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Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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The Leather Technology Centre

A Research Contract for

UNIDO
P.O. Box 300
A-1400
Vienna
Austria

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IMPROVEMENT IN THE QUALITY OF ETHIOPIAN RAWSTOCK

Final Report

P. J. Stosic
February 1997

A Research Contract for

UNIDO

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M W Parsons

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SUMMARY

Through the work carried out in this definition project the major natural defect problem of "ekek" occurring on Ethiopian sheep skins has been linked to high levels of ectoparasite burdens on the live animal. Data collected on raw material quality has confirmed:

- High incidence of ectoparasite infestation of sheep skins - predominantly biting lice and keds;
- Lower levels of ectoparasite infestation of goat skins - predominantly lice and demodex;
- Positive correlations between ectoparasite burdens and processed skin quality.
- Seasonal and regional variations in ectoparasites and diseases on sheep and goat skins.

Data collected on the levels of low and reject grade skins occurring in commercial production have confirmed:

- General increase in low and reject grades for both sheep and goat skins;
- Increase in "life time" defects occurring on sheep and goat skins;
- High incidence of "ekek" damage - identified as scatter cockle.
- A combination of three factors appears to have influenced the increase in damage occurring on Ethiopian skins: climatic/farming changes, reduction in animal husbandry extension work and increased competition for skins.

The specific interest of this project is "ekek" damage occurring on hair sheep skins. Work carried out during the project has confirmed:

- "Ekek" damage grading between tanneries was consistent. The damage term was being applied across the board to the same type of damage occurring on pickled, wet blue and crust material.
- "Ekek" damage is consistent with scatter cockle damage.
- Cockle damage was shown to have a positive correlation with the level of biting lice on raw material.
- Biting lice and keds were found to be the major ectoparasites infesting raw sheep skins.
- "Ekek" damage is no longer considered to be a regionally based problem. However skins inspected from the Western regions provided the highest numbers of uninfested/clear skins (over 40%), double that from the Northern and Eastern regions.
- Sheep skins from Wello region were found to have a relatively higher incidence of biting lice and keds compared to skins from mixed origins.
- "Ekek" was successfully predicted on pickled sheep skins from lice and ked infestations on the raw material.
- "Ekek" has not been identified as a problem on goat skin production. This is a reflection of the relatively low levels of ectoparasites found on goat compared to sheep skins.

- "Ekek" damage levels were seen to be high both during and after the rainy season periods. The damage levels were consistent with the high levels of biting lice and keds found on the skins.
- Pitting damage (possible mycotic dermatitis) increased significantly on sheep and goat skins during the humid rainy season. A smaller increase in pox damage was also seen.
- Tick and demodex damage to sheep and goat skins decreased during the rainy season.

In order to significantly improve the quality of Ethiopia's leather industry raw material the levels of identified ectoparasite infestations need to be controlled. It is recommended that a pilot trial is needed to demonstrate:

- Control of the problem parasites;
- Control costs to the farmer;
- Cost and input required of skin traders;
- Quality gain to the tanner.

Form discussions with MOA and UNIDO officials it is suggested that a diazinon dipping treatment in the Amara region, using a group of 10-20 farmers may fulfil the requirement for the pilot trial. However, results from the FAO project need to be taken into consideration before the treatment regime is identified.

1. INTRODUCTION

1.1. Background

This report summaries the findings from the work carried out in Phases I - IV of the project including the two planned field visits to Ethiopia under Phase II (27/08/96 and 18/11/95). The field visits formed the central crux of the project. They were primarily designed to confirm the nature and extent of damage occurring on rawstock and processed materials with that being reported previously and found on exported material. The specific interest of this project is damage occurring to hair sheep skins, however goat skins were also inspected during the visits at the request of the Ethiopian Tanners' Association (ETA) and the Ministry of Agriculture (MOA).

Ethiopian hides and skins have traditionally had a good reputation for quality in the world markets. However currently rawstock suffers from bad husbandry and a wide range of diseases and parasitic attack. UNIDO reported that increasing amounts of damage to hair sheep skins have recently been associated with the spread of a bacterial disease ("Ekek" in Amharic) transmitted by insects[1]. It has been recognised by UNIDO, ETA and the overseas Ethiopian leather importers that there was now a growing problem regarding parasitic and disease damage on Ethiopian rawstock.

It has become progressively more difficult to obtain the quality and volume of material required to produce the desired standard and range of finished leathers. The need for action has been recognised by UNIDO, MOA and leather producers/users as a matter of urgency. It was proposed that this project should identify the occurrence and causes of ante-mortem damage to rawstock of major concern to the leather manufacturer and from this work recommendations for the introduction of improvement schemes made.

1.2. Aims of the Project

The specific aims of the project were to review and clarify the current skin damage situation in Ethiopia with reference to the types of damage surveyed on "exported" material and make recommendations for improving raw material quality based on these findings.

The project work consisted of four phases:

Phase I	Problem definition.
Phase II	Field trips.
Phase III	Sample examination and reporting.
Phase IV	Recommendations for improvement schemes.

[1] Berg J. - Hides and skins, leather and leather products improvement scheme. Regional Africa Mission Report, UNIDO, June 1993.

2. PHASE I - PROBLEM DEFINITION

The "natural" damage seen during the various inspection stages of pickled, crust and finished sheep skins fell into five main category types. These damage categories were:

1. "Cockle" type nodules (up to about 5 mm) in rib and scatter patterns (subsequently identified as "ekek" damage");
2. Tick damage;
3. Larger nodules (10-20 mm), possibly pox lesions;
4. Demodex cysts and grain eruptions;
5. Pitting (possible mycotic dermatitis).

The major cause of down grading of sheep skins was found to be "cockle" damage, with the majority of skins being affected. Tick, pox and demodex damage were the next major quality affectors with only relatively few skins being affected by the pitting damage.

Five types of "natural" damage were also seen on wet blue goat skins selected from low and reject grades. These damage categories were:

1. Pox lesions;
2. Demodex cysts and grain eruptions;
3. Tick damage;
4. Pitting (possible mycotic dermatitis);
5. Pale scar damage.

2.1. Ekek Damage

The export of processed and semi-processed[2] skins constitutes Ethiopia's second largest export commodity. However over the last 10 years there are indications that the quality of the raw material has been deteriorating, with increasing numbers of reject grades and the appearance of a defect termed "ekek". Estimates from Ethiopian tanners have put the numbers of reject skins, at certain times of the year, at as high as 50-60%; of these rejects 80-90% can be affected by "ekek".

The economic implication of increased amounts of damage and associated fall in quality of both finished and semi-processed material are considerable. **Table 1** outlines, in monitory terms, the returns from good quality and rejected skins. The reported increasing volume of reject material becomes critical when, as in the case of sheep skins, the price of the raw skins exceeds the price being received from the sale of reject grades.

Each of the tanneries keep their own grading records for different grades of pickled and wet-blue material being produced. Data collected by one of the tanneries over the last 5 years showed how in absolute terms levels of rejected pickled sheep skins have increased from around 20% in 1991 to 50% in 1995. However, these figures are not usually broken-down in to the direct causes of the reject damage. Some tanneries have sampled their reject and low grade material and classified the major down grading damage. Reported figures for the level of "ekek" damage occurring on rejected material varied from 50 to 90%. Levels of flay damage were reported at around 20% and putrefaction damage at about 15%.

[2] Ethiopia has traditionally been a supply of quality raw materials for the leather industry world wide but since 1984 the export of raw skins and hides has been banned.

Table 1 **Raw material and export prices of Ethiopian sheep and goat skin material during the two field visits. Approximate values at time of visits given in US$.**

SHEEP SKINS	Price US$ / dozen		GOAT SKINS	Price US$ / dozen	
	1st Visit	2nd Visit		1st Visit	2nd Visit
Raw skin	38	28	**Raw skin**	19	18
Pickle Grades:			**Wet-blue Grades:**		
I-III	85	85	**I-III**	55	55
IV	56	45	**IV**	35	35
Reject	24	15	**V**	30	25
			Reject	24	15

Inspection of exported material and of processed material during the subsequent field visits has indicated that the majority of the damage seen on the skins was found to be as a result of "cockle" type nodules. The "cockle" damage seen on the inspected exported pickled and finished sheep skins was a) consistent with damage seen during the two field visits and b) was consistently identified by tannery technicians and sorters as being typical of "ekek" damage. The levels of "cockle" damage seen on the inspected skins is consistent with the reported levels of "ekek" (50-90% of reject grades).

Currently the tanneries are unable to detect "ekek" damage in raw material and the pickle inspection is the first point at which the damage can seen. The tanneries have indicated a historical link with the Wello region and the first occurrence of "ekek". There are also reports of a seasonal pattern to the occurrence of "ekek"; being higher during or just after the wet or rainy periods.

From the work carried out during the project there appears to be some confusion over the nature of the "ekek" problem[3]. "Ekek" is not a disease as such but a generic grading term used by tanners, and means "itch" in Amharic. The typical "ekek" seen and identified on the skins was typical of "cockle" type damage. The nature of "cockle" damage to sheep skins has been described previously and it is likely that there has not been an emergence of a new disease affecting Ethiopian skins but increasing levels of an existing problem of ectoparasite infestations.

"Ekek" is not currently a major problem on goat skin production. Demodectic mange and pox type diseases appear to be the major natural causes of rejection for goat skins. Both these types of damage can, unlike "ekek", be easily detected at the raw material stage.

2.2. Cockle Damage

Cockle is a term used by the leather industry to describe small, hard lumps or nodules that appear on sheep skins.[4] The defect only becomes apparent after the removal of the hair and epidermis and is usually first seen at the pickle grading inspection. "Ekek" identified on crust (unfinished) leather is shown in **figure 1**. This damage is consistent with scatter cockle, namely hard lumps that appear slightly darker than surrounding leather with regions of superficial abraded grain damage[5].

Scatter or spread cockle - This type of damage was found scattered all over the skin in the most severe cases, but particularly in the neck and lower belly regions on less affected skins (**figures 2a-b**). The

[3] Berg J. (June 1993) - UNIDO Regional Africa Mission Report discussed the possibility of "Ekek" being a bacterial disease transmitted by insects.

[4] Everett A.L., Willard H.J., Bitcover E.H. & Naghski J. (1969) - J. Am. Leather Chem. Ass. 64(150-163).

[5] Dempsey M. (1983) - Hide, Skin & Leather Defects, LASRA.

nodules were usually about 5 mm in diameter, but could be larger particularly if they merged. In some instances the nodules were associated with slight grain damage and a "brownish" discolouration (**figure 2c-d**).

Rib cockle - This is where the nodules appear in lines or rib patterns. In slight cases of rib cockle the lines of nodules are restricted to the neck region (**figure 3**), but in severe cases distinct lines are seen running from the backbone into the flanks of the skin.[6] Only a few (3%) of the pickled pelts inspected had clearly identifiable rib cockle.

Previous work has related the formation of "cockle" nodules on sheep skins to the allergic response of the skin to ectoparasites, in particular rib cockle had been related to ked infestations[7] and scatter cockle damage to biting lice infestations.[8,9]

2.3. Other Types of Damage

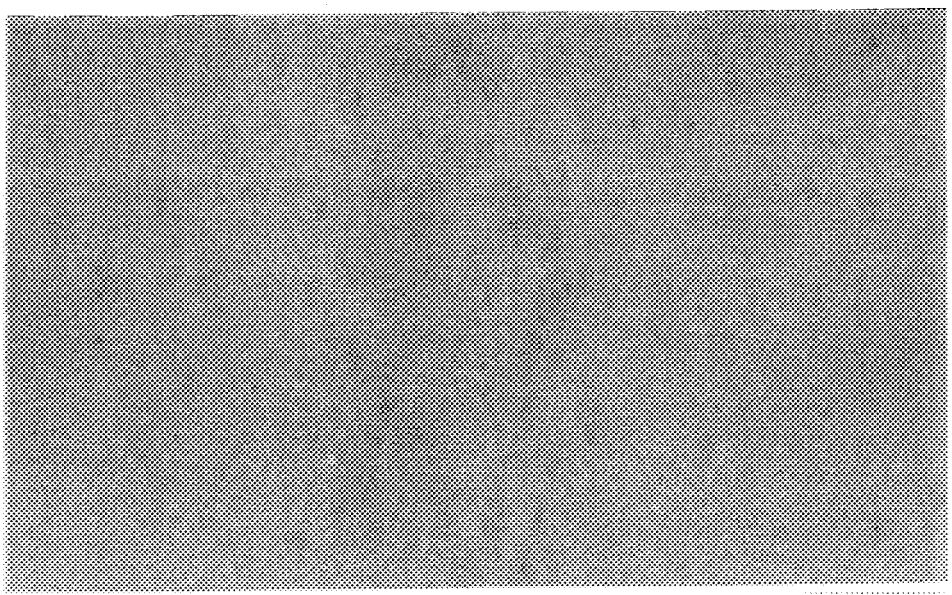
Compared to cockle other types of damage occurring on the pickled pelts accounted for a relatively small proportion of the low grade and rejected sheep skin material. An example of typical tick damage seen on the skins is shown in **figure 4**. The damage was found predominately around the edges of the skins, but in some instances severe damage was found in the central panel or butt area causing rejection.

Damage caused by pox type diseases (**figure 5**) and demodex (**figures 6a-d**) were less frequent than tick damage and less widely spread over the sheep skins compared to the same type of damage seen on goat skins. A defect similar to lumpy skin disease (LSD)[10,11] was seen on both sheep and goat crust leathers (**figures 7a-b**). This type of damage was, however, said to be relatively uncommon and had not been seen in any quantity on inspected pickled or wet blue material. The pox type disease seen on pickled sheep skin in **figure 5a** exhibits some of the same LSD characteristics seen on the crust samples, namely raised plaque areas and a jig-saw puzzle patterning where the nodules have converged.

The pitting illustrated in **figure 8a** on wet-blue goat skin, gives the classical appearance of damage caused by *dermatophilus congolensis*, confirmed by the scarring, distorted follicle growth and grain surface (**figure 8b**).

[6] Haines B. (1970) - J. Soc. Leather Tech. & Chemists 54 (108-117)
[7] Hannigan M.V., Everett A.L., Roberts I.H. & Naghski J. (1976) - J. Am. Leather Chem. Ass. 71(411-424).
[8] Halligan G. & Johnson A.C. (1992) - J. Am. Leather Chem. Ass. 87 (39-51).
[9] Heath A.C.G., Cooper S.M., Cole D.J.W. & Bishop D.M. (1995) - Vet. Parasitology 59 (53-58)
[10] Tancous J.J. (1986) - Skin, Hide & Leather Defects, LIA.
[11] It should be noted that LSD is a disease of cattle not sheep or goats, but it is caused by a capripox virus and is characterised by the formation of nodules in the dermis and epidermis. Capripox viruses affecting sheep and goats also cause papules that enlarge into nodules which may/may not exude and encrust, regress or become sit-fasts and so produce similar types of skin damage. Scott G.R (1990) - Animal Diseases in the Tropics 4th Ed. Balliere Tindall. Davies F.G (1991) - British Vet. J 147(489-503).

a.



