

The Ruminant Stomach: not just sausages and animal food

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The raw material

The stomach of ruminants are quite complicated and is fundamentally different (morphologically and functionally) from the stomach of non-ruminants. It is divided in four sections as shown in *Figure 1*.

The rumen occupies about 2/3 of the entire stomach; the three other

stomachs occupy the residual 1/3 in equal parts, being quite small compared with the rumen. The flattened entire stomach has an area of 1.0-1.5m², depending on sex, age and species.

Histology and microscopic anatomy

Three layers can be clearly differentiated:

- Serous membrane
- Muscular coat
- Mucous epithelium

The loose-structured serous membrane and the two-layered muscular coat - the two outer layers of the stomach - are of no interest to the leather industry. They may be viewed as the equivalent to the subcutis from hides and skins. The internal layer of the stomach - the gastric mucosa - is the part most suitable for the tanning industry and may be compared with the corium.

The most interesting parts of the stomach for the leather industry are the rumen and reticulum, being characterised by an exciting surface structure (grain). Almost 65% of the mucous membrane of the rumen is covered with long cones (villi). These are about one centimetre long and give the tanned skin a characteristic appearance similar to terry-towel or cloth. This provides an ideal surface, as shown in *Figures 2, 3 & 4*, for novel softy garment leathers.

Figure 1: Four sections of the cow stomach.

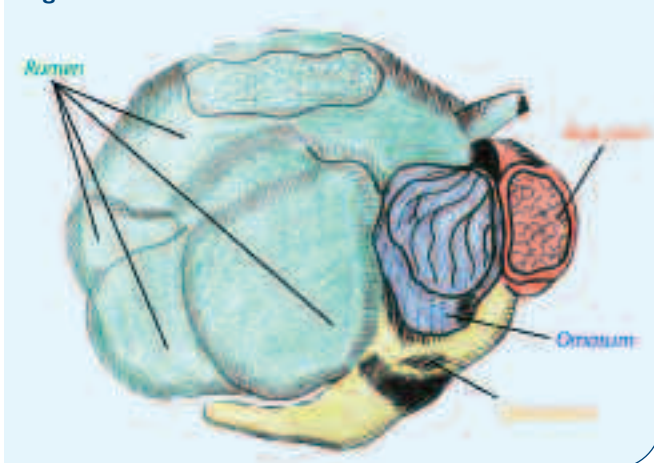


Figure 2: Tanned rumen stomach.



Figure 3: Rumen leather.
Note the terry-cloth character.



Figure 4: Rumen leather.
Note finger-like villi (x8 enlarged).

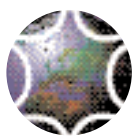


Figure 5: Tanned reticulum stomach. Note that the ledges are still high.



Figure 6: Dyed reticulum leather (x8 enlarged).



Figures 7 and 8: Ladies shoe and handbags made of glazed reticulum leather.

The reticulum is, however, the most attractive part of the ruminant's stomach. Remarkably, the structure provides a relief of pentagonal or hexagonal forms arranged in ledges of 8-12mm height. In addition, these geometrical reliefs are divided by toothed ridges, some 0.2-0.4mm in height, into small bizarre areas. These are shown as Figures 5 & 6.

The application of a reptile-like glazing finish provides a beautiful leather for shoes and leather goods, and examples are given as Figures 7 & 8.

The processing of stomach leather

There is little literature dealing with the tanning and finishing of ruminant stomachs. In addition, most of the published recipes were developed under laboratory conditions as opposed to running production, so are not helpful for the practical tanner.

The main reason for this lack of practical detail is probably because the production of stomach leather is more difficult than processing hides and skins. The fact that the stomach is presented as a large sack makes

Panel I

Production relevant data for heavy weight cow stomach

RAW MATERIAL: WEIGHT & AREA

Fresh (green) - weight	10-12 Kg
Washed and fleshed - weight	7-9 Kg
Waste: flesh, grease (fat) - weight	1-3 Kg
Reticulum - weight	1- 1.5 Kg
Rumen - weight	6- 8 Kg
Reticulum - area	1-1.5 sq.ft.
Rumen - area	6-8 sq.ft.

