



# Gut health in poultry

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Bogota  
July 2013



The background of the slide is a blue-tinted collage. It includes a laboratory setting with a person in a white lab coat and a multi-channel pipette in the foreground. In the background, a group of people in lab coats are gathered around a table, and a large chicken is visible in the lower right foreground.

# *Gut anatomy, development and function*

## Gut overview

- Gut health is essential for good growth and FCR
- Gut health relies on acquisition and maintenance of a balanced gut flora
- Gut health relies on the proper development of the gut tissues
- Intestinal tract is the largest organ in the body
- Contains ~70% of a bird's immune cells
- Intestinal tract is a larger in terms of % of overall body weight early in life

## Gut overview

- A specialised tube running the from beak to the cloaca where feed is digested and absorbed
- Divided into distinct regions
- Each region has a specific role
- Each region has a specific structure

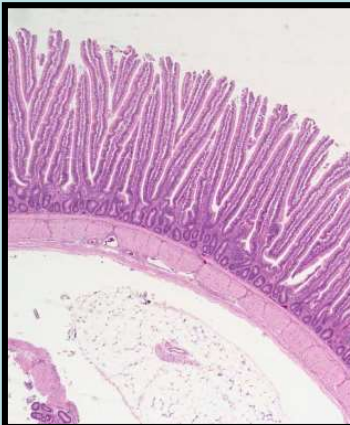


## Small intestine:

Feed is mixed with bile, bicarbonate and enzymes to start digesting the lipids, proteins, sugars in the diet.

The resultant molecules are then absorbed through the transport around the body

The villi and microvilli intestine provide a large for this to occur



:

Outpouching of the oesophagus  
Feed is softened and fermented  
Stored for up to 6 hours  
pH of around 5.5  
Indicates start of digestion

## Large intestine

The caeca is the site of major bacterial fermentation.

Caecal contents consist of the material the bird is unable to digest or which has not been absorbed.

From this the bacteria produce shortchain fatty acids, organic acids, vitamins and other nutrients that can be absorbed by the host

The colon is a short region where some water absorption occurs

## Proventriculus:

- Proventriculus secretes acid and pepsin
- Feed stays in this region for short time
- pH 2.5-3.5



## Gizzard:

- Mechanically grinds the feed
- Tough inner koilin layer
- Thick outer muscular layer
- Sets the rate of feed passage



# The result of good digestion!



Caecal dropping



Faecal dropping

**Very important to recognise the difference in these types of droppings**



- Consequence of impaired digestion
  - Feed passage
  - Fatty and wet faeces
  - Poor FCR

