# Equine Digestive tract

## Learning Outcomes

By the end of this section you will be able to:

- Describe the anatomy of the gastrointestinal tract of the horse

# Equine Digestive tract

## Content

- Overview
- The mouth
- The stomach
- The small intestine
- The large intestine

# Equine Digestive tract

## Natural environment of horse

- Roam over 8 to 26 km/day (nomadic animals)

- Graze little and often
  - Grazing 16 to 20 hours/day
  - Low quality feeds, high in fibre

# Equine Digestive tract

## Natural environment of horse

- Highly social animals ($\uparrow$ survival)
- Communicate $1^o$ by body language
- Prey animals (fight of flight) – hide or run

# Equine Digestive tract

## Diet

- Intestinal system designed to process:
    - ↑ amounts of ↓ quality forage
    - Ingested on almost continual basis
- So – principle diet should be forage

# Equine Digestive tract

## Departure from natural state

- Continually grazing and moving

- Not voluntarily confine

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## Changed use

- Mechanisation of agriculture:
  - Working animal to leisure or sports horse

- Types of feedstuffs changed
  - Include energy dense feeds – cereal grains
  - Meet energy requirements of sports horse

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## Changed feeding management

- Meal feeding:
  - Large meals of cereal grain x 2 daily

- Grain supplementation ↑than forage
  - Often less than recommended
  - Minimum 1 kg DM forage/ 100 kg LW
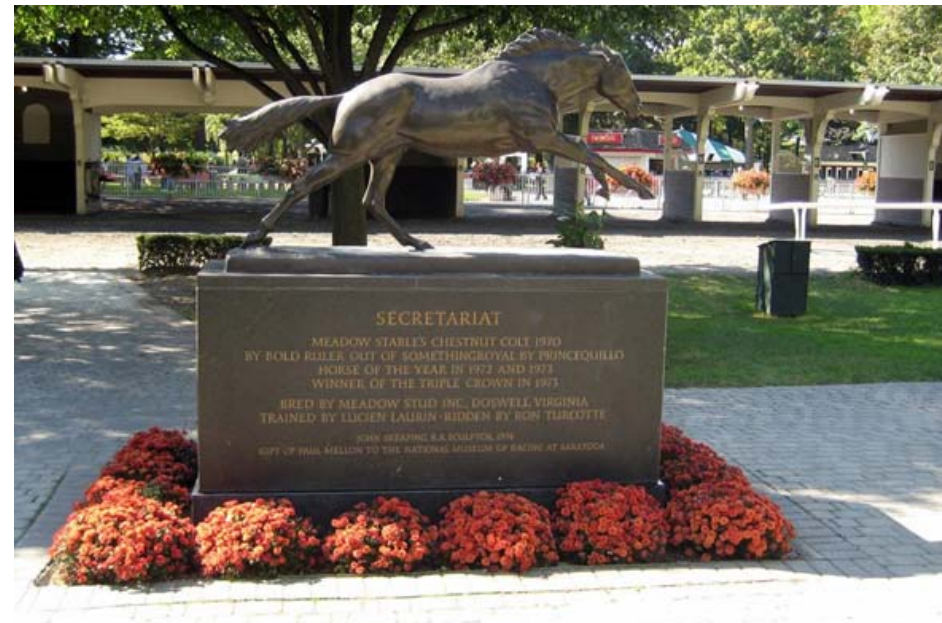
- Whilst intestinal system remains largely unmodified

# Equine Digestive tract

## Encountered some problems

- Health implications:
  - Gastric ulceration
  - Hind-gut acidosis
  - Azoturia
  - Laminitis
  - Colic

- Outcomes:
  - Poor performance
  - Irreparable damage
  - Euthanasia

# Equine Digestive tract

## What can we do?

- Consider digestive anatomy and physiology
  - Maintain gut health

- Understand behavioural needs
  - Maintain good welfare

- Develop dietary management regimes that avoid or even overcome diet-related problems

# Equine Digestive tract

## GIT – as a whole

- Horse classified anatomically as non-ruminant herbivore
  - Non-ruminants = enzymatic digestion (limited fibre degradation in LI)
  - Ruminant = fibre digestion in the rumen
  - Horse = sit between these

