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Ethiopian Hides and Skin Defects and Quality Status: An Assessment at Wet Blue Stage

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Abstract

Hides and skins are important byproducts of livestock playing significant role in the Ethiopian economy. However, the potential of the sector is not adequately exploited due to factors limiting quality of the products. The objective of this study was therefore to identify the major defects of hide and skins and assess their impact on quality. The study was conducted in eight purposely selected tanneries in and around Addis Ababa. Overall, 648 hides, 648 sheepskins and 324 goatskins were assessed at wet-blue stage for defects and quality grading. Defects were categorized into pre-slaughter, peri-slaughter and post-slaughter problems. The findings showed 13 different types of defects; the major ones being cockle (28.4-60%), scratch (31-40.74%), scar (9.72-17.9%), flaying defect (35.2-69.44%) and putrefaction (20.2-25.31%). No single hide or skin was found free of defects. Irrespective of the type and number of defects observed, no skin or hide was found to fall in grades 1 and 2 whereas grades 3 and 4 accounted for only 0.31-2.47%. On the other hand, majority of the hides and skins were grouped in either low grade (5 and 6) or reject categories. Similarly, out of the total sample examined, pre-, peri- and post-slaughter defects accounted for 70-87%, 36.7-75.3% and 27.2-32.9% respectively. When data were filtered for each defect category to show the impact of each on quality, pre- and post-slaughter defects caused maximum loss of quality in cattle hide and sheepskins whereas peri- and post-slaughter defects were responsible for higher loss of quality in goatskins. Similarly, highest rate of rejection was caused by post-slaughter problem in cattle hide (66.7%) and goatskins (67%). About 66-73% and 17-18% of hides and skins were

downgraded to low grade and reject categories by cockle problem alone. Whereas scratch was responsible for 45-82% of the products earning low grades. Similarly, flaying defect only has resulted in 22-24% of hides and sheepskins being rejected while deteriorating majority of goatskins to low grade category. Putrefaction, although prevalent in lower proportion, has the capacity to cause major rejection mainly in cattle hides and goatskins compared to sheepskin. In conclusion, in the presence of other major pre-slaughter problems and slaughtering defects, ectoparasite control alone may not significantly improve the quality of both hides and skins. Therefore, it is strongly recommended that hide and skin quality improvement programs should include strategies that can alleviate all major problems from supply side (pre-slaughter to post-slaughter) stages.

Keywords: Ethiopia; Hide/Skin; Defect; Quality; Wet Blue

Introduction

Export commodities of Ethiopia are mainly agricultural outputs like coffee, hides and skins, and oil seeds and nuts. As these are the main sources of foreign earnings, they automatically define the country's capacity to import other materials used in manufacturing. Hides and skins as important economic components contribute significant amount to the national economy by providing 14-18% of the foreign exchange earnings [1].

The national annual off take/killing rate for Ethiopian cattle, sheep, and goats, are 10 %, 35 %, 38 %, respectively [2]. Since the country is gifted to have large livestock population of 55.694, 26.537 and 25.035 million bovine; sheep and goats respectively, based on population size and off take rate, the number of hide and skin that should be produced annually is expected to be 5,569,400 hide, 9,287,950 sheepskin and 9,513,300 goatskins [3]. Of these, the actual number of hides and skins collected in the country is 26% hide, 80% sheepskin and 65% goat skin which reach the different tanneries; the rest being either consumed locally or sold illegally through cross border illicit markets [4]. Moreover, the quality of those hides and skins reaching tanneries is not up to the desired standard hence leading to down grading and rejections along the processing line with ultimate reduction in the volume exported to the world market [5].

Poor animal husbandry practices expose the animals to skin diseases, scratches and wounds. Most of the hides and skins produced in the country are from backyard slaughter which predisposes the raw materials to slaughter defects such as flaying defects (holes, gauge marks, poor patterns and ripping, etc.) and veinnines due to poor bleeding. Absence of differential pricing for good quality raw materials has also discouraged good post-slaughter handling; altogether limiting supply of good quality skins and hides and compelling tanneries to function under capacity [6,7]. The objective of this study was therefore to evaluate at wet blue stage those factors potentially causing quality deterioration of Ethiopian hides and skins and estimate the contribution of major defects in this regards.

