Effects of skin and hide defects on quality grades and physical characteristics of crust leather

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Abstract

Leather is one of the important export commodities in Ethiopia. However, its quality and physical characteristics are affected by diseases, handling and storage problems. A cross-sectional study was conducted to identify major hide and skin defects and assess their effect on quality grades and physical characteristics of crust leather. A total of 6530 hides and skins were inspected at Sheba Tannery and Leather Industry Private Limited Company (PLC) through standard operative procedures. For tests on physical characteristics of crust leather, top 6 defects of skin and hide were identified thereby each 5-crust leather per defect were evaluated by standard experiments for determining testing tensile strength, tear strength and percentage elongation at break. The overall hide and skin rejection was 32.7%. The rejection in wet blue hide (23.5%) was higher than for wet blue salted and dry goatskins (5.1%) and pickled sheepskins (4.1%). Scratch (20.5%), Wound (14.6%) and Cockle (12.7%), were the most common pre-slaughter skin and hide defects found in wet blue hide, goatskin and pickled sheepskin, respectively. Knife cut with proportion of 21.1%, 17.5% and 4.5% respectively in wet blue hide, goatskin and pickled sheepskin was the major slaughter defect. Putrefaction was of the most common post-slaughter defect in wet blue hide (5.3 %), pickled sheepskin (1.6%) and goatskin (2.7%). Among the identified major defects, statistically significant reduction ($p<0.05$) were noted in tensile strength, tear strength and percent elongation of the crust leather. Major skin and hide defects lead to considerable economical losses through reducing quality and physical performance characteristics of crust leather. Hence, innovative leather grade correction technologies are timely important.

Keywords: Defects; hide; physical characteristics; quality; skin

Introduction

Leather industry is one of the oldest and largest industries in the global economy through its massive potential for employment, growth and exports earnings. Leather is an important input to footwear, gloves, belts, apparels and others. In the 2001, world demand for the leather and leather products was USD 24.3 billion (Adem, 2019) and it escalated to USD 347.50 billion in 2010 (TDAP, 2011). Leather upper footwear market is the biggest market amongst all the leather sub-sectors, accounting for more than 70% of the global leather consumption (TDAP, 2011) and 58.5% of the global footwear types (IBISWorld, 2010; TDAP, 2011). Footwear consumption has been rapidly increasing worldwide from year to year; from 11 billion pairs in 1999 (Ashebre, 2014) to more than 20 billion pairs of shoes in 2005 (Shahin et al., 2007) and then estimated to be 25 billion pairs in 2018 (IBISWorld, 2010; TDAP, 2011). About 83% of the global footwear products are manufactured in Asian countries, where china shares 70% (TDAP, 2011).

Ethiopia has the largest livestock population in Africa. The country is 10th largest in the world with an estimated population of 60.3 million heads of cattle, 31.3 million sheep and 32.7 million goats (CSA, 2017). The animal resources gave the country a comparative advantage in raw materials needed for the leather sector. The country has a long tradition in processing and export of leather and its products. The modern leather goods industry dates back to the time when the modern tanning industry was established in mid 1920s by the Ethiopian Investment Agency (Asegedom *et al.*, 2019). Next to coffee, leather and leather products contribute a lot for Ethiopian export earnings (Fereja *et al.*, 2017; Asegedom *et al.*, 2019). However, the leather sector in Ethiopia still suffers with tremendous challenges along its value chain. Traditional husbandry management, extensive farming system, prevalence of rampant animal diseases, backyard slaughtering habit, lack of modern facilities i.e. slaughtering, preservation and transport, weak marketing system and information and lack of awareness of actors on the value chain are the major obstacles in this industry (Mesele *et al.*, 2015; Fereja *et al.*, 2017). Estimates of losses to the Ethiopian economy due to such problems reached US$ 14 million per year (Solomon, 2011). Hence, this study had identified major defects of hide and skin (pre-slaughter, slaughter and post-slaughter) and determined their effect on quality and physical characteristics of crust leather.