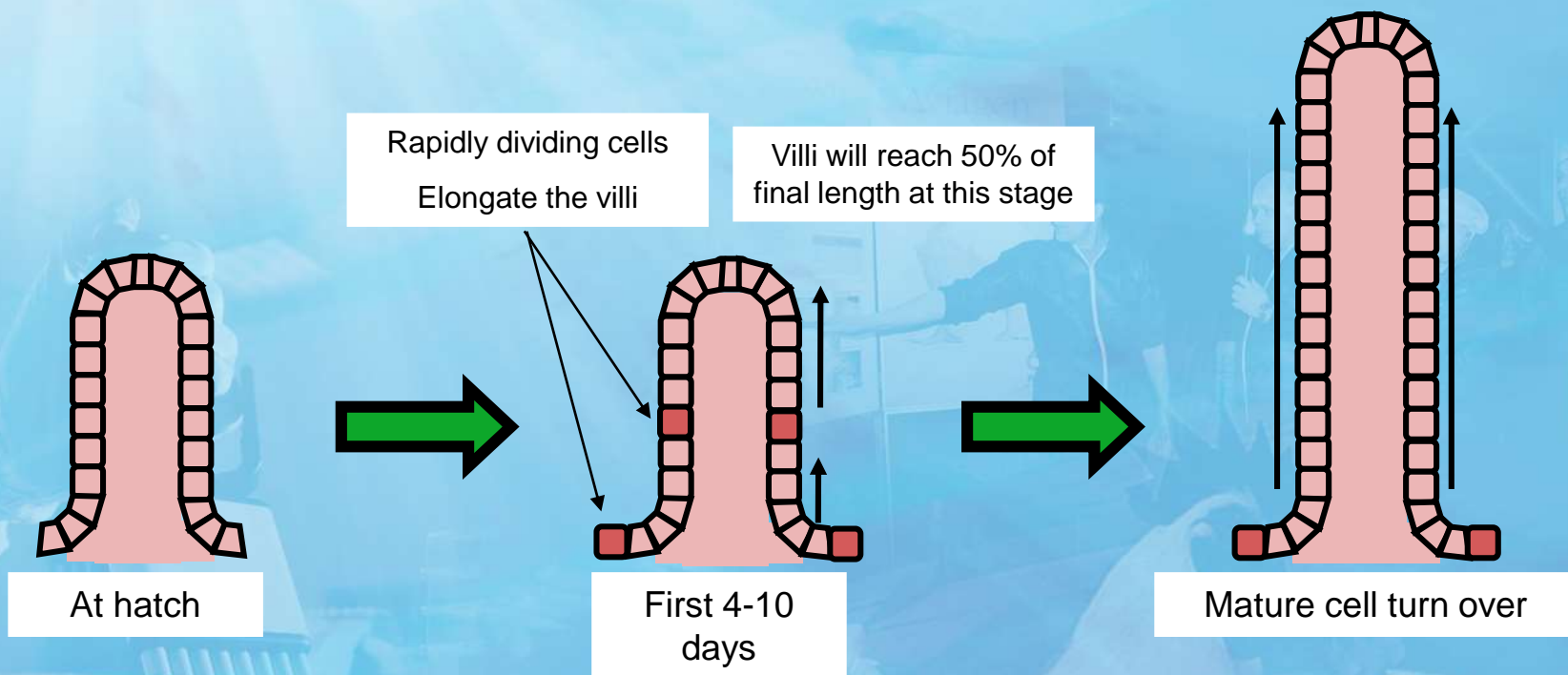


# Gut development

- Day 17 of incubation till hatch – key period
  - An indicator of poor in-egg development is poor gut tone
- After hatch the gut starts to mature
  - Switch from yolk nutrition to external feed
  - Enzyme production increases
  - Immune system starts to mature
  - Gut flora starts to colonise
- First 10 days when villi undergoing rapid development
  - Maximum development at 4 days in duodenum and 10 days in jejunum and ileum
- If the birds are stressed likely to impair gut maturation

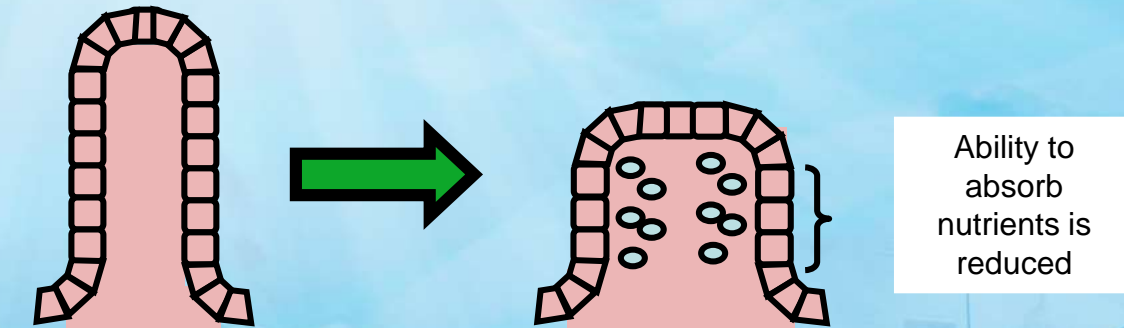


- Villi development



- Factors such as cold stress and poor feed/water access can impair this development.
- A key aspect of villi development is stimulation from the gut microbiota