- Git begins at lips and ends at anus

- GIT consists of 3 functional regions
  - Stomach ⎤
  - Small intestine ⎦ Foregut
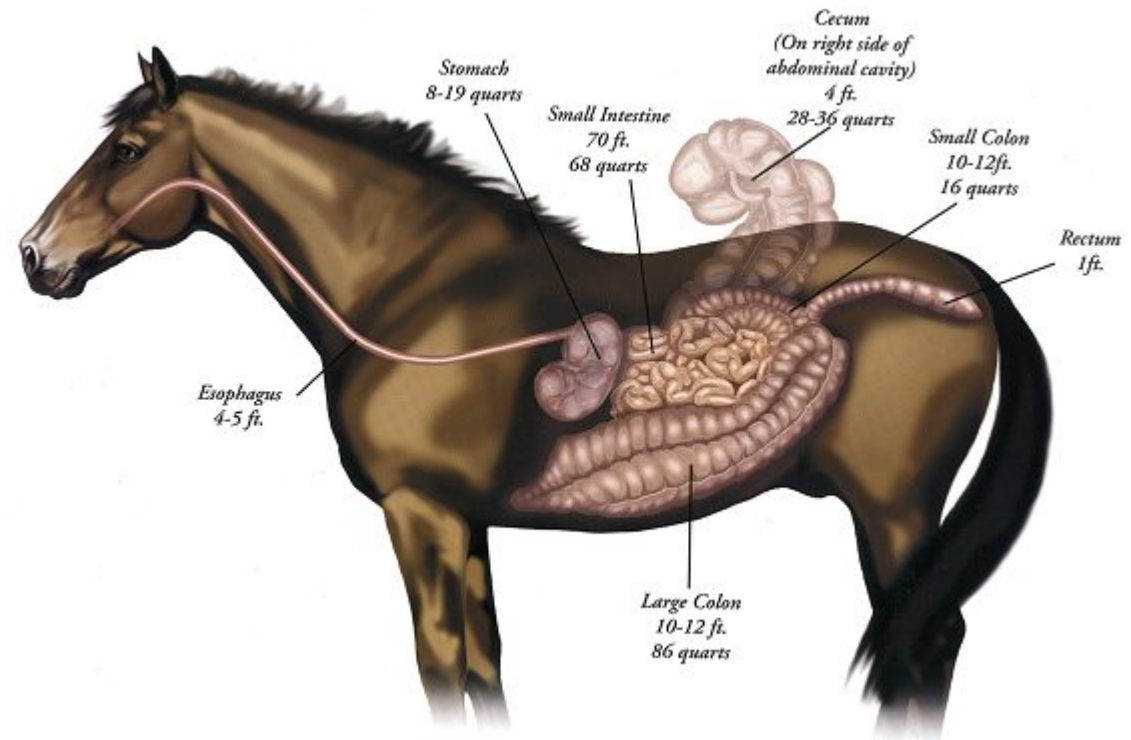  - Large intestine (hindgut)

# Equine Digestive tract

## GIT – as a whole

- Consists of:
  - Mouth
  - Pharynx
  - Oesophagus
  - Stomach
  - Small intestine
  - Caecum
  - Large colon
  - Small colon
  - Rectum

- Associated organs:
  - Teeth
  - Tongue
  - Salivary glands
  - Liver
  - Pancreas

~ 100 feet long in mature horse
Changes in diameter at various section
Lined with mucous membranes



Stomach 8-19 quarts

Small Intestine 70 ft. 68 quarts

Cecum (On right side of abdominal cavity) 4 ft. 28-36 quarts

Small Colon 10-12ft. 16 quarts

Rectum 1ft.

Esophagus 4-5 ft.

Large Colon 10-12 ft. 86 quarts

# Equine Digestive tract

## The mouth

- Digestion begins in the mouth

- Upper lip guides food into the mouth

- Feed torn by upper and lower incisors (in case of grass)

- Molars and premolars grind the forage – ↓ particle size



Molars (n = 12)

Pre-molars (n = 12)

Incisors

- Chewing = essential for digestion (regular dental checks important)