Materials and Methods

Description of the study area

The study conducted in Sheba Tannery and Leather Industry Private Limited Company (PLC). It is located in Wukro town in eastern zone of the Tigray Regional State, Northern Ethiopia between longitudes and latitudes of 13° 47' 59.99" N 39° 35' 59.99" E. It is 47 km north from Mekelle, the capital city of the region. The tannery obtains rawhide and skin mainly from Tigray region, Addis Ababa, Gondar and Wollo areas of Amhara region. The company is one of the largest tanneries in the country that exports most of its products to Italy, China, India, Pakistan, the Netherlands, Turkey, Thailand, Malaysia and other countries. Besides, it supplies finished products like shoes and other leather articles to domestic markets (Kahsay *et al*., 2015; Kuria *et al*., 2016).

Study design and sampling

A cross-sectional study design was employed on wet blue hide, pickled sheep-skin, and air-dried and salted goatskin collections of the tannery. One batch, a total of 6,530 skins and hides, of which 1,950 pickled sheep skin, 1,800 air dry goat skin, 1,780 wet salted goat skin and 1,000 wet blue hide received from the beam house operation were examined for defect type at crust leather stage. Moreover, 9,500 hides and skin (3,900 sheep skin at pickled stage, 3,600 goats at wet blue stage and 2,000 hides at wet blue) used for further analysis of defects and quality grading.

Defect assessment and quality grading

Each selected skin or hide was examined for defects (pre-slaughter, slaughter and post-slaughter) in natural light by trained skin selectors of the company and the research groups. Criteria indicated in Quality Standard Authority of Ethiopia as described in the International Organization for Standardization (Muralidharan *et al*., 1999) were used to identify defects and graded leather quality.

Determination of effect of defects on physical characteristics of crust leather

Crust leather is the term applied to leather, which is dried after tanning but has not yet been dyed. After descriptive analysis of data on defects observed

(Table 1-3), top six major defects for each of hide, sheep skin and goat skin (wound, scratch, brand mark, putrefaction, knife cut and cockle) were selected for determining the effect of those defects on physical characteristics of leather (tensile strength, tear strength and percent elongation). For each defect, 5 each for wet blue goat skin, wet blue sheep skin and wet blue cattle hide were selected. Considering five skin/hide per an identified major defect, 90 samples (5 skin/hide*6 defects = 30 hide, 30 sheep skin and 30 goat skin) were purposively selected at crust level. All samples were collected by cutting in accordance with official sampling position as per the Society of Leather Technologist and Chemists methods IUP 2 (Kuria *et al.*, 2016). Tensile-strength, percent elongation and tearing strength evaluation were conducted in accordance with the official method of analysis adopted by the Society of the Leather Technologists and Chemists as it has been stated by Kuria *et al.*, (2016). Then the specimens were conditioned by keeping them in standard environment, i.e., temperature 20 ± 2 °C and relative humidity 65 ± 2% for 48 hours before testing as it has been described in the International Organization for Standardization (Muralidharan *et al.*, 1999).

Tensile strength test (TNS): Tensile strength indicates the overall strength of the leather. Thicknesses of the specimens were measured according to IUP/6 testing method, using a standard measuring instrument as described by Kuria et al., (2016). The cross-sectional area of each specimen calculated by multiplying its width by its thickness, and values expressed in square centimeters. The span length of the tensile test is 100 mm apart and the crust leather specimen clamped in the jaws so that the edges of the jaw lie along lines AB, CD (Figure. 1). The machine then run until the specimen is broken and the highest load reached taken at the breaking load. The formula is Tensile strength (kg/cm^2) = Load at breaking (kg)/Cross sectional area (cm^2) (Kuria *et al.*, 2016).

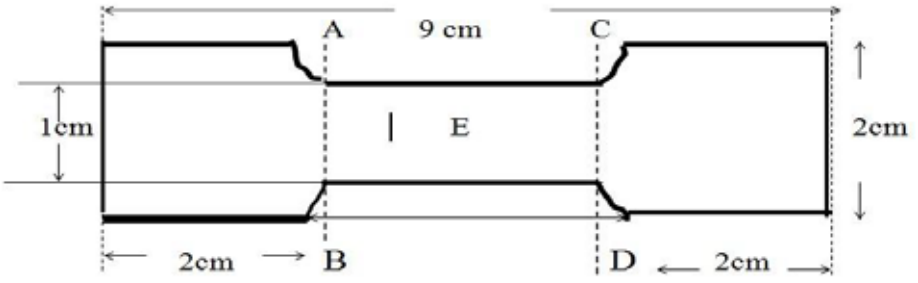

Figure 1: Schematic illustration of a standard tensile sample -Dumbbell shape (ISO 2589:2016 [IULTCS/IUP 4]).