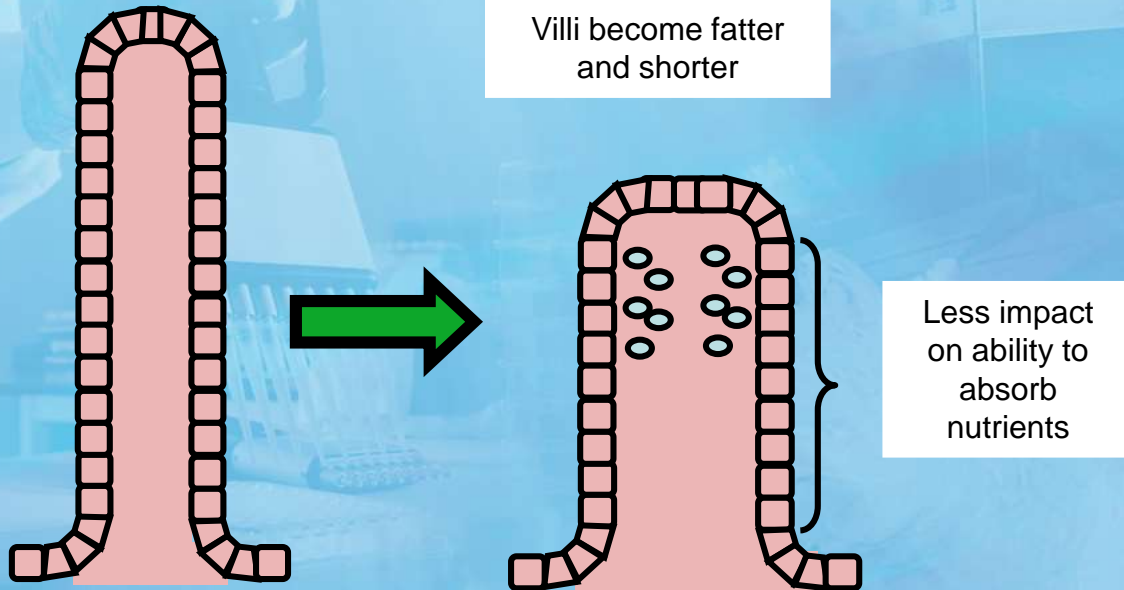
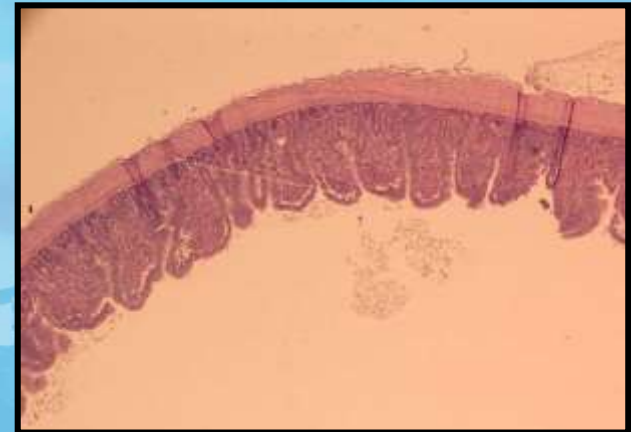
- Impact of poor development