Materials and Methods

Study Areas and Study Materials

Overall, 1620 hides and skins (N=648 hides; 648 sheepskin; N=324 goatskin) were collected from eight purposely selected tanneries (Table 1) located in and around Addis Ababa in 100km radius to identify defects potentially affecting hides and skin quality and assign grades to each one of them according to the quality standards described by ESQA and Juhani [8,9]. The raw materials are sourced from different areas throughout the country.

0	Tannery Name	Hide	Sheepskin	Goatskin
1	Colba tannery	108	108	108
2	ELICO tannery	108	108	0
3	Ethio tannery	108	108	0
4	Mojo tannery	108	108	108
5	Addis Ababa tannery	108	108	0
6	Abiyssinia tannery	0	0	108
7	Dire tannery	108	108	0
8	Debre Brhan tannery	0	108	0
	Total	648	648	324

Table 1: Number of hide and skins assessed for defects and quality status (grades) from selected tanneries of Ethiopia.

Data Collection

The hide and skin samples included in this study were taken in such a way that the materials were evaluated one by one indiscriminately in a continuous manner from the heaps of hides or skins at wet blue stage until the desired number is obtained from each tannery. Defect types and grades were listed for each hide and skin by experienced selection and grading experts of the tanneries [8].

Data Analysis

Data was coded in Microsoft Excel spreadsheet; pooled and single defect types were filtered out and analyzed using SPSS version 20 to compare the proportions and relative contributions of major defects and grades of the raw materials in relation to individual and effect categories.

Results

Overall Prevalence and Grades of Hide and Skin

This study has revealed 13 different types of defects which can be categorized under pre, peri and post-slaughter problems (Table 2).

No	Defect types	N=648 Hide%	N=648 Sheepskin%	N=324 Goatskin%
Pre-slaughter defects				
1	Cockle(ekek)	41.98[a]	60.00[b]	28.40[c]
2	Scratch	44.60[a]	31.00[b]	40.74[c]
3	Brand marks	8.02	3.5	3.4
4	Pox lesions	2.16	4.63	3.09
5	Scar from wounds	17.59[a]	9.72[b]	9.88[b]
6	Tick mark	2.31	0.46	0
7	Shrinkage	0.15	0.46	0.93
8	Poor substance	2.62	10.49	4.32
Peri-slaughter defects				
9	Flaying defect	59.88[a]	35.20[b]	69.44[c]
10	Veinnines	0.93[a]	14.20[b]	26.85[c]
11	Ripping defect	0.93	3.24	1.54
Post-slaughter defects				
12	Putrefaction	24.38[a]	20.20[b]	25.31[a]
13	Processing defect	2.62	0.31	0.31

Table 2: Over all prevalence of hides and skin defects observed at wet-blue stage.
*Proportions with different superscripts are statistically different among the three skin products

Cockle, scratch, wound (scar), flaying defect(flay cuts, scores, gouges, holes, poor pattern) and putrefaction appeared in majority of the hides and skins whereas prevalence of veinniness caused by poor bleeding is more common in sheep and goat skins than in cattle hides. Although there were hides and skins affected by only one defect type, majority of them had multiple types of defects originating from one or more of the defect categories. Cockle was much more prevalent in sheepskins followed by hides and goatskins ($P<0.0001$). Similarly significantly more hides and goatskins were recorded than sheepskins for presence of scratches ($P=0.003$) whereas scars from wounds are more important in cattle hides than in shoat skins. Cattle hides and goat skins were found to be much more vulnerable to slaughter/flaying defects ($P<0.0001$) and putrefaction ($P<0.05$) than sheepskins.

As presented in Table 3, there was no single hide or skin with grade one or two category whereas the proportions of hides and skins falling in grade 3 & 4 were very minimal (ranging between 5.87% and 10.49%). On the other hand, majority of hides and skins were segregated under the low grades five and six (62.65% for hides and sheepskin and 69.75% for goatskin) followed by reject category. Significantly higher number of hides and sheepskins were rejected compared to goatskin ($P<0.05$).

Hide and skin quality (grade)	Hide		sheepskin		Goatskin	
	Frequency	%	Frequency	%	Frequency	%
Grade three	2	0.31	6	0.93	8	2.47
Grade four	36	5.56	59	9.1	26	8.02
Grade five	148	22.84	172	26.54	111	34.26
Grade six	258	39.81	234	36.11	115	35.49
Reject	204	31.48	177	27.31	64	19.75
Total	648	100	648	100	324	100

Table 3: Grade categories of hides and skins regardless of the defects observed.

