Recent Developments in the Short-term Preservation of Cattle Hides*

by

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Abstract

Every year substantial dollar losses in hide value occur in the United States that are directly attributable to the combined effects of hide autolysis and bacterial degradation. Much of this value could be recovered through the effective application of short-term preservation chemicals immediately after slaughter. Two areas of critical importance for recovering hide value are in rural (i.e., small sources such as farms or local butchers) hide collection and in scheduling the processing of fresh hides. A two to three day delay in curing is to known adversely affect grain quality on rural collection hides, especially in hot weather. Even good quality packer hides delayed in delivery or just delayed in process over a weekend can result in a loss of grain quality.

To address these needs, we have evaluated a wide range of Generally Regarded as Safe (GRAS) and non-GRAS preservation treatments. Collagenase inhibitors have been incorporated to reduce grain damage from autolysis as well as damage from bacterial enzymes post-slaughter. Thus, we were able to extend the "shelf-life" of fresh hides by three to six days and prevent loss in hide value.

Several GRAS and non-GRAS chemical combinations achieved the desired results during bench scale testing and the data obtained will be discussed. Larger scale field-testing is in progress and details on these trails will be presented.

Resumen

Cada año ocurren cuantiosas pérdidas en dólares en el valor de las pieles en los Estados Unidos que son directamente atribuibles a los efectos combinados de autolisis y degradación bacterial. Mucho de esta perdida de valor podría evitarse por medio de la aplicación efectiva de productos químicos preservantes a corto tiempo inmediatamente después del faenamiento. Dos áreas de crítica importancia en la recuperación del valor de la piel en entornos rurales (pequeños suministros como haciendas o carnicerías locales) en la recolección de pieles y en la programación del procesamiento de pieles verdes. Se conoce que una demora de dos o tres días en comenzar la salazón en pieles del entorno rural resulta en adversos defectos en la calidad de la flor, especialmente en temporadas cálidas. Aun pieles de buen origen como de frigoríficos, por retrasos en entrega o en procesamiento durante un fin de semana, podrían resultar en pérdida de calidad de la flor.

*A **Technical Note** based on a presentation at the 104th annual meeting of the American Leather Chemists Association at the Grandover Convention Center, Greensboro, NC, on June 20, 2008. Mention of trade names and commercial products in this manuscript is intended to provide specific information on preliminary scientific work that addresses concerns of the leather industry.

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Manuscript received July 5, 2008, accepted for publication August 1, 2001

BACKGROUND

Every year the US cattlehide industry incurs substantial dollar loss due to the combined effects of hide autolysis and bacterial degradation. The tanner downgrades otherwise high quality leather due to these effects when there is significant delay in curing or processing following slaughter. The net cost of such downgrading may be as high as $8 to $16 per hide. A hide that significantly degrades to the point of even partial hair loss prior to brine curing typically loses $20 to $30 in value. Thus, there is more than adequate incentive for a chemical intervention to provide short-term preservation (STP) in situations where there could be a delay in curing or processing.

While sodium chloride in tannery wastewater does not pose a significant problem in the United States, in most of the rest of the world it does. In the Indian state of Tamil Nadu, where about 60% of the country's leather industry resides, a 2005 court ruling requires that all tanneries' effluents must treat their effluent with reverse osmosis[1]. Further, they must evaporate the salt concentrates from RO and have zero wastewater discharge. While this drastic measure is not a global requirement, it clearly points to a significant trend and highlights the importance of reducing overall salt usage and contribution.

Worldwide, the major source of sodium chloride waste discharge from the leather industry is from hide and skin preservation. According to one estimate[2], hide preservation accounts for up to 500kg of waste per ton of hides. Clearly, the hide and skin and tanning industries must find alternatives if this environmental burden is to be corrected.

New Zealand has a long history of utilizing short-term preservation programs. They have noted additional benefits beyond quality improvement using such systems. Among the benefits noted are:

- Avoidance of a rehydration step following salt or brine curing
- Preservation requires as little as one-hour
- Significant sodium chloride discharges are avoided

Buckman Laboratories, in cooperation with the Leather and Shoe Research Association (LASRA), demonstrated the efficacy of a variety of antimicrobials available in New Zealand, including Busan 40® and a number of other dithiocarbamates plus several other Buckman and competitive microbicides[3] (Halligan). They determined that the addition of a small amount of boric acid greatly enhanced the effectiveness of three commercially available microbicides* for short-term preservation. Under laboratory conditions, they preserved fresh hides for up to 10-days. Under field conditions, 5-7 days were possible.

* Busan 1009, Busan 1130 and Busan 94 (trademarks of Buckman Laboratories, Inc.)

Buckman Laboratories[4] has isolated the bacterial contaminants of fresh US cattlehides and characterized those using 16S ribosomal RNA sequencing techniques. As previously reported, they analyzed over 100 isolates, and identified 35 different species of bacteria, many of which had not been previously described in hides or leather. A large number of the identified bacteria demonstrated proteolytic activity. Proteolytic activity indicates the potential to cause putrefaction and hence damage to hides and skins.