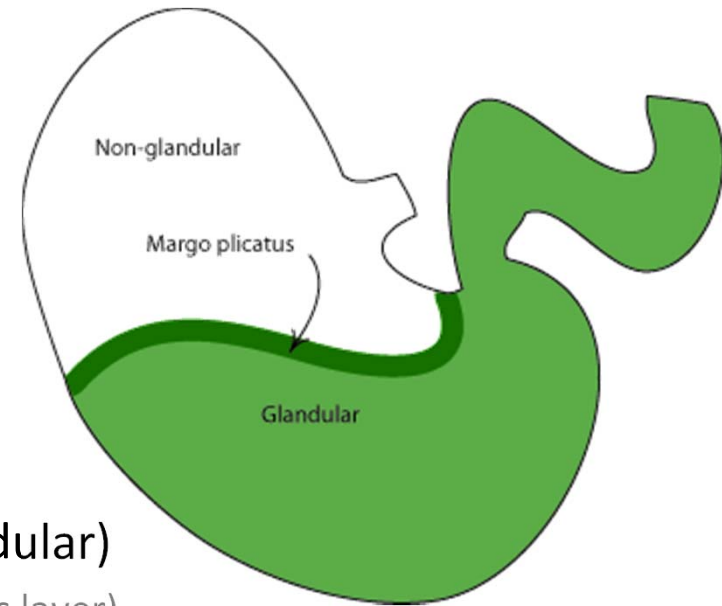- Horse chews 70 – 90 times/minute (saliva produced in response to chewing)
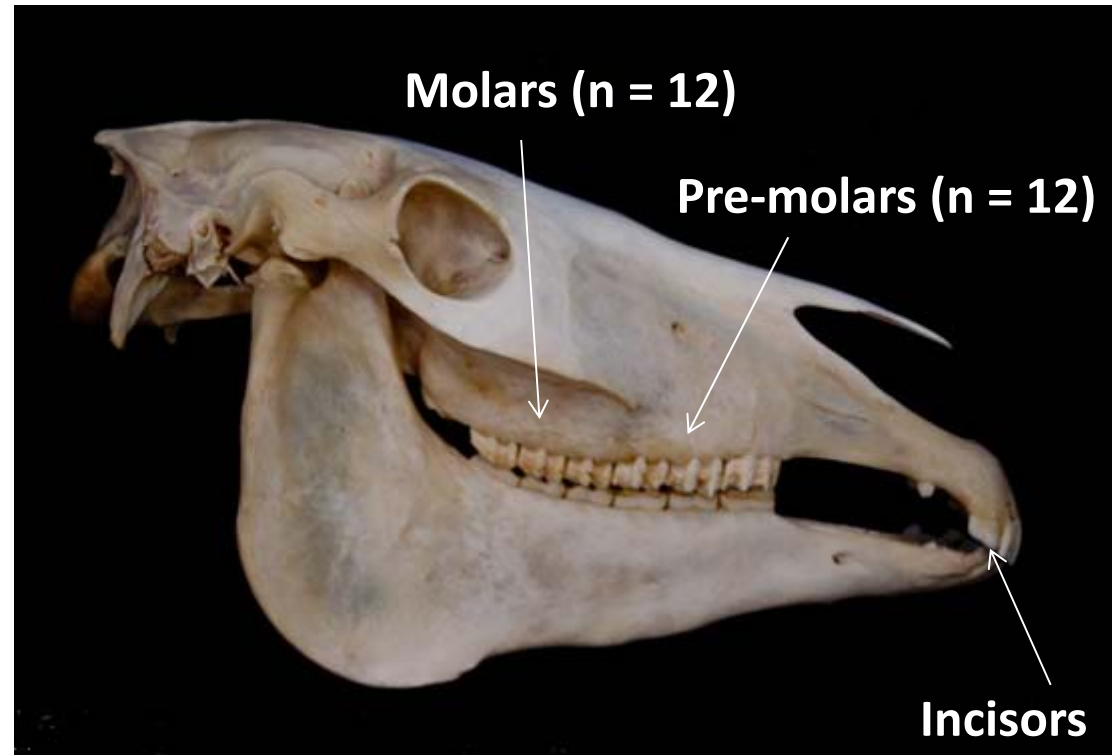
# Equine Digestive tract

## The stomach

- Size – relatively small and inelastic
  - Capacity of ~ 8 litres (~ size of a rugby ball)
  - Important not to over fill (no more than 2 kg per meal)
  - Reason why we feed little and often

- Divided into 2 sections (non-glandular and glandular)
  - Non-glandular section is where food enters (no mucous layer)
  - Glandular is where hydrochloric acid is produced (protected by mucous layer)