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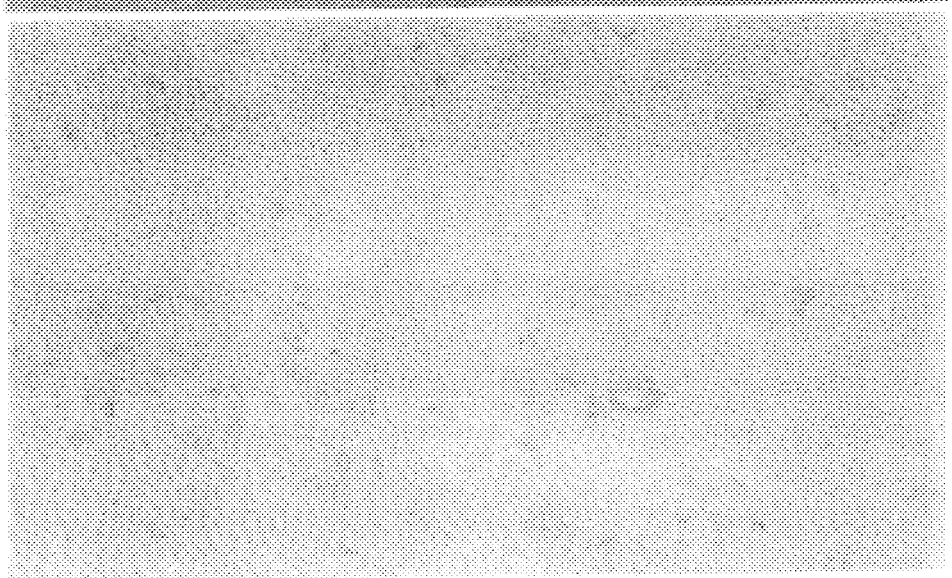

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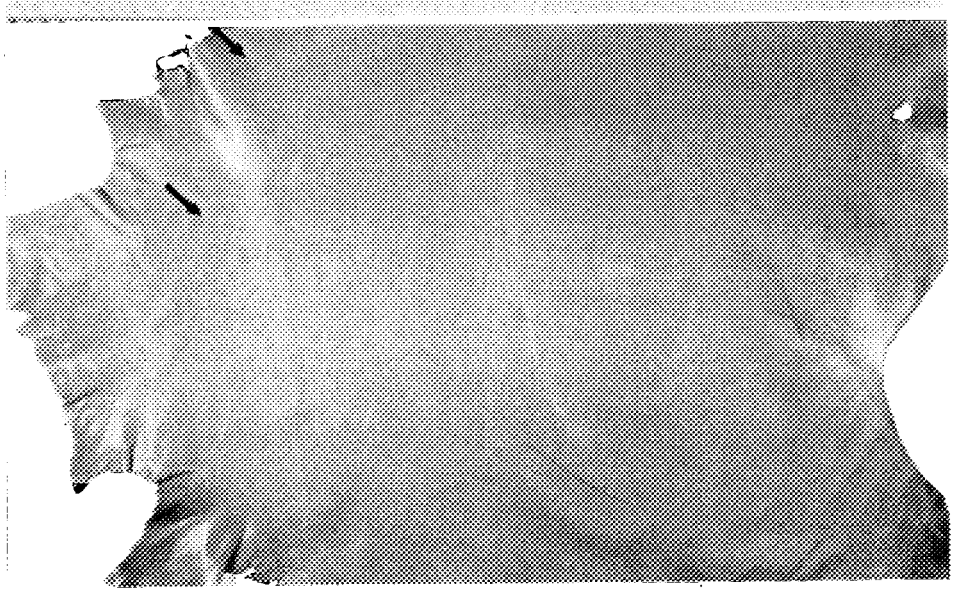
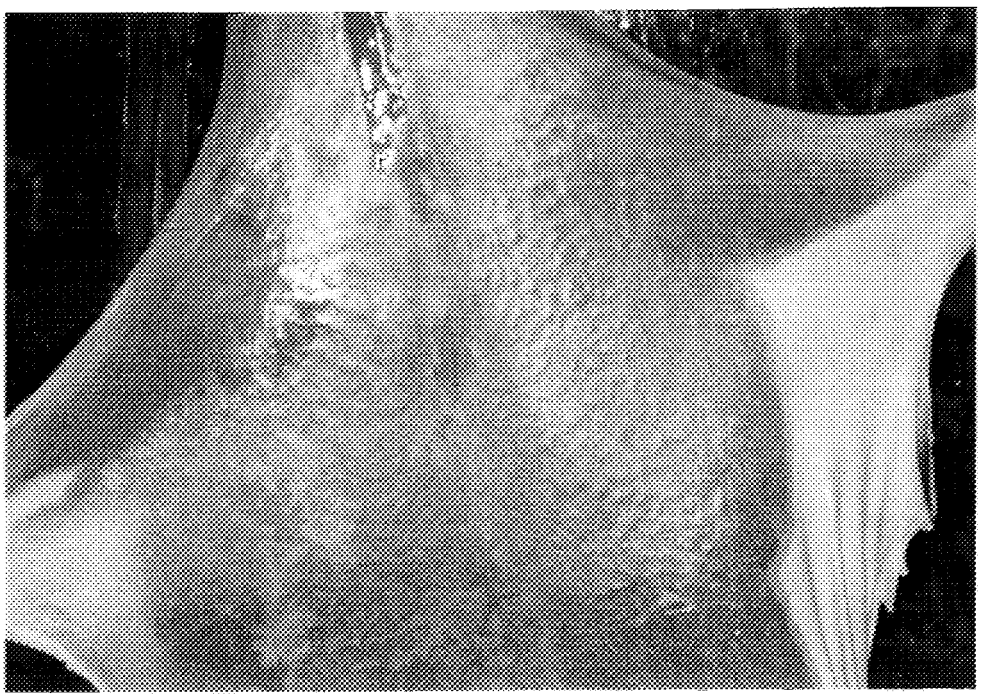


Figure 1 "Ekek" damage on crust leather.
a. Grain damage (approximate size)
b. Grain damage (x2).
c. Damage predominantly around neck and shoulder region (arrows)

a.



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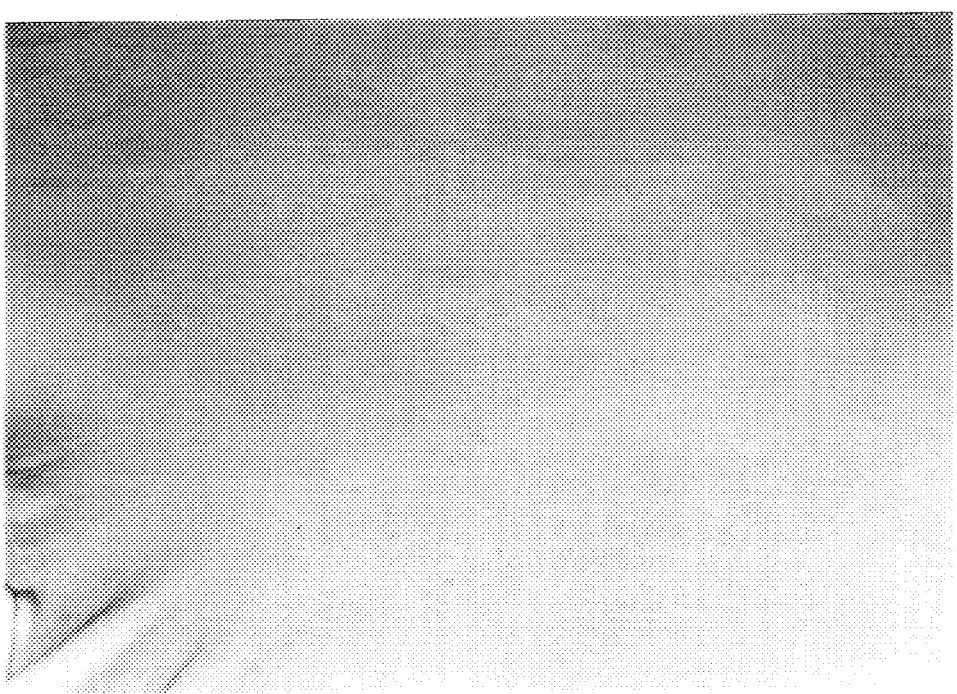
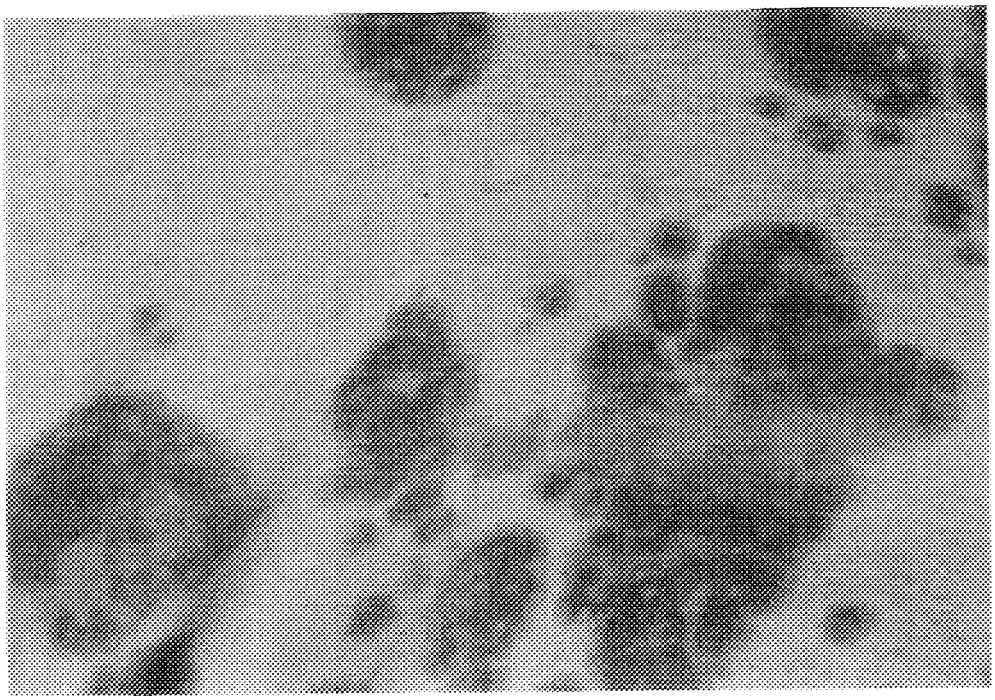


Figure 2 Cockle damage seen on pickled sheep skins.
a. Scatter cockle nodules seen over the main body of the skin.
b. Raised nodules seen in neck and shoulder region of skin.

c.



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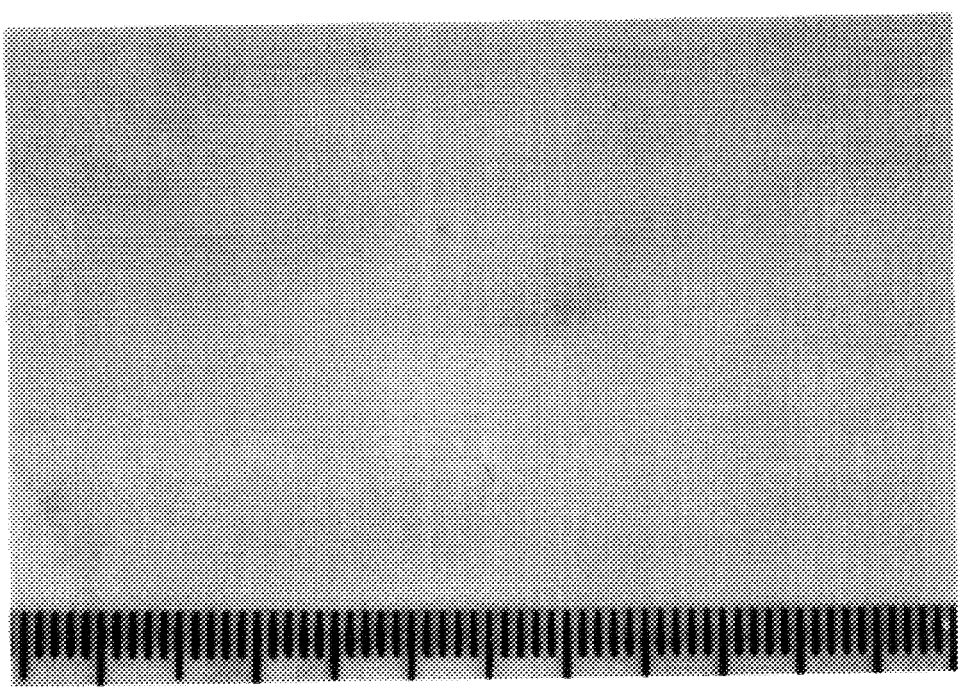


Figure 2 Cockle damage seen on pickled sheep skins.
c. Raised nodules with discolouration seen in neck and shoulder region of skin.
d. Cockle nodules seen on grain surface of pickled sheep skin (approximate size).

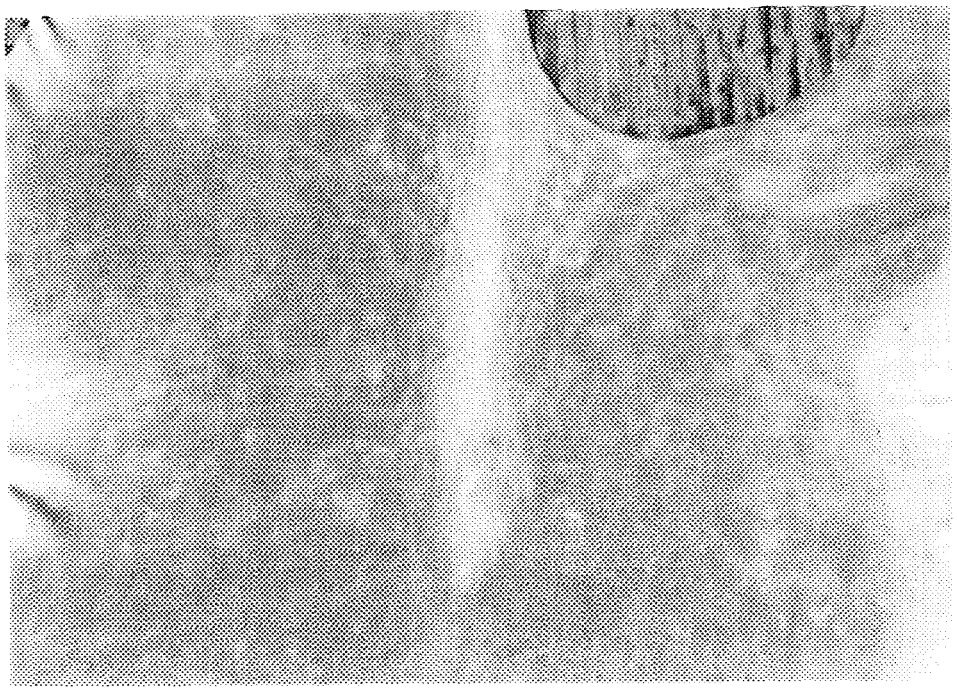


Figure 3 Rib cockle seen in neck region of pickled pelt.