Mitchell[5] reported that 1,2-Benzisothiazolin-3-one (BIT) in combination with boric acid preserved fresh cattlehides for up to 12-days as long as excellent chemical contact is assured.

Hanlin, *et al*.[6] produced two bacteriocins, nisin and pediocin AcH, from stock cultures. In combination with sodium dodecyl sulfate (SDS @ 0.25%); these bacteriocins were effective at controlling the growth of Gram-positive bacteria that predominate immediately following hide removal from the carcass. They also reported a dramatic shift in the bacterial population within 48-hours of hide removal from predominantly Gram-positive cocci and rods to Gram-negative motile rods. In particular, they noted the presence of Gram-negative *Proteus* species that release highly proteolytic enzymes. These enzymes remain active even after growth of the bacteria is controlled. SDS was introduced to provide the stress required to control these Gram-negative bacteria, which otherwise are not normally sensitive to bacteriocins.

Oppong, *et al*.[7] determined that metalloproteinases, such as collagenase from contaminating bacteria, as well as endogenous proteolytic enzymes present in a hide or skin at the time of slaughter, cause serious hide damage. They identified certain metalloproteinase inhibitors that disrupt these enzymes and thereby abate hide deterioration. Despite the control of these metalloproteinases, other bacterial proteolytic enzymes are typically produced that can degrade hide tissue. Thus, a dual control is required to provide optimum results. In these dual chemical systems, enzyme inhibitors inactivate the metalloproteinases, but have little effect on the other proteolytic enzymes present. Antimicrobials control the growth of bacteria, and thereby reduce the concentration of extra cellular enzymes that can digest protein material. The dual action utilizes both of the mentioned mechanisms to maximize protection.

Buckman Laboratories, LTDA (Brazil)[8] applied fourteen different common antibiotics to fresh bovine hide at dosages that equaled the cost of conventional bactericide treatments. Each of the fourteen antibiotics provided more than 24 and less than 48-hours of protection against the development of odor and hair slip, symptomatic of putrefaction. Where such antibiotics may have clinical application, widespread use of such compounds is ill advised. Such industrial use could contribute to microbial resistance to these chemotherapeutic agents that typically exhibit a narrow range of efficacy.

Various conventional microbicides also studied by Buckman-Brazil, offered increased protection for up to 48 to 60-hours. Likewise, combinations of conventional bactericides with proprietary metalloproteinase inhibitors also provided 48 to 60-hours of protection under laboratory conditions. This demonstration has lead to the development of successful short-term control strategies that are in commercial use today in Brazil.

SCOPE AND OBJECTIVES

Buckman Laboratories, Inc. (USA) has continued the work started by Buckman-Brazil and Buckman-Australia and conducted further significant evaluations of both traditional synthetic antimicrobials and metalloproteinase inhibitors for short-term preservation. Wide ranges of available conventional chemistries as well as some developmental products have been tested for efficacy in this application. We have expanded the scope of these investigations to include numerous sound alternatives that are commonly used for food preservation.

In the United States, several hide processors have relayed the need for short-term preservation utilizing chemistries that are generally recognized as safe, or "GRAS," under US Food and Drug Administration (FDA) regulations. Regional collectors of hides have indicated interest in preserving fresh hides to assure hide quality for a minimum of three days prior to processing. Typically, these "route hides" experience significant delays in transit from satellite butcher facilities to the hide processing (brine-curing) plants, resulting in significant hair slip, particularly in hot weather. Some hide processors desire minimum protection of six days with reduced use of chilling, icing, or refrigeration for transportation and holding at domestic tanning locations.

Another significant concern is that some byproducts from hide processing and tanning are destined for incorporation into various food products; "natural" recovered collagen sausage casings are a good example. Many hide processors and tanners would like to preserve their ability to use renderings from hide fleshing and trimmings in food products, for example, as edible tallow. Similarly, it is important to some to be able to use byproducts in pet foods with the blessing of the US Department of Agriculture (USDA).

In response to this expressed need for GRAS preservation alternatives, we have conducted a comprehensive evaluation of accepted food additives, in combination with proprietary collagenase inhibitors. From this work, we have discovered several GRAS combinations that will provide between three and six days of protection and non-GRAS combinations that offer up to seven days protection against significant hide damage.