- Acidic – pH ~ 1.5 to 2 in the glandular region

- Little digestion of feed – some protein break down (no absorption)

- Rate of passage – rapid (~ 20 minutes)

Non-glandular

Margo plicatus

Glandular

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## The small intestine



- Size – a 21 to 25 m long narrow tube
  - ~ 30 % of horse's GIT volume (75 % of its length)
  - Joins the stomach to the large intestine

- Three main parts
  - Duodenum (first part after the stomach) – mixing and neutralising
  - Jejenum
  - Ileum (last part before the LI) – absorption of nutrients

- pH of digesta entering the SI ranges from 2.5 to 3.5

- Bile (secreted from the liver) buffer the pH to approx. 7 to 7.5 – (no gall bladder)

- Brunner's glands secrete bicarbonate into the lumen – further neutralise digesta
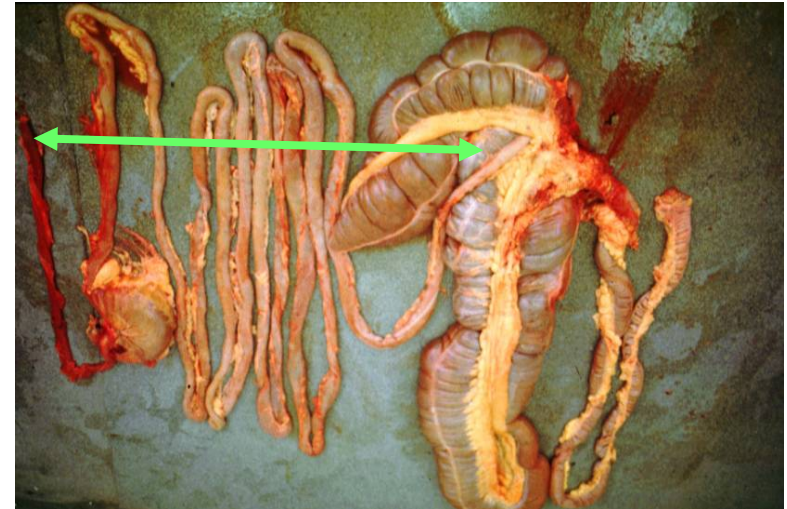
# Equine Digestive tract

## The small intestine



- Neutral pH required for:
  - Transport of nutrients across gut wall
  - Optimal activity of enzymes (amylases, lipases etc)

- Surface area increased by:
  - Villi (0.5 to 1 mm long)
  - Crypts (covered by columnar epithelium)
  - Crypts secrete enzymes and mucus to cover intestinal surface

- Absorption greatest in proximal jejenum

- Rate of passage between 45 mins and two hours
  - Depends on diet, type of food, meal size, and amount of forage in the diet

- Digesta moves at 30cm/min via peristalsis (muscular contractions)
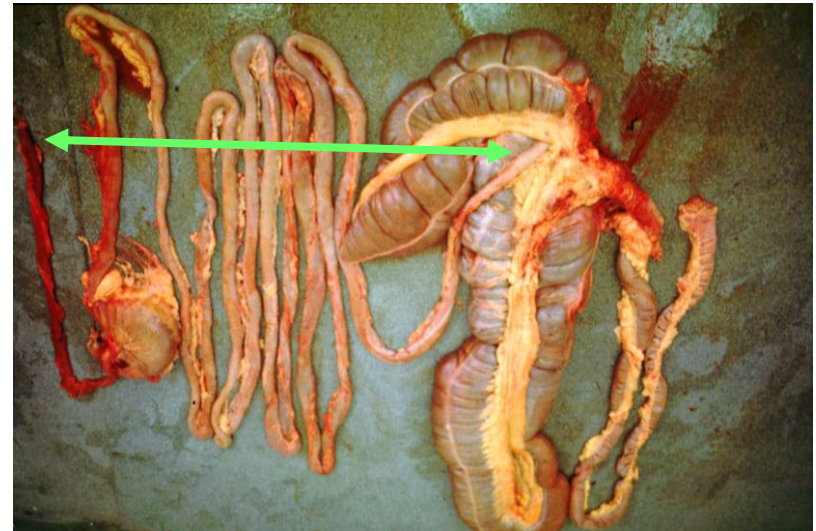
# Equine Digestive tract

