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Short Note

Alternatives to Salt Preservation: Preservation by Reducing Moisture Content

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Abstract: The first step in leather processing is the preservation or curing of hides and skins. Conventionally 40-50% of common salt is used to preserve the skins and hides, which leads to an increase in the Total Dissolved Solids (TDS) and chlorides (Cl) in the tannery effluent. Hence, researchers are demanded to look for alternative methods of preservation with less salt or salt-less preservation. In this paper, we report the results of the investigations carried out by reducing the moisture content of the skins using acetone and preserving them using low concentrations of boric acid. The properties and qualities of the crust leather are at par with the salt preserved skins. Also, this method offers significant reduction in TDS in the tannery effluent. The results obtained in this study substantiated that reducing the moisture content of the skins and hides to certain extent and applying boric acid helps in preserving the hides and skins for more than a month.

Key words: Short term preservation, acetone, boric acid, moisture content, leather, pollution reduction.

Introduction

India, with world's largest livestock population, is having at least 3600 authorized slaughterhouses. The hides and skins available from the meat industry are processed into leather in about 2500 tanneries across the country, after proper curing. The leather industry is one of the largest revenue earning sectors in India. But the process of leather making generates huge volumes of liquid and solid matter containing variety of chemical and biological wastes. Tannery effluent exhibits high values of the environmental pollution parameters like Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solids (SS) and Total Dissolved Solids (TDS). Common Effluent Treatment Plants (CETPs), which have been established to treat the effluent discharged by tanneries, have effectively removed SS and also brought down COD and BOD within safe limits (Mariappan, 1997; Vinod et al., 2003). But TDS still remains high even in the treated effluent. The major portion of TDS is contributed by common salt used in preservation of hides and skins and to some extent in pickling process (Sarkar, 1981). The increased TDS will affect the fertility and quality of the soil when used for irrigation. Because of the pollution problem, the tanneries are forced to close down not only in developed countries, but also in developing countries like India. Hence, the leather industry is demanded to look for a cleaner option for each step of leather making.

Even though, there are several chemical (Hughes, 1974), physical and biological methods of preservation available, the most commonly used method is by using common salt (Bienkiewickz, 1983). This leads to an increase in the TDS (55%) and chlorides (40%) in the total leather processing operation (Ludvik, 1996). Hence,

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researchers are forced to look for alternative methods of preservation to reduce the pollution load. Use of *Azardirachta indica* (neem) extract in the preservation of skins has recently been reported from our Institute (Preethi et al., 2006).

The main focus of this paper is on significant reduction of total dissolved solids in treated tannery wastewater. As moisture content of the skins (about 70%) is the main reason for bacterial attack and further putrefaction, we have standardized a method in which the moisture content is reduced by 20-25% using 10% acetone and then using lower quantities of the chemicals.

Materials

Skins

Freshly flayed goat skins of average weight 1 kg and average area of 5 sq.ft. collected from local slaughterhouse located at Perambur, Chennai, India were taken for the study.

Salt

Commercial grade sodium chloride of 60% purity.

Acetone and boric acid

Acetone and boric acid of laboratory grade were purchased locally.

Methods

The optimum concentration of boric acid for ambient preservation of skins was found to be 0.5% (w/w). Moisture content, total extractable nitrogen (Bureau of Indian Standards, 1971), bacterial count (Cruickshank, 1965), shrinkage temperature (Bureau of Indian Standards, 1971), and pollution load like BOD, COD, TDS and TSS were assessed periodically (Eaton et al., 1995).

Results and Discussion

Curing is the protective treatment administered soon after the hides and skins are flayed. The curing agent creates an environment for the hides in which the contaminant organisms cannot function. Freshly flayed hides/skins contain a variety of microorganisms which are derived from air, water, soil and extraneous filth, apart from the inhabitants of the skin. This biological matrix with 65-70% moisture serves as a perfect medium for the microbes and undergoes disintegration by the hydrolytic enzymes secreted by these organisms, which results in defective raw material with voids and hence poor quality leather.