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LABORATORY PROTOCOL

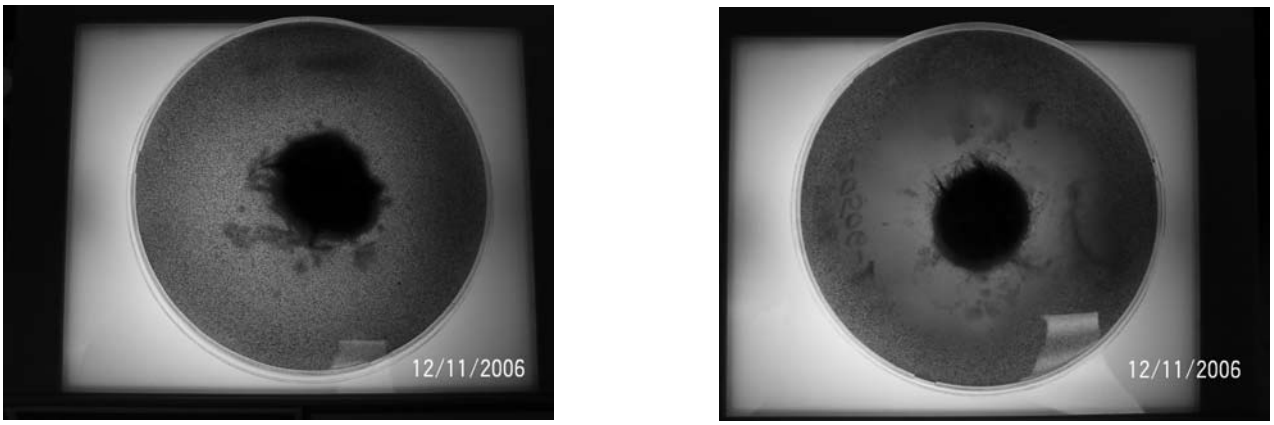
We conducted bench-scale evaluations at Buckman Laboratories, Inc. in Memphis, TN between January 2007 and February 2008. The short-term preservation investigation involved:

- four separate 1-week trial campaigns
- evaluation of 22 different chemical compounds
- evaluation of 85 different chemical combinations
- treatment of 264 fresh hide pieces
- over 1400 bacteria measurements using Petrifilm® and Azocoll plates

Fresh cattlehides were cut into roughly 200-400g pieces. Each piece was weighed and put in a benchtop Dose tanning drum for processing along with the prescribed float and chemicals. The float used was 20-30 percent of green hide weight and was at room temperature (RT). Chemicals were added directly through the drum door and the drum was rotated at 15 rpm for 30 minutes. Following the 30-minute process time, the hide pieces were removed from the drum, allowed to drip dry, and reweighed. The pH of the float was determined with ColorpHast® pH indicator strips. Hide pieces were preserved in Ziploc® bags at room temperature. The retained hide pieces were checked for odor and hair slip at various time intervals over the next seven days and the results recorded. At each review, a score of 1 to 3 was assigned to each sample based on the degree of either hair slip or odor. In this testing, a score of one (1) was minimal to no damage. A score of two (2) indicated moderate damage and a three (3) indicated severe damage. Throughout these trials, once a hide piece scored a three for either odor or hair slip it was discarded and no further observations were made.

The hide exudate pH was measured after 24-hours. The exudate was also tested for biological activity at various times after treatment using 3M Petrifilm for total aerobic plate counts. These were incubated at either RT for three days or at 37 deg. C for 48-hours, after which the colonies were counted and recorded.

Pieces of the retained die-cut hide plugs were placed on Azocoll plates to monitor collegenase activity. In some instances, the exudates were pipeted into wells formed in the Azocoll plates as an alternative method. The Azocoll plates were incubated at 37 deg. C for up to 7-days, with observations made daily. The degradation of the Azocoll substrate manifests itself as a transparent, pink halo around the hide sample. As shown in Figure 1, a halo around the hide sample indicates the degradation of the opaque azo-dye collagen complex.



No halo around hide plug

Complete halo around hide plug

Figure 1: Azocoll Plate Analysis
(Editor Note: For copies of original color photos contact author or JALCA editor)

CHEMISTRIES SCREENED

We evaluated four distinct categories of chemicals for short-term preservation. As depicted in Figure 2, these were:

- Traditional USEPA, FIFRA-registered microbicides
- GRAS food additives/preservatives
- Patented non-GRAS collegenase inhibitors
- Patented GRAS collegenase inhibitors