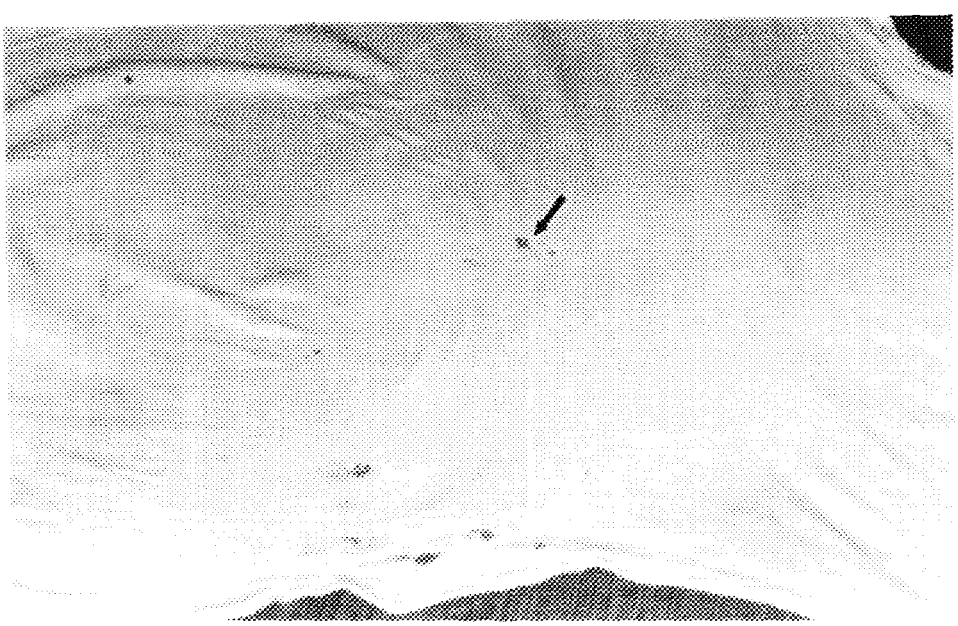
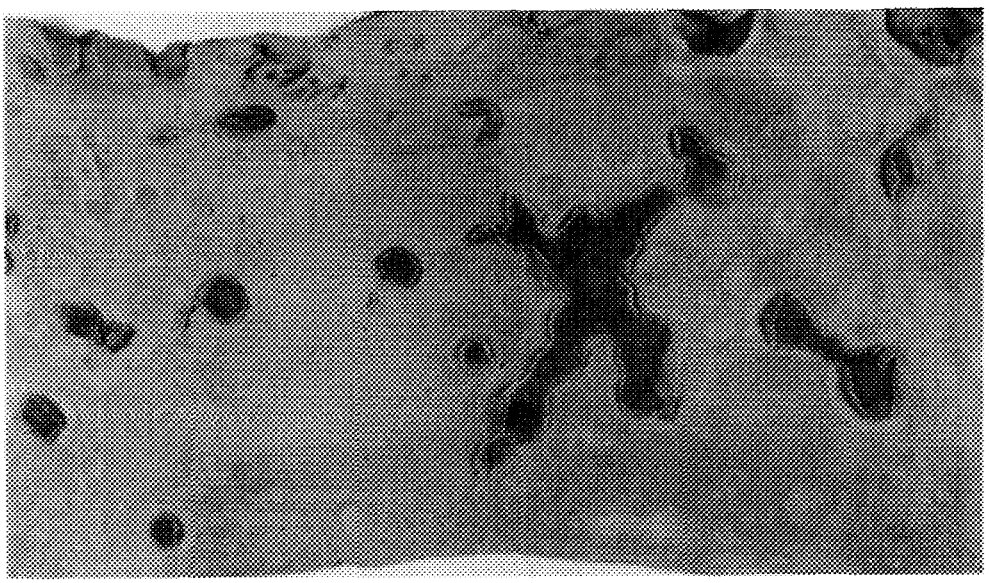


Figure 4 Tick damage caused to pickled sheep skins
Note ticks still attached (arrow).

a.



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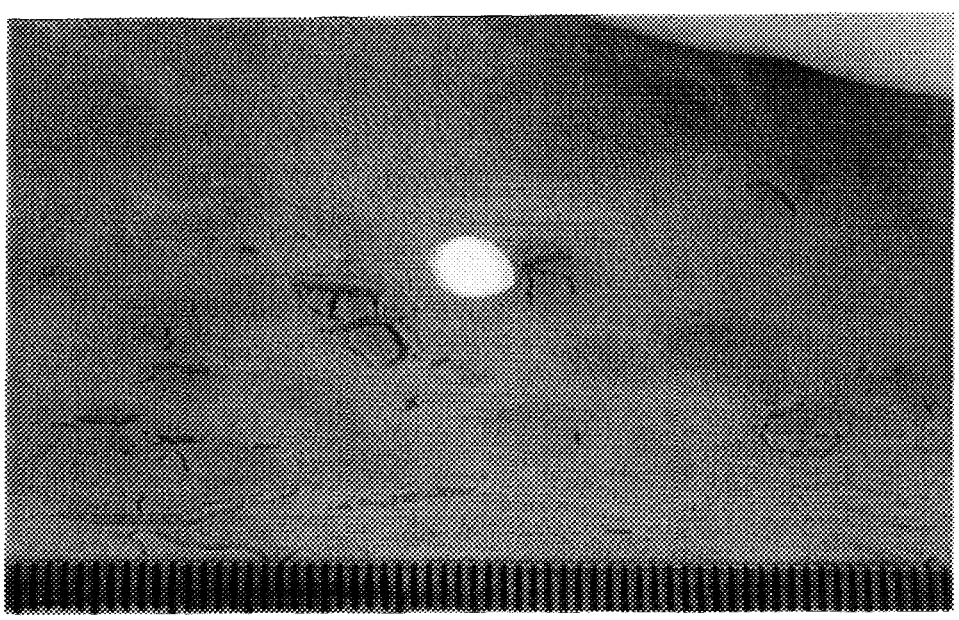
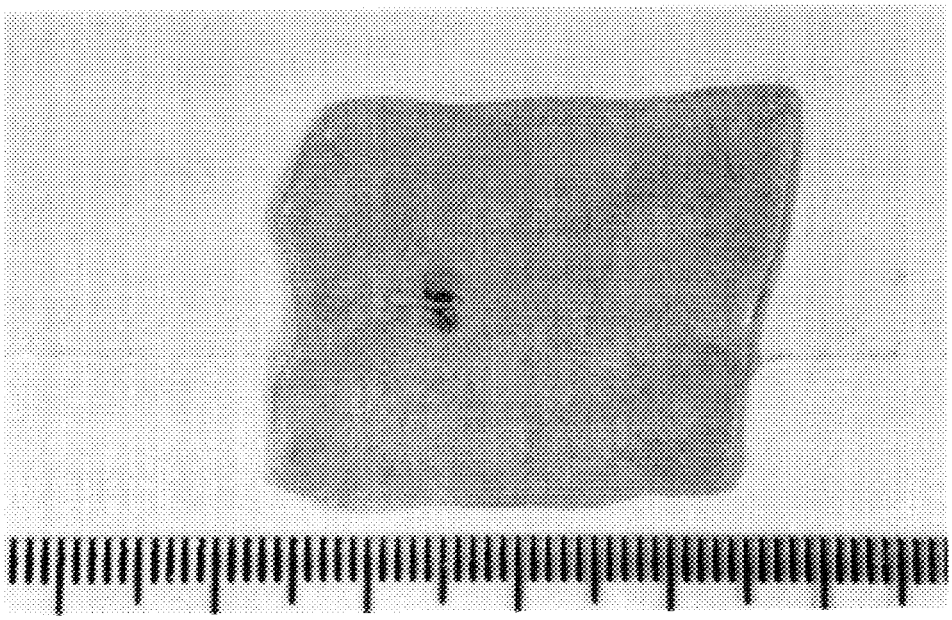


Figure 5 Pox type disease seen on semi-processed sheep skins.
a) Converged lesions and scar areas on pickled skin
b) Lesions seen on wet blue material
(approximate size).

a.



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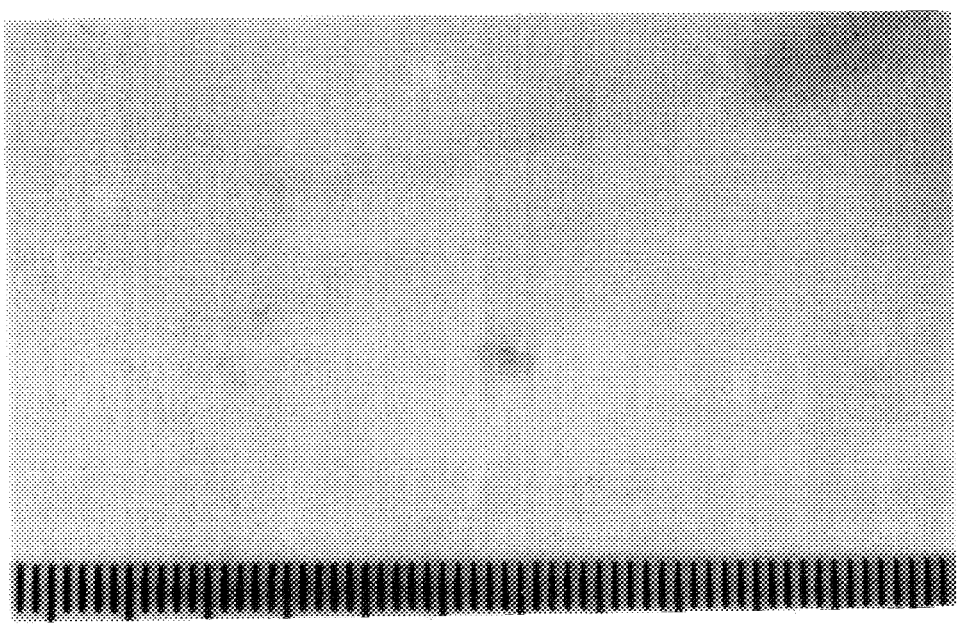
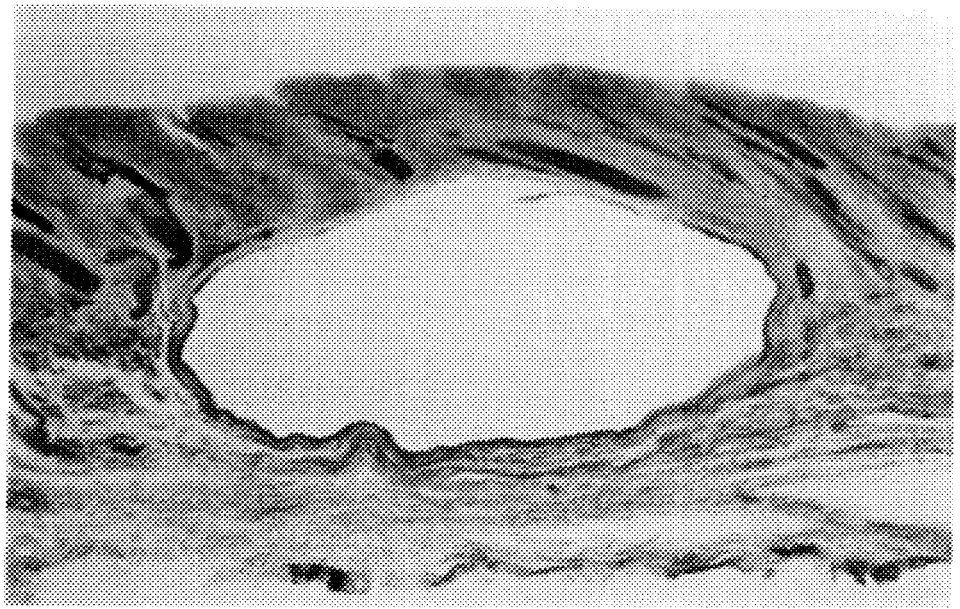


Figure 6 Demodex cysts on pickled sheep skins.
a. Dark cyst containing mites (approximate size).
b. Erupted cyst with central pit damage (approximate size).

c.



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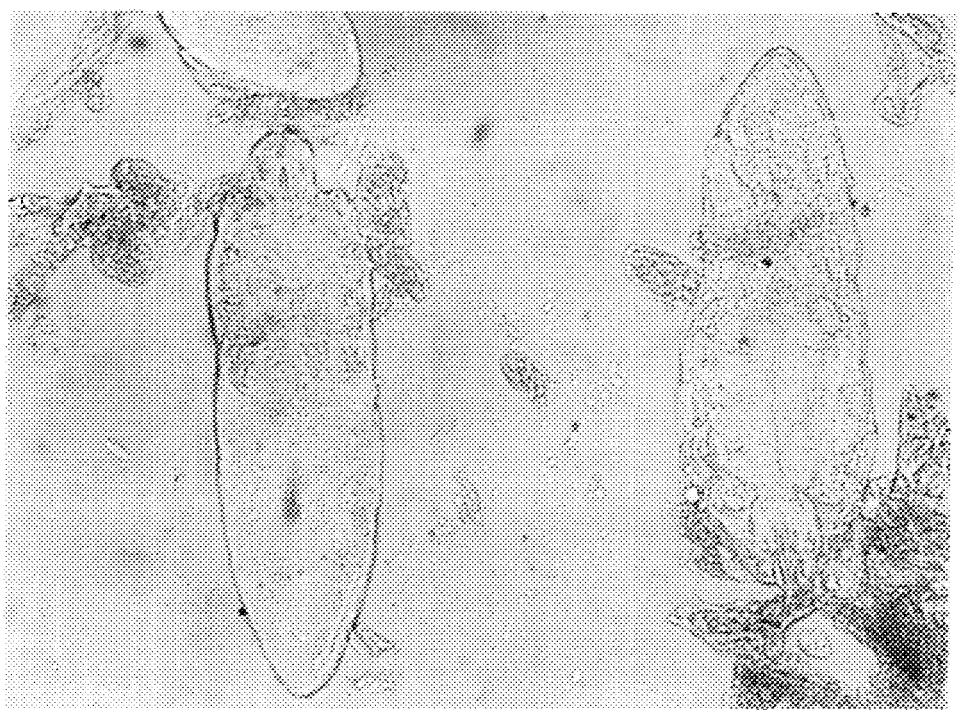
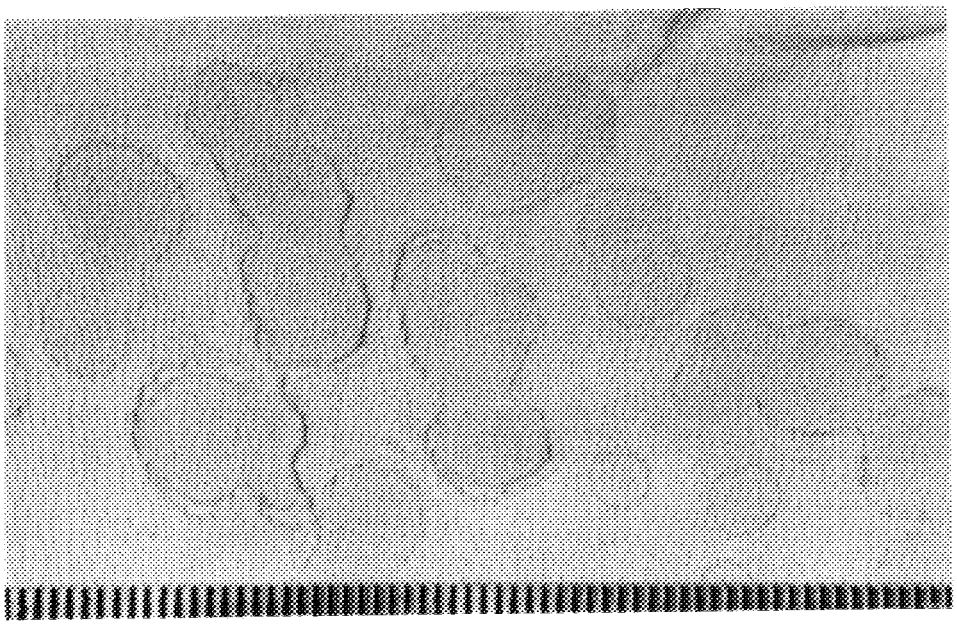
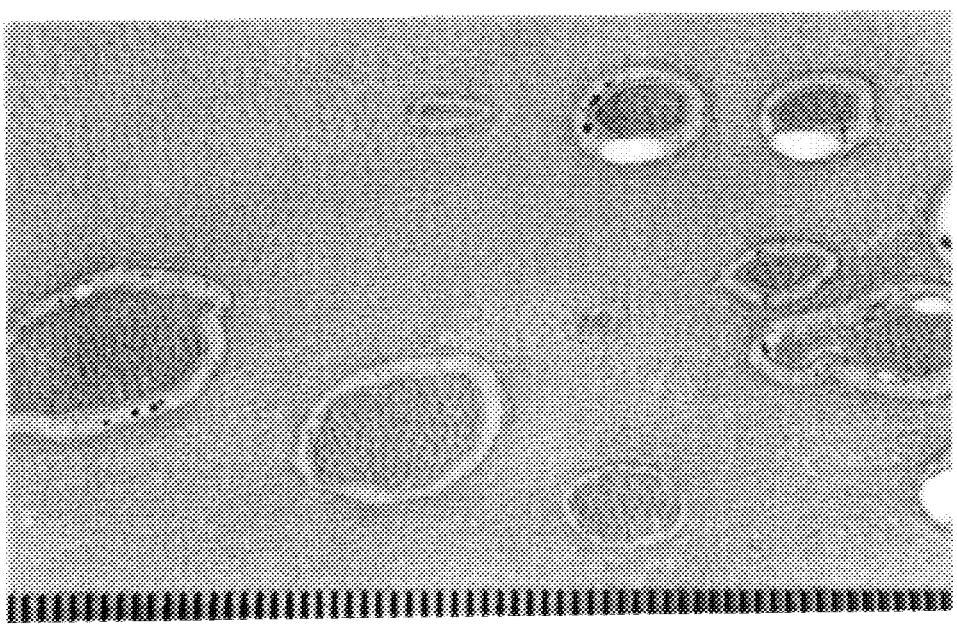


Figure 6 Demodex cysts on pickled sheep skins.
c. Cross section of cyst (x47).
d. Isolated mites (x475).