Different methods of curing like chemical preservation using boric acid (Kanagaraj et al., 2005), potassium chloride (Bailey David and Gosselin Joseph, 1996), soda ash (Rao et al., 1983), biocidal methods like use of benzalkonium chloride (Cordon et al., 1964), aureomycin, terramycin (Berwick et al., 1996) and physical methods like drying, freezing, and chilling have been used to preserve the skins and hides before they are processed into leather. But the most commonly used method is salting method, using 40-50% sodium chloride, which leads to lots of pollution problem. We have tried a method of preservation wherein the moisture content of the skins is reduced by acetone, then preserving the skins with very low quantities of preservative (0.5% boric acid).

Table 1 shows the moisture content, total extractable nitrogen, shrinkage temperature and bacterial count of the skins preserved by using acetone + boric acid and common salt.

Table 1: Moisture content, total extractable nitrogen, shrinkage temperature and bacterial count of the skins preserved by the methods of acetone + boric acid and common salt

Method of preservation	*Days of preservation*	*Moisture count*	*Nitrogen content (g/kg)*	*Shrinkage Temperature (°C)*	*Bacterial count*
Acetone (10%) + Boric acid (0.5%)	1	60	2.86 ± 0.02	65 ± 2	4×10^{10}
	4	55	2.70 ± 0.03	70 ± 2	3×10^{10}
	7	45	2.65 ± 0.04	71 ± 2	3×10^{8}
	30	34	2.50 ± 0.05	72 ± 2	2×10^{8}
Salt (40%)	1	70	3.60 ± 0.03	65 ± 2	6×10^{10}
	4	70	4.00 ± 0.04	69 ± 2	5×10^{10}
	7	60	4.40 ± 0.05	70 ± 2	4×10^{10}
	30	50	5.50 ± 0.07	71 ± 2	4×10^{10}

Mean value of three determinations

Table 2 depicts the reduction in pollution load in the acetone + boric acid group when compared to the salt group.

Table 2: Reduction in pollution load in soaking liquor

Pollution load in soaking liquor (g/kg of raw material)	*Acetone + Boric acid (10% + 0.5%)*	*Salt (40%)*
BOD	10.8	11
COD	12.5	26
TDS	15.5	281
TSS	13.2	36.9
Cl	0.6	205

* Mean value of three determinations

The main purpose of performing bacterial count was to determine the number of bacteria present in the new method of preservation without salt. The bacterial count is very much reduced in the acetone plus boric acid group because of the biocidal activity of boric acid. Reduction in moisture content by acetone might also be a reason for the decrease in bacterial count. The total extractable nitrogen progressively increases with the period of preservation. The salt-less preservation with acetone plus boric acid showed 2.5 g/kg when compared to the corresponding salt cured skin (5.5 g/kg) at the end of one month. The decrease in volatile nitrogen content might be due to the fact that boric acid acts as a bactericide, thus inhibiting the putrefaction.

There is no significant change in the shrinkage temperature of the salt-cured and saltless-cured skins showing that there is no deleterious effect developed on the skin matrix by the newly developed method.

The main benefit of this new method of preservation is the reduction in the usage of water. Normally, for salt-cured skins, 300% (v/w) of water is used for soaking, and the water is changed at least three times to ensure complete removal of salt. But for this method, one time wash with 300% (v/w) was found to be more than sufficient. Another added advantage of this method is the degreasing property of acetone which removes all the fat in the first step itself.

Despite the strong smell of acetone and its fast evaporation rate, acetone is surprisingly not toxic. The US EPA has specifically listed acetone as one of the few solvents that is not listed as hazardous air pollutant and does not cause cancer or other serious illness unless it is taken orally (US EPA, 2003). But care should be taken while handling as it is highly inflammable.

The US EPA classifies boric acid as low to very low in toxicity for skin irritation (US EPA, 1993). It has already been reported that saturated solutions of boric acid (Hughes, 1974; Barrett, 1983) and 5% boric acid treatment (Kanagaraj, 2005) could be considered as an alternative for salt curing.

Our aim in this study is to further reduce the concentration of boric acid. Hence acetone is used to reduce the moisture content. The chemicals used are less toxic to handle. This method of curing does not require any additional skills or infrastructure, and the cost of preservation also works out cheaper when compared to the conventional method.

It is well known that acetone has a tendency to absorb moisture from the inner layer to the surface layer and to reduce the moisture levels of the skins. This property of acetone along with the bactericidal property of boric acid provides an effective and useful method of preservation of goat skins.

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