FINISHED LEATHER

Shrinkage temperature - Reticulum (synthetic/semi-chrome)	74-78°C
Shrinkage temperature - Rumen (full chrome)	82-87°C
Tensile strength - Reticulum	65 Kg.cm ²
Tensile strength - Rumen	90 Kg.cm ²
Elongation at break - Reticulum	55%
Elongation at break - Rumen	72%

mechanical treatment during beamhouse and wet finishing operations impossible.

SOAKING

The raw material can be either raw or wet salted. Independent of normal soaking, a thorough rinse is absolutely necessary to remove residual food and digestion enzymes. To avoid unintentional loss of skin proteins, a non-tanning preserving chemical in combination with an effective wetting/degreasing agent is essential. This must be followed by hand-fleshing on a beam.

DEGREASING

The rumen: This section has a very high fat content and should be degreased prior to liming, after deliming and bating, and possibly in a dry cleaning unit after crusting.

The reticulum: This section has a much lower fat content, and only needs degreasing after deliming and bating.

LIMING

A combination of sodium sulfide - sodium hydrosulfide - lime has proved best to open up the quite hard cones for rumen garment leathers. The honeycomb stomach for leather goods needs a weaker liming.

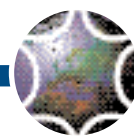
DELIMING AND BATING

This process is carried out in the usual way with a combination of ammonium chloride/sulfate or other safe deliming agent. This is then followed by a strong bate in combination with an anionic washing agent.

PICKLE BLEACH

There are several strong reasons for a pickle bleach with sodium chlorite.

- To destroy and remove the high percentage of non-collagen fibres of the cones;



Guideline formulation: Rumen stomach leather

Operation		Product and Process detail	T°C	Time
% calculated on green weight				
Soak	800	% Water	20	
Drum 8-12 rpm	0.05	% Cortymol FUN ⁽¹⁾		
	1.5	% Eusapon OD ⁽¹⁾		12-15h
		Auto run 5 min, 55 min lay		
		Rinse very well		
% calculated on fleshed weight				
Liming	50	% Water	25	
Drum 4-6 rpm	1.5	% Sodium sulfide		
	1.5	% Sodium hydrosulfide		60
	2.5	% Lime		
	100	% Water	25	30
	150	% Water	25	60
		Auto run 5 min, 55 min lay		2 day
		Rinse well		
Deliming	300	% Water	30	
Drum 4-6 rpm	1.0	% Ammonium chloride		
	0.5	% Decalcal N ⁽¹⁾		60
Required: cut section lime free				
Bating	300	% Water	30	
	1.0	% Basozym CS 10 ⁽¹⁾		
	0.4	% Eusapon S ⁽¹⁾		90
		Rinse well		
Pickle & bleach	100	% Water	20	
Drum 6-8 rpm	8.0	% Salt		10
	0.8	% Formic acid (85%)		
	0.7	% Sulfuric acid (96%)		20
	2.0-3.0	% Imprapell CO ⁽²⁾		120
	1.0-1.2	% Sodium thiosulfate		30
Check residual oxidation with potassium iodide/starch paper. If the paper shows blue, add more sodium thiosulfate, run 20 mins and check again				
		Drain well		
Chrome tannage	100	% Water	25	
Drum 6-8 rpm	5.0	% Salt		10
	6.0	% Chromitan MSN ⁽¹⁾		120
	2.0	% Lipoderm Liquor AI ⁽¹⁾		O/night
		Drain float		
Pile for min 24 h. Flesh on Banjo				
% calculated on re-fleshed weight				
Retanning	150	% Water	30	
Drum 12-14 rpm	6.0	% Tannesco HN ⁽³⁾		60-90
		Rinse well		
Neutralise	150	% Water	30	
	0.5	% Sodium formate		
	0.5	% Sodium bicarbonate		
	1.0	% Eusapon OD ⁽¹⁾		60
		Rinse well		
Pre-fatliquor	150	% Water	30	
	6.0	% Lipoderm Liquor AI ⁽¹⁾		
	4.0	% Lipoderm Liquor LA ⁽¹⁾		
	2.0	% Lipoderm Liquor PN ⁽¹⁾		60
	x	% Formic acid (85%)		
		Drain float		
Pile overnight hang dry				
% calculated on dry weight				
Wet back	800	% Water	50	
	1.5	% Eusapon OD ⁽¹⁾		
	0.5	% Ammonia		60
		Rinse well		
Dyeing	500	% Water	50	
	6.0-8.0	% Dyestuff		30
	2.0-4.0	% Lipoderm Liquor SLW ⁽¹⁾		40
	x	% Formic acid (85%)		20
		Rinse cold		
		Pile up, toggle dry at room temp.		
		Iron using fur-ironing machine		