Associations Between Cattle Hide Quality and Defect Category

About 82%, 60%, and 28% of hides examined had pre-slaughter, Peri-slaughter and post-slaughter defects respectively. Among these, hides with pre-slaughter defects only (N=185), Peri-slaughter defects only (N=60) and post-slaughter defects only (N=27) were filtered out and their grades assessed to know the impact of each defect categories on quality of the products. Best quality grades (grade 1 & 2) were absent in all of the defect categories (Figure 1). Although it is relatively small proportion, peri-slaughter defects such as ripping, flaying and bleeding problems caused relatively less quality deterioration than pre- and post-slaughter defects (P=0.005) . On the other hand, post slaughter problems (mainly putrefaction), when they occur, really cause the greatest damage to quality leading to rejection of 66.7% of the products compared to the other two stages of hide production (P<0.0001).

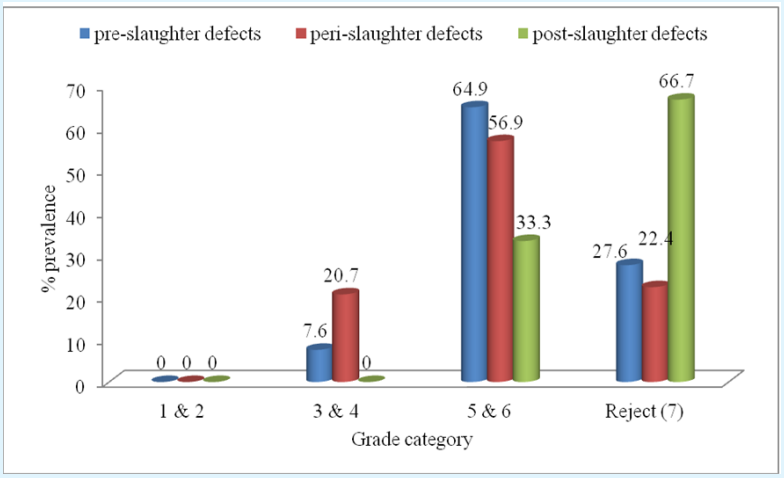

Figure 1: Quality grades of hides in relation to defect category (pre-slaughter, peri-slaughter or post-slaughter).

Association between Sheepskin Quality and Defect Category

When the different sheepskin defects are pooled into three different categories: pre-slaughter, Peri-slaughter and post-slaughter, the prevalence becomes 87%, 36.7%, and 32.9% respectively. Among these, sheepskins with pre-slaughter defects only (N=306), Peri-slaughter defects only (N=24) and post-slaughter defects only (N=32) were filtered out and their grades assessed to know the impact of defect categories on quality of the products. As seen in figure 2, best quality grade (grade 1 & 2) sheepskins were absent in all of the defect categories. Majority of the skins fall under low grade (5 and 6) in all cases where as significant proportion of skins also got rejected in almost similar proportion (P>0.05) regardless of the stages at which the defects were created (Figure 2).

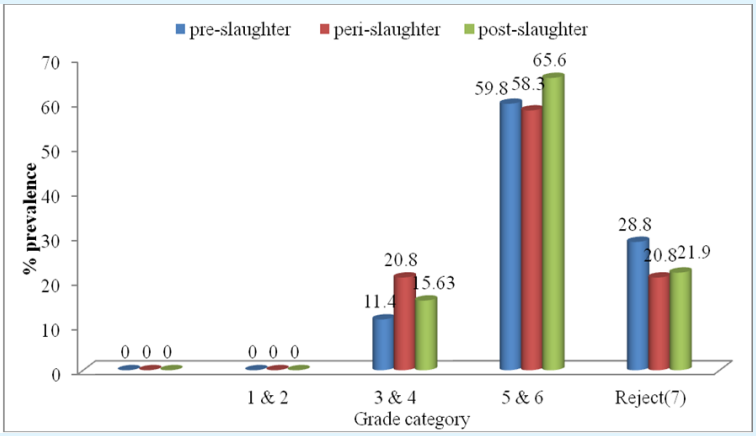

Figure 2: Quality grades of sheepskins in relation to defect category (pre-slaughter, peri-slaughter or post-slaughter).

