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Evaluation of salt cured Kenyan hides and skins Part I of a case study at Mariakani Curing premises, Coast province, Kenya.

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Abstract:

A study was conducted at curing premises at Mariakani at the Coast province of Kenya, where salt curing of hides and skins from Cattle, goat and sheep was evaluated. The parameters investigated eventually compared various species in aspects related to blood yield at slaughter point and moisture loss during preservation in a span of 0, 7 and 14 days. The results indicated that blood yield (%) based on body weight showed Sheep>Goat>Cattle. Moreover, moisture weight was highest on the first 7days and reduced to the minimum on day 14 onwards. However, the highest % moisture loss when Cattle hides, sheep and goat skins were compared indicating that both in day 7 and 14 hides>goat>sheep. Incidentally blood yield of an animal specie positively correlated to that of body weight. This was exhibited when Goat skins (weighing 12 kg ± 2.65) yielded 5.5% ± 1.12 blood of its body weight whilst Sheepskins (weighing 13kg± 2.00) yielded 6.7% ± 1.72 of its body weight. The resultant effluent for such moisture production indicated that various amounts of complex contaminant were produced in the process. The final effluent emanating from the cured hides and skins were further characterized and the parameters such as the COD, Lead, Copper, Zinc, Salinity, particulate matter, pH and turbidity were analysed. It is envisaged that further studies be undertaken to evaluate the effluents impact; on soils, aquatic and atmospheric systems to determine the extent of potential damage to the environment.

Key words: Curing, Hides, Skins, Salinity, Contaminant, Effluents, Blood yield.

Introductions

Hides and skins curing premises all over the world are known to be critical points of pollution. These are areas that are used to preserving hides and skins for the purposes of increasing shelf life to the materials. The methods of preservation are varied and are demand driven by markets from one country or region to another. Some of the techniques that are used world wide include air drying, frigorific, salting (both wet and dry salting), ground and shed or suspension drying amongst many. The fastest emerging method and widely practiced method, considered popular in Kenya is the salting method which comprises 85% of the total hides and skins cured. Salting of the hides and skins act as partial anti bacterial/fungal agents assisting in improving on shelve-life. Essensiatially 25-30% of the salt from wet salted hides and skins are incorporated into the curing material and eventually binding into the fibrous matrices of the hides and skins structure. However the remaining 70-75% of the salt are superficially held in the material and easily washed or shaken off potentially turning to air, liquid or solid waste.

The number of registered curing premises operating in the country by 2008/09 period was estimated to be about 800. However the figure could be higher due to many of the curing places for hides and skins remaining elusive to the regulatory authorities. Field surveys also further indicated that the amount of salt used and those that are disposed are of very high amounts and as such an environmental concern. For example, in 2008/09 period the total number of hides and skins production in Kenya was estimated at 2.5 million hides and over 6 million skins. If this production is converted into units, where one skin (of Av. 5 sqft) is equivalent to one unit and one hide (of Av. 25 sqft) is equivalent to 5 units, it translates to 18.5 million total units (i.e. 12.5 million unit hides and 6million skins) per annum.

Thus to estimate the total amount of salt used in the curing of hides and skins in the country, it was prudent to consider the average application or usage of salt per unit which was considered to be 0.5 to 0.75kg of salt per unit. Therefore the derived total consumption of salt for purposes of curing hides and skins was found to between 9,300 tonnes to 13,000 tonnes per annum.

It is with this background that this study found it essential to evaluate the curing of hides and skins and subsequently ascertain the amount of blood each carcass produces species wise in relation to its body weight. Finally in addition, the effluent and contaminant load was to be determined a selected site in Maraikani, Coast province in Kenya.

Methodology

Samples were collected from Mariakani which is approximately 45km from Mombasa. The temperature range between 27^{0}C to 32^{0}C. Humidity is registered at an estimated value of 84% with Winds recorded at about 13km/h. Two premises were identified for the exercise i.e. a slaughter house to determine blood yield ($^-$L) after slaughter and a curing premises to evaluate moisture loss (%) was used.

Blood Yield (-L)

Blood yield was collected on graduated 5 liter containers immediately after slaughter using a fresh container in every slaughter/animal. The blood collection was done on a holstered position of the carcass to maximize on yield through gravitational influence. Therefore, blood yield in % was obtained using amount of blood collected (kg) divided by live-weight of the animal multiplied by 100.

Moisture Loss (%)

Moisture loss in percentage (%) was obtained on day 7 and 14. Loss on Day 7 was obtained by finding the difference between the green weight of a hide/skin at start of curing minus the weight at day 7. Whilst for moisture loss at day 14 it will be registered as the difference between weight of a hide/skin at day 7 with that obtained in day 14.

