Innovative Bio-degreasing Solutions

Muhammad A. Gazi

Novozymes A/S, Denmark

Introduction

Natural fats and grease is a barrier for producing uniform and consistent high quality leathers from hides and skins as the fats are hydrophobic and thus prevent good penetration and exhaustion of all wet-end processing chemicals, if it's not adequately removed in the early stages of leather and double face processing.

Degreasing is one of the most important and critical processing steps involved in sheepskin production. Natural fats if not removed properly from the skins during the leather manufacturing process will give rise to a number of faults in the resultant leathers such as fatty spews in the form of white crystalline deposits, foul odor, and uneven dyeing and finishing which are major losses to the tannery. Although, there are a number of ways of degreasing skins conventionally in the wet end such as aqueous emulsification of natural fats with surfactants or extraction of natural fats with solvents aided by addition of non-ionic surfactants, the enzymatic hydrolysis of natural fats in combination with surfactants results in far superior degreasing performance when compared to standard degreasing methods.

A unique acid lipase[1] used at the depickle stage has been found to vastly improve degreasing efficiency for nappa and doubleface sheepskins when used in synergy with an acid protease[2] while decreasing the use of surfactants as well as obviating the need for solvents in Bowe type dry-cleaning (degreasing) machines. This acid lipase can also be applied efficiently to improperly degreased wetblue nappa and doubleface sheepskins to produce outstanding degreasing performance before further processing.

The benefits for the tanner include improved leather quality such as improved grain break, lighter weight and better flatness, enhanced dye yield, increase area yield and improved physical properties. Furthermore, the reduction in surfactant consumption and omission of Bowe dry cleaning/degreasing system offers substantial process efficiency thereby optimizing production costs as well as ecological benefits for the environment and treatment of the effluent.

Methodology

Degreasing studies with the acid lipase have been done on pickled nappa and doubleface sheepskins where the fat contents were analyzed before and after degreasing, and compared with control trials which followed a standard process**.**

Trials were conducted on NZ pickled nappa skins and Spanish pickled doubleface skins to demonstrate the effectiveness of the acid lipase. A full scientific assessment of the process was carried out to understand the improvement in degreasing efficiency and leather quality.

1. Degreasing trials on New Zealand pickled skins
   i. Control
   ii. Acid Lipase + Acid Protease
2. Degreasing trials on Spanish double face pickled skins
   i. Control
   ii. Acid lipase + Acid Protease

Both sets of trials were dyed and finished within a bulk lot.

Analysis of samples was done as follows:

- Fat content including FFA
- Histochemical staining of natural fats showing fat location and degree of hydrolysis

Results and discussion

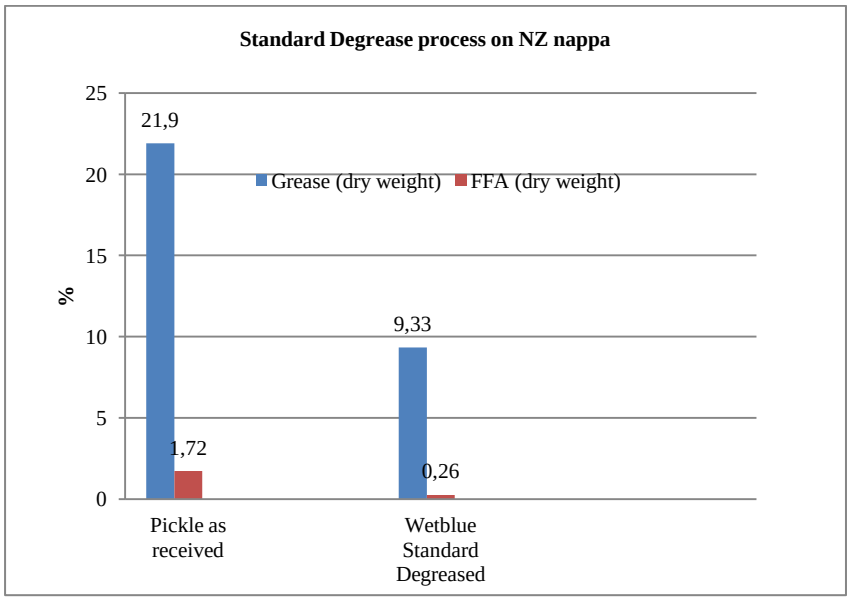


Fig.1 Results of standard degreasing of NZ nappa (Control)