Association between Goatskin Quality and Defect Category

Pooled goatskin defects revealed 70%, 75.3%, and 27.2% for pre-slaughter, Peri-slaughter and post-slaughter defect categories respectively. Among these, goatskins with pre-slaughter defects only (N=46), peri-slaughter defects only (N=46) and post-slaughter defects only (N=12) were filtered out and their grades assessed to know the impact of each defect category on quality of the products (Figure 3). As usual, best quality grades (grade 1 & 2) were absent in all the three categories. Majority of the goatskins fall under low grade (5 and 6) in pre-slaughter and peri-slaughter categories whereas most of the goat skins categorized under post-slaughter defect only were rejected compared to those in the other two groups (P<0.001).

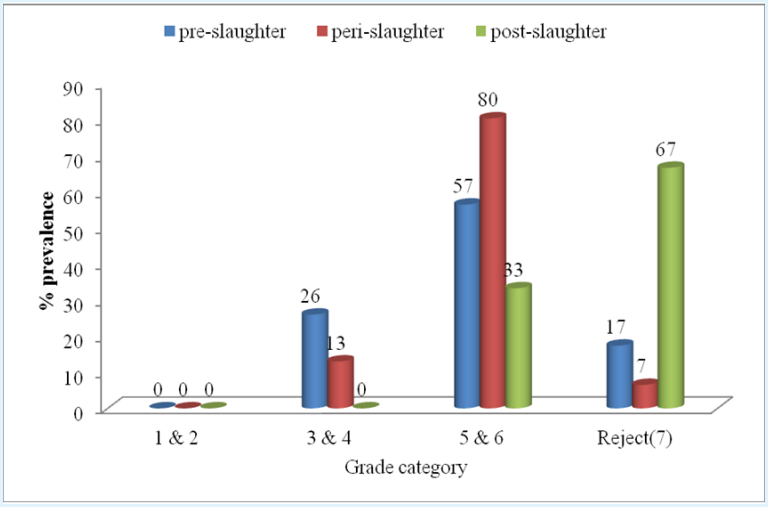

Figure 3: Quality grades of goatskins in relation to defect category (pre-slaughter, peri-slaughter or post-slaughter).

Individual Effects of Major Defects on the Quality/Grades of Hide and Skins

Among the various defects observed during this study, cockle (ekek), scratch and wound (scar) from pre-slaughter defects, flaying defect from peri-slaughter and putrefaction from post-slaughter defects were problems observed with high frequency. Accordingly, the impact of each of these major defects on quality (specifically on grade values of the hides) when they occur singly was evaluated.

Cockle

Cockle is small hard nodule, which form in the skin following ectoparasite infestations such as by sheep ked and lice. Twenty nine cattle hides, 115 sheepskins and 11 goatskins were found to harbor defects due to cockle only. Here also, there was no hide or skin falling under grades one and two (Figure 4). Cockle was responsible for 17-18% of the hides and skins rejected in the absence all other defects affecting quality. Moreover, most of the hides and skins affected by this problem received low grade (5 and 6). Hence, no significant difference was observed on the effect of cockle among grades of hides, sheepskin and goatskin (P>0.05).

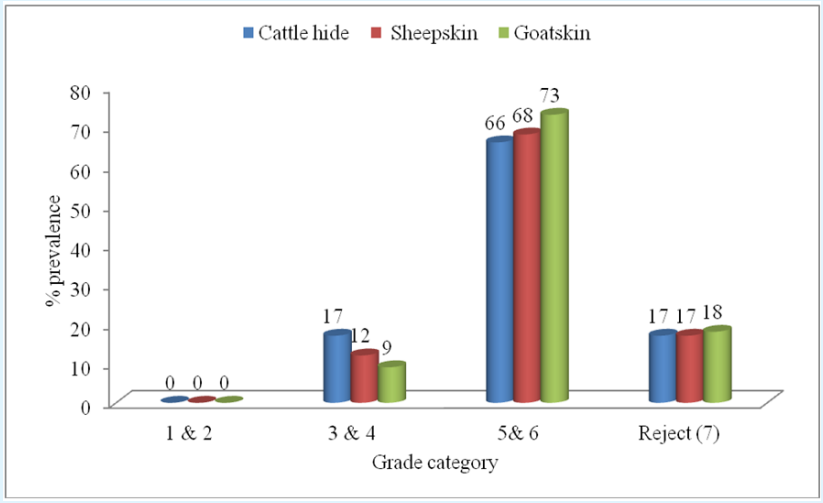

Figure 4: Quality grades of hides and skins affected by cockle only.