## The large intestine (also known as the hindgut)

- Size – approx. 7 metres long (capacity ~ 150 litres)
  - ~ 60 % of horse's GIT volume



- Three main parts
  - Caecum (first part after the ileum)
  - Large colon
  - Small colon
  - Rectum

- Large intestine lined with mucus-secreting glands – no digestive enzymes

- Digestion & absorption in LI depends on microbial fermentation feed residues from SI
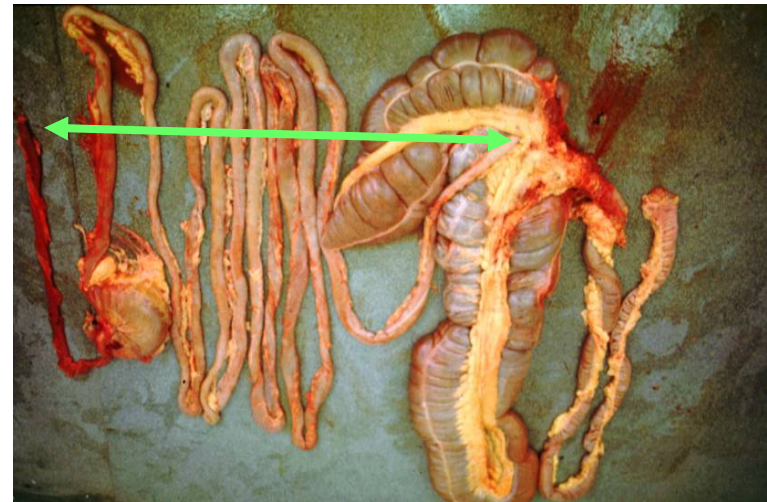
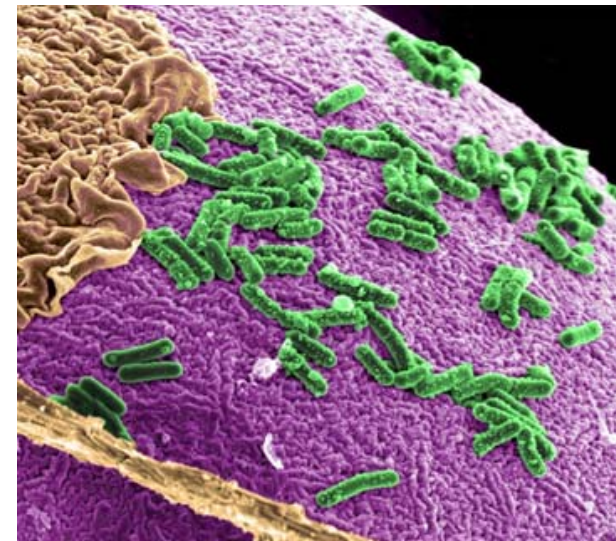## The large intestine (also known as the hindgut)

- Caecum – 1.2 metres long (capacity of ~ 30 litres)
  - ~ 15 % of horse's GIT volume
  - Large blind-ended sack-like structure
  - Digesta enters LI through ileo-caecal valve; leaves through the caeco-colic valve (both at top)
  - Large fermentation vat (similar to the rumen of the cow)

- Large colon -  3 to 3.5 metres long (capacity of ~ 90 litres)
  - Right and left ventral colon
  - Left and right dorsal colon
  - Four parts connected by bends known as flexures (often sites of impactions)

- Small colon
  - Same length as large colon
  - Smaller diameter
  - Main function = absorb water

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## The large intestine (also known as the hindgut)

- Horses do not produce enzymes to digest fibre

- Microbes ferment digest – produce end products:
  - Volatile fatty acids (VFA) = acetate, butyrate and propionate
  - Gases = carbon dioxide ($CO_2$) and methane ($CH_4$)

- Microbes – over 400 species (probably more)
  - Bacteria ($10^9$/ml)
  - Fungi ($10^3$/ml)
  - Protozoa($10^4$/ml)

- pH of LI = 6 to 7 (very important to maintain correct pH)
  - Bicarbonate and phosphate salts secreted
  - Rapid absorption of VFA

