

# Turning of Cow Stomach, a Slaughter House By-product into Value-added Products

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**ABSTRACT:** This study investigates to turn the stomach of cow into exotic leather and then leather products that would add value to the end of leather industry. For this purpose, three pieces of cow stomachs are taken to convert into leather through pre-tanning, tanning and post tanning operations i.e. soaking, liming, deliming, bating, pickling, tanning, retanning, dyeing, fatliquoring, finishing etc. Some mechanical operations are also carried out, such as drying and stacking. Several mechanical investigations have been conducted, including tensile strength, stitch tear strength colour rub fastness and shrinkage temperature in order to assess the overall physical properties of prepared leather. Chemical analyses have also been carried out (chromic oxide content, fat content and pH) to find out the quality of leather. It is observed that tensile and stitch tear strengths are much lower than any of the grained upper leather. But the results demonstrate that colour rub fastness is good enough to meet the standard value. Among the different chemical analyses, pH and % of fat content meet the standard value, but chromic oxide content (%) of one sample is below than the standard value of grained upper leather. All these might be due to the prevalence of difference in composition between hide/skin and the stomach of animals. The prepared stomach leather could be used in making of fancy leather goods like key ring, wrist watch belt, hair clip, bracelet etc.

**KEYWORDS:** Exotic Leather, Cow Stomach, Tanning, Tensile & Stitch Tear strength, Color fastness, Cow Leather.

## 1. INTRODUCTION

Leather is the product which is obtained by converting the putrescible outer coverings of animals into non-putrescible materials with definite physical, chemical and biological properties through tanning process so that they can be used in our daily life and industries [1]. But exotic leathers are explicitly different type of leathers as these are produced from outer coverings of rare species of animals or from the parts of animals that are not usually used for leather manufacture [2]. Rare species are strictly prohibited in Bangladesh to be hunted and slaughtered [3]. The cow's stomach differs from monogastric, because it has four chambers, while the monogastric has a single chambered belly. These four chambers are namely-rumen, reticulum, omasum and the abomasum. The rumen is the widest portion of the creature which consists of several sacs. It can accommodate 25 gallons or more of materials depending on the size of the cow and can act as storage vat and fermentation vat. The reticulum has a pouch-like structure which lies close to the heart.

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It also forms a network similar to the honeycomb. A small tissue fold lies between the reticulum and rumen, but the two aren't separate compartments and therefore they are called rumino-reticulum. The rumen combined with the reticulum makes up 84% of the volume of the entire stomach. On the other hand, the omasum has a globe-shaped structure which contains leaves of tissues like pages in a book. The omasum also known as manyplies is smaller than rumen and reticulum and makes up about 12% of the stomach's total volume with the capacity of holding up to about 15 gallons. The abomasum, also known as 'true stomach' is the only compartment that is lined with glands. This part is similar to the non-ruminant's stomach [4]. Special treatment is required for exotic leather production due to their unique fiber composition and exceptional grain texture. Cow's stomach leather can be used in manufacturing different types of feasible small objects i.e. key ring, coin purse, bracelet etc. Such goods can build a new park and also enhance the country's economy in local or international level.

## 2. MATERIALS & METHODS

Cow Stomach is available in everywhere in Bangladesh. Three pieces of cow stomachs are collected from Ghosh Patti, Kawran Bazar, Dhaka, Bangladesh. All the chemicals used in leather processing are based on the weight measured. The weight of the fresh raw materials is 5.5 Kg (not salted).

### **3. PRODUCTION OF NOVELTY LEATHER FROM COW STOMACH**

The preparation of stomach leather is conducted in four consecutive steps i.e. pre tanning, tanning, post tanning and finishing operations. They are discussed as below.