Scratch

Forty four cattle hides, 24 sheepskins and 22 goatskins were found to harbor defects due to scratch only. Scratch was responsible for only 5-13% of the hides and skins rejected in the absence all other defects affecting quality (Figure 5). Moreover, most of the hides and skins affected by this problem received low grade (5 and 6). This defect is significantly less damaging in goat skin than others (P<0.05) as witnessed by large proportion of goatskins falling in the grade categories of moderate quality (grades 3 to 4).

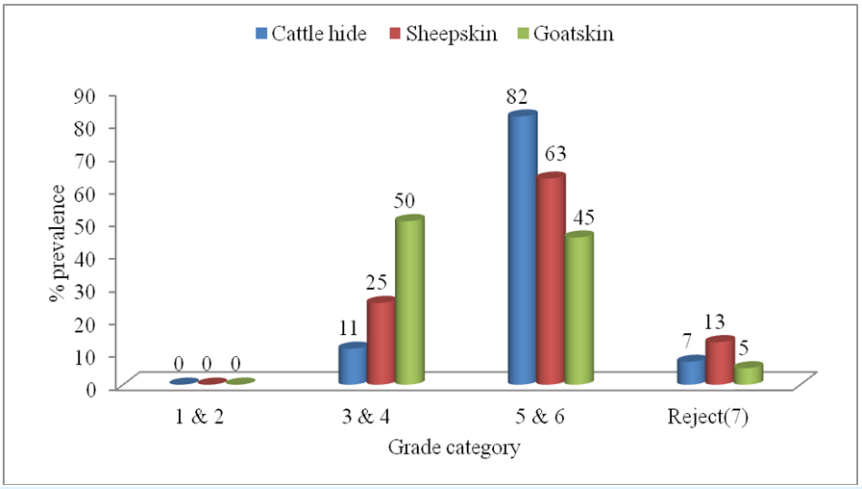

Figure 5: Quality grades of hides and skins affected by scratch only.

Scar/Wound

Scars and wounds were also one of the major problems affecting especially cattle hides and sheepskins. Fifteen hides, 16 sheepskins and one goatskin were found to harbor defects due to scars/wounds only. The problem was responsible for 24-44% of the hides and sheepskins rejected in the absence all other defects affecting quality although rejection was not observed in goatskins affected solely by this problem. In the same way as described for other major defects, most of the hides and skins affected by this problem received low grades (5 and 6) whereas hides and skins receiving grades 3 and 4 were very low in number (Figure 6). No significant difference was observed on the effect of scars/wounds among hide, sheepskin and goatskin grades (P>0.05).

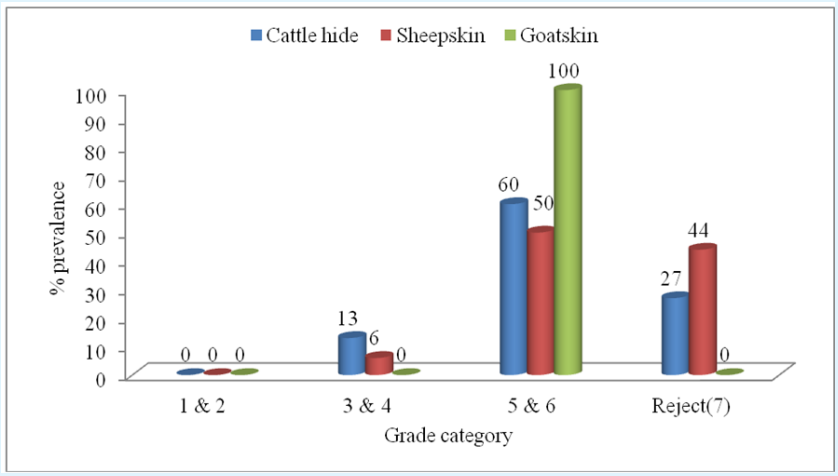

Figure 6: Quality grades of hides and skins affected by wounds/scar only.

Flaying/Slaughter Defect

Among peri-slaughter defects, flaying defect was one of the most prevalent man made problem affecting hide and skin quality. Sixty hides, 25 sheepskins and 32 goatskins were found to harbor defects due to improper slaughter and flaying only. The problem was responsible for 22-24% of the hides and sheepskins rejected in the absence all other defects affecting quality (Figure 7) which is much higher compared to the 3% rejected in goatskins (P=0.017). However, significantly higher proportions of goatskins with flaying defects only received low grades (5 and 6) than cattle hides and sheepskins with similar defects (P=0.003).

