FOODS AND CARCASS EVALUATION

Short-Term Preservation of Cattle Hide for Collagen and Leather Production

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Story in Brief

Fresh cattle hide is a highly perishable commodity. Bacterial action and autolytic changes are responsible for this spoilage. Lowering the water activity (a_w) of the hide sufficiently to retard autolysis and bacterial activity would preserve it in a condition suitable for leather manufacture as well as food-grade collagen production. Absorption flakes (Super-Slurpers) in combination with sodium chloride, each 5 percent by weight of the hide, were found to lower the a_w enough to prevent mold growth and hair slippage (decomposition). Soda ash and anhydrous sodium carbonate in a 15 or 20 percent solution in water also seemed to prevent mold growth and hair slippage for 9 days storage after being immersed for 24 hours.

Introduction

Raw cattle hide is a highly perishable product due to autolysis and bacterial action immediately after its removal from the carcass. This perishability reduces the value of the hide for leather manufacturing. Development of collagen, a fibrous component of hide, as a possible protein extender or for other food uses has set new limits and demands on potential preservation methods for cattle hide. Several methods have been proposed for short-term preservation of hide; only a few of the methods have been found to be satisfactory for leather production. However, most have been developed without food quality considerations.

Water is essential for the growth of microorganisms, germination of bacterial spores and enzyme activity. If the water activity (a_w) of hide is controlled or brought to a level where microorganisms fail to grow and the enzymes are inactivated, the hide can be preserved for the production of leather as well as food-grade collagen.

The purpose of this research was to develop a short-term (up to 7 days) method of preserving cattle hide suitable for leather production and the manufacture of food-grade collagen at a reasonable cost, keeping in mind the current industrial procedures and pollution control guidelines.

Materials and Methods

Experiment 1

Various combinations of Super-Slurper (hydrolyzed starch-polyacrylonitrile graft co-polymers) and sodium chloride were used to adjust the a_w of raw cattle hide to a microbiostatic state. Immediately following flaying, the hide was washed thoroughly by spraying cold water to remove blood, dirt and manure and to cool the hide. Samples of hide (20 cm × 25 cm) were placed over saw horses flesh side down and allowed to drain for 45 minutes. After draining, the samples were weighed and each sample rubbed, on the flesh side, with a dry mixture containing Super-Slurper and granulated sodium chloride (each 5 or 2.5 percent of hide weight). The samples were stacked on racks. Completed packs were covered with butcher paper to control evaporation and air-borne mold contamination and stored at room temperature (25 to 28°C). Each pack contained five hide samples. The top, bottom and middle sample served as controls while the remaining two samples were used to test for moisture, residual salt and total plate counts.

Moisture was determined using the microwave oven drying method developed by Kellenberger and Loller (1979). Drying cycles were extended to 30, 45, and 60-second intervals, separated by a 2-minute moisture evaporation period for each of the four cycles. The carousel feature in the oven alleviated the problem of sample location. Microwave dried samples were placed in a 105°C forced air drying oven for 1 hour and then allowed to cool for 1 hour in a desiccating cabinet before weighing.

Residual salt content was determined using AOAC (1980) and a Dicromat 1-20 Salt Analyzer (Diamond Crystal Salt Co., St. Clair, Minnesota). Standard plate counts were done in duplicate every 4 days using the FDA-AOAC Aerobic Plate Count Method (AOAC, 1975).

Experiment 2

Granular soda ash (100 percent pure, 58 percent Na_2O minimum) and anhydrous sodium carbonate were dissolved separately in water to make a concentration of 10, 15 and 20 percent (w/v) each. Raw hide samples about 10 cm × 15 cm were washed thoroughly in water to remove blood, dirt and manure and drained for about 30 minutes. Four samples of hide were placed in each of the above solutions taking care that the hides were completely immersed and that there was at least 2.5 cm high excess fluid over the samples. The solutions and the samples were occasionally agitated to ensure thorough distribution. Samples were tested over a 7-day period. After each day's treatment one hide sample from each of the solutions was removed, drained and allowed to dry at room temperature (25 to 28°C). Each sample was packaged in a PVC bag and left at room temperature without sealing the bag. The samples were examined visually for hair slippage and mold growth.

Results and Discussion

Experiment 1

"Super-Slurpers" are water jelling absorbents made by chemically grafting man-made acrylic compounds to cereal grain starch and hydrolyzing the combinations. These co-polymers were introduced in various forms between 1973 and 1977 by the USDA Northern Regional Research Center, Peoria, Illinois. None of the Super-Slurpers tested alone or in various combinations with sodium chloride were effective in preventing hair slippage and/or mold growth except Absorption

Flakes (Table 1). Yellow Absorption Flakes in combination with sodium lactate and sodium chloride were tested over a 5-day period (Table 2). Sodium chloride 5 or 7 percent combination with the Super-Slurper was found to be more effective in preventing hair slippage and mold growth.