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GPS, Temperature and Humidity Readings

Georaphical positioning was determined by Garmin's etrex personal navigator^{TM}, Temperature and humidity was measured by using an Electronic Weather Station (Brannan)

Chemical Analysis

Total concentrations of Pb, Cu and Zn in each sample (acidified with 1% $HNO3$) were determined by Atomic Absorption spectrometry (Perkins Elmer Analyst 100). COD was carried out using standard methods (APHA, 1965; Thompson and Walsh, 1989) and pH of the samples, TDS and EC were s measured using a standard electrode (Hanna Italia 800-276868, Hanna Instuments). Turbidity was measured using microprocessor turbidity meter (HANNA HI 93703, Hanna Instruments).

Data Analysis

One-way ANOVA) were carried out using the statistical package Minitab for windows, release 12.1 (State College, PA, USA). Mean differences were determined using *t*-test (paired two samples for means) and Pearson Correlations using Excel program (Microsoft^{TM} Office 2003). Graphs were generated also using Microsoft^{TM} Office 2003.

Results and Discussion

The primary focus of the experiment was to investigate the beginning of the slaughter process (i.e from the slaughter house to the curing premises) and ascertain how the effluent starts to be generated. Of interest was the study of blood yield which was not necessarily affecting the total effluent production in the curing premises but a good start of the potential sources of effluent production. The performance of various type of animals was investigated in Mariakani over a period of fifteen minutes after slaughter and this indicated that based on body weight per animal weight, Sheep had the highest blood yield (%) with Cattle showing the lowest (%) (Fig.1).

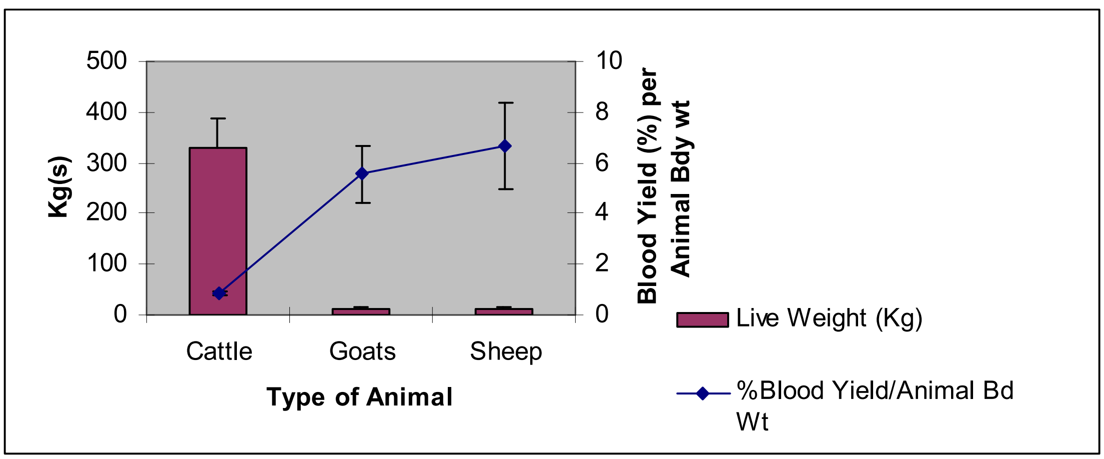

Fig. 1: Blood yield (%) per Live weight of Cattle, Goats and Sheep as obtained from Mariakani slaughter house

Mostly in the coast province wet salting is done by using marine salt while in the high potential the curing premises utilize mostly Magadi salt. For the arid and semi arid areas they mostly apply rock salt during the curing phases (Table 1). However marine salts under field conditions are usually associated with impurities and have a lower reuse value.

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Table 1: Comparison of different types of salt used in curing of hides and skins in Kenya

Type of Salt	Sodium Chloride content
Marine salt	89.5% m/m
Magadi salt	82.35%m/m
Rock salt	79.70%m/m

Fig. 2: A wet salting premises in Mariakani, Coast province. (Photograph by Mwinyihija)

To implore further, two distinct climatic parameters were taken into consideration. It became prudent to compare results from two different ecological zones to find out if any significant differences existed. This investigation involved moisture loss determination between the coastal (Fig. 2) and high potential zones (Fig. 3).