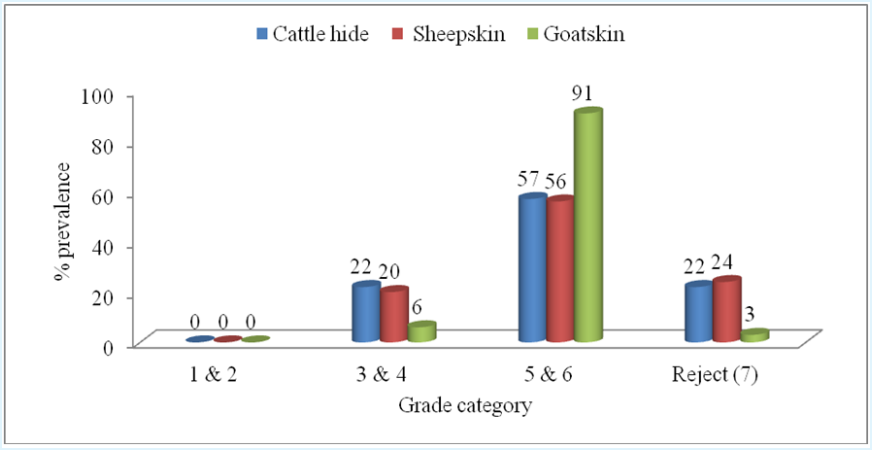

Figure 7: Quality grades of hides and skins affected by flaying defect only.

Putrefaction

Post-slaughter defects are caused as a result of handling, storage and processing problems. Among post-slaughter defects, putrefaction was one of the most prevalent problems affecting hide and skin quality. Eighteen hides, 31 sheepskins and 13 goatskins were found to harbor defects due to putrefaction only. The problem was responsible for 62-83% rejection rate of the hides and goatskins in the absence all other defects affecting quality (Figure 8) which is much higher compared to the 19% rejected in sheepskins ($P<0.05$). Although rejection was low in sheepskin affected by putrefaction, most of these skins fall under low grade category (Figure 8).

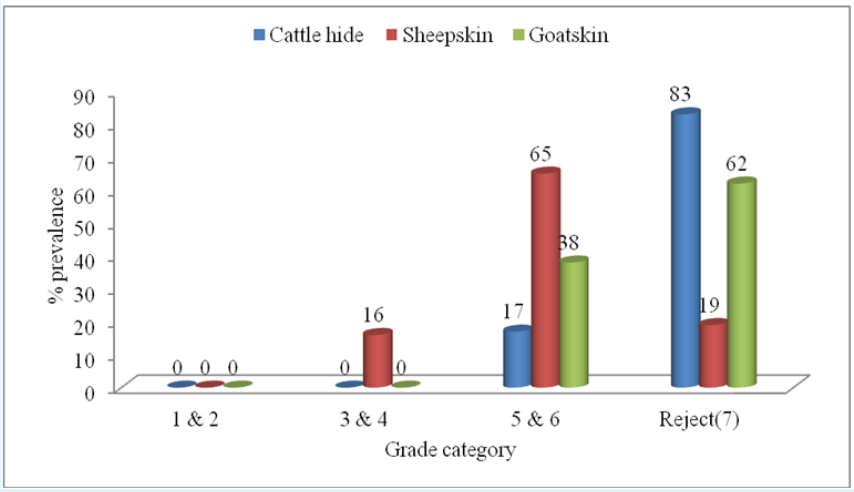

Figure 8: Quality grades of hides and skins affected by putrefaction only.

Discussion

Prevalence of Hides and Skins Defects

In agreement with the reports of Zemene and Addis; Kahsay, et al. and Behailu, et al., the findings of this study proved that no single hide or skin was found free of defects implying the high prevalence of the factors that undermine the quality of the raw material [10-12]. Supports the findings of the present study Zemene and Addis and Assefa, et al. reported that cockle, scratches, flaying defects, and putrefaction were the most prevalent problems in both hides and skins [10,13].

The same studies have documented high prevalence of pre-slaughter defects such as cockle caused by ectoparasites and mechanical damages such as wounds and scratches. Behailu, et al. reported that peri-slaughter defects are more prevalent than pre-slaughter defects; while the present study clearly indicated that defects occurring on live animals caused by ectoparasite and animal handling problems are dominant over peri- and post slaughter defects [12]. This difference might be due to the fact that most of the pre-slaughter defects caused by disease problems may not be adequately discernible on raw hide and skins.