Poorly developed

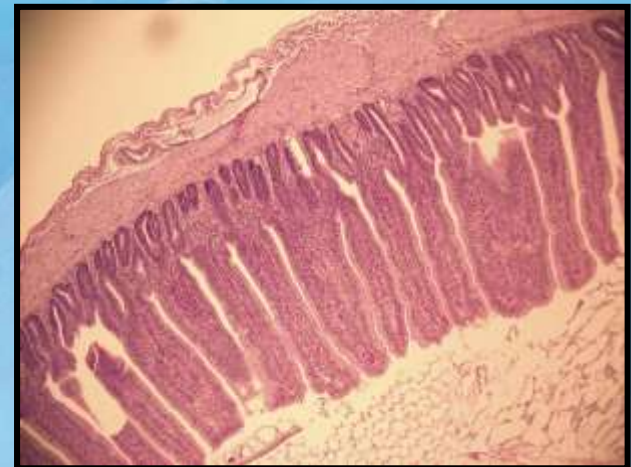
Ability to absorb nutrients is reduced

Cocci infection  
Villi become fatter and shorter

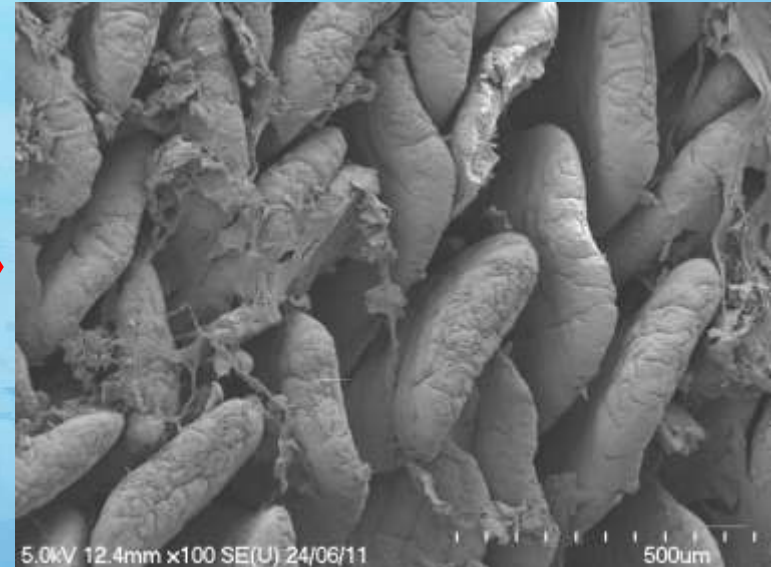
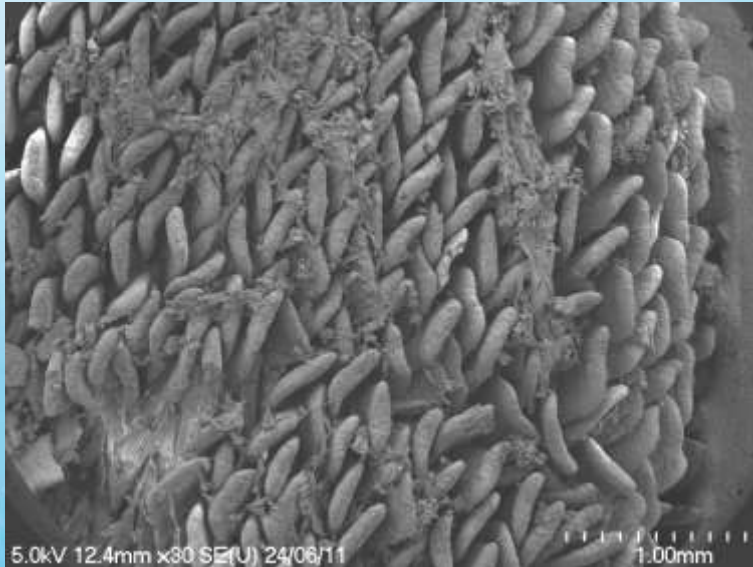


Well developed

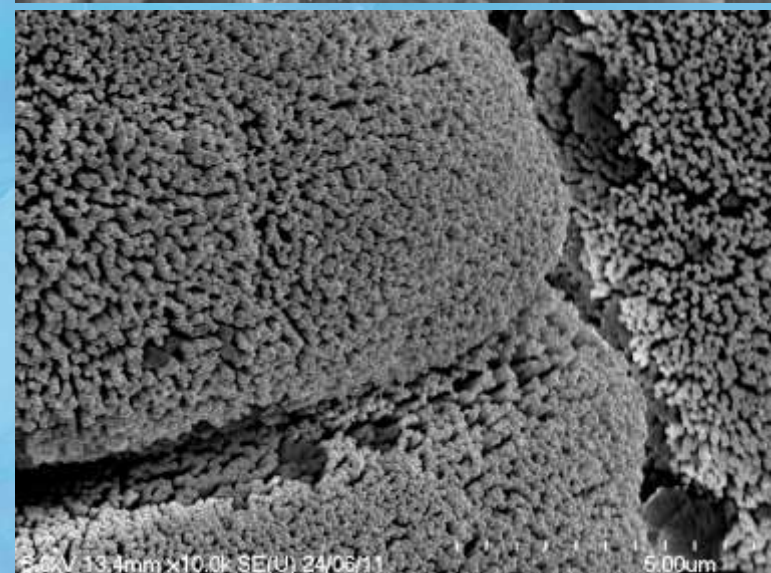
Less impact on ability to absorb nutrients