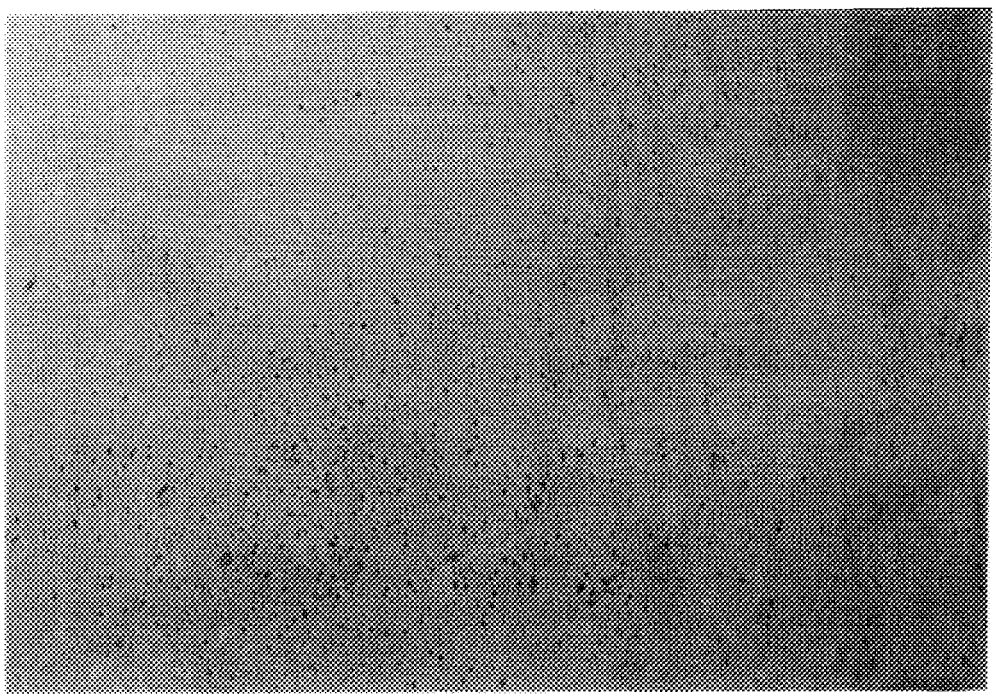
a.



b.

Figure 7 Lumpy skin disease damage on crust leather.
a. Sheep skin (x2)
b. Goat skin (x2).

a



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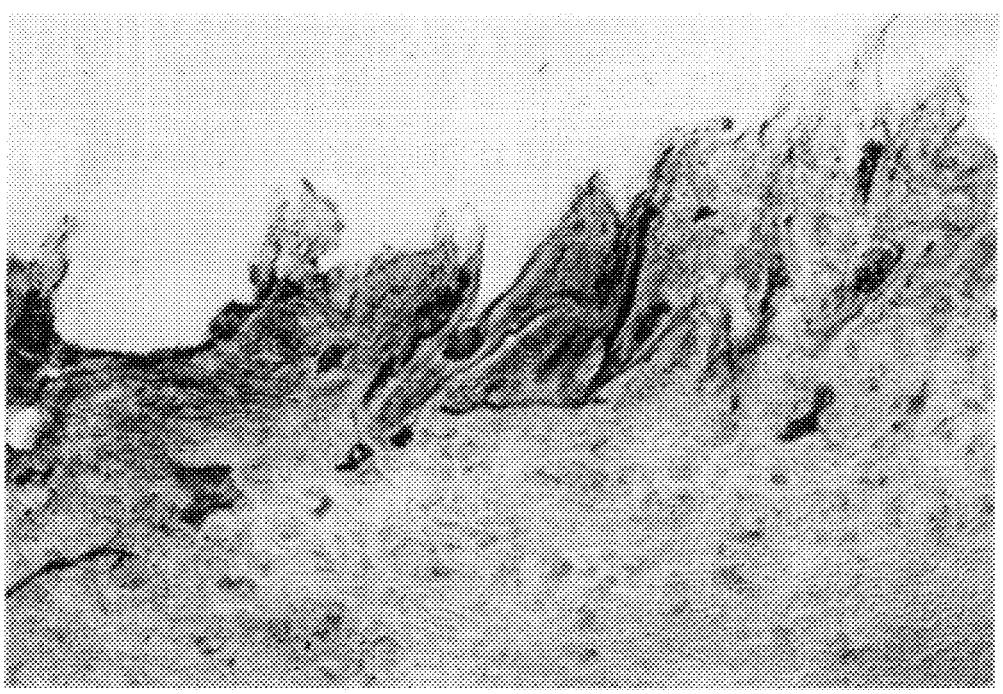


Figure 8 a) Severe Pitting found on wet blue goat skins.
b) Cross section of pitting (x15).
Azure A and cresyl violet staining.

3. PHASE II - FIELD TRIPS

3.1. Aims of Field Visits

The specific objectives for the two field visits were to:

1. Meet Ethiopian UNIDO, Ministry of Agriculture (MOA) and FAO officials to discuss work being undertaken on UNIDO and FAO projects.

2. Inspect raw and processed materials and relate findings to:

- Damage seen on processed and finished leathers previously examined:
  (a) on exported material and b) to defining any regional or seasonal variations occurring;
- Damage seen on selected raw material through processing - with specific reference to confirming ectoparasite burden and damage relationships;
- Damage defined as due to "ekek".

3. Discuss current and potential animal health schemes to aid in controlling ectoparasite infestations.

3.2. Outline of Field Visits

Work carried out during the visits included inspection of:

- A range of raw materials (fresh, dried and wet salted) at skin collection sheds in Addis Ababa and at the different tanneries visited;
- A range of processed and semi-processed material (pickled, wet-blue and crust leather) at the different tanneries visited;
- Selected, inspected raw material followed through to the pickle stage.

Approximately 1100 raw and processed skins were inspected for damage. Details of the numbers of skins inspected during the visits are given in **tables 2a&b**. Detailed itineraries for the field visits are given in **Appendix I** with the names and locations of the tanneries visited.

All the raw sheep skins and the majority of the goat skins inspected were from general supplies i.e. they were not from pre-rejected material. A range of damage identified on wet-salted sheep was followed through to the pickle stage of processing to correlate raw and process damage characteristics. The majority of the processed skins inspected were from low grades (grade V or rejects) or had been pre-selected by the tanneries to illustrate the range of damage "types" they regularly encounter.

3.3 UNIDO/FAO Projects

Concerns were raised as to the potential overlap between the two UNIDO and FAO sheep skin disease projects. During the two field visits discussions with Dr. Kassa, the FAO Ethiopian project leader, took place allowing assessment of the progress and direction of the FAO project in relation to the work being carried out under the current UNIDO project.

3.3.1. FAO Project

The specific objectives of the FAO "*Sheep and goat diseases project*" were:

1. To identify the aetiology and pathogenesis of the important skin diseases in sheep and goats commonly known as ekek.
2. To develop a method or tests for identifying the important skin diseases which lead to rejection in the tanneries in the fresh stage.
3. To test and evaluate a cost effective control program for important skin diseases in sheep and goats.

Details of the current status of the project (at the time of the second field visit), an outline of the experimental work being carried out and a summary of the general findings from the project are given in **Appendix II**.

3.3.2 UNIDO Project

This current UNIDO project, through its definition of the main problem areas to tanners, is complimentary in nature to the agricultural/veterinary based FAO project. It is important to understand the implications of the types/extent of the damage to the leather industry.

The end goal of the UNIDO project is to recommend control/improvement schemes which would have to be integrated into animal production/natural resources programmes. The third objective of the FAO project in essence forms this "follow-on" implementation phase.

Information on the types and nature of damage occurring on sheep and goat skins[12] have provided a basis for some of the FAO project work. Information on regional and seasonal damage variations covered in this report, along with recommended control/improvement schemes can be integrated with the findings from the trial treatment and control phase of the FAO project.

Table 2a **Material inspected during first field visit.**

Inspection Site	Raw Material	Pickled Skins	Wet-blue	Crust/ Finished
Sheep Skins				
Skin stores	39	-	-	-
Tanneries	65	99	18	8
Goat skins				
Skin stores	9	-	-	-
Tanneries	14	15	28	8

[12] Note that goat diseases and goat skin damage are not covered in the FAO project.

Table 2b Material inspected during second field visit.

Inspection Site	Raw Material	Pickled Skins	Wet-blue	Crust/ Finished
Sheep Skins				
Skin stores	214	-	-	-
Tanneries	188	147	-	10
Goat skins				
Skin stores	50	-	-	-
Tanneries	97	3	81	10

4. PHASE III - FIELD VISITS DISCUSSION

Information obtained from previous discussions with tanners indicated that skin damage ("ekek") is worse during or just after the rainy seasons (August to November and February to April). The timing of the two inspection visits was therefore chosen to coincide with the periods just after the rains at the end of November (the first visit) and during the main rainy season (the second visit). This year the first rainy season had been unusually long, starting early and continuing for nearly 6 months.

The general consensus from Ethiopian tanners[13] during the two visits was that:

- The primary skin damage occurring on sheep skins is still "ekek", and that the extent of the damage remains at the high levels experience over the last few years;
- The levels of damage currently being found on goat skins has increased particularly over the last few months (June to August);
- Skins from the lowland areas, up to now not considered to be good raw material for high quality leather manufacture, may become increasingly important in the future as competition for raw material increases. This factor makes regional variation in damage occurrence potentially more important in the future.

4.1. Damage Statistics

Data collected from two Ethiopian tanneries on the levels of damaged sheep and goat skins for the period 1994 to 1996 are shown in **figure 9**. The levels of rejected pickled sheep skins[14] (**figure 9a**) show the reported marked increases associated with the end of the rainy seasons around December/January and April/May.

Similar increases in the amounts of rejected wet-blue goat skins are also apparent over the same periods (**figure 9b**), however it can be seen that the absolute levels of rejected goat skins dramatically increased over the period November/January 1995/96 when rejection levels approached those seen in the sheep skins. Both sheep and goat skins have shown raised levels of rejection since June 1996.

These rejection figures have not been broken-down in to the direct causes of the reject damage, however speculated causes for this recent rejection increase are linked with the unusually long rainy season experienced in most parts of Ethiopia. Resultant problems with poor cure (salting and more particularly air drying, the primarily method for preserving goat skins), putrefaction and possible increased parasite/disease levels would have impacted on the overall quality of the raw material available to the tanning industry.

[13] Expressed by tannery representatives at the Tanners Association Meeting 28/9/96
[14] Data kindly supplied by Ethiopian Tanning and Pickling Factory.

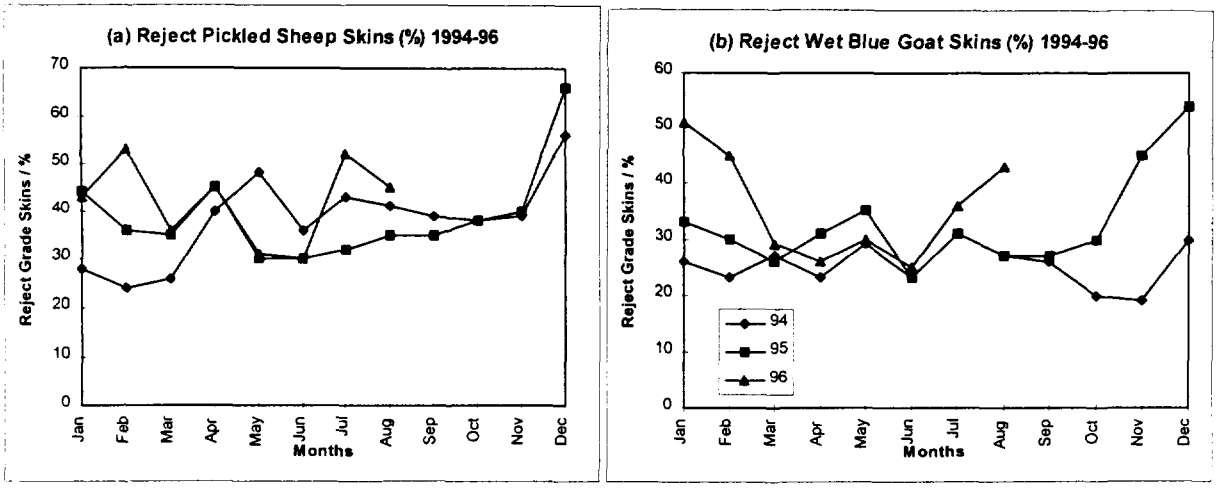


Figure 9 Reject skins grades from 1994 to 1996 as a percentage of a tannery's (a) pickled sheep skin and (b) wet blue goat skin production.

4.2. Ectoparasite and Disease Inspections of Raw Material

Inspection of raw material was carried out at a number of different skin sheds and at different tanneries in and around Addis. Inspection of fresh, wet-salted and dried sheep and goat skins was carried out noting any signs of damage or infestations. Collated data has allowed seasonal and regional comparisons to be made on the levels of damage.

4.2.1. Sheep Skins

The types of ectoparasites found on skins during the two visits were similar, predominantly biting lice and keds, along with sucking lice and ticks (**figures 10-13**). Although the same type of parasites were found on the skins, the levels seen varied between visits with fewer skins being affected by keds and sucking lice, while more were affected by ticks[15] during the second visit (**table 3**). Nearly half the skins inspected (46%) during the second visit were seen to have single infestations of biting lice, compared to a third during the first visit (**table 4**). There also appeared to be greater levels of lice infestations with more eggs and immature lice present than during the second visit. The number of clear skins (no infestation) also slightly increased during the second visit.