In agreement with the findings of the present study, several studies have also ascertained that peri-slaughter defects such as flay cuts and post-slaughter defects like putrefaction also prevail in processed or unprocessed raw hides and skins examined from different parts of Ethiopia [10-12,14]. However, the proportion of hides and skins affected by post-slaughter defects was much lower than the other two categories.

As one of the major pre-slaughter defects, cockle was much more prevalent in sheepskin than in goatskin and cattle hide. In assessment study made at Addis Ababa and Modjo tanneries, also it was shown that sheepskin and hides had higher frequency of ekek (cockle) than goatskin have also concluded that majority of the cockle-affected pickled skins at Bahir Dar tannery were sheepskins compared to goatskins [10,14,15]. Since cockle (ekek) is mainly caused by ectoparasites such as sheep ked and lice, the fact that sheepskin has much more hair/wool than that of goats and cattle might have predisposed the animals to higher infestation by these parasites. Kassaye

and Kebede have shown that sheep ked was the dominant species of ectoparasite recovered from sheep whereas lice infestation dominates in goats [16].

The other pre-slaughter management problem of hides and skins is the occurrence of scratch marks of different degrees. Skin scratches that occur in pre-slaughter stage are much more prevalent in goatskin and cattle hides than in sheepskin. This difference may be related to animal management and/or the wool/hair cover of the animals. While found no difference between sheepskin and goatskin Kahsay, et al. reported a much higher prevalence of scratch problem in wet blue hides, goatskins and pickled sheepskins suggesting that differences in management problems during the life of the animals could determine the occurrence of scratches. Majority of the livestock in Ethiopia roam freely in the wilderness and are subjected to thorny and shrubby vegetation resulting in scratched hides with poor quality [11,17].

Flaying defects occur due to inadequate experience of the flayers and may also vary with some intrinsic factors associated to the animal species. In this study, flay defects were found to be much more common in cattle hides and goatskins than in sheepskins. Contrary to this observation Azene, et al. reported that flay defects were more prevalent in sheepskins than in goat skins [17]. The perception and attitudes of slaughter men may cause variations in the attention given to the raw materials during flaying. In most places, sheepskin is much more valued than goatskin and cattle hide often leading to keeping the latter for home use, which does not necessarily deserve much care on flaying [18].

Putrefaction was found to be the dominant post-slaughter defect affecting hide and skin quality. The result of this study is in agreement with the reports of that mentioned the higher rejection and depreciation in value of hides and skins was caused as a result of post slaughter defects mainly putrefaction [11]. On the other hand, a much lower prevalence of this defect was noted by Azene, et al. [17]. Since putrefaction is a result of bacterial action due to inappropriate preservation, such variations may arise from lack of awareness on the value of the raw hide/skin, improper storage, delayed and inadequate preservation technique as well as inadequate access to markets that discourage selling the materials as soon as they are removed from the animals.

Situation of Hide and Skin Quality Grades

Ethiopian hides and skins have for long been considered as one of the finest products in the world market [19]. However, given the widespread prevalence of defects that could potentially undermine the values of hides and skins, it is unwise to expect higher grade quality hides and skins in large number in the tanneries included in this study. We have unequivocally shown that best quality hides and skins (grades 1 & 2) were totally absent and those falling in grade categories of 3 and 4 were very few compared to the low (grades 5 and 6) and reject (7 grade) categories. A research done at Bahir Dar tannery by Azene et al. has also ascertained absence of the two best quality grades among pickled sheep and goatskins. Similarly, Behailu in his study at Colba tannery in Ethiopia has concluded that only 0-2.1% of hide and skins were found falling under grades 1 and 2 [17,12]. Grading of hide and skins is affected by the stage in the process of production. For instance, Zembaba, et al. have shown that the proportion of grade 1 sheep and goatskins collected and stored by collectors in Bahir Dar town was between 21 and 30% in fresh or salted stage. Most pre-slaughter defects are visualized only after the hairs are removed during tanning process [20]. This is further supported by the fact that these authors failed to report any pre-slaughter problems in their data.

