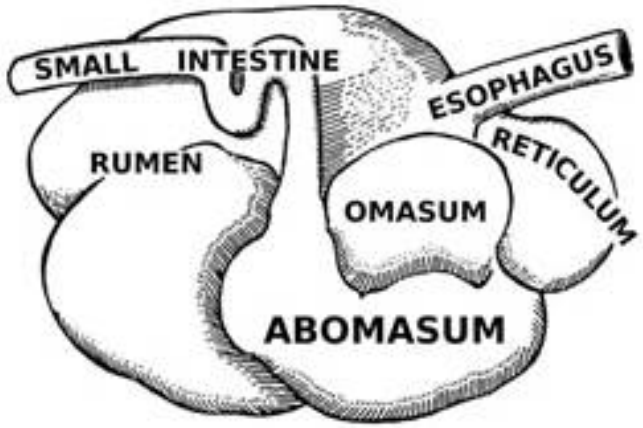
Ruminology
Diseases of the forestomach

Ruminology

The forestomach of the ruminants can be divided into primary structures, reticulorumen and omosabomal are separated by reticuloomasal orifice.



The reticulorumen of an adult cow occupies almost the entire left half of the abdominal cavity and has capacity of up to 90 kg of digesta.

- The establishment of rumen microbes in newborn animals requires contact with older animals at least 1-2 weeks.

- Live weight gain is improved by greater digestibility accompanied by higher level of VFA, also higher ammonia level which indicate a greater protein digestion by rumen microbes.

- The ciliates represent 2% of the weight of the rumen content and increase in their number two times within about one day by means of binary fission in the rumen, the almost same number of increased ciliates flows to the posterior alimentary tract of the host and digested in the abomasum and small intestine as nitrogen nutrients.

- The bacteria and protozoa provide the ruminant with cellulose digestion, protein and non protein nitrogenous utilization, essential amino acids, synthesis of vitamin B and detoxication.

- The cellulitic Gram negative bacteria ferment carbohydrates producing acetic, propioic and butyric volatile fatty acids.
- The normal pH of the rumen ingesta is 6-7 and maintained by alkalinity of saliva, alkaline feed, buffering action of rumen ingesta and by elimination of acids from rumen by passage posteriorly.
- However increase or decrease ruminal pH resulting of indigestion. The animal control over the fermentation process by selecting the feed, adding a buffer like saliva, continous agitation and mixing the forestomach contont.

- Retention of ingesta in the rumenoreticulum for one to three days allows sufficient time for bacterial disintegration.
- Bacteria obtain adequate nutrient from their hydrolysis of the plant feeds. Digestion of the feed stuffs in the reticulorumen occurs by microbial fermentation.
- The mucosal epithelium absorbs and exchanges products of the fermentation without secretory function.

Forestomach fermentation depends on:

(1) Amounts and types of ingested feed and water.

(2) Buffering of saliva to counteract the acidity of the fermentation products.

(3) Eructation of the gases produced by fermentation.

(4) Reticuloruminal motility to provide mixing; rumination, remastication and passage of ingesta.

(5) Rumen temperature and exchanges of electrolytes and volatile fatty acids across the rumen wall.

Abnormalities of any one of these functions can lead to digestive disturbances.

- Ruminal motility is used as an index of digestive function in the ruminants.
- Ruminal ingests divided into upper layer of free gas, lower layer of fluid containing gas bubbles and suspended food particles but the undigested fibers float on the top.

Stages of the rumination cycle

Ruminal cycle	Reticulorumen	Omasum
Stage 1 **Result**	Two contractions of reticulum and reticuloruminal fold *Reticular contents pass over reticuloruminal fold into rumen.	Dilatation of omasal canal *Passage of feed into the omasum
Stage 2 **Result**	Contraction of ruminal atrium, dorsal blind sac and ruminal pillar. Movement of reticular fluid over reticulorumin fold into relaxed rumen. *Passage of coarse particles over the ruminal pillar into dorsal blind sac. *Movement of dorsal sac results in squeezing and mixing of solid contents.	Contraction of omasal canal *Transport of feed from omasal canal into omasum
Stage3 **Result**	Contraction of ventral sac and pillar of rumen with relaxation of dorsal sac. *Fluid part of rumen contents returns to dorsal sac and ruminal atrium and is forced through the fibrous matter.	Contraction of omasum *Contents squeezed. Slow removal of contents to abomasum.
Stage 4 **Result**	Contraction of dorsal sac and pillar of rumen. *Transfer of accumulated gut contents to the cardia resulting in eructation.	Contraction of omasal canal. *Emptying of omasal canal.
Eructation	Reticular contraction prior to stage 1. Reticular bolus projected into mouth.	