Tear strength (TRS): Tearing strength is the load required to continue a tear in a crust leather sample, once load is applied. There are different ways to measure tearing strength. Most common double edge tear method used in this study using the standard IUP/8 method as described by Kuria et al., (2016). The samples were punched out using a steel die of standard dimension, and taken for thickness measurement and the specimens were conditioned by keeping them in standard environment, i.e., temperature 20 ± 2 °C and relative humidity 65 ± 2% for 48 hours before testing (Muralidharan *et al*., 1999). The prepared samples were mounted in the universal tensile measuring machine (UTMM), and then the load was applied at a constant rate of 100 mm/min, till break (Kuria *et al.*, 2016).

Data analysis

Data entry made through Excel spreadsheet version 2010 and analyzed using STATA12 statistical software. Descriptive statistics used to report percentages and counts. One sample t-test used to compare deviation of mean of physical characteristics of the selected defects against their standard. At all levels, $p<0.05$ was considered statistically significant.

Ethical approval and consent to participate

A letter of request to work in the tannery was prepared and approved by the management body of the tannery. This study was conducted once a consent was obtained and necessary inputs was permitted. Examination of skins and hide for defects and physical quality performance characteristics made by willing and allowed expertise.

Results

Defects of skins and hides

In this study, wet blue hide had the highest percentage of defects. The major pre-slaughter, slaughter and post-slaughter defects were scratch (20.5%), knife cut (21.1%), and putrefaction (5.3%), respectively (Table 1). On pickled sheepskin, the prevalence of pre-slaughter defect (27%) was higher than at slaughter (5.6%) and at post-slaughter (4.2%). The major pre-slaughter, slaughter and post-slaughter defects on pickled sheepskin were cockle (12.7%), knife cut (4.5%), and putrefaction (1.6%) respectively (Table 2). Major pre-slaughter defect of both wet blue salted and air-dried goat skin were presence of wound (14.6 %) followed by scratch marks (9.2 %) while knife cut (18 %) was the high-

est slaughter defect (Table 3). Their effects on the quality grading and physical performance of leather were as follows.

Table 1: Pre-slaughter, slaughter and post-slaughter defects on wet blue hide

Defects	**Pre-slaughter (N=1000)**		**Slaughter (N=1000)**		**Post-slaughter (N=1000)**	
	N	%	n	%	N	%
Brand mark	29	2.9				
Scratch	205	20.5				
LSD	27	2.7				
Wound	17	1.7				
Cockle	61	6.1				
Wart	3	0.3				
Poor pattern			4	0.4		
Hole			19	1.9		
Knife cut			211	21.1		
Machine defect					1	0.1
Putrefaction					53	5.3
Heat					29	2.9

N=total sampled hide/skin; n=samples with defects, LSD= Lumpy skin disease

Table 2: Pre-slaughter, slaughter and post-slaughter defects on pickled sheepskin

Defects	Pre-slaughter (N=1950)		Slaughter (N=1950)		Post-slaughter (N=1950)	
	N	%	n	%	n	%
Brand mark	0	0				
Scratch	202	10.4				
Pox	19	0.9				
Wound	132	6.7				
Cockle	248	12.7				
Wart	0	0				
Poor pattern			9	0.5		
Hole			12	0.6		
Knife cut			87	4.5		
Machine defect					29	1.4
Putrefaction					32	1.6
Heat					24	1.2

N=total sampled hide/skin; n=samples with defects

Table 3: Pre-slaughter, slaughter and post-slaughter defects on air dried and salted goatskin