Legend: Products by (1) BASF Ag, (2) Clariant, (3) TFL

- To guarantee a better take-up of tanning agents, fatliquors and dyes;
- To get an even and clear substrate for level and brilliant shades;
- The older the animal, the darker the stomach pigmentation, and the greater the need for a strong bleach.

TANNING

Chrome tannage: Chrome tannage alone - without using synthetic or vegetable tanning agents in a retanning stage - produces the best results when seeking a light, soft and fluffy (terry cloth-like) garment leather.

Synthetic tannage: Replacement syntans that provide good filling are most suitable to tan the honeycomb stomach (reticulum) for leather goods. If this tannage is supported by a chrome retannage, then this leather is ideal for very individual shoe uppers.

FATLIQUORING

Rumen garment leather: All fatliquors that provide good penetration are suitable. This ensures an absence of surface grease to guarantee ironing on the fur-ironing machine and avoids potential problems of sticking and burning.

Honeycomb (reticulum) leather: Fatliquors are needed that suit glazing on a reptile glazing machine.

DYEING

Rumen garment leather: Dye penetration must be complete to avoid lighter scratch marks. Use dye offers of 6-8% on the dry weight.

Honeycomb (reticulum) leather: Only 1-2% dye on the dry weight is recommended to get a pronounced two-tone effect during glazing.

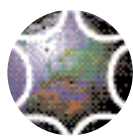
FINISHING

Rumen garment leather: It is most important that the dyestuffs are well fixed. Finishing comprises ironing using a fur-ironing machine at 120°C. The effects produced are shown in Figure 9.

Honeycomb (reticulum) leather: Before buffing, the high ledges have to be flattened by kiss plating. After buffing and dedusting, the leathers can be glaze finished. Apply the glazing finish by brush, dry, kiss plate, and glaze on a reptile glazing machine. Kiss plate again at 50°C, 200 atm., for 2 seconds.



Figure 9: Dyed and finished rumen leather ironed on a fur-ironing machine. (x8 enlarged).