- **Indigestion**

It is a general term for a group of diseases characterized by dysfunction of the reticulorumen, decrease its motility, discontinuous grazing and abnormal feces. It is usually results in anorexia, decrease in ruminal contraction, ruminal distension, mild bloat, decrease milk production, sometimes abdominal pain, diarrhea, recumbency and death.

The general causes o f rumen dysfunction:

(1) Inadequate quantity of feed

(2) Improper ratio of nutrient elements.

(3) Infrequent and irregular feeding.

(4) Too much feed.

(5) Sudden changes in feed.

(6) Infrequent and inadequate water intake.

(7) Spoilage or moldy feeds.

(8) Fever.

(9) Internal or external parasites.

(10) Prolonged or heavy oral dosing with sulpha drugs or antibiotics.

Classification o f indigestion:

[1] Primary Indigestion:

(1) Reticuloruminal fermentative (Microbial /biochemical) disorders.

1) Simple indigestion.
2) Acute rumen lactic acidosis.
3) Subacute rumen lactic acidosis.
4) Rumen alkalosis.
5) Chronic indigestion in calves.

(2) Reticuloruminal motor disorders/Diseases of the ruminal **wall.**

1) Traumatic reticuloperitonitis.

2) Frothy bloat and free gas bloat.

3) Vagal indigestion.

[2] Secondary:

(1) Secondary reticuloruminal motor inactivity.

(2) Secondary reticuloruminal microflora inactivity

Reticuloruminal fermentative disorders

Simple indigestion

Definition:

It is the inability of animal to digest feed stuff due to an abrupt change in the ration, where the rumen microflora are not metabolically adapted with nutrient substrates or produce inhibitory substances to decrease fermentation.

Etiology:

(1) Indigestible and damage foods include moldy or overheated feeds, frosted forages and partly fermented spoiled or sour silages. One or several animals on the same ration may have signs.

(2) Indigestable substances as placenta, balls of hair or wool, heavily contaminated roughage with sand, mud and/or dust.

(3) Sudden change of food from green to dry.

(4) Less water intake especially during dry season.

5) Deficiencies of one or more nutrients in animal fed poorquality roughage (late cut, highly lignified hay, straw, bedding or scrub fed during drought period).

(6) Deficiency in protein and readily digestible carbohydrates, diminish microbial populations and fermentative processes.

(7) Deficiencies of specific mineral nutrients as cobalt.

(8) Inhibitory substances such as antibiotics or some plant products.

(9) Secondary indigestion in cases of fever, septicemia, toxemia and other diseases cause ruminal atony.

Pathophysiology:

(1) Primary ruminal atony caused by dietary abnormalities: overeating on grains (acidity) or high protein diet (alkalinity) or toxic amides and amines produced (include histamine) as well as decreasing of food intake.

(2) The decline in microbial digestive processes results in prolonged breakdown of ingested feed stuffs, constipation, sharp decrease in volatile fatty acids productions in the atonic reticulorumen resulting in a fall in milk yield.

(3) The feces are usually reduced in quantity and are drier than normal on the first day then fermentation and acidosis occurs 24-48 hours later on, irritating ruminal mucosa

causing diarrheic.

NB: In adult cattle passage of ingesta through the digestive tract requires 1.5-4 days (total 30-50 kg of feces/day divided into 10-24 defecations) and often delayed in cases of indigestion.

Clinical findings:

(1) Reduction in appetite, dullness and depression.

(2) Drop of milk production.

(3) Decrease In frequency and amplitude of rumen contractions or ceases o f rumination.

(4) The distended rumen and mild abdominal discomfort usually resolves when the rumen movements return to normal size in about 48 hours.