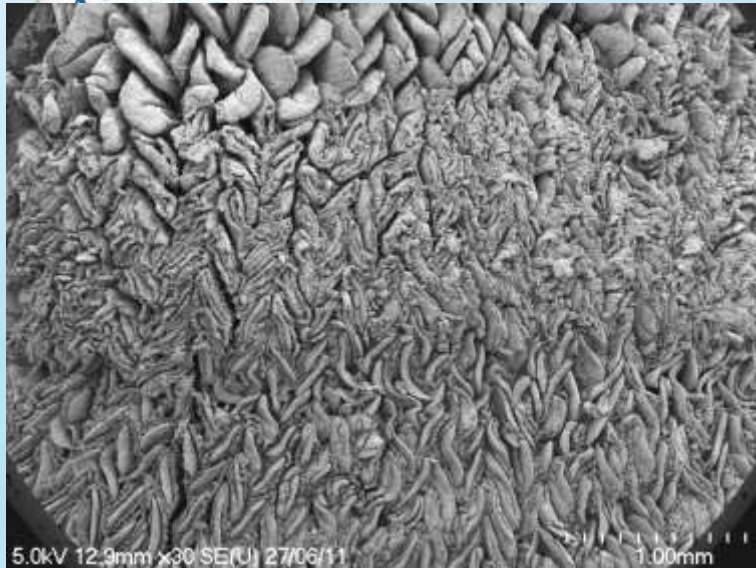
# Scanning electron micrographs



- They are long and free with intact villi tips
- Microvilli are even and regular



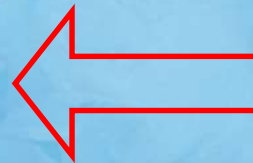
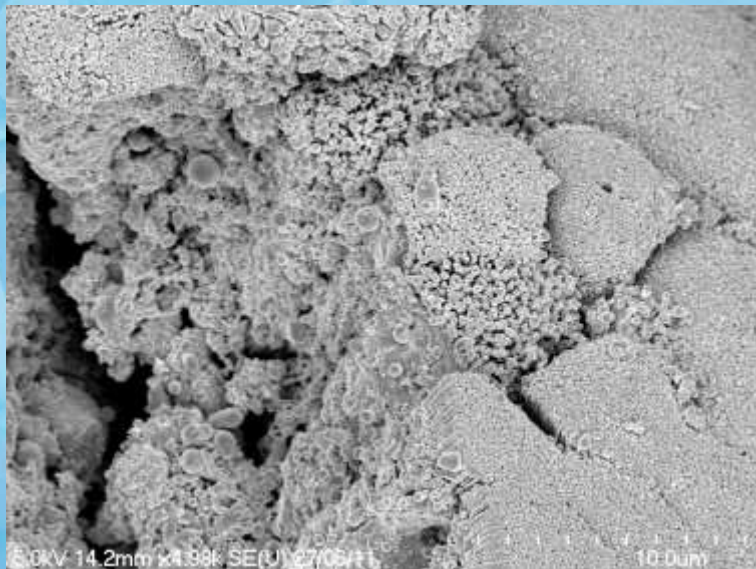




layers of enterocytes appear to be peeling away from the villi core



Poor villi. There is severe erosion of the villi tips



The microvilli appear stunted and irregular



The background image is a composite of two scenes. The top half shows a group of people in a laboratory or office setting, with one person pointing at a large screen displaying a diagram. The bottom half shows a close-up of several white chickens in a farm environment. The entire image is overlaid with a semi-transparent blue filter.

