CHAPTER 40

The Effects of Alligator Skin Storage Techniques on "Red Heat"

Dennis N. David[1]

SPOILAGE of salt-cured skins by micro-organisms prior to tanning is a problem with all types of skins in the tanning industry. "Red heat" occurs commonly when skins are stored for extended periods, especially in hot and humid conditions. Within Florida, where alligator *(Alligator mississippiensis)* skins derived from a nuisance alligator programme have been stored and sold since 1981 (see Hines and Abercrombie Chapter 5; Ashley and David Chapter 41), red heat has been responsible for significant numbers of skins developing "slip scale", which reduces their value.

Although salt inhibits the growth of most types of micro-organisms, the group of bacteria responsible for red heat are tolerant to salt. Physiologically, they are highly specialized organisms, of the genus *Halobacterium*. Red heat manifests itself as red or pink patches on the flesh side of the skin, which are due to carotenoid pigments in the developing bacteria. The group was discovered as a consequence of its ability to grow on and discolour the surfaces of salted fish and salted animal skins. They occur naturally in brine ponds and can be isolated from salt produced by this method. As they remain viable in such salt for some time (Stanier *et al.* 1970), it could be a source of contamination during skin curing.

The chromogenic (pigment producing) activity of these bacteria acts as a prominent indicator of spoilage in alligator skins. In advanced stages, scale slippage occurs, ultimately reducing the value of a skin by fifty to ninety percent. The nutritional requirements of *Halobacterium* sp. are complex, and the organisms require many amino acids and vitamins for growth. Even under the best conditions, *Halobacterium* sp. grow very slowly, showing a generation time of about seven hours (Brock 1970). Skin spoilage can occur from one to several weeks following colonization, depending on storage and environmental variables.

Spoilage control of traditional skins used within the tanning industry is accomplished through the use of bactericides. Many of these chemicals are hazardous or harsh, and with alligator skins, may themselves cause scale slippage. A review of methods used in the tanning industry to prevent red heat in conventional raw skins revealed that phenols and boric acid have been used with success on the skins of other species (Thorstensen 1976; van Jaarsveldt 1982, Chapter 39). This chapter describes the results of an experiment designed to evaluate the effectiveness of chemical treatments on preventing red heat on alligator skins stored under different conditions.

METHODS

Alligator trappers in Florida use three skin curing-storage techniques (salt box; refrigeration; and salt brines), depending on individual circumstances and needs, past experiences and successes. All three methods were used in this experiment.

Alligator skins 1.2-3.0 m in total length were collected during spring from nuisance alligators, fresh road kills and confiscated animals. To limit the number of skins needed and to reduce potential variability between skins, each was halved longitudinally or quartered such that 36 individual pieces resulted.

Three treatments were applied to the skins: salt only; a chemical treatment of 1% by weight of boric acid, 1% naphthaline and 98% salt (well mixed); and, a 0.5% (by weight) solution of sodium pentachlorophenate (Chapman Chemical Co., Memphis, Tennessee, USA) dip. To maximize chances of infection, all skin samples were salted with salt removed from skins heavily infected with red heat.

Two replicates, each with two skin samples, were used under each of the three storage techniques: salt box; refrigeration (5-15°C); and, brine. Skins were inspected for red heat and scale slip monthly for the first three months, then each three months until the experiment had run a year.

RESULTS

The results after one year are summarized in Table 1, and indicate clearly the effectiveness of some combinations relative to others.

[1]Florida Game and Fresh Water Fish Commission, 4005 South Main Street, Gainesville, Florida 32601, USA.

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Table 1. The results of storing pieces of *Alligator mississippiensis* skin for twelve months using different techniques, and different curing procedures. Data refer to months of storage before red heat and scale slip occurred on at least one of the four half or quarter skins in each treatment; "ND" indicates red heat conditions were not detected during the 12 months. BN-Salt = a mixture of 1% boric acid, 1% naphthaline and 98% salt; phenol dip was a 0.5% (by weight) solution of sodium pentachlorophenate.

Storage Technique	Condition	Treatment (months until condition detected) 100% Salt (Control)	BN-Salt	Phenol dip then 100% salt
Salt box	Red heat	1	1	ND
	Scale slip	2	5	ND
Refrigeration				
	Red heat	3	12	ND
	Scale slip	12	ND	ND
Brine	Red heat	ND	ND	ND
	Scale slip	9	ND	ND

Salt Box

Skins treated with only salt and stored in salt boxes began showing signs of red heat during the first month and scales began slipping during the second month of storage. Skins treated with boric acid-naphthaline and held in salt boxes also developed red heat during the first month but scale slippage did not occur for five months. Neither red heat nor slippage occurred during the 12 months with skins treated in a phenol dip before storage in salt within salt boxes.