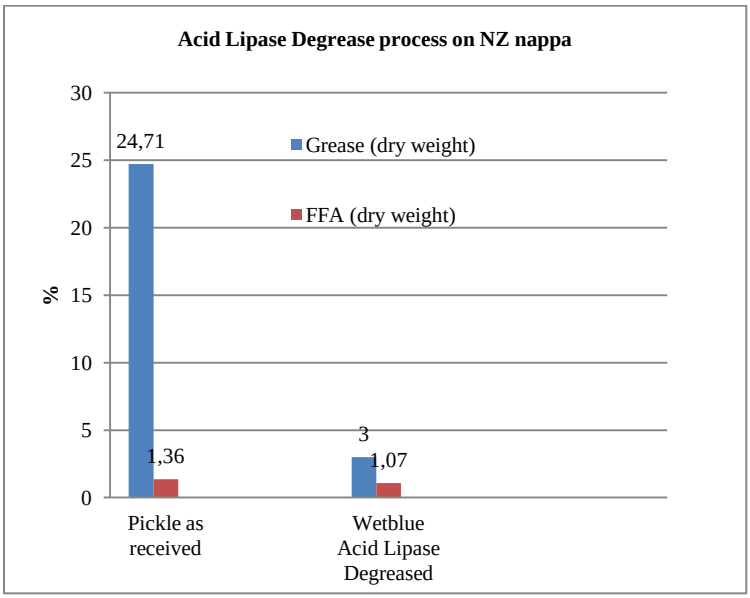


Fig.2 Results of Acid Lipase degreasing of NZ nappa

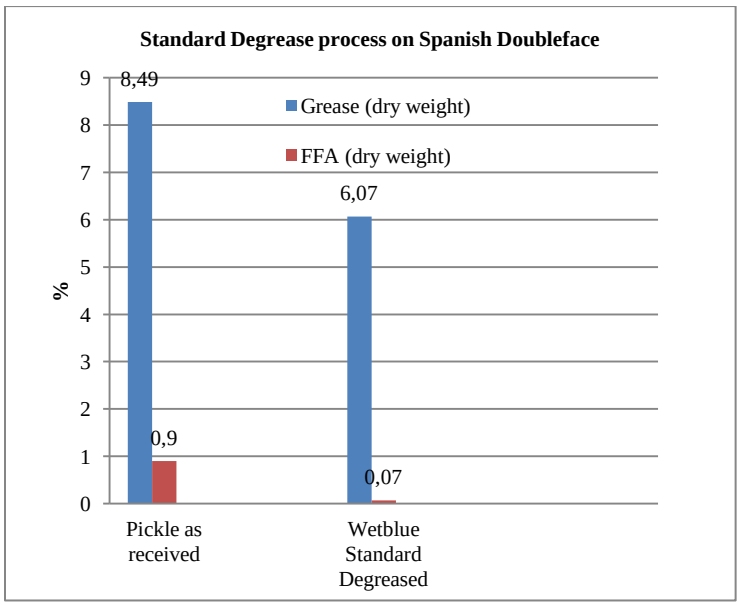


Fig. 3 Results of standard degreasing of Spanish double face (Control)

