

The Impact of Beamhouse Processes on Bacterial Growth

A. Lama*, S. C. Allen, G. Attenburrow, M. Bates, A.D. Covington, A.P.M. Antunes

The University of Northampton, Park Campus, Boughton Green Road, Northampton, NN2 7AL, UK

Introduction

Various bacterial species including potential pathogens have been isolated from hides and skins (1, 2). During conventional leather processes, due to the extreme environmental conditions, the probability of bacteria surviving on hides is reduced. Alternatively total or partial replacement of the hazardous chemicals with non-hazardous chemicals during more eco-friendly processing, may provide suitable conditions for bacterial growth. In this instance the eco-friendly processes will be referred as best available technology (BAT) processes.

Aim

To determine the effects of the conventional and BAT beamhouse processes on bacterial growth.

Beamhouse (a) and Tanning (b)

The various stages of beamhouse and tanning processes that were carried out in this study are: pre-soaking, soaking, unhairing/liming, re-liming, delimiting, bating, pickling and chrome (Cr)-tanning.

Raw materials

Calfskins (Latco Ltd., UK).

Inoculation of Bacterial Species

An average of log (8.68±0.10), log (8.73±0.51) and log (9.95±0.11) colonies of *Bacillus cereus* (ATCC 11778), *Staphylococcus aureus* (NCTC 12981) and *Pseudomonas aeruginosa* (ATCC 10145) were inoculated on decontaminated calfskins.

Methods

- A pure culture of a known bacterial species was inoculated on decontaminated skin samples.
- A conventional or a BAT beamhouse process was carried out with the inoculated skin samples.
- All samples were tanned using a chrome(III) salts.
- Effluent was collected at the end of each beamhouse stage and tanning process. The effluents were analysed to determine the presence of the inoculated bacterial species.
- Pulsed-field gel electrophoresis (PFGE) was also carried out to analyse the isolated bacterial DNA.

Results and Discussion

- The pre-soaking and soaking processes appeared to provide suitable conditions for bacterial growth (Figures 1, 2 and 3).
- Presence of sodium sulfide and lime (high pH) during the conventional and BAT unhairing/liming process appeared to reduce bacterial growth considerably (Figures 1, 2 and 3).
- Bacterial growth occurred during the delimiting and bating process indicating that bacterial species may went to a non-culturable but viable state during the unhairing process with recovery occurring when suitable growth conditions were present.
- Both the pickling and the Cr-tanning process appeared to inhibit bacterial growth (Figures 1, 2 and 3).
- Results obtained from PFGE of the isolated bacterial DNA shows that the alteration of the bacterial DNA did not occur during the leather making processes (Figure 4).

Conclusion

Factors such as available nutritional sources, presence of chemicals that may promote or inhibit bacterial growth, pH, moisture, temperature and processing time may be responsible for the presence or absence of bacterial cells during the leather making process.

Keywords:

Bacteria, effluent, conventional and BAT beamhouse processes.

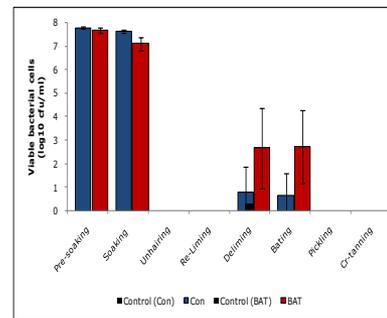


Figure 1: Enumeration of *P. aeruginosa* in effluent during conventional (con) and BAT processes.

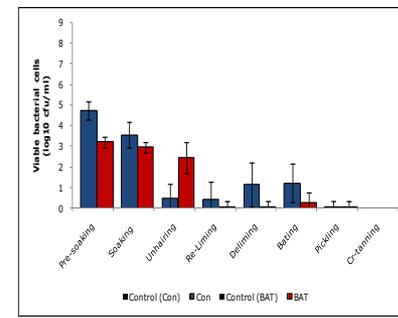


Figure 2: Enumeration of *B. cereus* in effluent during conventional (con) and BAT processes.

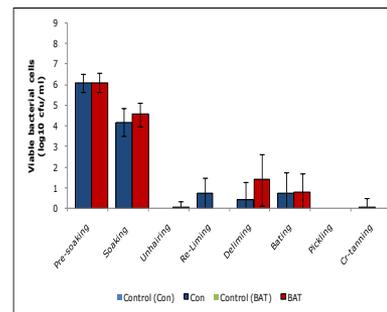


Figure 3: Enumeration of *Staphylococcus* species in effluent during conventional and BAT processes.

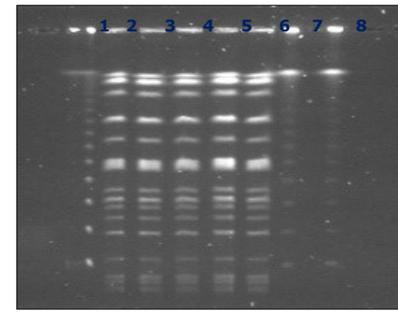


Figure 4: Pulse-field gel electrophoresis of *P. aeruginosa* DNA isolated at various stages of the conventional beamhouse process (lanes 2-6). Lanes: 1, 7 and 8: DNA marker (lambda ladder).

Notes:

- (a) **Beamhouse operations:** Beamhouse operations are the primary stages of the leather manufacturing process.
- (b) **Tanning:** Tanning is a process of stabilising the collagen matrix to convert raw hides or skins to leather.

References

- Oppong, D. Bryant, S.D. Rangrajan, R. Steele, S. Radwell, D. and Hyllengreb, L. (2006) *Journal of American Leather Chemists Association*. **101** (4): 140-145.
- Kayalvizhi, N. Anthony, T. and Gunasekaran, P. (2008) Characterization of predominant bacteria in cattle hides and their control by a bacteriocin. *Journal of American Leather Chemists Association*. **103** (6): 182-187.