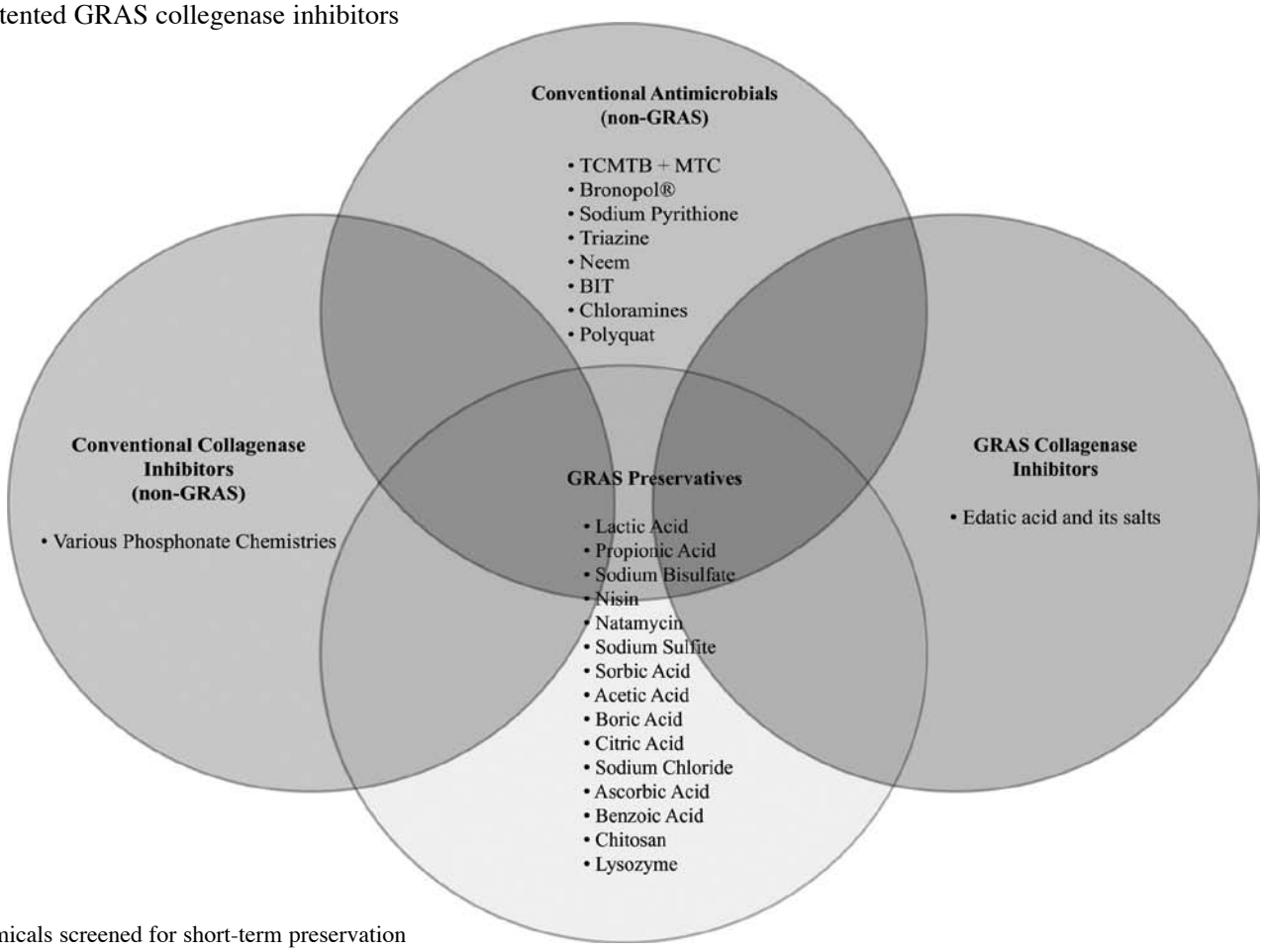


Figure 2: Chemicals screened for short-term preservation

The intersection of the rings in this figure represents possible combinations that were considered as candidates for testing.

LABORATORY RESULTS AND OBSERVATIONS

We treated a total of 264 fresh hide pieces in the laboratory, evaluating numerous different combinations of 22 different chemical compounds. To rate each of these combinations, we calculated a ranking score for each trial based on a composite of performance measurements. The data included in this composite score included hair pull, odor, and bacterial counts in the hide exudates. Each sample was graded based on the number of days elapsed following treatment for which no significant deterioration was observed. For bacterial counts, we used a level of 1-million cfu per ml as the cutoff. The ranking score was calculated as:

Ranking Score = No. days without hair pull + No. of days without offensive odor
+ No. of days bacterial levels were less than 1-million cfu/ml

Thus, for a hide piece that survived 3-days without significant hair pull or odor and with a bacterial count of less than 1-million cfu/ml, the ranking score would be three + three + three, for a total of nine.

As shown in Figure 3, twenty-seven pieces scored 11 or higher. These pieces had been treated with a wide range of conventional microbicides and GRAS preservatives, with either GRAS or non-GRAS collagenase inhibitors. Some of these top performers provided at least 6-days protection. Upon further analysis, we observed that another 44 pieces had ranking scores of either 9 or 10; half of these were GRAS systems. Most of these 44 treatments provided three days of protection against degradation.

During the course of the laboratory trials, we were able to gauge the impact of the delay after hide removal on treatment efficacy. Some pieces were treated after significant delays post slaughter. Others were treated within only a few hours of slaughter. Yet others we treated within minutes of slaughter and hide removal. In addition, some pieces had been frozen after slaughter and subsequently thawed before treatment. In general, we observed that the best results were obtained when the treatment occurred within a few hours post slaughter. Beyond that, there was a noticeable drop off in performance. Frozen and thawed pieces were the most difficult to protect.