No major signs of disease were found on any of the skins beyond a "yellowing" and "scabbing" of the skin surface (**figures 14a-b**). It was thought that this yellowing of the skin surface could be a result of mycotic dermatitis (*dermatophilus congolensis* or streptothricosis) infections. However, the bacterium could not be detected from samples and no major skin damage was detected on selected skins processed to the pickle stage. This type of fatty deposit could be the result of irritation due to other ectoparasites such as lice, and it was noticeable that heavily lice infested skins tended to be more greasy in nature.

Dry hard scabs were found along the neck on a small number of dried sheep skins (**figure 15a**), which again was thought could be a result of mycotic dermatitis infections. Although the bacterium could not be detected from samples, deep pitting was associated with the "scab" area after selected skins had been processed to the pickle stage (**figures 15b-c**). This pitting is characteristic of mycotic dermatitis infections of hair sheep skins where the hair follicle and skin surface growth is distorted, some dense areas of possible scar tissue were also found to be associated with some of the pits.

[15] A wider variety of ticks were seen on both sheep and goat skins during the second visit

4.2.2. Goat Skins

Inspection of predominantly air dried goat skins revealed low levels of ectoparasites compared to sheep skins, (**table 5**). Biting and suckling lice were not found on goat skins during the first visit and there was a noticeable higher incidence of dry scabbing (in neck and back bone regions) during the second visit. However it should be noted that relatively few skins were inspected during the first visit making quantification of these differences difficult.

Table 3 **Percentage of sheep skins affected by ectoparasites during field visits.**

DESCRIPTION	AFFECTED SKINS(%)	
	1st Visit	2nd Visit
Biting lice	65	64
Keds	44	21
Sucking lice	6	3
Ticks	1	7
"Yellow" skin surface	6	7
Clear	21	27

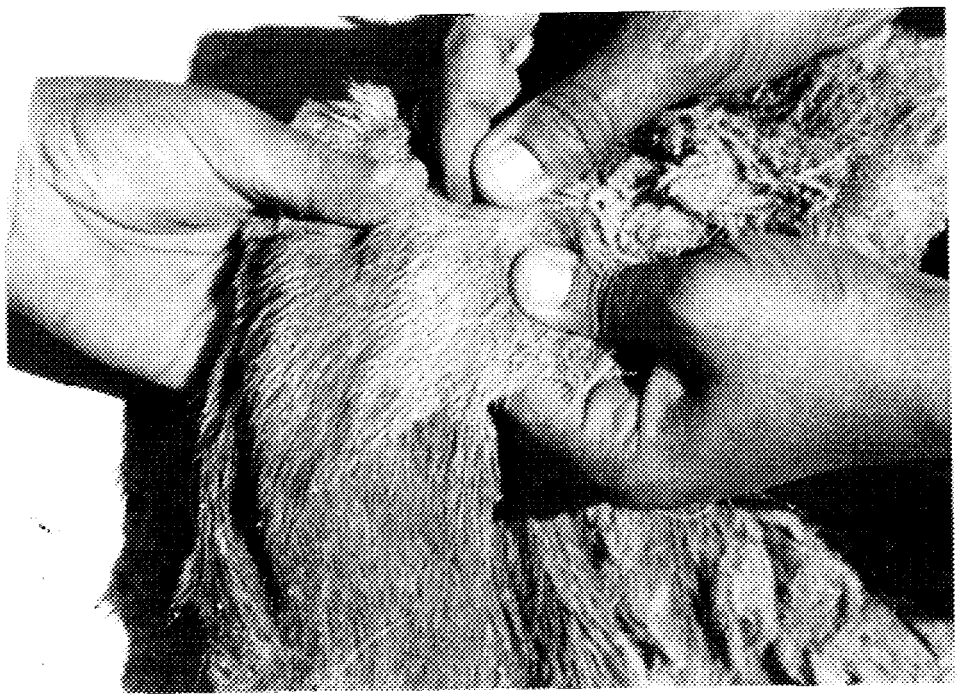
Table 4 **Breakdown of ectoparasite infestations on sheep skins.**

DESCRIPTION	AFFECTED SKINS (%)	
	1st Visit	2nd Visit
Biting Lice only	30	46
Keds only	15	6
Sucking Lice only	1	1
Ticks only	0	3
Biting & Sucking Lice	2	2
Biting Lice & Keds	29	12
Mixed Lice & Keds	2	0
Ticks & Sucking Lice	1	0
Ticks & Biting Lice	0	3
Biting Lice, Keds & Ticks	0	1
Clear	21	27

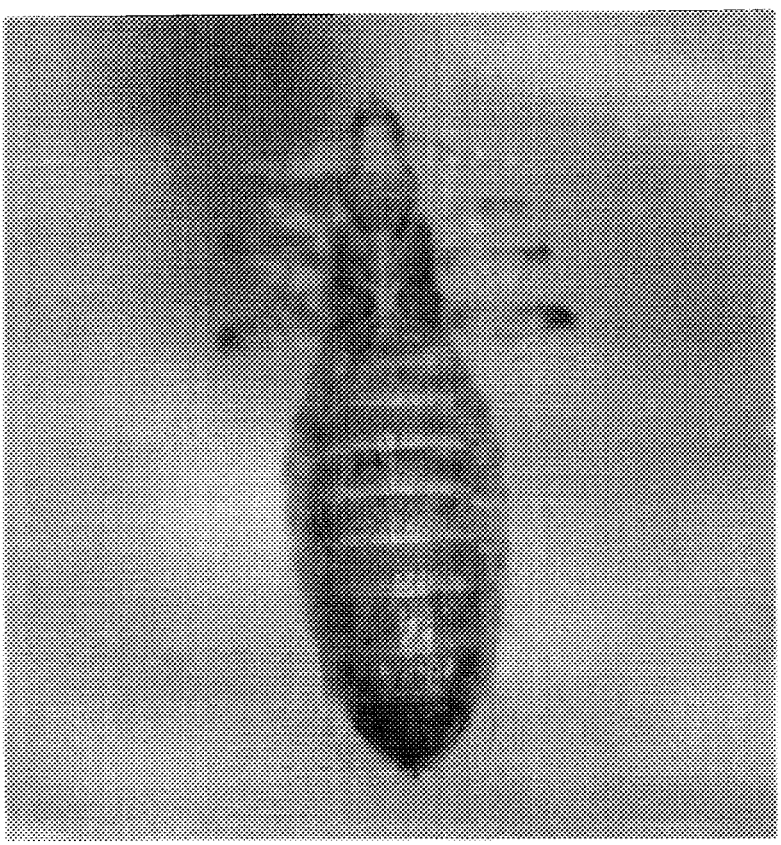
Table 5 **Percentage of goat skins affected by ectoparasites and diseases during second field visit[16].**

DESCRIPTION	AFFECTED SKINS (%)
Biting lice	10
Sucking lice	14
Demodex	9
Ticks	1
Yellow/ Scabbing	14
Pox	9
Clear	48
Number of skins	(147)

[16] Includes skins of mixed or unknown regional origin.



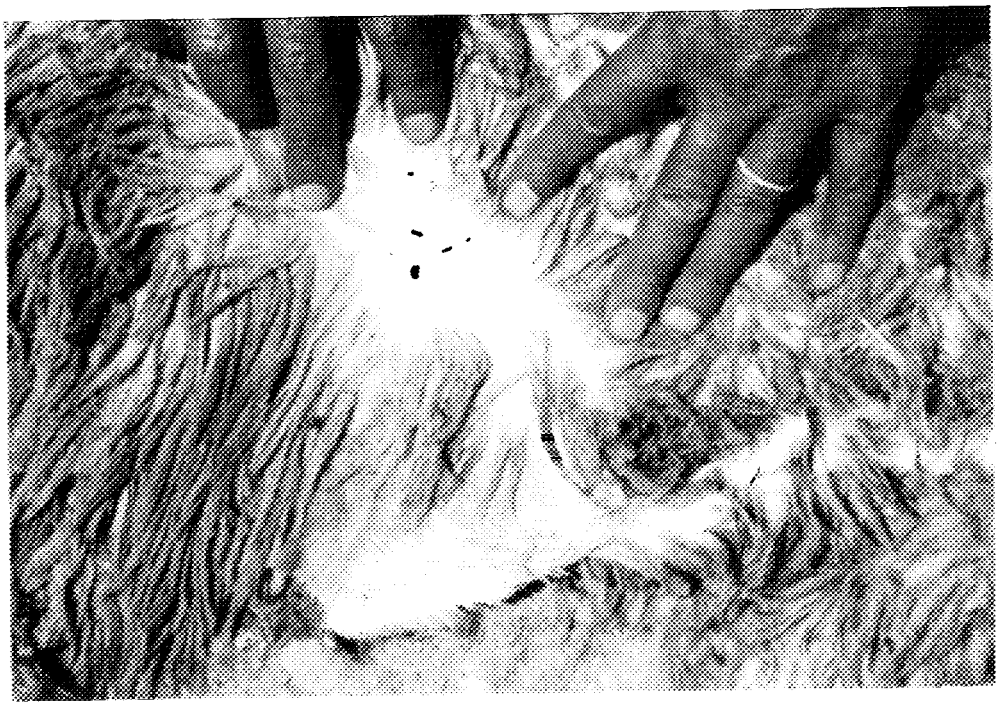
a.



b.

Figure 10 Sucking lice.
a) Seen close to the skin surface, on wet salted sheep skin.
b) Recovered from a wet salted sheep skin (x58).

a.



b.

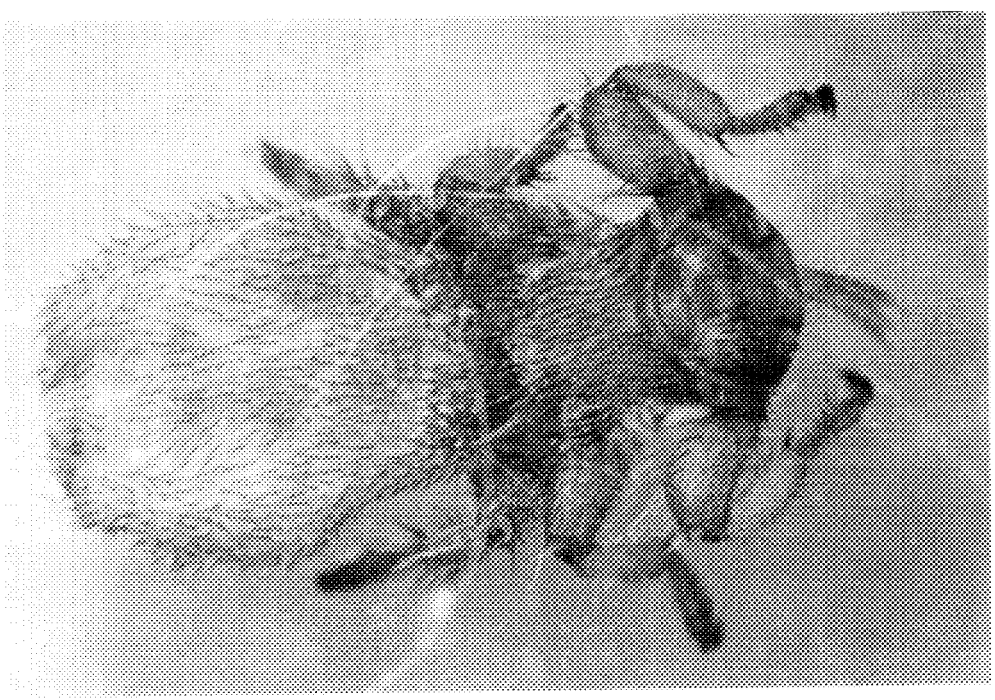


Figure 11 Sheep Ked (*Melophagus ovinus*).
a) Seen close to the skin surface, on wet salted sheep skin.
b) Recovered from a wet salted sheep skin (x20).

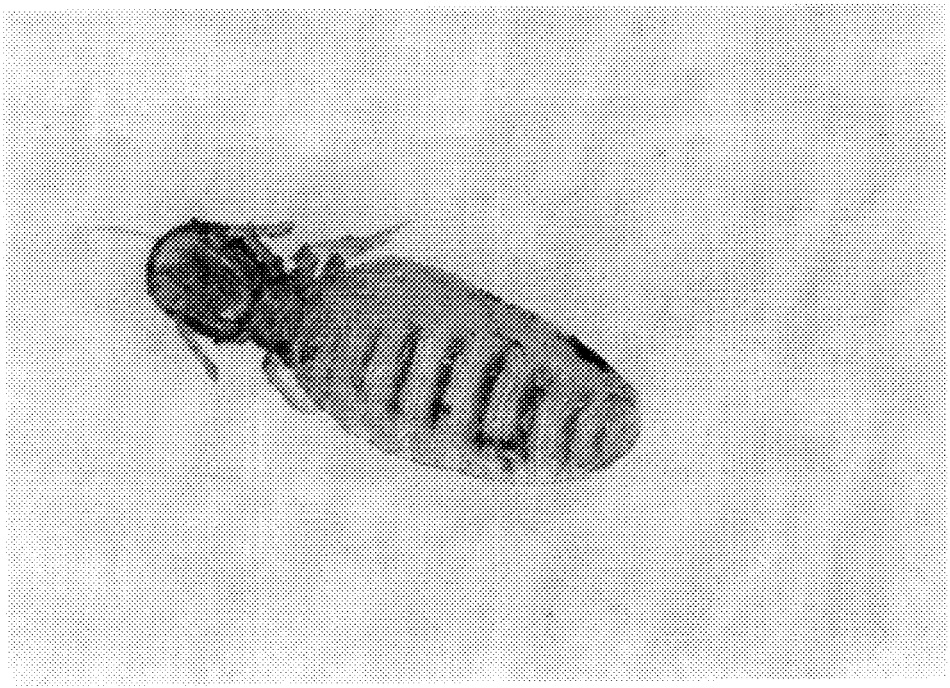


Figure 12 Biting louse recovered from a wet salted sheep skin (x45).