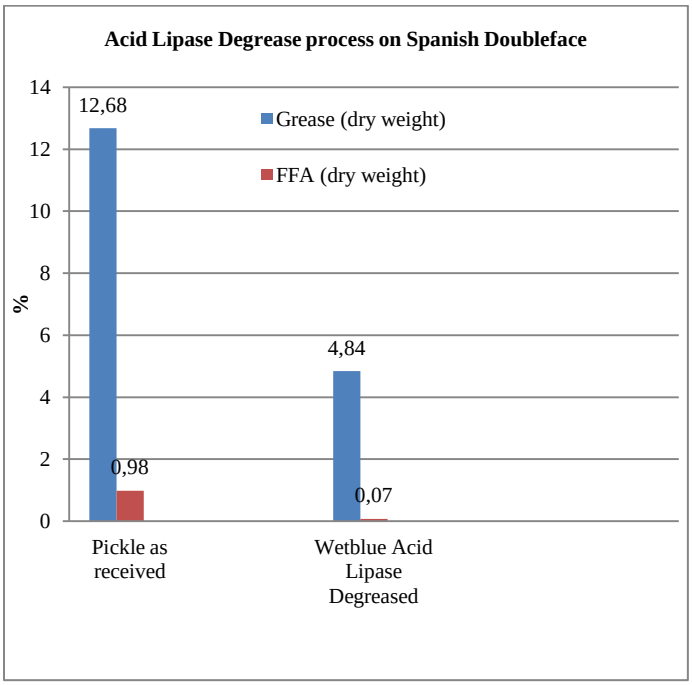
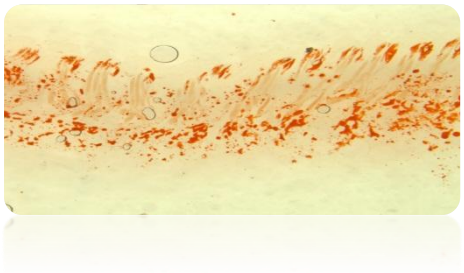


Fig. 4 Results of Acid Lipase degreasing of Spanish double face

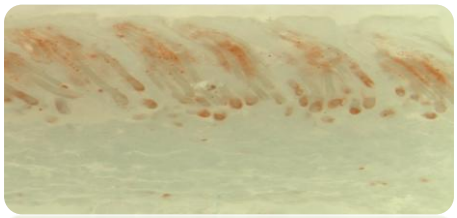
Standard degreasing of pickled NZ nappa



Pickle as received

20.75% grease (dry weight)
1.63% free fatty acids (dry weight

Fig.5 Pickle as received

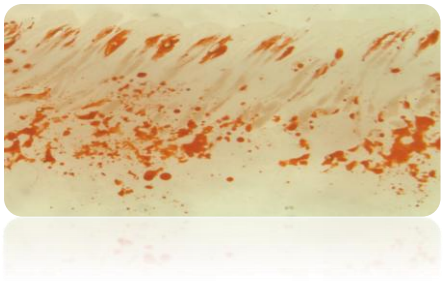


Control standard degreased wetblue

7.83% grease (dry weight)
0.22% free fatty acids (dry weight)

Fig. 6 Standard degreased wetblue (Control)

Acid Lipase degreasing of pickled NZ nappa



Pickle as received

23.37% grease (dry weight)
1.28% free fatty acids (dry weight

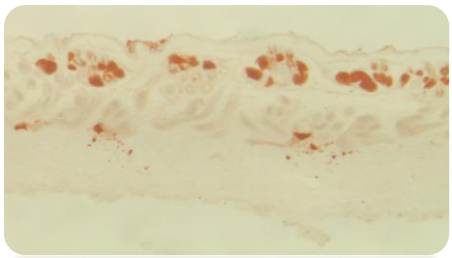
Fig. 7 Pickle as received

Acid Lipase degreased wetblue

3.36% grease (dry weight)
0.92% free fatty acids (dry weight

Fig.8 Acid Lipase degreased wetblue

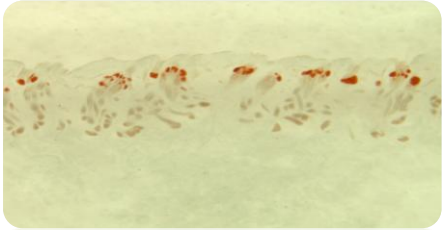
Standard degreasing of Spanish double face