Diagnosis:

(1) History and clinical symptoms.

(2) Evaluation of rumen fluid:

1) pH: It is decreased to 5-5.5 in subacute or chronic rumen acidosis as well as a decrease in ruminal total volatile fatty acids (TVFA) and ammonia concentration.

2) Sedimentation/floatation test: By putting seaved ruminal juice sample in 50 ml cylinder. The particles collected with each other and settled by gravity. If microbes active digestion occurs with production of gases and VFA causing refloatation of particles to the top of test tube within 3-9 minutes. More longer time occurs in mild inactivity. Complete settling indicate complete inactivity.

3) Cellulose digestion test: By putting seaved ruminal juice in 15 ml capacity screw capped test tube from which cotton fiber thread is tied, the other end is tied with a bead immersed in ruminal juice sample. If the bead is settled in bottom within 24-36 hours, indicate digestionof cotton (cellulose) which occur in active microbes. Delaying settling occurs in cases of inactive microbes.

4) Rodex potential (oxidation-reduction potential): By putting 20 ml seaved ruminal juice with lml of methylen blue 0.03% in test tube. If dark blue color occurs within 3 minutes indicate highly active microbes. If takes 3-6 minute, indicate moderate inactivity. If more than 15 minutes, indicate inactivity.

5) Glucose fermentation test: By putting 10 ml sieved ruminal juice with 0.5 ml of 16% glucose solution in saccharometer. If gas formation occur within l-2ml/ hour, indicate active microbes. More gas formation indicates tympany. Less gas formation indicates inactivity.

6) Microscopical examination for evaluation of the number and activity of protozoa in the rumen fluid. Activity and concentrations of large and small protozoa were reduced in cows with indigestion. The larger protozoa was the first to disappear.

7) The normal rumen fluid chloride concentration is less than 30 mEq/L. It increases in excessive chloride intake, or reflux of abomasal ingesta into the rumen caused by abomasal disease, or obstruction of intestine flow.

Rumen juice in healthy, acidosis and alkalosis

	Healthy	*Acidosis*	*Alkalosis*
Physical examination:			
(1) Color*	Green to brownish	Milky gray	Varies
(2) Odour	Aromatic	Sour	Moldy
(3) Consistency	Viscous	Watery or thin	Watery or thin
(4) Sedimentation test	5-15 minute	Longer time	Longer time
(5) Cellulose digestion test	24-36 hours	Longer time	Longer time
Biochemical examination:			
(6) pH	6.2-7.2	Less than 6	More than 7
(7) Total acidity/unit	8-25	Reach 70	Decrease
(8) Total VFA "mol/L"	60-120	Less than 30	-
(9) Rodex test	Blue color in 3 minutes	Longer time	Longer time
(10) Glucose fermentation test	1-2 ml/hours	Little or absent	Little or absent
Microscopical examination:			
(11) Protozoa**	Active, motile, crowded	Inactive, dead or absent	Inactive, dead or absent
(12) Main bacteria	Gram negative	Gram positive***	Proteolytic bacteria and bacteria produce ammonia

*Color depend on feed intake

**Microscopical examination under low power, protozoa and bacterial count in healthy juice are 200,000 and $2x10^6$ per ml rumen juice.

*** Amylolytic bacteria such as Streptococcus bovis, Lactobacillus acidophalus, etc.

Treatment:

(1) Remove or treat the real cause

(2) Slight exercise and ruminal massage.

(3) Oral preparations to increase the activity and population of rumen microflora such as nux vomica, ginger and tartar emetic in powder form after mixed with water (e.g. Supermach, Bykodigest/1-2 sachet daily till recovery).

(4) Parasympathomimetics preparations such as, physostigmine and neostagmine in small doses repeated at short intervals increase ruminal activity.

(5) Oral use of magnesium oxide or hydroxide (Igm/kg BW) if ruminal pH is decreased.

(6) Rumen transfaunation which contains active and healthy microflora as one liter for calves, 3 Liters for adult cattle and 8 to 16 L is more desirable

NB: Rumen juice remains viable for up to 9 hours at room temperature or 24 hours under refrigeration.

NB: Treated animals regained their appetite and ruminal activity within one week post treatment.