## *Monitoring gut health*

# Indicators of poor gut health

- A gut health problem usually manifests itself with
  - Poor growth rates
  - Flock uniformity
  - Wet litter
  - Wet faeces
  - Feed passage
  - Frothy caecal droppings





# Gut Scoring

- Giving a gross overview of gut function
  - Ongoing infections or disruptions of gut function
  - Efficiency of absorption of nutrients
- In younger birds (e.g. 7 days)
  - Can indicate quality of brooding
- Can give an indication of underlying gut issues
  - Malabsorption
  - Poor uniformity
  - Feed quality
- Also allows a flock to flock measure of gut health

# Gut Scoring

- Birds scored:

Scored scale:

- Redness of the mucosa

Bird ID: Bird Breed:		Gizzard Erosion			<u>Coccidiosis</u>			Feed passage	
		0	1	2				Yes	No
	Redness	Gut tone			Consistency of contents			Mucus	
Duodenum	0    1    2	0    1    2			0    1    2			Yes    No	
Jejunum	0    1    2	0    1    2			0    1    2			Yes    No	
Ileum	0    1    2	0    1    2			0    1    2			Yes    No	
Caeca	Colour: Dark      Light	Consistency: Watery      Pasty			Foamy      Gassy				
<u>Other notes:</u>									



- Is there mucus present?
  - In the duodenum mucus is common
  - In jejunum and ileum you shouldn't see mucus
- Is there feed passage?
- What do the caeca look like?
  - Presence of gas
  - Consistency
  - Colour



# Caecal characterisation

**Normal**



**Mild imbalance**



**Severe imbalance**



- Histology can help us explain changes we see in gut morphology
- Highlight sub-clinical disease
  - Coccidiosis
  - Viruses
- Show appropriate development
  - Highlighting previous challenges (management and disease)

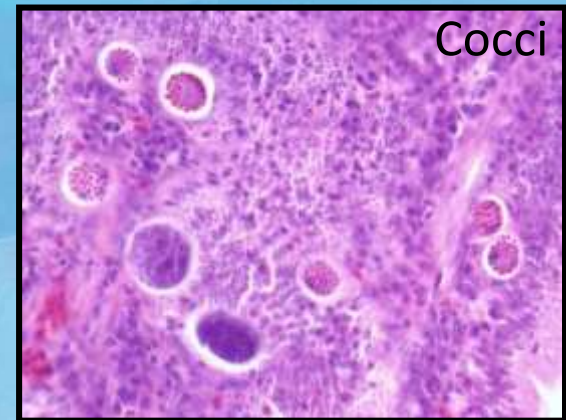
# Gut histology

Good villi



Poor villi

Cocci





# Cocci in the gut

- It is sometimes possible to see the effects of subclinical coccidiosis at the gut surface