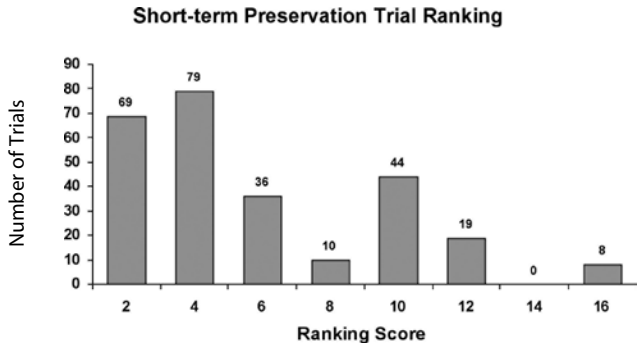
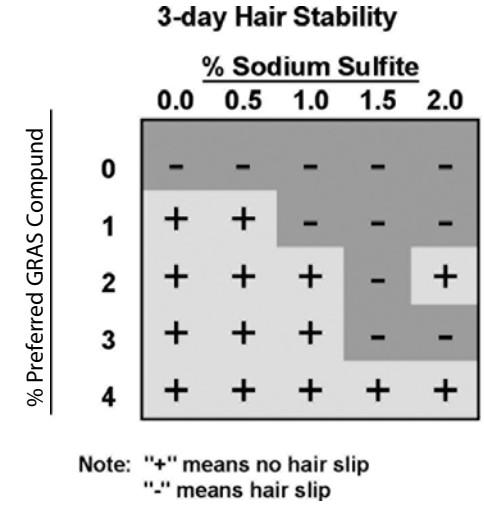


Figure 3: Ranking scores for 264 short-term hide preservation trials

EVALUATION OF GRAS SHORT-TERM PRESERVATIVES

Hanlin, *et al*.[9] indicated that sodium sulfite and acetic acid in combination provided effective preservation of fresh hides. When we repeated these studies in our laboratory, results were highly unpredictable and the odor generated from the system was undesirable. This led us to investigate replacement of the acetic acid with alternative GRAS food preservatives. Among the alternates tested were: ascorbic acid, lactic acid, benzoic acid, sorbic acid, boric acid, citric acid, and propionic acid. We also tested the inorganic acid sodium bisulfate. Of these, one was selected as providing significant and reproducible protection with or without sodium sulfite.

As shown in Figure 4, the presence of sodium sulfite did not affect test results. There is clearly a dose-response relationship for the selected GRAS compound. The optimum dosage appears to be below 1% on a hide weight basis. These combinations produced three to seven days preservation and were judged to be good enough to apply in field tests.



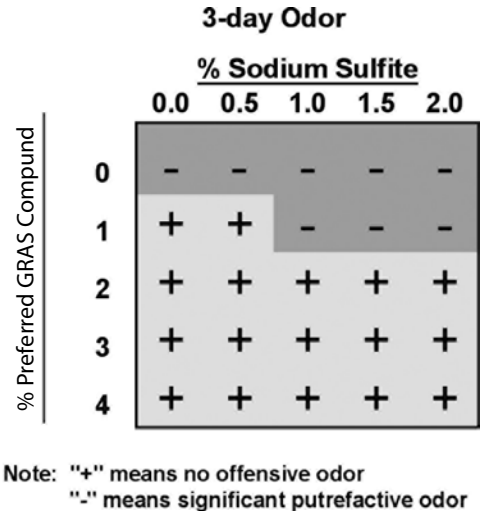


Figure 4: Preferred GRAS Compound as a Short Term Preservative

FIELD TRIALS

To date, we have conducted five field trials in cooperation with a domestic hide collector/processor during different seasons of the year; trials were conducted during the months of December, January, April, May, and August. When trials were run during the winter, the treated hides were stored in a heated garage at approximately 78 degrees Fahrenheit. A significant portion of this collector/processor's hide mix includes "route hides," more commonly known as butcher or locker hides. Many small butchers slaughter cattle only occasionally, generating hides on an intermittent basis. These butchers generate relatively small numbers of hides and they are typically held untreated for up to three days, awaiting pick-up by the collector. The fresh hide shown in Figure 5 is typical of the hides collected from butchers. These hides are eventually transported to the hide processor where they are brine cured and sold to tanners both in the US and abroad. Severe contamination with manure, as shown, represents a very real challenge to any preservation system.

FIELD TRIALS PROTOCOLS

In the first two field trials, we processed fresh hides in a steel drum, one or two hides at a time. A Morse Model 201/20-1 Portable Drum Rotator, shown in Figure 6, was used for mixing. Float was added to the drum at room temperature along with the prescribed chemicals. The hide was rotated for 30-minutes, removed from the drum, and drip-dried. The treated hides were placed in heavy plastic bags, put on pallets, and stored in a heated building and inspected daily for signs of putrefaction. Ambient temperature in the building was maintained at approximately 78 deg. F.

Field Trials 1 and 2 – In the first trial, two hides were treated at a time and the float was limited to 10 to 15% by weight. For the second trial, a maximum of one hide was treated in each trial and some trials were run on half hides. In the second trial, the float was increased to 25-30% to improve contact with the chemical but the 30-minute mixing time was retained.