Hydrophillic colloids have a higher affinity for the unbound water than does the hide; as a result, the colloid draws water away from both the hide and bacteria causing osmotic stress and an uninhabitable environment for the microbes. Microbial growth within the colloid itself is hindered by lack of nutrients. The resulting low water in the hide also retards enzyme activity, thus preventing autolytic changes. A combination of sodium chloride and Super-Slurper resulted in a a_w which prevented the spoilage of hide even after 5 days. However, an excess of colloid may remove too much moisture from the hide making it unsuitable for leather production. Lower concentration of colloid can be incorporated by addition of sodium chloride.

Experiment 2

This experiment is in progress. The effect on hair slippage and mold growth only were examined with the following results.

Samples treated with 10 percent soda ash solution for 24 hours showed slight mold growth but no hair slippage after 9 days storage. No mold or hair slippage was noticed for any of the other treatments. Samples which received a treatment with 10 and 15 percent solution of anhydrous sodium carbonate for 1 and 2 days

Table 1. Effect of Super-Slurpers on hair slippage and mold growth

Super-Slurper Combinations	Hair slippage	Mold growth
Stasorb 372 (A.E. Staley Co., Decatur, IL)		
5% Stasorb	Extensive - 6 days	Extensive - 6 days
2.5% NaCl + 2.5% Stasorb	Extensive - 6 days	Extensive - 6 days
2.5% NaCl + 5% Stasorb	Extensive - 6 days	Extensive - 6 days
5% NaCl + 2.5% Stasorb	—	Extensive - 2 weeks
Waterlock (Grain Processing Co., Muscatine, IA)		
5% Waterlock	Extensive - 6 days	Extensive - 6 days
2.5% NaCl + 2.5% Waterlock	Extensive - 6 days	Extensive - 6 days
5% NaCl + 2.5% Waterlock	—	Extensive - 2 weeks
SGP Absorbent Polymer 502 S (Henkel Corp., Minneapolis, MN)		
5% SGP	Extensive - 6 days	—
2.5% NaCl + 2.5% SGP	—	Extensive - 2 weeks
5% NaCl + 2.5% SGP	—	Extensive - 2 weeks
2.5% NaCl + 5% SGP	—	Moderate - 6 days
2.5% NaCl + 5% SGP + 0.1% Pot Sorbate	—	Scattered
2.5% NaCl + 7.5% SGP + 0.25% Pot Sorbate	—	Scattered around edges
Absorption Flakes (Spenco Medical Corp., Waco, TX)		
5% Yellow Absorption flakes (YAF)	—	Minute amount
2.5% NaCl + 2.5% YAF	—	Minute amount
5% NaCl + 2.5% YAF	—	No mold growth
5% NaCl + 2.5% YAF + 2.5% White AF	—	No mold growth

Table 2. Effect of Absorption Flakes on hair slippage and mold growth

5% Yellow Absorption Flakes, 1% sodium lactate, 0% sodium chloride
Average Moisture Content = 52.18% Residual Salt Content = 9.50% (hide only)
Day 2 — developed filamentous white growth
Day 3 — developed black and green colonial growth
Day 4 — developed moderate hair slip
Day 5 — extreme hair slippage and mold growth evident

5% Yellow Absorption Flakes, 1% sodium lactate, 2.5% sodium chloride
Average Moisture Content = 51.00% Residual Salt Content = 2.00%
Day 2 — developed minute hair slip
Day 3 — developed green and white colonies and moderate hair slip
Day 4 — developed extensive hair slip
Day 5 — extreme hair slippage and mold growth evident

5% Yellow Absorption Flakes, 1% sodium lactate, 5% chloride
Average Moisture Content = 46.83% Residual Salt Content = 3.65%
Day 5 — developed minute green and white scattered colonies, but no hair slip was apparent

5% Yellow Absorption Flakes, 1% sodium lactate, 7.5% sodium chloride
Average Moisture Content = 45.63% Residual Salt Content = 4.04%
Day 5 — developed scattered minute green and white colonies, but no hair slip was apparent

5% Yellow Absorption Flakes, 0% sodium lactate, 5% sodium chloride
Average Moisture Content = 47.63% Residual Salt Content = 3.53%
Day 5 — no signs of decay (no mold growth or hair slippage)

5% Yellow Absorption Flakes, 0% sodium lactate, 7.5% sodium chloride
Average Moisture Content = 44.07% Residual Salt Content = 3.77%
Day 5 — no signs of decay (no mold growth or hair slippage)

developed mold growth after 9-day storage but no hair slippage while none of the other treatments showed evidence of spoilage (hair slippage, mold growth).

Literature Cited

AOAC. 1975. Official Methods of Analysis. 12th ed. Association of Official Analytical Chemists, Washington, D. C.

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