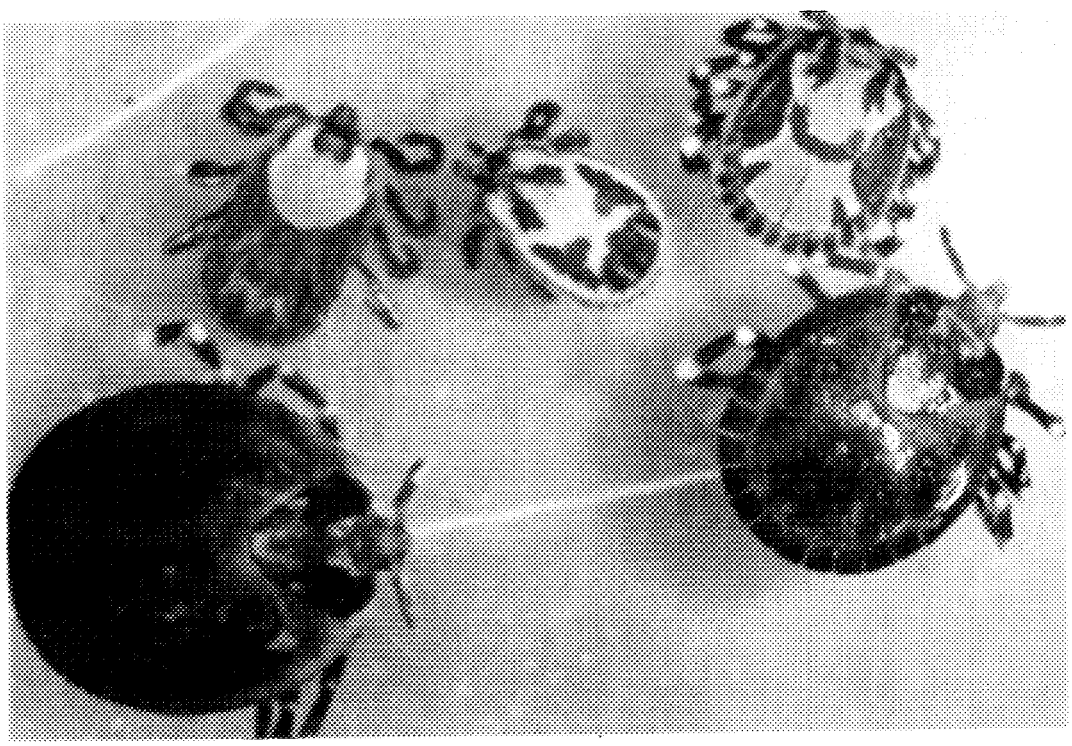
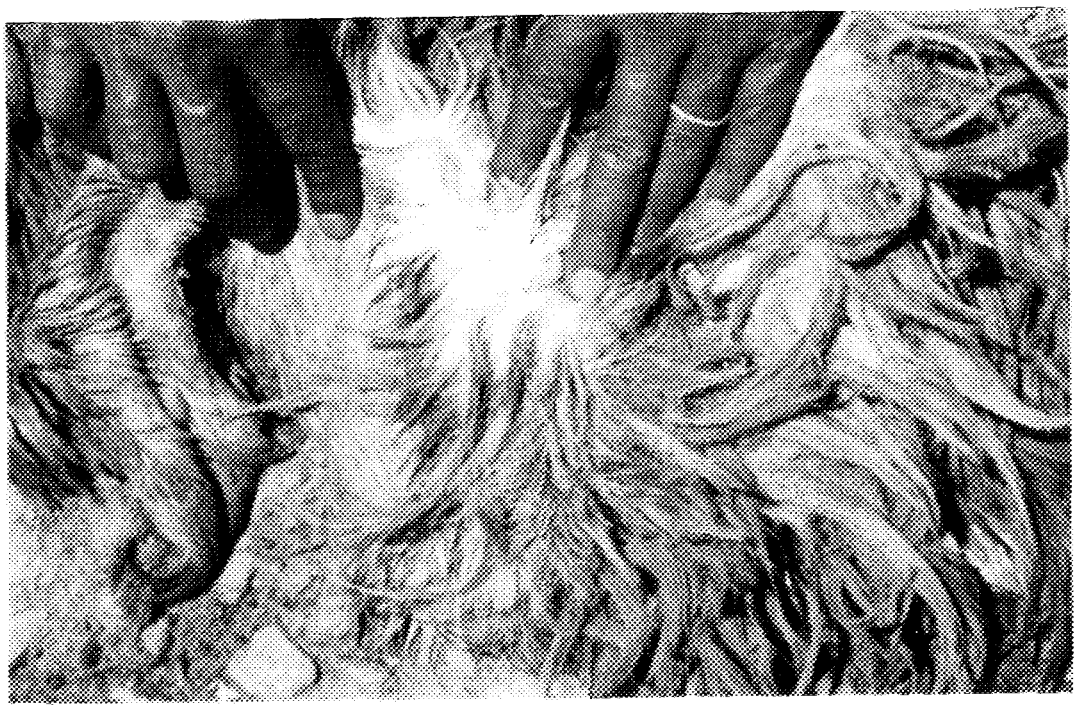


Figure 13 Different types of ticks recovered from fresh and wet salted sheep skins (x15).

a.

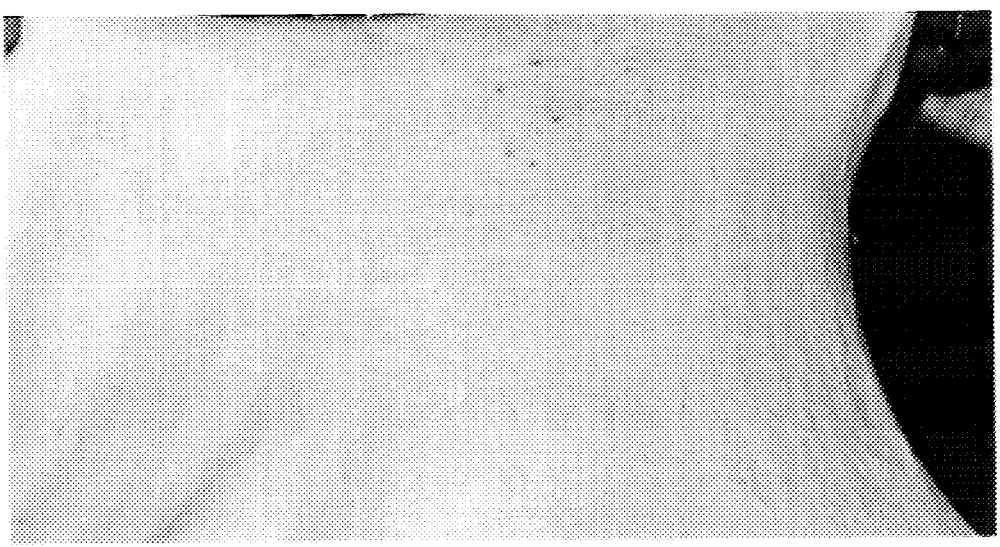


b.

Figure 14 Examples of yellow scabbing seen on wet salted sheep skins.

a.

b.



c.

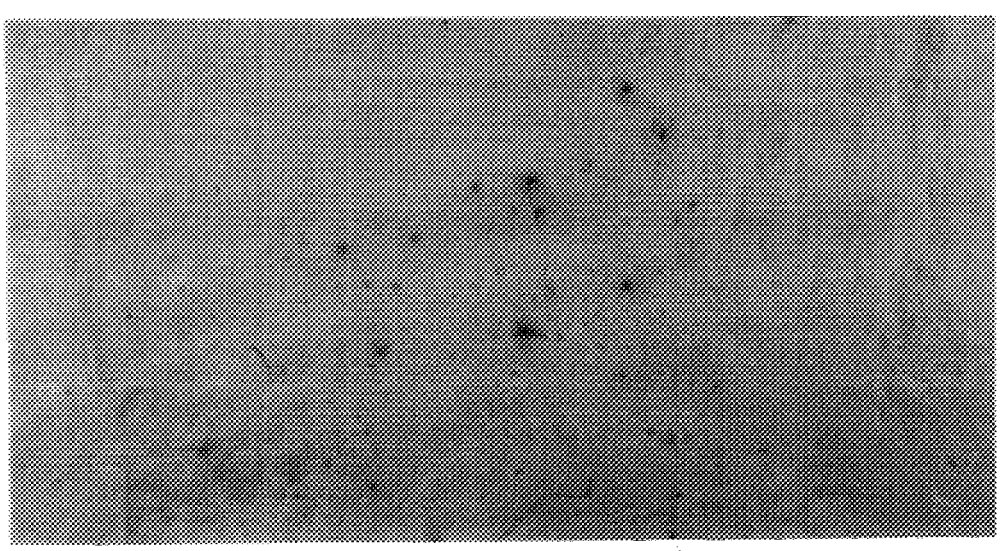


Figure 15 a) Dry scabbing seen on an air dried sheep skin.
b) Resulting pitting damage seen on pickled skin.
c) Pitting damage (approximate size).

4.3. Regional Variations

In order to assess any regional variations in ectoparasite levels the sheep and goat skins were assigned to five regions North, West, South, East and Central (outlined in **table 6**). Comparing the relative proportions of sheep skin parasite infestations (**table 7**) it can be seen that:

- Levels of biting lice infestations were high (over 55%) for all regions with the highest number of skins being affected in the Eastern and Central areas (approximately 70% of skins affected).
- There was a marked variation in the proportion of skins affected by keds. The Western and Eastern region skins having very low levels, while nearly 40% of Northern skins were affected.
- Only low numbers of skins were affected by sucking lice, the highest being in the Central region (7%).
- Nearly 10-15% of the Eastern (highest), Northern and Western skins were affected by ticks. Very low levels of Southern and Central skins were affected.
- The skins inspected from the Western regions provided the highest numbers of uninfested/clear skins (over 40%), double that obtained form Northern and Eastern skins.

Comparing results from Northern sheep skins obtained from the first[17] and second field visits (**table 7**), the numbers of skins affected by biting lice and ticks increased slightly, while the numbers affected by keds and sucking lice appear to have decreased. The proportion of clean skins remained at about 20%.

Table 6 Regional basis of sheep and goat skins origins.

Region		Description
North	Gondar Gojam Wello Tigre	Highland areas
West	Wellega Illubabor/Jimma	Highland areas
South	Gamagofa Sidamo Arsi Bale S.Shewa	Lowland/Highland areas
East	Harerge/Harrar Ogaden	Lowland areas
Central	Addis N.Shewa	Highland areas (medium)

Table 7 Comparison of relative proportions of sheep skins affected by ectoparasites on a

[17] The majority of skin assessed in the first visit were either from mixed origins or from the Northern regions of Ethiopia.

regional basis. Full regional break-down is given in Appendix III.

DESCRIPTION	AFFECTED SKINS (%)						
	North (1st Visit)	North	West	East	South	Central	Total[18]
Biting lice	55	61	56	69	58	68	64
Keds	48	39	0	3	10	26	21
Sucking lice	7	1	2	0	3	7	3
Ticks	0	7	9	14	3	1	7
"Yellow"	7	9	7	6	8	3	7
Clear	22	21	42	20	28	33	26
Number of Skins	(58)	(122)	(43)	(35)	(79)	(72)	(402)

Tanneries have reported the Wello region[19] as being the area which first produced significant amounts of "ekek" damaged sheep skins. In order to try and establish if the same kind of damage, and ectoparasite burdens, were occurring on skins from this region fresh and freshly salted skins held by skin collectors in Dessie and Gimba were inspected during the first visit.

During the inspection of the raw material only keds and biting lice were found. Only 8% of the skins were clear of any infestation, 31% had only keds, 11% had only biting lice and 50% had mixed ked/lice infestations. Although the sample size was relatively small, there is an indication that there may be a higher incidence of ectoparasite infestations in this region (92%), compared with the average figure obtained in **table 3** from mixed origin material (79%). A higher proportion of skins were affected by keds (73% in Wello region compared to 44% on skins from mixed origins), and fewer skins carried biting lice infestations (38% in Wello region compared to 65% on skins from mixed origins).

Comparisons of the regional variations in disease and ectoparasite incidence on inspected goat skins is shown in **table 8**. The most notable differences between the regions are:

- Relatively high levels of sucking lice on the Northern skins (about 20%) compared to the other regions (about 5%).
- High levels of demodex nodules (23%) found on the Southern skins.
- High levels of scabbing (20%) found on the Eastern skins (possible mycotic dermatitis).

The highest proportions of clear skins (no infestations) were seen in the batches of skins originating from the Eastern regions (56%). Significantly more clear goat skins were seen compared to sheep skins, reflecting the respective ectoparasite incidence.

Table 8 **Comparison of relative proportions of goat skins affected by ectoparasites on a regional basis. Full regional break-down is given in Appendix III.**

[18] Includes skins of mixed or unknown regional origin.
[19] A highland region north of Addis Ababa

DESCRIPTION	AFFECTED SKINS(%)		
	North	East	South
Biting lice	11	4	14
Sucking lice	19	4	5
Demodex	5	8	23
Ticks	1	4	0
Yellow/ Scabbing	13	20	9
Pox	9	12	9
Clear	47	56	41
Number of skins	(92)	(25)	(22)

4.4. Seasonal Variation

Cockle (ekek), tick, pox and demodex damage were seen on sheep skins during the two visits, only the pitting type damage (**figure 15**) appeared to have a direct seasonal incidence. Mycotic dermatitis (thought to be the cause of the pitting) is known to have a higher incidence during warm, humid conditions - similar to those occurring during the second rainy season visit.

However, the majority of damage (88%) seen on the sheep skins during the second visit was still found to be "scatter cockle" type nodules, which occurred at a slightly higher incidence than during the first visit (**table 9**). Similar levels of "rib cockle" were found during the two visits (4%).

The levels of tick and demodex damage appeared to have decreased during the rainy season compared to the previous rates of incidence (but were consistent with raw material ectoparasite incidences), while the pox type damage was seen to be slightly increased.

Table 9 **Percentage of pickled sheep skins affected by damage.**

DAMAGE TYPE	AFFECTED SKINS (%)	
	1st Visit	2nd Visit
"Cockle" - Scatter	73	88
- Rib	3	4
Tick damage	14	9
Pox lesions	9	12
Demodex cysts	7	1
Pitting	0	7
Number of skins	(99)	(147)

Pox lesions, demodex cysts and grain eruptions and tick damage were found on inspected goat skins during both visits. From discussions with tannery representatives it was indicated that there had been an increased incidence on goat skins of a pitting and scaring type damage over the June - August period.

The relative incidence of the various damage types seen during the second visits are shown in **table 10**, relatively few skins were examined during the first visit making it difficult for direct seasonal comparisons to be made.

The majority of the pitting had the classical appearance of damage caused by *dermatophilus congolensis*, confirmed by scarring, distorted follicle growth and grain surface. However a larger type of pitting was also seen on pieces of wet blue which was consistent with demodex cysts erupting at the grain surface, confirmed by cyst damage seen on the flesh side of the skin and the remains of the erupted cyst seen in cross sections of the pitted area. The pale scar patches also seen on wet blue skins, could be a result of healed damage resulting from, for example, heavy lice or mild *dermatophilus congolensis* infections. This superficial type of scarring is very different from the gross damage caused by pox (viral) infections.

Table 10 Percentage of wet blue goat skins affected by damage during the second visit.

DAMAGE TYPE	AFFECTED SKINS (%)
Pox lesions	10
Demodex cysts	15
Tick damage	2
Pitting	15
Pale scar damage	20
Number of skins	(147)

4.5. Raw Material Selection and Processing Results

Wet-salted sheep skins were selected, during the first visit, at the raw stage to be either "good" or "bad" in terms of visible signs of infestation, disease or damage. The "bad" skins were found to have ked, biting and sucking lice infestations. These skins were processed to pickle and graded by the tannery as follows:

"Good" batch - 90% I-IV grades (70% I-III grade)

"Bad" batch - 70% reject grade (no grade I)

All the damage seen on the skins was in the form of scatter "cockle" type nodules of varying severity, and identified as being typical of "ekek". **Figure 16** illustrates the positive correlation exhibited between the extent of damage seen on the pickled skins (commercial grading) and the level of ectoparasites (lice and keds) found on the raw skins. (Note that there were only 2 skins graded as having level 3 infestations). This was the first time that "ekek" damage had been predicted from a raw material inspection.

A similar exercise was carried out during the second visit, where wet-salted sheep skins were selected at the raw stage to be either "good" or "bad" in terms of visible signs of ectoparasites. These skins were processed to pickle and graded by the tannery representatives for "ekek" damage only:

	Grade I/III	Grade IV/Reject
"Good" skins	100% (20% III)	0%
"Bad" skins	53% (33% III)	47%

All the skins used in this trial were classified as Grade I raw materials. The resultant high level of low grades (nearly 50%) is consistent with the reported incidence of "ekek" and illustrates the problem of initial raw material quality grading.