#### **3.1 PRE-TANNING OPERATIONS**

##### **3.1.1 SOAKING & CLEANING**

Cow stomachs are always dirty and contaminated and they need to be washed perfectly to remove all those dirt. Washing and all subsequent chemical steps are mostly conducted in open vessels or bowl, where the pelts are moved in the solution by a paddle and hand. All these raw materials are soaked with 300% water, 0.5% wetting agent (commercially known as Ld-600), 0.5% bactericide (BUSAN 40L) for an average time of two hours. After that washing and cleaning is repeatedly performed with hand for several times until all the dirt are completely removed and the stomachs as well as water looked clean. Finally the water is drained.

##### **3.1.2 LIMING**

Cautiously the liming process is done to help the stomach to be swelled. In this step, the stomach is treated with 200% water at normal temperature, 8% lime and 3% lime auxiliary. To conserve the structure of the stomach, lime is used in two installments. The 1<sup>st</sup> installment is with 4% lime which is added to the bowl and treated for 30 minutes with regular howling. And then in the 2<sup>nd</sup> installment 4% lime is added and run for another 15 minutes. The bowl is then kept in rest for 2 days with howling of 10 minutes in every 2 hours. The bath is then drained.

##### **3.1.3 FLESHING & SCUDDING**

Some flesh and fat adhered to the stomachs even after liming are separated off at this fleshing stage. The stomachs are hand fleshed and scudded by sharp hand knife and slicker to remove all those fatty matters and flesh. It takes 2-3 hours to be scudded and hand fleshed all the stomachs.

##### **3.1.4 RELIMING**

After that the stomachs are re-limed for a day with 200% water at normal temperature, 6% lime, and 2% masking agent (NaOH). The process is run for 6 hours with regular howling of 15 minutes in every 2 hours.

##### **3.1.5 DE-LIMING & BATING**

For the purpose of lowering the pH and removing of introduced lime from the pelt, the stomach is delimed with 150% water at normal temperature and 2% Ammonium Sulfate for 1 hour with regular howling. Bating is done in the same bath to make the pelt soft and supple as well as to ease and accelerate the tanning process. For this, 0.5% of bate powder is added to the bath liquor and run for another half an hour. A cross-section is checked by phenolphthalein which gives a colorless effect indicating the completion of the process. A regular washing is carried out afterwards.

##### **3.1.6 PICKLING**

The pickling method is primarily done to bring the collagen into acidic conditions as required for the chrome tanning operation. The process is dealt with 150% water and 10% common salt for 15 minutes. Then 0.8% diluted Formic acid (1:10) is added to the liquor and run for another 30 minutes. To accelerate the process 1% Sulfuric acid is added to the bath in 4 installments with interval of 15 minutes. And finally, 0.5% Hypo is also mixed with the same bath and run for half an hour with regular howling. After checking the final pH of the stomach (pH 2.8), the pelt is kept for overnight.

#### **3.2 TANNING OPERATION**

##### **3.2.1 CHROME TANNING OPERATION**

By tanning cross links are formed with the collagen through different types of bonds without modifying the natural fiber texture [5]. In Chrome tanning, there are two methods available namely, one bath and two bath method. One bath method is cheap and easy to carry out and furthermore, gives superior tannage and better color [1]. So, one bath chrome tanning is followed in the pickled bath. Half of the pickled bath is used in the process of chrome tanning. 4% of Chrome powder is added to the pickled bath and run for an hour. After that 4% Chrome powder is again added and run for another 90 minutes. Finally 0.25% Fungicide is mixed with the bath and run for 15 minutes to protect the tanned stomach from fungal attack. The bath is then kept for 8 hours for proper penetration. To ensure the penetration of chrome salt, cross-section of pelt is checked.

##### **3.2.2 BASIFICATION**

The process is conducted in the same tanning bath by adding 2% Sodium-bi-Carbonate (1:10 dilute solution) in three installments with interval of every 40 minutes. And finally 0.2% Preservative (commercially known as BUSAN

30L) is mixed in the bath. Final pH (3.8) is checked. The pelt is then piled for 5 days for ageing.

### 3.3 POST TANNING OPERATIONS

The choice of post tanning processes depend on the primary tannage and the type of leather the tanner is attempting to make.