Guideline formulation: Reticulum stomach leather

Operation		Product and Process detail	T °C	Time
% calculated on green weight				
Soak Drum 8-12 rpm	800 %	Water	20	
	0.05 %	Cortymol FUN ⁽¹⁾		
	1.5 %	Eusapon OD ⁽¹⁾		12-15h
		Auto run 5 min, 55 min lay		
Rinse very well				
% calculated on fleshed weight				
Liming Drum 4-6 rpm	300 %	Water	25	
	2.5 %	Sodium sulfide		
	1.5 %	Lime		120
		Auto run 5 min, 55 min lay		36h
Rinse well				
Delime + Bate Drum 4-6 rpm	300 %	Water	30	
	0.7 %	Ammonium chloride		
	0.5 %	Decalcat N ⁽¹⁾		40
		Required: cut section lime free		
	0.8 %	Basozym 1000 ⁽¹⁾		
	0.4 %	Eusapon S ⁽¹⁾		60
Rinse well				
Pickle & bleach Drum 6-8 rpm	100 %	Water	20	
	8.0 %	Salt		10
	0.8 %	Formic acid (85%)		
	0.7 %	Sulfuric acid (96%)		20
		Required: pH 2.0-2.5		
	2.0-3.0 %	Imprapell CO ⁽²⁾		120
	1.0-1.2 %	Sodium thiosulfate		30
Check residual oxidation with potassium iodide/starch paper. If the paper shows blue, add more sodium thiosulfate, run 20 mins and check again				
Desalt Drum 8-12 rpm	200 %	Water	25	10
	at 1°Be	Basyantn DXL-N		
		Auto run 5 min, 55 min lay		o/night
		Drain float. Wash well		
	300 %	Water	25	
	15.0 %	Basyantn DXL-N		30
	15.0 %	Basyantn DXL-N		60
Pre-fatliquor	10.0 %	Basyantn DXL-N		60
		Auto run 5 min, 55 min lay		o/night
		Rinse well		
	200 %	Water	40	
	5.0 %	Lipoderm Liquor SWL ⁽¹⁾		
	3.0 %	Lipoderm Liquor PSE ⁽¹⁾		
	1.0 %	Lipoderm Liquor PN ⁽¹⁾		60
	x %	Formic acid (85%)		20
Horse up				
Dry at room temp				
% calculated on dry weight				
Wet back	500 %	Water	35	
	0.5 %	Eusapon S ⁽¹⁾		40
Rinse well				
Retan + Dyeing	500 %	Water	40	
	4.0 %	Tannesco HN ⁽³⁾		20
	0.8-1.5 %	Dyestuff		30
	2.0-4.0 %	Lipoderm Liquor SLW ⁽¹⁾		30
	x %	Formic acid (85%)		20
		Rinse cold.		
Pile up, toggle dry at room temp. Kiss plate at 50 °C, 200 atm. Buff flesh carefully & dedust Apply glazing finish				
Finish	100 pt	Emalina ⁽⁴⁾		
	95 pt	Luron Top AC ⁽¹⁾		
	100 pt	Luron Binder U ⁽¹⁾		
	6 pt	Eukesol Oil SR ⁽¹⁾		
	700 pt	Water		
Fix		1-3 pad/spray coats.		
		Dry at room temp.		
	100 pt	Glyoxal 40%		
	870 pt	Water		
	30 pt	Formic acid (85%)		
Dry well.				
Glaze				

Legend: Products by (1) BASF Ag, (2) Clariant, (3) TFL, (4) Lamberti S.p.A

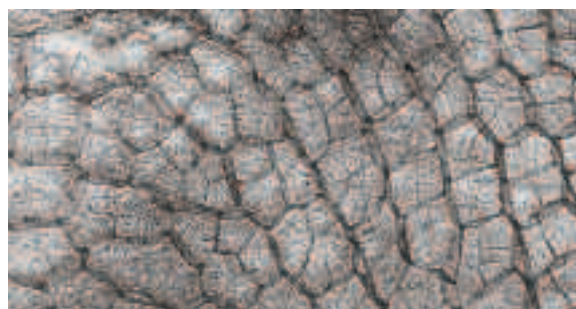


Figure 10: Vacuum dried reticulum leather. Flattening and fixing of the ledges.

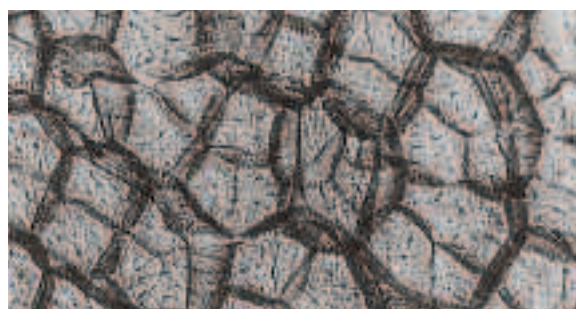


Figure 11: Glazed and plated reticulum leather.

If the appearance needs the high ledges to be maintained, but minimised, the crevices can be filled and the ledges stuck down by a fixing or glueing process. In this event, the glazing finish is sprayed or brushed onto the still wet stomachs. These are then placed on a vacuum dryer at 50°C for 3 minutes. then toggled and dried completely at 30°C. The results are shown as Figure 10.

The leathers can then be glazed using the reptile glazing machine, then kiss plated at 50°C, 200 atm. for 2 seconds, as shown in Figure 11.

MECHANICAL OPERATIONS

It is emphasised that two machines exclusively used within fur processing are very important for a first class production of ruminant stomach leather.

- The Banjo or fleshing disc, for refleshing and levelling after tanning
- The fur-ironing machine for ironing the finger-like cones (villis).

Literature

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