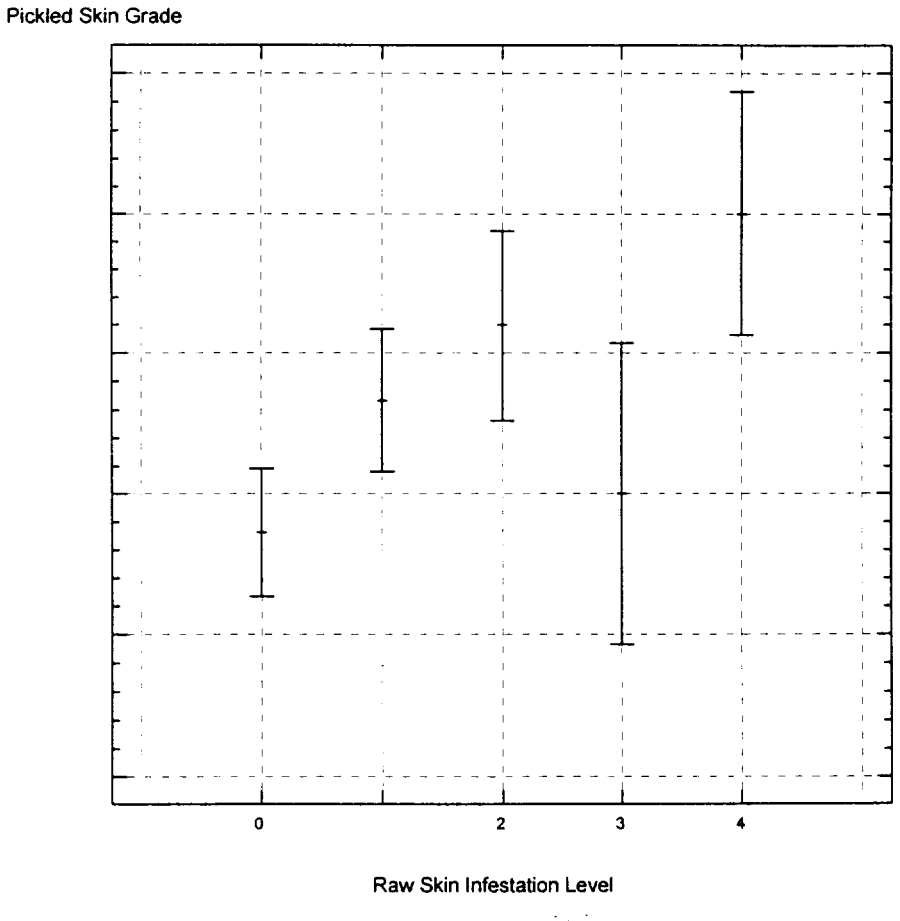


Figure 16 Mean commercial pickled skin grades obtained from raw sheep skins with different levels of ectoparasite infestations (n=30). (95% confidence intervals as error bars).

Key:

Commercial pickled grades:	1 = I (good)	Parasite infestation level*:	0 = none
	2 = II		1 = slight (1-5 parasites)
	3 = III		2 = moderate (6-10 parasites)
	4 = IV		3 = heavy (11-20 parasites)
	5 = Reject		4 = severe (20+ parasites)

*Parasite infestation levels were estimated by counting the total number of parasites visible on hair partings on the neck, shoulders, backbone and belly areas of the skin.

5. PHASE IV - RECOMMENDATIONS FOR IMPROVEMENT SCHEMES

Through the work carried out in this definition project the major natural defect problem of "Ekek" occurring on Ethiopian sheep skins has been linked to high levels of ectoparasite burdens. In order, therefore, to significantly improve the quality of this material the levels of these infestations need to be controlled. Three areas for further raw material improvement activity are recommended:

5.1. Awareness and Recognition of the Problem

The "Ekek" problem is not confined to any particular region and is now at such high levels that it is significantly affecting a national resource. The problem is a national one and needs to be tackled on a national basis. Current small animal farming practices are not effectively controlling the levels of ectoparasite infestations. Farmers are either unaware of the problems associated with high levels of infestation or unable/unwilling to take any action to address the problem.

A programme of education needs to be undertaken to reinforce the financial and health benefits of good parasite management, which would include such areas as:

- Parasite transmission of diseases;
- Associated increased milk/meat returns from healthy animals;
- Potential financial gain from good quality skins.

This last point, *financial gain to the farmer for good quality skins*, should be the fundamental principle of any raw material improvement programme undertaken. Different schemes around the world have shown that if a programme is to be successful there has to be a finial incentive for the primary producer. At the very least the farmers' treatment costs have to be covered either through free/subsidised access to treatments, or through increased returns, "quality premiums", for their skins.

Information on the treatment regimes and resultant cost and incentive implications need to be more clearly defined before a wide scale control programme can be implemented. Currently the cost of dipping an animal is estimated as 1 Birr[20], compared to a skin price of about 15 Birr. Potentially an animal may be dipped 2 or 3 times during its life. Results from the FAO project should give an indication as to the effectiveness of a number standard parasite treatment practices. Previous work by other researchers has indicated that:

- Good dipping practices with an appropriate insecticide, or

- Shearing alone or in conjunction with an insecticide treatment (pour-on)[21],

at the appropriate time during the year should effectively control biting lice and keds and thus reduce skin defects resulting from allergic responses.

5.2. Demonstration Project

A demonstration or pilot project is required to establish, and show, the benefits from a simple treatment regime to each of the links in the skin marketing chain (farmer, skin merchant and tanner). It is suggested that in the first instance this is confined to one region, were animal husbandry extension work is already well established. A number of localised farmers need to be identified with a central skin collector/merchant who feeds directly to a local tannery. This will help ensure direct communication

[20] 1 Birr = US$ 6.35

[21] Heath A, Cole D, Bishop D. Pfeffer A. Cooper S & Risdon (1995) - Vet. Parasitology (56) 239-254.

channels and help in collecting information on skin quality from the tanner to evaluate potential levels of premium. This quality premium evaluation will be necessary over a 2 to 3 year period - there will be a lag phase between implementing parasite control treatments and significantly improving skin quality. Base line damage levels would need to be established in the area before the treatment programme is implemented.

Eventually it is envisaged that farmers could potentially group together into producer co-operatives to treat and sell there own skins directly to tanneries. Such co-operatives would aid in diluting the treatment costs for an individual, while increasing bargaining power and peer pressure to other farmers to control diseases. Producer co-operatives would also increase the effectiveness of extension work concerned with "off take" and "putrefaction" damage - the only other two damage categories out of direct control of the tanner.

Plunge dipping of animals is considered the most effective method of controlling ectoparasites. It is understood that many regions have animal dipping facilities, but in the majority of cases these are no longer functional. Alternatives, such as the use of "make shift" drum/barrel dips for small ruminants (i.e. sheep or goats are physically lifted and dipped in a drum containing the treatment chemical), or spray "back packs" are understood to be used in some regions.

For a single treatment pilot trial the use of a good, broad spectrum insecticide, such as diazinon (organophosphate), is suggested. Diazinon is one of the few treatment chemical readily available, on a commercial basis, in Ethiopia. It is understood that other treatment chemicals such as deltamethrin and cypermethrin (synthetic pyrethroids) and amitraz (formamidine) are available but not widely used. Ivermectin products are not currently registered for use in Ethiopia; the chemical also has the disadvantage of not fully controlling biting lice (one of the major problems).

Timing of the treatment operation will require careful consideration. Factors such as meat and milk withdrawal times and the anticipated slaughter time of the animal will need to be considered. As previously stated skin damage caused by both lice and keds is the result of allergic responses of the animals. Remove the parasite and the damage will begin to resolve itself. Work by previous workers suggests that at least 2 months is required for this process to occur. Results from the FAO project will provide information on both treatment efficiencies and timings. Significant numbers of sheep and goats are slaughtered around the religious holidays (Christmas/Easter/Ramadan), suggesting that for maximum effect a treatment programme should be based around these events.

The widespread use of treatment chemicals to control parasites inevitably raises problems concerning resistance of parasites to these chemicals. There is currently no apparent resistance problems in Ethiopia[22], probably due to the fact that control treatments are not in widespread use. However, this potentially very serious problem must be taken in to consideration during planning of any widespread treatment programmes. The potential of simple alternatives such as shearing (being evaluated under the FAO project) should also be considered against such long term factors.

5.3. Integrated Approach to the Problem.

In order for the full financial befit from treated skins to be realised, i.e. the quality premium being passed back to the farmer, the tanner must be able to obtain high quality skins. This means that the other "off take" and "preservation" types of damage must also be controlled. A skin free of parasite damage but affected by flay and putrefaction defects is still useless to the tanner. It is there for essential that the ectoparasite control programme is integrated with other extension work being carried out to minimise all unnecessary damage to skins.

[22] From discussions with Ethiopian MOA officials.

In summary a pilot trial is needed to demonstrate:

1. Control of the problem parasites;
2. Control costs to the farmer;
3. Cost and input required of skin traders;
   Quality gain to the tanner.

The suggested pilot trial should be carried out:

- In an area where animal husbandry extension work is already well established;
- Involving a group of local farmers;
- Skins being collected by one central skin collector/merchant;
- Leather processing being carried out by a local tannery;
- Over a 2 to 3 year period to establish improving skin quality;
- Establishing base line damage levels prior to treatment programme implementation;
- In conjunction with farmer (& skin collector) education on "life time", "off take" and "putrefaction" damage.

The parasite control treatment needs to be:

- A single treatment (i.e. this should not be a comparative trial);
- Simple in operation and organisation;
- Chosen taking the results from the FAO project in to consideration;
- Chosen taking resistance and environmental considerations in to account.

However, from discussions with MOA and UNIDO officials during the field visits, it was suggested that a diazinon dipping treatment in the Amara region, using a group of 10-20 farmers may fulfil the requirement for the pilot trial.

6. DISCUSSION & CONCLUSIONS

Work carried during the field visits has related the formation of "cockle" nodules to the presence of ectoparasites, in particular biting lice and keds, on raw skins (and thus the live animal). The resulting scatter cockle damage has also been identified with the "ekek" damage term used by the Ethiopian graders. From discussions with managers, production and technical staff of the seven tanneries visited, and inspection of selected damaged material, it was established that the "ekek" damage term is being applied across the board to the same type of damage occurring to pickled skins.

It has been established that "Ekek" damage is not confined regionally to the Wello area. It has been confirmed that badly affected skins are now coming from other regions such as North Shewa, Gondar and Godjam. The major ectoparasites affecting sheep skins from a variety of origins were confirmed as biting lice and keds. The relative numbers of skins affected by these parasites tended to be higher on skins from the Wello region, although this needs to be confirmed as the sample size was small.

Data collected on the levels of low and reject grade skins occurring in commercial production have confirmed:

- General increase in low and reject grades for both sheep and goat skins;
- Increase in "life time" defects occurring on sheep and goat skins;
- High incidence of "Ekek" damage - identified as scatter cockle.

Information on sheep and goat skin semi-processed material obtained from a number of tanneries has confirmed the reported general increase in the levels of low and reject material over, at least, the last five years. Damage problems are currently at unacceptable high levels with individual tanners indicating that at "peak" damage periods no grade I material is being produced.

Generalised seasonal peaks are apparent around December/January and April/May which correspond to the periods just after the two rainy seasons (February/March and August/November). However, it is difficult to directly compare data from different tanneries as the grading criteria, production levels and regional origins of raw material vary at different times of the year and from tannery to tannery.

The reported levels of low grade/reject material are caused by a number of different types of damage occurring on the skins:

1. "Life time" defects - parasite/disease scratch and branding;
2. "Off take" defects - flay damaged and misshaped;
3. "Preservation" defects - putrefaction, crack, smoke and hide beetle damage;
4. "Production" defects - various physical and chemical damage.

Breakdown of rejection causes by one tannery have indicated a steady increase in the "life time" defects occurring in their production over the last three years. This increase corresponds with increased incidence of parasite/disease damage seen on exported material over the same period and high levels of parasite damage seen on skins during the two UNIDO field visits (particularly "Ekek" damage). Significant amounts of putrefaction and hide beetle damage were also seen during the second UNIDO visit. Poor salt curing[23] and air drying[24] of skins can occur during periods of high atmospheric humidity, i.e. during or just after rainy seasons, which then contribute to the "seasonal" increases in damage.
Data collected on raw material quality has confirmed:

[23] Under humid atmospheric conditions salt can absorb moisture from the atmosphere which results in a reduced salt content at the surface of the skin, salt can also be lost from the skins by drainage of this moisture. Leaching out of salt can also occur where skins are left open to rain.

[24] The drying procedure becomes protracted allowing bacterial activity to occur. Storage of dried skins under humid atmospheric conditions results in the gradual increase in skin moisture, allowing bacterial and fungal activity to occur.

- High incidence of ectoparasite infestation of sheep skins - predominantly biting lice and keds;
- Lower levels of ectoparasite infestation of goat skins - predominantly lice and demodex;
- Positive correlations between ectoparasite burdens and processed skin quality.
- Seasonal and regional variations in ectoparasites and diseases on sheep and goat skins.

Information collected during the second UNIDO visit confirmed that the majority of sheep skins, irrespective of regional origin, are affected by ectoparasites. Biting lice appeared, overall, to have the highest rate of incidence and regional spread. Keds were the next single biggest sheep skin ectoparasite problem. Both these ectoparasites are known to produce allergic responses in the host animal that result in similar "cockle" type damage on processed skins. Scatter cockle damage, a characteristic associated with biting lice infestations[25], was again identified as the major natural damage type occurring on pickled sheep skins. This scatter cockle damage was identified by tannery representatives as characteristic of the damage termed "ekek".

"Ekek" has not been identified as a problem on goat skin production. This corresponds to the general low levels of ectoparasites found on goat skins. Demodectic mange and pox type diseases appear to be the major natural causes of rejection for goat skins. Both these types of damage, unlike "ekek", can be easily detected at the raw material stage. A seasonal increase of *dermatophilus congolensis* infections is indicated during/after the rainy seasons.

A seasonal influence on damage occurrence is indicated by the different parasite and disease incidences found during the two field visits. Lice populations have a natural seasonal (and regional) variation linked to temperature and humidity levels[26]. Where marked temperature fluctuations occur a reduced louse population may be expected during very cool or very hot periods. However, lice are also sensitive to prolonged exposure to high fleece moisture levels[27], for example wet fleeces after heavy rain storms. This factor, rather than temperature fluctuations[28], would explain the reduced incidence of suckling lice experienced during the second visit. However, the most noticeable fact concerning the incidence of biting lice (*Damalinia ovis*) is the very high numbers of skins affected from all regions during both visits. This louse is capable of a very rapid population expansion by changing to asexual reproduction by parthenogenesis[29], which means any climatic influence on populations levels could be masked, particularly if levels are already high. Sheep skins were seen to have relatively higher levels of eggs and nymphs during the second visit.

Keds are also particularly sensitive to climatic conditions, favouring cooler, wetter rather than dry, hotter areas. Classically keds are a problem in highland regions, and this was found to be the case in Ethiopia, with the highest incidence of ked infestations occurring in Gondar, Tigre and Arsi regions. Interestingly no keds were found in the Western region skins inspected, although this region was classified as "highland". This finding may be explained by the type of farming or husbandry practices used in this region. Seasonal climatic influences on ked populations is seen in the reduced levels of keds found on Northern skins during the second visit compared to the first. Ked populations are slow to recover from adverse conditions and a large number of keds found on a skin is indicative of a long term infestation and potentially greater amounts of skin damage.

The damage to goat skins, identified by tanners as the main causes of the recent increases in rejected material, have been linked to demodex mites and *dermatophilus congolensis* infections. Rainfall and

[25] Halligan G & Johnstone A C (1992) - J. Am. Leather Chem. Ass. (87) 39-51.
[26] Radostits O M, Blood D C & Gay C C (1994) - Veterinary Medicine
[27] Murray M D (1963) - Aust. J. Zool., (11) 173-82.
[28] Except possibly in the highland regions were greater temperature fluctuations can occur.
[29] Urquhart G M, Armour J, Duncan J L , Dunn A M & Jennings F W (1992) - Veterinary Parasitology.

humidity play a major role in the occurrence of both demodecosis[30] and dermatophilosis[31], with greater incidence of these diseases occurring during prolonged wet, humid periods.