Defects	Pre-slaughter (3580)				Slaughter (3580)				Post-slaughter (3580)			
	Dry skin (N=1800)		Salted skin (N=1780)		Dry skin (N=1800)		Salted skin (N=1780)		Dry skin (N=1800)		Salted skin (N=1780)	
	n	%	n	%	n	%	n	%	n	%	n	%
Brand mark	3	0.2	8	0.4								
Scratch	87	4.8	82	4.6								
Pox	65	3.6	71	4								
Wound	163	9	100	5.6								
Cockle	19	1	22	1.2								
Wart	0	0	0	0								
Poor pattern					12	0.7	8	0.4				
Hole					9	0.5	7	0.4				
Knife cut					100	5.5	221	12.4				
Machine defect									13	0.7	11	0.6
Putrefaction									15	0.8	35	1.9
Heat									4	0.2	8	0.4

N=total sampled hide/skin; n=samples with defects

Quality grading of skins and hides

The overall rejection of skins and hides was 32.7% of which it was 23.5% for wet blue hide, 5.1% for wet blue salted and air-dried goat skin, and 4.1% for pickled sheepskins. None of the skin and hide scored grade I-III. Only 3% of wet blue salted and air-dried goatskin, 1.1% of pickled sheepskin and 0.07% of wet blue hide were of grade IV. The majority of the skin and hide were in grade VI and VII (Table 4). The distribution of defects in the quality grades of skins and hides was as shown in Tables 5 -7.

In pickled sheepskin, most defects, particularly *cockle/ekek* and scratch were highly distributed in grade IV-VII. The defects responsible for rejection of pickled sheepskin were cockle (18.7%), putrefaction (15.2%), flay cut (10.3%), scratch (9.5%), scar (9.2%), poor pattern (8.5%), pox (7.1%), machine defect (6.4%), poor substance (4.3%), vein mark (4.9%), and crack (4.6%) (Table 5). On wet blue goatskin, most defects distributed in grade IV-VII. The defects responsible for rejection of wet blue goatskin were crack (18.9%), cockle (18.6%), scar (17.4%), scratch (15.9%), vein mark (11%), flay cut (5.4%), brand mark (3.4), poor pattern (2.3%), putrefaction (1.5%), pox (1.5%), machine defect (0.4%), and wound (0.4%) (Table 6). On wet blue cattle hides; brand mark, knife cut, putrefaction and scratch marks were most important defects observed in hide quality grades of IV-VII. Defects responsible for rejection of wet blue hide were knife cut (25.6%); putrefaction (20.2%), scratch (15.7%), scar (11.5%), cockle (7.4%), brand mark (6.4%), wound (3.8%), machine defect (3.5%), poor pattern (1.6%), tick damage (1.6%), crack (1.3%), lumpy skin disease (1%), and vein mark (0.3%) (Table 7).

Table 4: Grading proportion of hide and skin in Sheba tannery and leather industry

Input type	IS	IQ	Grades							
			I	II	III	IV	V	VI	VII	Rejected
Wet blue hide	Small	516	-	-	-		17	79	217	203
	Medium	720	-	-	-	2	28	315	195	180
	Large	638	-	-	-		103	201	189	145
	Extra large	978	-	-	-		73	718	51	136
	Total	2852	-	-	-	2 (0.07)	221 (7.4)	1313 (46)	652 (23)	664 (23.5)
Wet blue salted and dry goatskin	Small	945	-	-	-	18	64	492	319	52
	Medium	766	-	-	-	17	308	261	126	54
	Large	789	-	-	-	39	323	271	119	37
	Extra large	1003	-	-	-	25	412	270	257	39
	Total	3503	-	-	-	99 (3)	1107 (31.6)	1294 (37)	821 (23.4)	182 (5.1)
pickled sheepskin	Small	945	-	-	-	12	58	500	325	50
	Medium	766	-	-	-	5	363	249	103	46
	Large	789	-	-	-		391	298	93	7
	Extra large	1003	-	-	-	23	412	267	260	41
	Total	3503	-	-	-	40 (1.1)	1224 (35)	1314 (37.5)	781 (22.2)	144 (4.1)

IS = Input size; IQ = Input quantity

Table 5: Distribution of defects on sheep skin at pickled stage in different quality grades (N=3900)