Refrigeration

Visible signs of red heat appeared in refrigerated skins (5-15°C) in salt after three months, but slippage had occurred on only half of the skins by 12 months. Treatment of skins under refrigeration with boric acid-naphthaline retarded growth of red heat for up to 12 months and prevented slippage during the entire 12 month period. Application of phenol to the skins prior to refrigeration prevented any development of red heat or scale slippage for the entire period. However, *all* refrigerated skins become dry and somewhat brittle after two months of storage.

Brine

Skins that were salted and stored in brine did not develop signs of red heat, but two skins showed signs of scale slippage after nine months. Small patches of black slime (unknown cause) were visible on the flesh side of the slipping skins. None of the skins stored in brine and treated with either boric acid or phenol developed any signs of red heat or scale slippage for the entire 12 month period.

DISCUSSION

Storage Methods

The use of a salt box for curing and storing alligator skins is the traditional and most frequent method employed by trappers in Florida. This is followed in frequency of use by refrigeration and then salt brine. A salt box is usually nothing more than a wooden crate which is placed in a cool, shaded area. They are simple to construct, inexpensive to maintain and skins receive little attention following curing. Trappers using boxes where problems with red heat have developed have had little success in eliminating it. Many have recurrent infections, in successive lots of skins, regardless of their efforts to disinfect their boxes and equipment. Apparently, once it appears, it often becomes firmly established in an area (possibly in the soil).

The results of this study indicate that salted skins placed in a salt box are the most likely candidates for spoilage due to red heat. The traditional use of salt boxes and their simplicity have both encouraged their use, but the present marketing system in Florida requires trappers to retain skins for longer periods than they did traditionally. This extended storage creates circumstances conducive to the occurrence and spread of red heat and skin spoilage.

Refrigeration between 5-15°C appears to retard the growth of red heat, but this practice has its own inherent problems in the field. Low humidity during refrigeration can cause skins to become dry and brittle, and, if proper precautions are not taken in storage, drippings from curing skins can accumulate at the bottom of a box, occasionally resulting in an inadequate brine on the bottom layer of skins, which develop scale slippage.

Brine solutions, although the least popular storage technique in Florida, have demonstrated promise for complete control of red heat, slippage and skin quality problems. The use of brine for skin storage has been discouraged because of bad experiences early in Florida's programme. If a brine solution is improperly prepared or "lost" (salinity levels too low), the entire lot of skins will slip. Skins stored in brine remain very pliable and appear to shrink less, but must be re-salted prior to transport or shipping.

Chemical Treatments

The addition of chemical bactericides to skins held under the three storage methods evaluated retarded or eliminated development of red heat and scale slippage.

Boric acid-naphthaline provided limited benefits when applied to skins stored in salt boxes but proved satisfactory when used in conjunction with refrigeration or brine storage. Phenol applied to the skin prior to salting proved to be the most effective of the bactericides tested, preventing the development of red heat and scale slippage in all storage conditions.

Application of bactericides to crocodilian skins can clearly extend the storage life, but there is also a need to consider potential problems which may develop with their use. Boric acid and naphthaline are relatively safe and can probably be used without harmful consequences, but phenol is a much harsher chemical and if handled improperly, both skinners and skins can be harmed.

CONCLUSIONS

The practice of wet-salting alligator skins and storing them in salt boxes for any extended time is the least desirable method for avoiding skin spoilage. Refrigeration can improve the storage life of wet-salted skins, but brine solutions, kept saturated with the regular additions of salt, appear to be the best storage method for crocodilian skins. The addition of boric acid and naphthaline to the salt acts to retard skin spoilage and can be easily and inexpensively incorporated into the skin curing process, for all storage techniques. The use of the phenol dip prior to salting skins is the most effective treatment for preventing spoilage, but is less desirable due to the possible hazards of handling a relatively harsh chemical.

Use of chemical treatments is perhaps best restricted to specific batches of skins, where red heat has started to develop, or where storage facilities are known to have harboured red heat previously. They are however an option for regular use if brines or refrigeration are not effective or adaptable to a particular producer's needs.

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