#### 3.3.1 TRIMMING

To remove the unwanted side bits, trimming is performed by hand knife. Then the weight of the trimmed stomachs is again taken which is 3.8 kg. The percentage of all chemicals for the next steps is based on this weight.

#### 3.3.2 ACID WASH

Acid wash is carried out to bring the pH down to around 3.2 [6]. Acid wash is done with 100% of water and 0.5% Acetic acid. After that, pH (3.2) is checked and the bath is drained.

#### 3.3.3 RECHROMING

Re-chroming is carried out in a bowl by adding 150% water at normal temperature, 0.5% acetic acid, 3% chrome powder and 3% chrome syntan and the process is run for an hour. After that 3% chrome powder, 1% cationic fat, 1% Remsol OCS, 1.5% Glutaraldehyde are added to the bath and run for another half an hour with regular howling. In the same bath 2% sodium bi carbonate (1:10 diluted solution) is added for basification purpose and run for 1 hour with slight howling. Finally the pH of leather is checked (3.8) and pile up for couple of days.

#### 3.3.4 NEUTRALIZATION

Neutralization is done in order to remove unwanted acids to prevent the deterioration during the drying process and to prepare the leather for the next subsequent stages. Therefore, proper neutralization is needed for the subsequent processes [1]. As the leathers are slightly dried, these are wet back by adding 150% water, 0.5% wetting agent and 1% oxalic acid in a bowl for 50 minutes. After that, neutralization is carried out.

For neutralization, 150% water and 2% sodium formate are used and run for 30 minutes and then 1.5% Neosyn BS3 (Neutralizing syntan) is added to the bath. After an hour, 0.5% Sodium bi carbonate (1:10 diluted solution) and 1% Remsol C2 is also added to the same bath in two installments and kept for another one hour. The final pH is checked (pH 5.0) with BCG (Bromo Cresol Green).

### 3.3.5 RETANNING & DYEING

After Neutralization, all the three stomachs are taken into three separate bowls to dye with three different color.

Both re-tanning and dyeing are carried out in the same bath. At first leathers are treated with 150% hot water (45°C), 0.2% Relugan RE (Acrylic resin syntan) and 3% Tanning OS (Replacement syntan). After an hour 3% Bay Syntan, 3% Mimosa and 3% Paramel P100 (Resin syntan) are also added to the bath and kept in howling for another half an hour. Subsequently, 2% Remsol C2 is added and run for 30 minutes. 2% DLE, 2% Neosin RWP and 2% Neosin N are added to the bath and again howled for 60 minutes. After that, 1% Formic acid (1:10 diluted solution) is added to the bath. Finally 4% dye of three different colours (maroon, blue and black) is added in the same bath and kept for 1 hour with regular howling. To ensure proper dyeing, cross-section of all the stomachs are checked. And then the baths are drained.

#### 3.3.6 FAT LIQUORING

Fatliquoring is the process of coating the surface of fibers and fibrils of the leather with a thin layer of oil or fat so that leather becomes soft even after drying. Because of fat liquoring, the fibers can slide over one another [7].

The process is dealt in a bowl with 50-60% hot water, 6% Remsol B40 (Synthetic Oil), 6% Remsol C2, 2% Trisul ML (Fish Oil) and 0.2% Preservative (BUSAN 30L) for 60 minutes. It is noteworthy that before treat the leather with fat all the fats are emulsified well in hot water at about 60-70°C. After one hour 2% Relugan RE and 2% Relugan GTW are also added to the liquor and run for another half an hour. Finally 0.5% Synthol O and 1% Glutaraldehyde are added to the bath and howled for one and half an hour. After that, 1.5% Formic acid is added to the bath in two installments with interval of 30 minutes. The liquor is drained and all those leathers are washed very well.

#### 3.3.7 DRYING

Nail drying method is followed to dry the leathers as well as to get increased and even area. The stomachs are nailed under the scorching sun on a wooden board with the grain side exposed to the sunlight and the flesh side having in contact with the wooden board for almost 5 hours.