Type of defects	Grade								
	IV		V		VI		VII/rejected		Total
	n	%	n	%	n	%	n	%	
Cockle/*ekek*	59	19.5	43	14.5	38	16.7	53	18.7	193
Scratch	47	15.6	54	18.2	35	15.4	27	9.5	163
Flay cut	29	9.6	38	12.8	20	8.8	30	10.6	113
Scar	22	7.3	26	8.8	23	10.1	26	9.2	97
Crack	24	7.9	22	7.4	18	7.9	13	4.6	77
Veins	34	11.3	24	8.1	13	5.7	14	4.9	85
Putrefaction	20	6.6	21	7.1	31	13.6	43	15.2	115
Poor pattern	23	7.6	20	6.8	15	6.6	24	8.5	82
Pox	19	6.3	15	5.1	12	5.3	20	7.1	66
Machine defect	13	4.3	22	7.4	12	5.3	18	6.4	65
Poor substance	12	4.0	11	3.7	11	4.8	15	5.3	49
Total defects	**302**		**296**		**228**		283		1105

NB: n=samples with defects

Table 6: Distribution of defects on goat wet blue stage in different quality grades (N=3600)

Defects	Grade								
	IV		V		VI		VII/reject		Total
	n	%	n	%	n	%	N	%	
Cockle/ekek	19	15.4	66	21.6	59	19.8	49	18.6	193
Scratch	11	8.9	42	13.8	35	11.7	42	15.9	130
Flay cut	6	4.9	18	5.9	9	9.7	43	16.3	76
Scar	12	9.8	53	17.4	55	18.5	46	17.4	166
Crack	13	10.6	45	14.8	52	17.4	50	18.9	160
Veins	49	39.8	56	18.4	47	15.8	29	11.0	181
Putrefaction	3	2.4	5	1.6	6	2.0	4	1.5	18
Poor pattern	3	2.4	7	2.3	5	1.7	6	2.3	21
Pox	2	1.6	2	0.7	2	0.7	4	1.5	10
Brand mark	0	-	3	1.0	2	0.7	9	3.4	17
Machine defect	2	1.6	2	0.7	0	-	1	0.4	5
Wound	2	1.6	2	0.7	1	0.3	1	0.4	6
Hole	1	0.8	2	0.7	2	0.7	0	-	5
Total grade	123		305		298		264		988

Table 7: Distributions of defects on wet blue hide stage in different grades (N=2000)

Defects	Grade										
	I-III		IV		V		VI		VII/rejected		Total
	n	%	n	%	n	%	n	%	N	%	
Cockle/*ekek*	0	0	1	1.6	2	1.7	25	9.7	23	7.4	51
Scratch	0	0	13	20.6	17	14.3	32	12.4	49	15.7	111
Knife cut	0	0	6	9.5	53	44.5	87	33.7	80	25.6	226
Scar	0	0	4	6.3	8	6.7	31	12.0	36	11.5	79
Crack	0	0	5	7.9	1	0.8	3	1.2	4	1.3	13
Veins	0	0	0	-	0	-	6	2.3	1	0.3	7
Purification	0	0	6	9.5	14	11.8	47	18.2	63	20.2	130
LSD	0	0	2	3.2	3	2.5	0	-	3	1.0	8
Machine defect	0	0	1	1.6	3	2.5	6	2.3	11	3.5	21
Brand mark	0	0	22	34.9	5	4.2	7	2.7	20	6.4	34
Poor pattern	0	0	0	-	5	4.2	3	1.2	5	1.6	13
Wound	0	0	3	4.8	6	5.0	8	3.1	12	3.8	29
Tick hole	0	0	0	-	2	1.7	3	1.2	5	1.6	10
Total defects	0	0	63		119		258		312		732

Table 8: T test Result for physical characteristics of goat and sheepskin crust leather and crust hide leather