Pickle as received

8.49% grease (dry weight)
0.90% free fatty acids (dry weight)

Fig. 9 Pickle as received

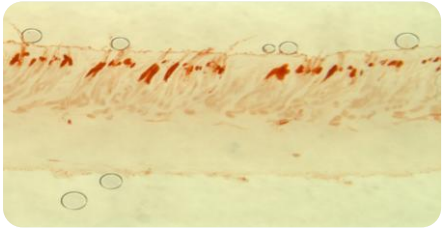


Control standard degreased wet blue

6.07% grease (dry weight)
0.07% free fatty acids (dry weight)

Fig. 10 Standard degreased wetblue (Control)

Acid Lipase degreasing of Spanish double face



Pickle as received

12.68% grease (dry weight)
0.98% free fatty acids (dry weight

Fig. 11 Pickle as received

Acid Lipase degreased wetblue

4.84% grease (dry weight)
0.07% free fatty acids (dry weight)

Fig. 12 Acid Lipase degreased wetblue

With reference to fig. 1 and 2, the residual fat content of pickled NZ nappa skins with the standard degreasing process results in 9.33% whereas degreasing with the acid lipase reduces the residual fat content significantly to only 3.0%. The degreasing efficiency of the standard process based on the initial fat content analyzed in the pickle is 57.3% versus a degreasing efficiency achieved of 87.8% with the acid lipase. The free fatty acid content analyzed for the acid lipase degreased skins were higher at 1.07% as compared to 0.26% for the standard degreased skins. Free fatty acids are reaction products in the hydrolysis of triglycerides with lipases which is an indication of the efficacy of the lipase. These maybe easily removed with improved washing after degreasing at elevated temperature.

Similarly, with reference to fig. 3 and 4, standard degreasing of Spanish doubleface skins resulted in residual fat content of 6.07% compared to 4.84% achieved with the acid lipase degreasing process. The degreasing efficiency of the standard process based on the initial fat content analyzed in the pickle is only 28.5% compared to a degreasing efficiency of 61.8% achieved with the acid lipase degreasing process. The free fatty acid content analyzed for the standard and acid the aid lipase treated skins were similar at 0.07%.

Histochemical analyses (see fig. 5-12) also reveal clearly that the there is much less residual fat stains for the acid lipase treated skins for both double face and nappa when compared to the standard degreased skins.

The evaluation and assessment of the final quality of acid lipase degreased nappa and double face skins were found to be favorable when compared to the standard production lot. The development and optimization of the use of acid lipase for improvement of conventional degreasing methods, production efficiencies and area yields, as well as reduction in the use of surfactants and production cost due to elimination of solvents are ongoing in both pilot scale and bulk production runs. The initial data collected reveal that all quality parameters such as lightness, softness, dye brilliancy, handle and feel, as well as area yields are positive for the acid lipase degreasing process and will be included in later publications.

Conclusions

The studies show that the acid lipase when applied in conjunction with an acid protease has the ability to vastly improve degreasing efficiency when compared to standard degreasing processes for both doubleface and nappa skins. The acid protease opens up the fiber structure and thus improves the penetration into the skin of the acid lipase which acts on natural fats, facilitating their extraction as well as water adsorption. In small skin production it can reduce the consumption of surfactants and obviates the need for Bowe degreasing systems for double face skins.

The environmental profile is also improved due to reduction in the use of surfactants and elimination of solvents resulting in significantly lower COD and BOD levels.

Acknowledgements
Novozymes Leather Team; BLC, UK

References

1) Novocor ADL registered trade mark of Novozymes A/S, Denmark
2) Novocor ABG registered trade mark of Novozymes A/S, Denmark