This indicates that in recent years, Ethiopian tanneries and the nation as a whole is experiencing an alarming situation that calls for the careful resolution of the problem. A study conducted by Muleken, showed that the proportion of best grades in raw sheepskin and goatskin have shifted towards the lower and reject grades in 2001 as compared to 1989, indicating quality deterioration of raw skin over 10 years [21]. According to tanners reports for the period from 1970-1980, the share of grade 1-3 pickled sheep and wet blue goatskins from Ethiopia was between 60-70% of total skins supplied to the world market. From 1989/88-1991/92, the share of grade 1- 3 skins dropped to 40 to 50% of total skins supplied. In 1996/97 the share further dropped to 20-30% and in 1997/1998, only 10-20% of skins were grades 1 to 3 [21]. Behailu also reported that tanneries state that only 10 to 15% of harvested skins qualify for top grades (grades 1 to 3), the rest being downgraded and rejected mainly due to deteriorations resulting from skin diseases and various defects [12]. Although this study has shown a reasonably lower rate similar to the findings of Azene, et al. and Behailu, estimates from some tanneries have put the percentage of rejects to be as high as 50 to 60% [12,17, 22-24].

Absence of improvements in the attention given to production of better quality raw materials and differential pricing schemes based on quality coupled with the declining price in the national and international market

might be significantly contributing to the dangerous situations of tanneries in a country endowed with the largest populations of livestock in Africa. The question is which major defects are contributing to such quality deterioration? It was observed that pre-slaughter and post-slaughter defects, when they occur cause maximum loss of quality in cattle hide and sheepskins whereas peri-slaughter and post-slaughter defects are responsible for higher loss of quality in goatskins. Similarly, highest rate of rejection was caused by post-slaughter problem (mainly putrefaction) in cattle hide and goatskins.

Despite the tremendous efforts made to control ectoparasitism in different pockets of Ethiopia, cockle alone, can still cause categorization of 66-73% and 17-18% of hides and skins under low grade (5-6) and reject (grade 7), respectively. A similar finding was documented by Azene, et al. [17]. However, in the latter study, the hides and skins were not selected against cockle problem only. Hence, the downgrading could be a combined effect of cockle and other factors. This study has clearly shown the impact of cockle caused mainly by ectoparasites on the quality grades of hides and skins in the absence of all other confounding factors. Nafstad, et al. concluded that inflammations caused by lice lead to partly irreversible changes in the dermis resulting in grain loss when the epidermis was removed during the liming in the tanning process [25]. This suggests that controlling ectoparasite alone can significantly improve the quality of the raw materials.

Although the widespread presence of other defects have undermined the magnitude of the real effect of scratches on populations of hides and skins, among those filtered out to have only this problem, it was responsible for 5 to 13% rejection rate with a further 45-82% of the products earning low grades (5 to 6). This defect caused more reduction in quality in hides and sheepskins when compared to goatskin. Scratches give leather a unaesthetic appearance and if deep, cause considerable loss of tear strength especially on skins. The leather whose depressions looked like scratches could be a consequence of the animal's effort to get relief from irritations by frequent rubbing of the body against an object [26]. Consequently, the raw materials might fetch lower prices [27].

Flaying defect, one of the most prevalent peri-slaughter defects, also caused significant rate of rejection (22 to 24%) mainly in hides and sheepskins. Despite the low proportion of rejects, majority of goatskins fall under low grade category; altogether suggesting the significant impact of flaying defects on the quality of the processed product. Careless use of knives coupled with inadequate flaying skill of slaughter men contributes to this kind of peri-slaughter problems Mohammad, et al. Among the total hide and skins examined, up to a quarter of them showed different degrees of putrefaction. Such defect occurring at post-slaughter stage caused major rejection in cattle hide and goatskins compared to sheepskin when only those hides and skins having this problem were filtered out and graded. Relatively lower prices provided for cattle hide and goatskins might discourage producers and collectors to care equally to sheepskin during storage and transportation of the raw materials [18]. Azene, et al. has also recorded up to 40% rejection at pickled stage among skins showing putrefaction. The raw hides and skins consist mainly of water and protein, which make them vulnerable to attack by microorganisms [17]. The microorganisms decompose the protein and eventually make the hide/skin unsuitable for the manufacture of good quality leather ultimately leading to huge amount of waste production in tanneries [27].

Conclusion

In conclusion, study on defects and qualities of hides and skins have clearly ascertained that none of the hides and skins examined at wet blue stage was free of defects, often harboring more than one type of problem. Majority of the raw materials reaching tanneries is of poor quality that immensely contributing to lots of waste generation in tanneries. It was observed that remarkable amount of solid waste is generated from the tanning industry that could be as the result of; quality deterioration of hides and skins as well as natural tannery process and played important role in posing critical environmental and society health issues. Therefore, we strongly recommend that hide and skin quality improvement programs should include all efforts that can solve the major problems from supply side (pre-slaughter to post-slaughter) stages.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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