Variables	Physical test	OBS	Crust goat leather			Crust sheep leather			Crust hide leather		
			Mean	SD	CI (95%)	Mean	SD	CI (95%)	Mean	SD	CI (95%)
Wound	Tensile strength	5	131.14	20.96	105.10-157.17	190.02	6.91	181.43-198.60	184.12	4.83	178.17-190.12
	Tear strength	5	88.24	10.71	74.93-101.54	81.06	10.32	36.31-165.8	90.54	2.80	87.06-94.01
	Elongation	5	53.32	5.67	46.27-60.36	61.42	12	46.50-76.33	64.3	2.7	60.8-67.7
Brand mark	Tensile strength	5	183.8	3.38	179.59-188	178.64	5.47	171.84-185.43	173.66	0.09	164.85-182.46
	Tear strength	5	92.2	4.46	86.65-97.74	89.78	1.1	88.40-91.15	88.06	2.43	85.04-91.07
	Elongation	5	61.2	2.01	58.69-63.70	62.14	2.85	58.59-65.68	62.92	4.67	57.11-68.72
Scratch	Tensile strength	5	178.62	4.62	172.87-184.36	175.46	8.67	164.69-186.22	180.44	10.93	166.8-194.01
	Tear strength	5	90.24	2.73	86.84-93.63	88.26	5.06	81.96-94.55	90.34	1.19	88.85-91.82
	Elongation	5	63.54	3.93	58.65-68.42	69.1	9.07	57.83-80.36	60.74	2.25	57.93-63.54
Knife cut	Tensile strength	5	182.14	3.77	177.45-186.82	128.3	2.78	124.84-131.75	138.22	2.43	135.19-141.24
	Tear strength	5	77.62	8.58	66.95-88.28	81.56	4.91	67.92-95.19	95.04	2.2	92.30-97.77
	Elongation	5	58.24	6.86	49.71-66.76	49.34	1.33	47.68-50.99	60.8	1.73	58.64-62.95
Putrefaction	Tensile strength	5	138.9	7.71	129.31-148.48	129.58	8.3	119.26-139.89	146.1	4.64	140.33-151.86
	Tear strength	5	91.4	1.23	89.86-92.93	89.12	9	77.93-100.3	79.42	1.79	77.19-81.64
	Elongation	5	43.5	2.59	40.28-46.71	45.32	3.26	41.26-49.3	64.18	2.75	60.76-67.59
Cockle/ekek	Tensile strength	5	189.96	2.27	187.13-192.78	178.1	3.51	173.73-182.46	183.62	10	171.19-196.04
	Tear strength	5	83.66	4.12	78.54-88.77	79.46	5.63	72.45-86.46	92.24	3.44	87.96-96.5
	Elongation	5	51.2	6.89	42.64-59.75	42.54	5.65	35.51-49.56	68.2	4.86	62.15-74.24

NB: Tensile strength (kg/cm^2=200); Tear strength (kg/cm^2=200); Elongation (% 70-80); OBS=observation; SD=standard deviation; CI=confidence interval

Effect of skin and hide defects on physical characteristics of crust leather

Normal standards values of TNS (200 kg/cm^2); TRS (200 kg/cm^2); PEL (70-80%) were compared with measurements of crust leather of skins and hides affected by either of wound, scratch, brand mark, putrefaction, knife cut or cockle. The difference in mean of the five measurements of each defect compared to the standard of the TNS, TRS and PEL was statistically significant ($p< 0.05$) (Tables 8).

Discussion

The quality of the rawhide and skin plays a decisive role on the quality of the leather and its' constituents. Quality of rawhide and skin is largely dependent on the extent of ante-mortem and postmortem defects. Slaughter and postmortem defects are controllable to certain extent, while ante-mortem defects pose serious challenges to tanneries (Habib *et al*., 2015). Scratch was the most frequent pre-slaughter defect of hides. Kahsay *et al.,* (Kahsay *et al*., 2015) had a similar observation in Sheba Tannery. However, Urgessa (2013) had reported cockle as most frequent pre-slaughter defect of hide from Addis Ababa and Modjo tanneries. These variations might be due to the differences in agro-ecology, deworming activities husbandry managements and the season that samples had collected. Agroecology that affects quality of feed and texture of the skin and hide reflects the substance or quality nature of the skin and hide whereas poor husbandry practices downgrade it. Cockle was the most frequent pre-slaughter defects on pickled sheepskin. The finding was in agreement with reports of Ashenafi *et al*., (2013) in Sheba Tannery and in Addis Ababa and Modjo (Urgessa, 2013). In wet blue goat skin, wound was most frequent pre-slaughter defect observed in the current study although cockle (Urgessa, 2013) and scratch (Sertse and Wossene, 2007) were reported from Addis Ababa and Modjo, and Sebeta, respectively.