Eventually, the operator of the processing facility judged the drum roller to be too cumbersome and so in trial three and in subsequent trials hides were dipped in a float that varied from about 50% to 100%.

Field Trial 3 – For the third trial, the hides were dipped in a 50-gallon open head steel drum. In some of these dipping trials, the chemical solution was made from scratch for each hide processed. Other trials were conducted by sequentially dipping hides in reconstituted float. The reconstituted float was produced by replenishing the float with fresh water and chemicals to restore it to its calculated original volume and treatment chemical concentration. A stick was used to force the hide under the surface and the process time was maintained at thirty minutes.

Following treatment, the hides were drip dried and placed in individual plastic bags for storage as shown in Figure 7. After holding the treated hides for six days, they were brine cured together with the normal production. The brine cured hides were then tanned at a domestic bluing facility (D.R. Diedrich). The wet blue was split and shaved and processed to finished leather by a domestic tanner (S.B. Foot).

Field Trial 4 – Since delay in treatment had been previously identified as a significant factor in short-term preservation, the fourth trial was conducted on-site at two different regional butchers in Wisconsin. In these butcher trials, hides were processed by dipping in various prescribed treatments within 30-minutes of take off.

At the first butcher facility (Trial 4, Series A), the first hide was treated in freshly prepared float and the second side was treated in the same float as the first without any additional water or chemicals (i.e., no reconstitution). The third side was left untreated and was used as a control.

At the first butcher facility (Trial 4, Series A), the first hide was treated in freshly prepared float and a combination of a conventional non-GRAS antimicrobial and a non-GRAS collagenase inhibitor. The second side was treated in the same float as the first without any additional water or chemicals (i.e., no reconstitution). The third side was left untreated and was used as a control. The fourth hide was treated in the used float from the third hide with a single "charge" of chemicals. Finally, the fifth hide was treated in the float from the fourth hide without any additional chemical. The untreated hide from Trial 4, Series A was used as the control.

Following treatment, all hides from both series of trials were placed in heavy black plastic bags, packed in steel drums, and then refrigerated on-site for two days. Following two-day storage, they were picked up by the route truck and transported to the curing facility, where they were brine cured according to the normal process. They were put in the brine curing raceways approximately 2-1/2- days post slaughter. These hides were subsequently delivered to a domestic tanner, Gutmann/Day Leather in Hartford, Wisconsin, where they were blued and processed into crust.

Field Trial 5 – The fifth and most recent trial was conducted at the hide processing facility. Three groups of three hides each were treated one hide at a time. Three unique preservation systems were employed consisting of: (1) a synergistic combination of a commercial biocide and a non-GRAS enzyme inhibitor, (2) a GRAS food preservative and (3) a minimum risk preservative together with a GRAS enzyme inhibitor. Each hide was lowered into a barrel containing 50% float and the prescribed chemical mixture. The hides were hooked and dipped in the solution with the help of a forklift truck as shown in Figure 8. The balance of the hide lot was processed in a brine raceway according to the normal procedure. Three of these brine-cured hides were taken at random as controls. The STP treated hides were