Tick activity is also influenced by climatic conditions. In tropical and sub-tropical regions the limiting factor is usually rainfall[32]. Tick activity and reproduction is generally greater during or just after the rainy season when vegetation growth is recovering. A greater variety of tick species were noted during the second visit and the numbers of ticks per skin appeared greater (over 15 ticks were counted on one sheep skin). Considerable regional variation in tick affected sheep and goats skins was noted with the highest incidence occurring in the East.

Recommendations for the improvement of Ethiopian raw material quality have been discussed and hinge around three areas:

- Awareness and recognition of the problem - a programme of education to reinforce the financial and health benefits of good parasite management;

- Demonstration project - to establish the benefits from a simple ectoparasite treatment regimes to each of the links in the skin marketing chain;

- Integrated approach to the problem - the ectoparasite control programme must be integrated with other extension work to minimise all unnecessary damage i.e. off take and putrefaction damage must also be prevented in order for the supply chain too benefit from improved farm/animal related damage.

[30] Venkatesan R A, Koteeswaran & Chandran M (1991) - J. Soc. Leather Tech. & Chem. (75) 130-133.
[31] Llyod D H & Jeninson D M (1980) - Br. Vet. J (136) 122-134
[32] Hunter A (1994) - Animal Health Vol. 2 Specific Diseases.

Appendix I - Field Trip Itinerary & Contacts.
First Field Visit (18/11/95 - 05/12/95)

Date	Day	Itinerary	Contacts/Comment
18 Nov 1995	Saturday	Arrive Addis Ababa	
19	Sunday	-	-
20	Monday	AM - Meeting with UNIDO & Ethiopian Ministry of Agriculture (MOA) contacts to discuss project and field work arrangements. PM - Veterinary Services (MOA), Region 14 Hide & Skin inspectors.	Mr. Z. Kebede - National Expert. Project DP Dr. Kassa Bayou - National Animal Health Research Centre. Mr. Tekle Zeleke - MOA Mr. Ababe.
21	Tuesday	AM - Meeting with UNIDO representatives. PM - Ethiopian Pickling & Tanning Factory.	Mr. Z. Kebede, Dr. Kassa Bayou, Mr. Tekle Zeleke, Ms. Birgitte Christensen - UNIDO Programme Officer. Raw material inspection.
22	Wednesday	Skin sheds around Addis Meeting with Tanners Council representatives	Mr. Z. Kebede, Dr. Kassa Bayou, Mr. Tekle Zeleke Mr Haile Selassie Derso - Chairman of Ethiopian Tanners Association, plus other tannery representatives
23	Thursday	AM - Dire Tannery, Wallia Tannery. PM - Ethiopian Pickling & Tanning Factory.	Raw material, pickle, wet-blue ad crust inspections.
24	Friday	AM - Ethiopia Tannery PM - Modjo Tannery	Raw material, pickle, wet-blue ad crust inspections.
25	Saturday	AM - Awash Tannery	Raw material, pickle, wet-blue ad crust inspections.
26	Sunday	Travelling to Wello region	-
27	Monday	AM - Region 3 MOA, Dessie PM - Kombulcha Tannery. Gebremichael Skin store, Dessie.	 Pickle, wet-blue ad crust inspections. Raw material inspection.
28	Tuesday	Gimba, Wello region	Fresh skin inspection
29	Wednesday	Return to Addis Ababa Debra Brahran Sheep Breeding Centre.	
30	Thursday	AM - Serbha Veterinary Laboratories. PM - Ethiopian Pickling & Tanning Factory.	 Inspection of previously selected rawstock at pickled stage.
1 Dec	Friday	AM - Ethiopia Tannery PM - EU slaughter slab Debre Zeit	Inspection of previously selected rawstock at pickled stage.
2	Saturday	AM - Ethiopian Pickling & Tanning Factory.	Inspection of previously selected rawstock at pickled stage
3	Sunday	-	-
4	Monday	AM - MOA quarantine offices PM - UNIDO/MOA/ Tannery representative	 Findings and round up discussions.
5	Tuesday	AM - Ethiopian Pickling & Tanning Factory. PM - Depart Addis	Inspection of Gimba skins at pickled stage.

Second Field visit (27/08/96 - 10/09/96)

Date	Day	Itinerary	Contacts/Comment
27 August	Tuesday	Arrive Addis Ababa	
28	Wednesday	AM - Meeting with UNIDO & Ethiopian Ministry of Agriculture (MOA) contacts to discuss project and field work arrangements. PM - Meeting with Tanners Council representatives	Mr. Zewdu. Kebede - National Expert. Project DP Dr. Kassa Bayou - National Animal Health Research Centre. Mr. Tekle Zeleke - MOA Mr Haile Selassie Derso - Chairman of Ethiopian Tanners Association, plus other tannery representatives.
29	Thursday	AM - Ethiopian Pickling & Tanning Shed PM - Ethiopia Tannery Shed	Mr. Zewdu. Kebede Mr Camil Raw material inspection.
30	Friday	AM - Ethiopian Pickling & Tanning Factory. PM - Awash Tannery	Mr. Zewdu. Kebede Mr Camil Raw material inspection.
31	Saturday	AM - Awash Tannery	Mr. Zewdu Kebede, Dr. Kassa Bayou Pickle, wet-blue ad crust inspections.
1 Sept.	Sunday	-	-
2	Monday	AM - Meeting with UNIDO representatives AM - Wallia Tannery. PM - Dire Tannery.	Mr. Z. Kebede, Ms. Birgitte Christensen - UNIDO Programme Officer. Raw material, pickle and wet-blue inspections.
3	Tuesday	AM - Ethiopia Tannery PM - Modjo Tannery	Raw material, pickle and wet-blue inspections.
4	Wednesday	AM - Serbha Veterinary Laboratories PM - Skin sheds around Addis	 Raw material inspection.
5	Thursday	AM - Ethiopian Pickling & Tanning Factory AM - Awash Tannery PM - Wallia Shed PM - Dire Shed	Inspection of previously selected rawstock at pickled stage. Raw material inspection.
6	Friday	AM - Awash Shed PM - Modjo Shed	Raw material inspection.
7	Saturday	-	
8	Sunday	-	
9	Monday	AM - Addis Ababa Tannery PM - MOA round up meeting	
10	Tuesday	AM - UNIDO round up meeting. PM - Depart Addis	

Tanneries visited and locations in Ethiopia:

First Field Visit
Ethiopian Pickling & Tanning Factory (Addis Ababa)
Modjo Tannery (1.5 hours outside Addis Ababa)
Awash Tannery (Addis Ababa)
Wallia Tannery (Addis Ababa)
Ethiopian Tannery (75 miles south of Addis Ababa, close to Modjo)
Dire Tannery (Addis Ababa)
Kombulcha Tannery (Wello region)

Second Field Visit
Ethiopian Pickling & Tanning Factory (Addis Ababa)
Modjo Tannery (1.5 hours outside Addis Ababa)
Awash Tannery (Addis Ababa)
Wallia Tannery (Addis Ababa)
Ethiopian Tannery (75 miles south of Addis Ababa, close to Modjo)
Dire Tannery (Addis Ababa)
Addis Tannery (Addis Ababa) - *Bovine material only*

Appendix II - FAO Sheep and Goat Diseases Project

Current Status of FAO Project

The project has effectively been rewritten since commencement in November 1995. There is no longer an element involving the artificial infestation of animals to assess resultant skin lesions and effects of control treatments. Instead naturally infested animals are being sourced. The training requirement incorporated into the project has therefore also been redefined, particularly in the area of marketing and extension work.

Phase I now consists of four stages to link the damage "cause" and "effect":

- Selection of hair sheep from the Wello region;
- Inspection of the live animal for external and internal parasites;
- Slaughter and inspection of the processed skins at the pickle stage for damage;
- Correlation of resultant pickle lesions with the results from the live animal inspection.

Phase II will still involve the treatment of infested sheep with commercially available chemicals and practices to investigate their effects on parasite levels and skin lesion types identified in Phase I.

Currently the project duration is set at 18 months, but it was indicated that this is likely to be extended. At the time of the visit Phase I work had just started and full analysis of results would be unlikely before the planned start of Phase II in November 1996. Two out of the three training elements had been completed[33].

Outline of Experimental Work

Phase I - Parasite burden and resultant skin damage analysis

80 hair sheep have been selected from and kept by farmers in the Wello region (March 1996). All have been inspected, the ectoparasite burdens established[34] and faecal sampled to establish internal parasite burdens. 30 animals have so far been slaughtered (June 1996), from which 20 skins have been processed to the pickle stage. Skin pathology (sectioning, skin scrapping and bacteriological analyses) on samples is still to be carried out.

Phase II - Parasite control/ treatment and resultant skin damage analysis

170 animals from the Wello region are to be used in 5 trial groups (treatment and control sub-groups). Each trial group will undergo different treatment regimes:

1. Diazinon (organophosphate) spray;
2. Diazinon spray + anthelmintics;
3. Ivermectin injection;
4. Shearing;
5. Shearing + anthelmintics.

Animals will be slaughtered from each of the trial groups a day 0, 60 and 120 post treatment. Parasite burdens and skin damage will be evaluated as per Phase I.

Summary of General Findings to Date & Comments

External parasite burdens - only lice and keds have so far been identified on the animals, no mycotic dermatitis or ticks were evident. Total burdens range from 0 to 700 lice per animal; 0 to about 50 keds per animal. These findings are consistent with those found on Wello/Dessie/Gimba skins during the first UNIDO field visit and Wello/Gondar skins inspected during the current visit.

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[33] Veterinary/parasite training (Dr. Kassa) and skin/disease pathology training have been completed; marketing/extension training apparently still required further definition.

[34] Ectoparasite burdens were established by counting numbers present on 5 hair partings at neck, shoulder, chest, rump, belly and back sites.

Internal parasite burdens - Faecal egg counts carried out so far indicate either only slight or moderate levels of infection. It will be important to understand not only the interaction between the ectoparasite and endoparasite burdens and the resulting type and levels of skin damage, but also the general nutrimental status of the selected animals (i.e. whether the animals are reared on high, maintenance or low nutritional rations). Heavy ectoparasite burdens can cause additional nutritional stress to animals already under stress through even moderate levels of internal parasites[35]. The combination of nutritional stress factors are likely to impinge on the extent (level) of skin damage and the recovery responses after treatment.

Skin damage - Pickled skin inspections carried out by Dr. Kassa and commercial tannery graders (Ethiopian Pickling and Tanning Factory) have identified predominantly "Ekek" (scatter cockle) and occasional rib cockle type damage.

Initial correlation between ectoparasite burdens on live animals and resultant skin damage confirm the findings from the first UNIDO field visit - where a positive correlation was exhibited between the extent of damage seen on the pickled skins (commercial grading) and the level of ectoparasites (lice and keds) found on the raw skins.

[35] Brunsdon R V & Vlassof A (1986) - New Zealand J. of Agriculture (51) 36-37

Appendix III

Table I **Regional variation in sheep skin ectoparasite burdens (percentage of skins affected).**

		AFFECTED SHEEP SKINS (%)					
Region	**Number of Skins**	**Keds**	**B.Lice**	**S. Lice**	**Ticks**	**Yellow /Scabs**	**Clear Skins**
North							
Gondar	54.0	53.7	57.4	0.0	5.6	5.6	16.7
Gojam	20.0	5.0	70.0	0.0	0.0	15.0	30.0
Tigre	40.0	42.5	60.0	2.5	12.5	12.5	20.0
Mixed	8.0	0.0	62.5	0.0	0.0	0.0	37.5
Total	***122.0***	***38.5***	***60.7***	***0.8***	***6.6***	***9.0***	***21.3***
West							
Illumubabor/Jimma	30.0	0.0	60.0	0.0	3.3	10.0	43.3
Wallaga	13.0	0.0	46.2	7.7	23.1	0.0	38.5
Total	***43.0***	***0.0***	***55.8***	***2.3***	***9.3***	***7.0***	***41.9***
East							
Harrar	20.0	5.0	70.0	0.0	20.0	5.0	15.0
Ogaden	12.0	0.0	75.0	0.0	8.3	8.3	16.7
Mixed	3.0	0.0	33.3	0.0	0.0	0.0	66.7
Total	***35.0***	***2.9***	***68.6***	***0.0***	***14.3***	***5.7***	***20.0***
South							
SE/Arsi	17.0	41.2	76.5	11.8	0.0	5.9	0.0
SE/S.Shewa/Bale	35.0	2.9	31.4	0.0	5.7	2.9	0.0
SW/Mixed	17.0	0.0	88.2	0.0	0.0	17.6	35.3
South/Mixed	10.0	0.0	70.0	10.0	0.0	10.0	30.0
Total	***79.0***	***10.1***	***58.2***	***3.8***	***2.5***	***7.6***	***27.8***
Central							
Addis	18.0	27.8	72.2	11.1	0.0	5.6	27.8
N.Shewa	54.0	25.9	66.7	5.6	1.9	1.9	35.2
Total	***72.0***	***26.4***	***68.1***	***6.9***	***1.4***	***2.8***	***33.3***
Mixed	***51.0***	***15.7***	***76.5***	***2.0***	***15.7***	***7.8***	***17.6***
Total (All Regions)	***402.0***	***20.6***	***63.7***	***2.7***	***7.0***	***7.0***	***26.4***

B.Lice = Biting lice
S. Lice = Sucking lice

Table II **Regional variation in goat skin ectoparasite burdens (percentage of skins affected).**

		AFFECTED SHEEP SKINS (%)						
Region	**Number of Skins**	**S.Lice**	**B.Lice**	**Demodex**	**Ticks**	**Yellow / Scabs**	**Pox**	**Clear Skins**
North								
Gojam	22.0	36.0	18.0	5.0	0.0	9.0	0.0	50.0
Gondar	39.0	23.0	0.0	10.0	3.0	23.0	10.0	36.0
Wello	31.0	6.0	19.0	0.0	3.0	3.0	13.0	58.0
Total	***92.0***	***18.5***	***10.9***	***5.4***	***1.1***	***13.0***	***8.7***	***46.7***
East								
E.Showa	9.0	0.0	0.0	11.0	0.0	22.0	0.0	78.0
Ogaden	16.0	6.0	6.0	6.0	6.0	19.0	19.0	44.0
Total	***25.0***	***4.0***	***4.0***	***8.0***	***4.0***	***20.0***	***12.0***	***56.0***
South								
Arsi	6.0	17.0	0.0	0.0	0.0	17.0	0.0	67.0
Dredowa	6.0	0.0	0.0	17.0	0.0	17.0	17.0	50.0
Mixed	10.0	0.0	30.0	40.0	0.0	0.0	10.0	20.0
Total	***22.0***	***4.5***	***13.6***	***22.7***	***0.0***	***9.1***	***9.1***	***40.9***
West								
Wellaega	3.0	0.0	33.0	33.0	0.0	0.0	0.0	67.0
Mixed	5.0	20.0	0.0	0.0	0.0	20.0	0.0	60.0
Total (All Regions)	***147.0***	***13.6***	***10.2***	***8.8***	***1.4***	***13.6***	***8.8***	***48.3***

B.Lice = Biting lice
S. Lice = Sucking lice

B L C

The Leather Technology Centre

Leather Trade House Kings Park Road Moulton Park Northampton NN3 6JD UK
TEL 0604 494131 Int Code 44 604 FAX 0604 648270 TLX 311210 BUREAU G