Of the slaughter defects, knife cut was most frequently observed slaughter defect on hide and skin which was in agreement with Berhe (2009) from Sheba tannery and leather industry. However, poor pattern was reported with high-

est frequency in Bahirdar (Zembaba *et al*., 2012). Likewise, Hailu, (2013) had also reported poor pattern as a slaughter defect of sheep and goats skin in many of the municipal abattoirs in the country. It might be due to skill and awareness of butchers. Commonly practiced backyard slaughtering habit of the community may also have great role for both defects.
Among the post-slaughter defects, putrefaction was in highest percentage on hide and skin. This finding was in agreement with those reported by Behailu (2015) from Colba (Ashenafi *et al*., 2013) and Sheba tanneries (Ahenafi et al., 2013). The prevalence of putrefaction was at higher rate on wet blue hide as compared to wet blue skin. This finding was in agreement with those reported by Kahsay *et al*., (2015) from Sheba tannery and Yacob *et al.*, (2008). Most of the post-slaughter defects are due to poor management or improper preservation and storage of skin and hide.

The observed defects have reduced the quality grading and resulted in significant reduction. Larger proportion of wet blue hide rejected, followed by wet blue goatskin. (Ashenafi *et al.*, 2013) had also reported financial loss of around USD 800, 000.00 and USD 250, 000.00 due to cockle defect-based rejection of pickled sheep and wet blue goatskin, respectively. The dominant defects were cockle, which were higher in both sheep and goatskin than hide. This was in line with the result observed by Berhanu et al., (2011) and Asefa et al., (2012) who had reported cockle as leading defects on sheep skin rejection. However, Kahsay *et al*., (2015) had reported scratch as the dominant defect of sheep skin, goat skin and hide.

During the current study, none of the skin and hides scored I-III quality grade which was unlike to the observations of (Behailu, 2015) who had reported only 8.8% from Colba tannery. Most of the skins and hides of this study scored quality grades of VI-VII which was in line with reports of 69% by Behailu from Colba tannery and 69.6% by Urgessa (2013) from tanneries in Addis Ababa and Modjo. The overall hide and skin rejection in this study was 32.7% of which 23.5% was wet blue hide, 5.1% for wet blue salted and dry goatskin and 4.1% for pickled sheepskin. Degrading and rejection of skin and hide after beam house operation incurs loss of cost of purchase and processing and subsequently incurring extra cost for correction during finishing or total rejection (Solomon, 2011 and Teklay *et al*., 2019).

Measurable properties of leather are physical properties such as tensile properties that determines the structural resistance of leather to tensile forces,

hence its state and usability (Habib *et al.*, 2015). Understanding the changes made on physical properties due to the various defects is a prerequisite for identification and development of leather defect correction technology through synthesis and application of selected tanning agent or filler material.
Percentage Elongation determines the elasticity of the material especially upper leather and footwear upper should possess high flexibility to prevent the appearance of cracks and tears in the ball area. High elasticity allows the material to withstand the elongation stresses to which it is subjected during footwear lasting, especially on the toe area (Nalyanya *et al.*, 2013). In this study, compared to standards, there was reduction in the mean differences of Tensile strength, Tear strength and percent elongation measurements of the skins and hides with any of the major defects (wound, scratch, brand mark, putrefaction, knife cut or cockle). This signifies serious damages attributed to poor quality leather, characterized by reduced percent elongation, elasticity, and tear strength. This seriously reduces quality of the raw materials required for finished products, thereby, a drop in the national economy.

Conclusion

Various skin and hide defects were identified among which pre-slaughter defects took higher proportion followed by slaughter defects. The defects seriously affected quality grading and significantly reduced tensile strength, percent elongation and tear strength. Rejection of the defective skin and hides incurs serious financial loss across the raw skin and hides marketing value chain and beam house operations. Therefore, we recommend further research on novel grade correction technologies of leather. Moreover, policies and actions on improved animal husbandry and locally feasible animal diseases control policies should be established in the country.

Competing Interests

The authors declare that they have no competing interests.

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