Figure 5: Typical "route hide" from butcher in winter

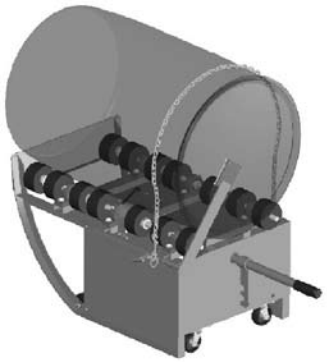


Figure 6: Morse Model 201/20-1 Portable Drum Rotator

Figure 7: Storage of treated hides

Figure 8: Hide dip treatment

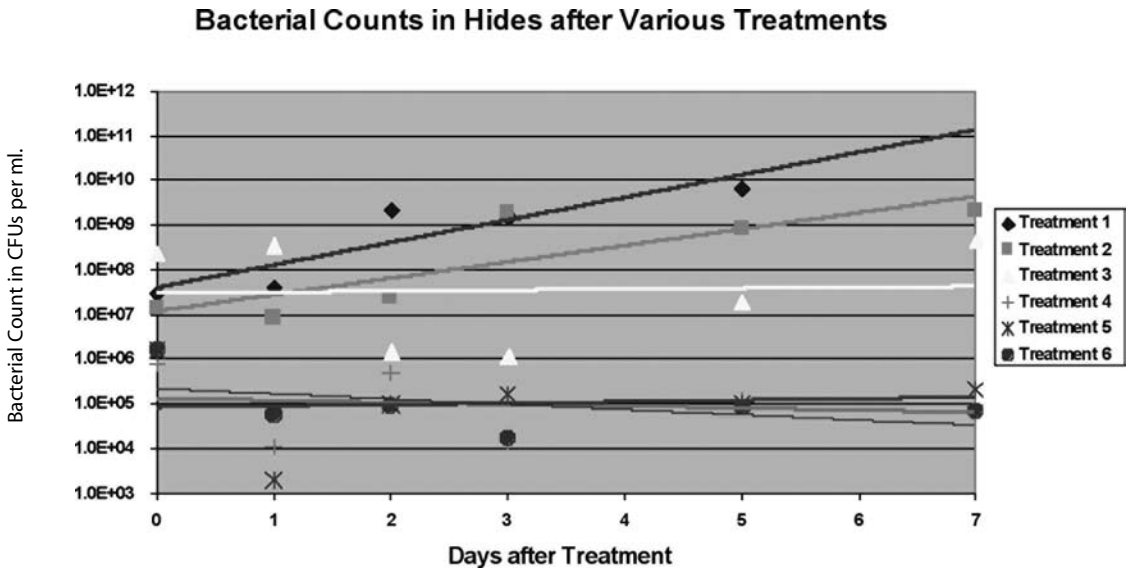


Figure 9: Total aerobic bacteria counts in hide following treatment in Trial 1

bagged and placed in barrels, four hides to a barrel. These were stored at room temperature and then transported along with brine cured control hides to a domestic tanner. Three days post slaughter they were tanned and then crusted.

FIELD TRIAL RESULTS AND OBSERVATIONS

Field Trial 1 – Of the two biocides tested in Trial 1, a combination of TCMTB, MTC and a proprietary phosphonate held bacteria levels in check for seven days (See Figure 9). This combination yielded complete inhibition of enzymatic activity as measured by the Azocoll plates – better than any other treatment in this series – for over seven days. We achieved acceptable preservation for three days as measured on-site by odor and hair slip.

Field Trial 2 – Following the results from Trial 1, the float was increased to improve chemical contact. Additionally, the loading on the drum was reduced from two hides to either one hide or a half a hide for each trial. Treated hides were held on-site for seven days at 78 deg. F. Seven of nine hides that had been treated with combinations of conventional biocides and an enzyme inhibitor were judged acceptable after seven days for hair slip and odor. One hide treated with a mixture of TCMTB and MTC with enzyme inhibitor exhibited slight hair pull at the edges after seven days. Likewise, one hide treated with Bronopol and an enzyme inhibitor showed hair pull in an area of the hide that was severely contaminated with manure.

Only one of three hides/sides treated with various combinations of naturally occurring GRAS food preservatives and GRAS organic acids was acceptable after seven days. This had been treated with Nisin, Natamycin and propionic acid. The other two showed significant hair pull and odor. A final hide that was treated only with propionic acid was likewise unacceptable after seven days.

Bacteria levels for the hides/sides treated with conventional biocides were significantly lower than observed on hides treated with GRAS materials. Overall, bacteria levels were higher than in the prior series of tests. We believe this was due to seasonal timing and the extremely high amount of attached dung (See Figure 5).

Field Trial 3 – In this trial, we evaluated two different application methods: the barrel roller and hide dipping in a 50-gallon drum. We also evaluated potential differences between treating hides in a fresh treatment solution, versus sequential dipping in reconstituted solution.

Five sides were treated by dipping in fresh float with a combination of a conventional microbicide and an enzyme inhibitor. These five sides were treated with a mixture of TCMTB, MTC and a non-GRAS enzyme inhibitor survived an average of 5-days (range: 2-7 days) without observable deterioration from hair slip or odor. In contrast, four hides processed by sequential dip, i.e., in reconstituted float, only survived an average of 3-days (range: 1-5 days).

A fully GRAS system consisting of two naturally occurring GRAS food preservatives, a GRAS enzyme inhibitor and a GRAS surfactant gave disappointing results; all four half hides treated with this combination were adequately preserved for less than two-days. Two of these GRAS-treated half hides were dipped in 100% fresh chemical and float and two were processed in the drum roller, in 30% fresh float and fresh chemical. No discernable difference in preservation was observed following treatment using the two different application methods.

All thirteen of the hides and half hides processed as part of this series, were placed in brine curing six-days after initial treatment. All but two of these hides/sides had already begun to show significant deterioration. Unfortunately, our evaluation of these hides was hampered by the lack of a control. After tanning and processing to the crust, S.B. Foot deemed only two hides acceptable for regular non-aniline production.

Two conclusions were made that impact subsequent testing:

1. Future trials should be conducted at the butcher facility so that they could be processed immediately after slaughter.
2. Suitable controls consisting either of untreated green hides or of hides that have been brine cured according to the usual process should be included in the protocol.

Field Trial 4, Series A – Both of the treated hides were evaluated after holding for 72-hours at degrees F. Odor and hair slip were minimal and the hides were graded as "1" for each criteria. However, the control hide was graded "3," severely damaged, for both odor and hair slip after only 48-hours holding.

Field Trial 4, Series B – Of the five hides, only the third and fourth hides were acceptable for hair slip and odor after 72-hours. These graded "1" for both parameters.

