<td>80%</td>
<td>4.25</td>
<td>3.20</td>
<td>2.20</td>
<td>5.2</td>
<td>3.0</td>
</tr>
<tr>
<td>95%</td>
<td>3.90</td>
<td>2.20</td>
<td>1.15</td>
<td>5.2</td>
<td>4.05</td>
</tr>
</tbody>
</table>

Temp. 28 ± 1°C. Mean of 3 observations
CONCLUSION

It has been concluded by this study that various fungi suspended on the finished leather and find themselves in the suitable medium for their growth. In the present study, it was observed that factories have wide doors, windows and openings, which permits the free exchange of indoor and outdoor fungi. The results obtained from these studies indicate that the fungi at suitable temperature and relative humidity deteriorate the stored leather samples. Subsequently, the vital activities of fungi brought about undesirable changes in the physical and chemical properties of finished leather rendering them unfit for commercial purpose. The present investigation provide impetus to develop certain preventive measures to make this leather free from infestation of fungi. The knowledge of specific fungi is necessary for solving this problem.

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