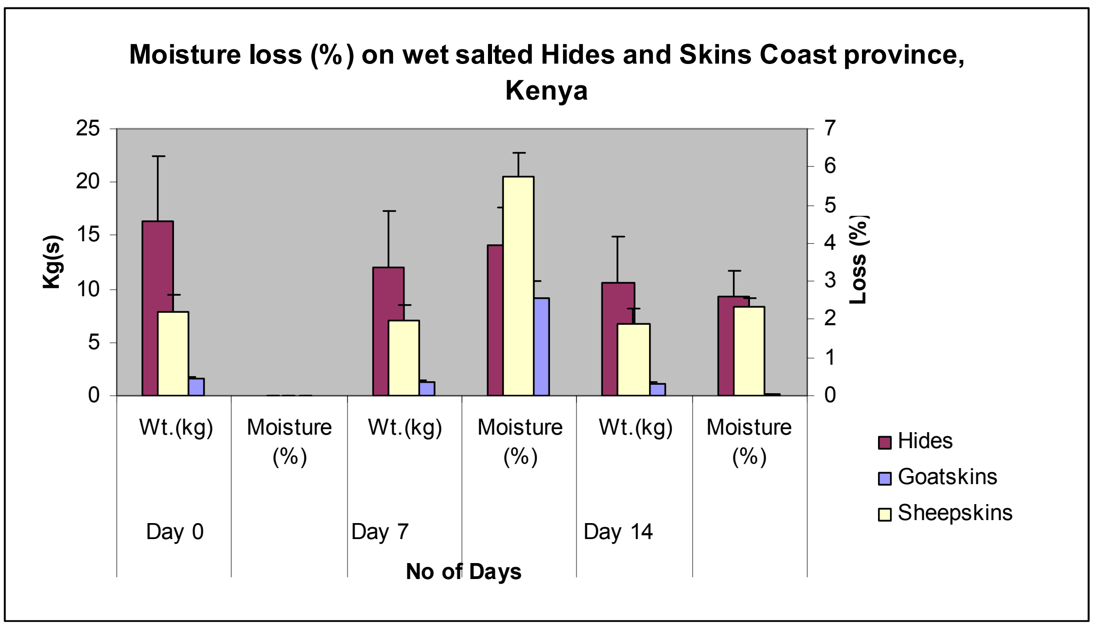

Fig. 3: Moisture loss (%) on wet salted hides and skins Coast province, Kenya.

In comparison, moisture loss in Coast province demonstrated that on day 7 a higher moisture loss of more than 6% of the weight was attained. Naturally weight loss for all the animal type was consistently reducing over time.

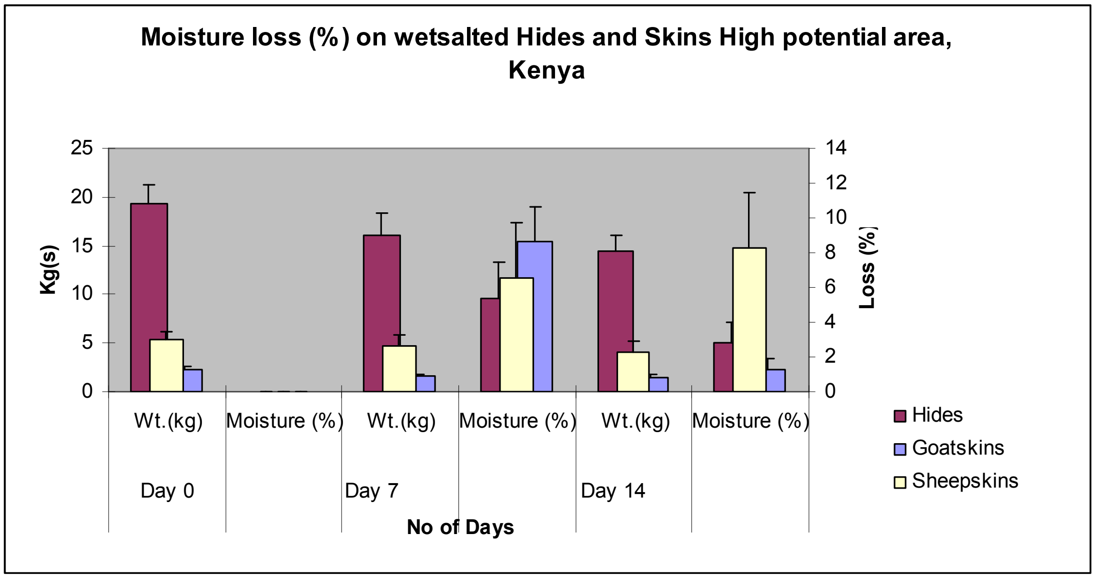

Fig. 4: Moisture loss (%) on wet-salted hides and skins high potential area, Kenya

For hides and goat skins in the high potential a general reduction in weight loss is observed. However for sheepskins the highest moisture loss of about 8% of the weight of the skin was observed this was very different to the hides and goatskins.

Indeed, when comparing the hides and goatskins moisture loss between high potential and coastal area using t test there was no significant difference ($p>0.05$). However, for sheepskins a great significance ($p<0.05$) was observed on day 14 where the highest moisture loss is demonstrated. This could most probably be attributed to the high temperatures and salt that had an emulsifying effect on the lipid and fatty tissues associated with sheep skins.