# Equine Digestive tract

## The large intestine (also known as the hindgut)

- Microbes need time to adapt to any changes in diet

- Abrupt changes:
  - Reduced diet digestibility
  - Colic
  - Acidosis

- Hindgut designed to process fibre

- Problems occurs when low fibre diets are fed

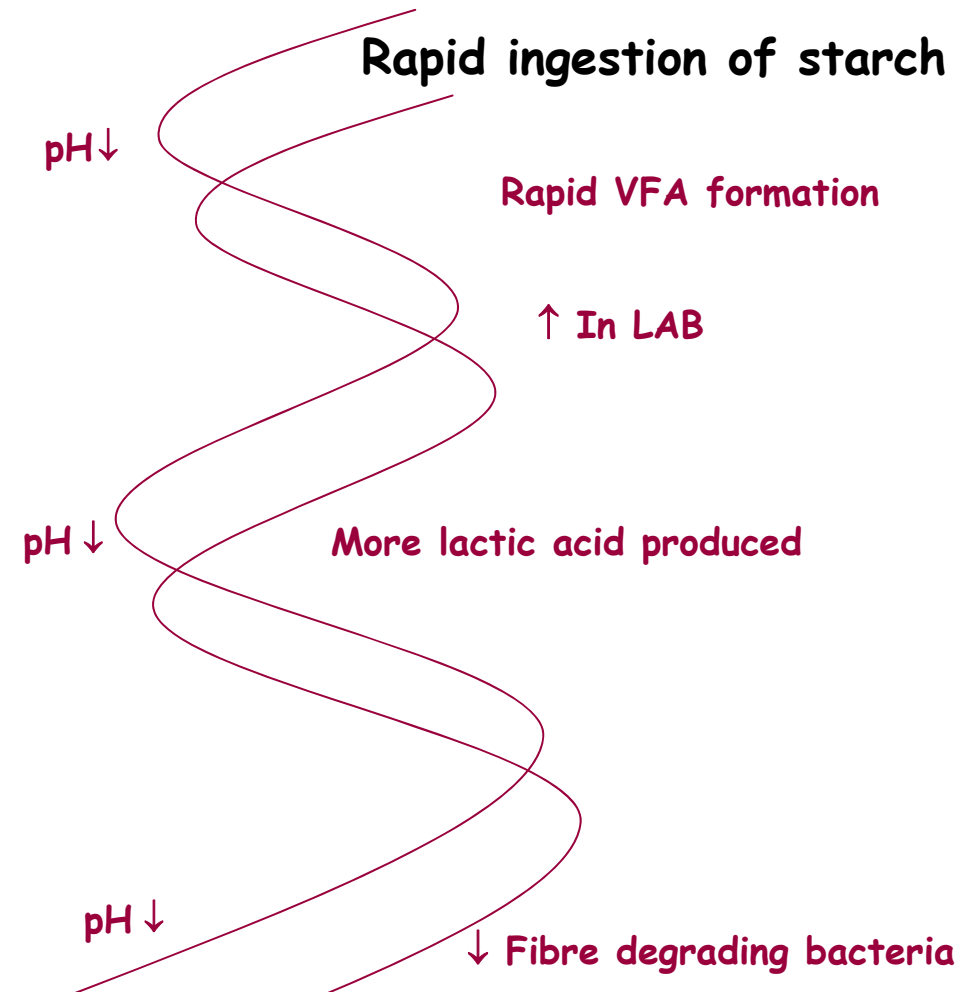- Particularly when high levels of starch are included in diet

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## The large intestine

- High amount of starch and sugars in LI
  - Undesirable

- Rapidly fermented:
  - ↑ levels of VFA
  - Lactic acid produced
  - ↓ pH

- Adverse affect on LI environment
  - Death of fibre degrading bacteria
  - Colic
  - Acidosis/laminitis

**Rapid ingestion of starch**

pH↓

**Rapid VFA formation**

**↑ In LAB**

pH ↓

**More lactic acid produced**

pH ↓

**↓ Fibre degrading bacteria**

**Unhealthy animal**

# Equine Digestive tract

## The GIT - conclusion

- Designed to process fibrous feeds

- Fibrous feeds required for
  - Healthy gut
  - Satisfy behavioural needs

- Sudden changes to diet or inappropriate diets can lead to:
  - Git disturbance
  - Reduced diet digestibility
  - Ill health

# Equine Digestive tract

# Thank you for listening