#### 3.3.8 STAKING & TRIMMING

Due to the delicate and fragile nature of the stomachs, staking operation is done to soften the leather using hand staking. After that, trimming is done as per requirement.

### 3.4 FINISHING

A finishing coat is given for the color needed.



A. Raw Omasum and Reticulum part of cow stomach



C. Key Ring Made from Stomach Leather



B. Prepared Stomach Leather



D. Wrist Watch Belt from Stomach Leather

### 4. RESULTS & DISCUSION

All the physical and chemical tests are accomplished following test standard. Three samples of three different colored leathers i.e. Blue, Maroon and Black identified as S1, S2 and S3 samples respectively pass through these tests. Before going through the physical tests, samples are conditioned following IUP-3 [8]. For physical tests IUP-6 [9], DIN Method 53331 [10], SATRA PM-8 [11] and SATRA TM-17 [12] methods are followed and for chemical tests, IUC-8 [13], IUC-4 [14] and IUC-11 [15] methods are followed.

Table 1: Average Tensile Strength

Observed Sample	Avg. Tensile Strength (kg/cm <sup>2</sup> ) for Omasum	Avg. Tensile Strength (kg/cm <sup>2</sup> ) for Reticulum
S1	30.50	35.5
S2	28.50	30.0
S3	35.00	38.5

Table 2: Average Stitch Tear Strength

Observed Sample	Avg. Stitch Tear Strength (kg/cm) for Omasum	Avg. Stitch Tear Strength (kg/cm) for Reticulum
S1	17.00	19.50
S2	15.50	16.00
S3	19.50	22.00

Table 3: Average Color Rub Fastness

Obs. Sample	Gray scale rating for Omasum	Gray scale rating for Reticulum	Std. Grey Scale Rating
S1	4	4/5	3
S2	4	5	
S3	4/5	5	

Table 4: Average Shrinkage Temperature

Obs. Sample	Shrinkage Temperature for Omasum (°C)	Shrinkage Temperature for Reticulum (°C)	Std. Value (°C)
S1	94	92	80~100
S2	96	95	
S3	91	96	

Table 5: Chromic oxide content, pH and Fat Content

Observed	% of	p <sup>H</sup>	% of Fat
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Sample	Chromic Oxide content	Value	Content
S1	2.53	4.1	12.50
S2	2.49	3.9	10.22
S3	2.51	4.2	11.42

Table 1, 2, 3 and 4 represent the physical properties of the stomach leather. It is clearly shown that the results regarding tensile and stitch tear strength are not good enough compared to the leather produced from skin or hide, although the colour rub fastness and the shrinkage temperature are good enough (standard values for tensile and stitch tear strengths are 100 kg/cm<sup>2</sup> and 30 kg/cm respectively). The results from table 5 regarding chemical tests are sufficiently good enough. The p<sup>H</sup> value is good, the percentage of chromic oxide is in between 2.49-2.53 which represents that the samples would withstand boil test (Standard values of pH and chromic oxide content are min. 3.5 and 0.8% respectively). Also, all the leathers possess sufficient fat content as the standard value is 3-12% for bag upper leather [16].

\*All the standard values represent here are based on the combination tanned bag upper leather (below 2 mm thickness).

## 5. CONCLUSION

At present the leather industry is the country's second largest foreign currency earner with respect of its real value addition [17]. Economic return in finished leather export in terms of value addition is minimum 50% higher than that of crust leather export, which are several folds in the case of leather products. Some people use the cow stomach as food and sometimes it is ended up as discarded wastage creating environmental pollution. Bangladesh is bestowed with nearly 24.5 million heads of cattle which are distributed throughout the country. By-products from the meat industries must be efficiently deemed as the growth of these industries depends largely on by-products and waste management [18]. A lot of stomachs can be collected during the period of EID-UL-ADHA. Better understanding and people's participation would develop the ability to turn cow's stomach into exotic products as the structure of stomach looks unique and the textures are pretty attractive. This could lead the country's economy and help to maintain the sustainable development.

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