The crust was evaluated for significant leather attributes after tanning and crusting by Gutmann/Day. The results of this evaluation, as shown in Table 1 were:

Notes to Table 1:

- There was a large amount of pinprick damage on all sides.
- Overall, the leather was empty – lacked fullness.
- Visual inspection of crust noted significant mechanical damage that appeared to be spreader damage from wringing.
- All sides showed significant grain pull from pasting.
- All of the sides had considerable draw, especially in the center of the side.
- None of the sides were considered "Full Grain" by the tanner but all were useable as "Regulars".

Leather Attributes - STP Field Trial 4

	Smoothness	Fat Wrinkles	Softness	Break	Grain
Test Sides					
AVE (10-sides)	3.00	2.90	2.50	3.60	3.50
RANGE	2-4	2-4	1-4	3-5	2-4
STD DEV	0.94	0.74	0.97	0.84	0.71
Control Sides					
AVE (2-sides)	3.5	2	3	3	4.5

1 = Excellent
2 = Very Good
3 = Fair
4 = Fair-Poor
5 = Poor

Table 1: Leather attributes – STP Field Trial 4

Treatment	Pin Prick	Grain Damage	Structural Damage	Temper	Break	Draw	Fat Wrinkles
			Leather Attributes Average Scores (Ave. of 4-values)				
1	3.50	3.50	3.50	2.00	1.75	3.75	2.25
2	4.33	4.33	4.00	2.83	1.50	4.33	3.67
3	3.50	3.50	3.67	2.50	1.33	3.50	2.83
4	4.33	4.33	3.83	2.83	1.50	3.67	2.67
			Leather Attributes Standard Deviations				
1	0.58	0.58	0.58	0.00	0.50	0.50	0.50
2	0.82	0.82	0.00	0.75	0.84	0.82	0.52
3	0.84	0.84	1.21	0.84	0.52	0.84	1.33
4	0.82	0.82	0.98	0.41	0.55	0.52	0.52

1 = Brine Cured Controls with no STP Treatment
2 = Conventional Microbicide + Enzyme Inhibitor
3 = GRAS Preservative
4 = Minimum Risk Preservative and Enzyme Inhibitor

Table 2: Crust leather evaluation summary – Field Trial 5

Following these trials, we concluded that in the future we needed to eliminate brine curing as a variable in testing. In future trials, both control and test hides should be obtained immediately after slaughter and flaying and should not be brine cured. This requires careful coordination with the tanner to assure timely processing of the STP treated hides and untreated controls into tanned wet blue and subsequently into crust. We need to eliminate any concern about the contribution of brine curing on top of STP treatment to leather attributes, especially draw and grain damage.

Field Trial 5 – Sides from the fifth and most recent series of trials were tanned and made into crust intended for full-grain aniline leather. Twenty-two of twenty-four sides were recovered from the tannery. These were inspected as crust for various attributes of interest to the tanner for full grain leather. Table 2 (see above) summarizes the inspection scores for each of seven different attributes. Overall, the hides were not suitable for aniline but were acceptable for pigmented or corrected grain leathers. As shown, we observed no significant differences between any of the treatments and the controls.

Among the factors that likely had a significant impact on results was the occurrence of abnormal amounts of fat and manure on some hides. In some instances, excess fat, meat, and manure were estimated to be close to 40-50% of the total green hide weight. Where chemicals have a high affinity for fat, this could have major implications. Likewise, the contaminants in manure may dominate with respect to the need to control bacterial levels and/or collagenase.

Economic Model

An April 2008 survey of domestic fresh hide users revealed that common transportation costs ranged from $2.50 - $3.50 per hide in refrigerated trucks, including icing. Use of a temporary preservation would eliminate the need for icing and refrigeration. In addition, the weight of the ice could be replaced with additional hides – approximately 10% more – from about 500 to 550 hides per truckload. The combined economic impact of eliminating icing is a savings of about $0.68 to $0.76 per hide. These savings are dwarfed by the savings could be realized by upgrading the hide from a renderer to a regular hide or from a D grade to a C grade or a B grade in the blue. These upgrades can add from eight dollars to thirty dollars to the ultimate value of the product. If only 25% of the hides are thus improved, the net improvement in value due to quality upgrading equals $1.60 to $7.50 per hide. Thus, total combined gains from $2.28 to $8.26 per hide are possible. We believe that these savings more than compensate for the added costs for short-term preservation.

Summary and Conclusions

In response to the need for short-term preservation of cattle hides, we surveyed the literature and came up with a short list of potential systems that could potentially provide a solution to the problem. These included both GRAS and non-GRAS systems that could also retain food value for the hide collagen. After a series of laboratory evaluations of the most promising systems, several were used in a series of field trials. Success was achieved with GRAS and non-GRAS systems by several measures. GRAS systems were shown to yield three or more days of protection, while non-GRAS systems yielded six or more days protection. Goals were met including minimal hair slip and malodor, as well as collagenase production and bacterial counts. Tannery-acceptable crust leather was produced from the treated hides. It is the intent of the authors to run field trials that are more extensive, in cooperation with several hide processors and tanners.

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