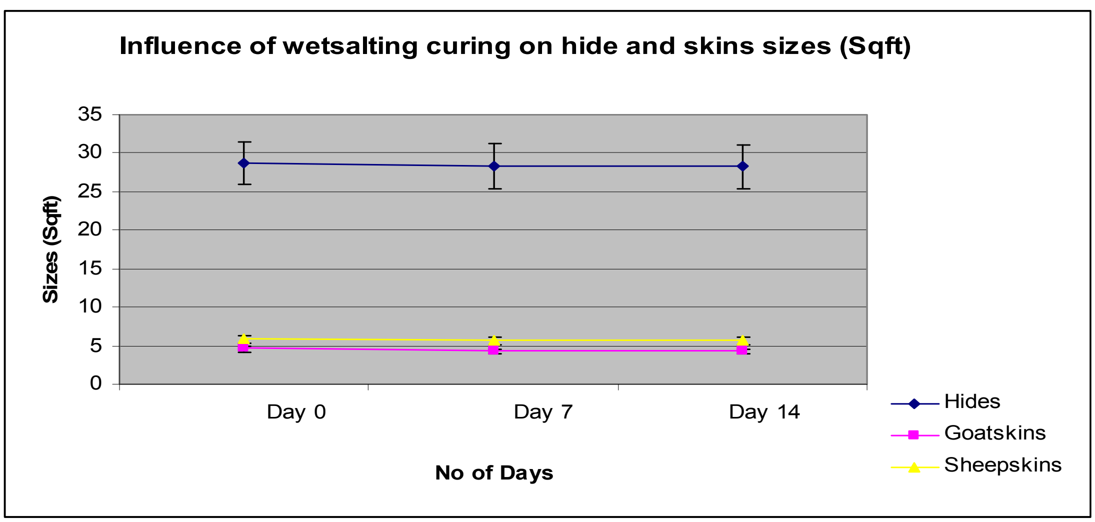

Fig. 5: Influence of wet salting curing on hides and skins sizes (Sqft).

When the impact of wet salting as a curing technique was evaluated on size (sqft) the reduction was minimal for all the types of material over time. However when specific days were subjected to a t-test to determine the difference on means, Day 0 showed a difference ($p<0.05$) when compared to both Day 7 and 14 respectively. This was not the case for Day 7 and 14 when compared indicating that wet salting has no effect of size after Day 7 ($p>0.05$).

The wet salting as a technique consequently produces on average for both high potential and coastal areas for hides slightly more than 4 litres after 24hrs, reducing to 3litres by day 7 (Table 2).

Table 2: Specific effluent production (-L) of hides and skins over time (Hrs/Days)

Type	Effluent produced (($^{-1}$L) over Time length (days/Hrs)		
	24hrs	7days	14days
Hides	4.0	3.3	<2.0
Goatskins	1.5	0.65	0.07
Sheepskins	1.3	0.35	0.38

On analysis of the effluent of released from the hides and skins it was characterized as indicated in the following analysis (Table 3).

Table 3: Characterization of Effluent produces at source in a hide and skins curing premises in Mariakani, Kenya.

Parameters	Values
COD (mg^{-}L)	29,520
Lead (mg^{-}L)	0.16
Copper (mg^{-}L)	ND
Zinc (mg^{-}L)	ND
Turbidity	839.5
Ppt	10
Ph	6.26
Temp. ^{0}C	26.6
Salinity (Ec)(ms)	20

These results indicated a very high COD value, turbidity, ppt and salinity levels predisposing the effluent as a rich source of contamination in atmospheric, aquatic and terrestrial ecosystems (Table 3).

When saline rich effluent is released to the terrestrial system it sets aridity which denudes the fertility of the soil and impacts negatively to inherent microbial mass (Fig 6). Moreover impacts in the air and related medium of contaminant transport or diffusion are conspicuously debilitative on buildings associated with curing, including the neighboring structures around such activities (Fig 7). In some instances soil erosion (Fig. 8) has also been associated through reduced binding potency of soils stability caused by salinity.

Figure 6: Saline rich effluent causing conditions of aridity around the curing premises. (Photograph by Mwinyihija)

Fig. 7: Debilitative effects of salinity observed on wet salting curing premises structures at Maraikani, Coast province in Kenya. (Photograph by Mwinyihija)

Fig. 8: Accelerated soil erosion in saline rich effluent pathways

Conclusion

The study demonstrated that the current rule of subjecting the hides and skins for 21 days has been overtaken by events. Different ecological zones have different trends on responses to the salting process and such there is need to profile various regions in depth to provide further guidelines on wet salting process. Therefore, costing for curing through use of salt will be reduced if these recommendations are considered. In lieu also the amount of salt discarded to the environment will be reduced. Subsequently lowering the environmental impact and providing cost effectiveness in wet salting without compromising on quality. However future studies will determine the salinity based damage on the soil chemistry and biology caused by the curing premises.

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