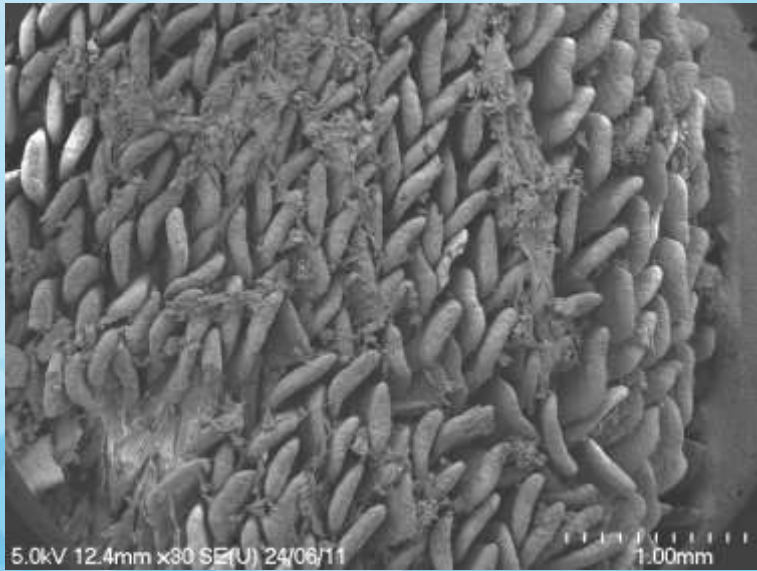
Normal even layer of villi



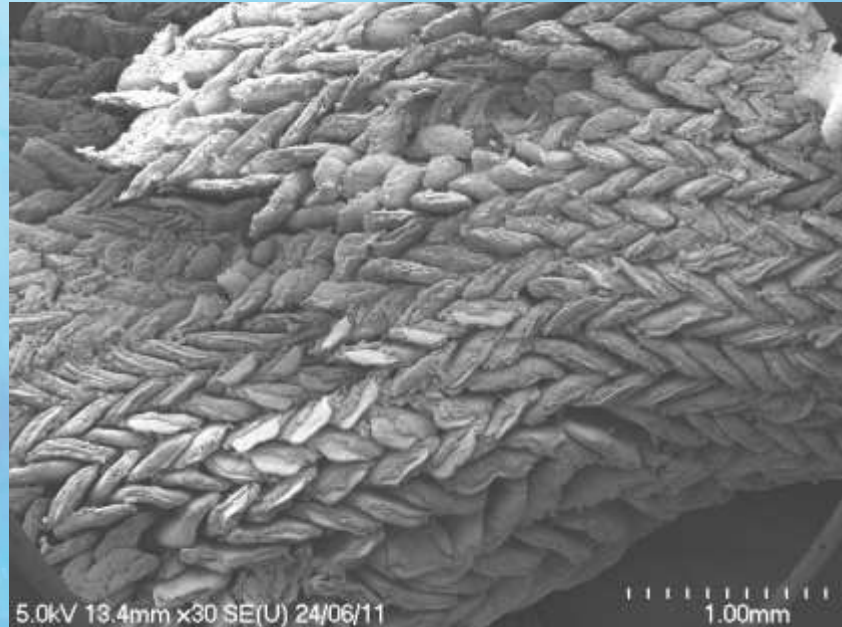
During cocci infection the villi become shorter and fatter resulting in a distinctive pattern

# Cocci in the gut

- Electronmicroscopy can show this nicely



Normal villi



Cocci infected villi. This is the pattern you can see

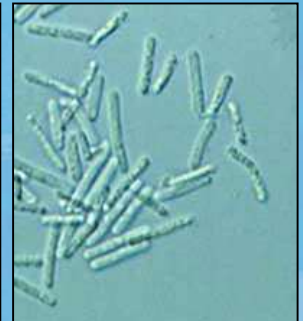
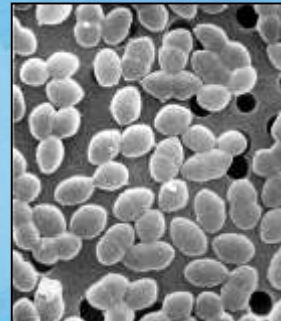
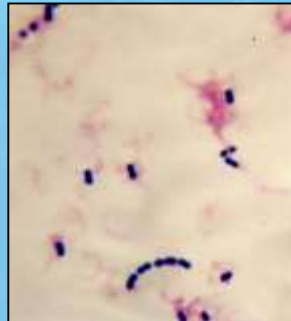
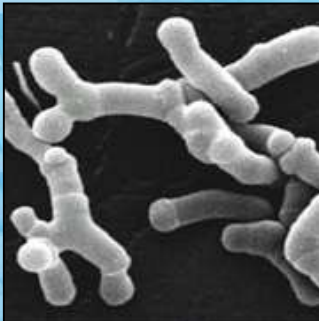
# *Gut Microbiota*





- Gut Microbiota

- Community of bacteria, viruses, fungi and protozoa living in the gut
- Approximately 700-800 species of bacteria in the chicken gut
- Bacterial cells outnumber host cells 10:1
- Consumes ~20% of dietary energy
- Highly metabolic organ



- Helps to direct the development of gut structure and gut immunity
  - Different bacteria influence the gut in different ways
- Modulates the immune response
- Aids digestion
- Produces nutrients from non-digestible dietary components
- Offers protection from gut pathogens

## Development of the microbiota

- The microbiota of a chicken takes a few weeks to fully mature
  - Crop colonised within 24 hours
  - One day post-hatch the ileum and caeca are both dominated by bacteria
  - After three days these levels increased 10-fold
  - Within two weeks the adult small intestinal microbiota will be established
  - After 30 days the caecal flora will have stabilised
- During this time the microbiota can be disturbed leading to dysbacteriosis and/or wet litter.
- Essential to ensure the gut gets a good start to ensure quicker maturation of microbiota



# Which bacteria are present?

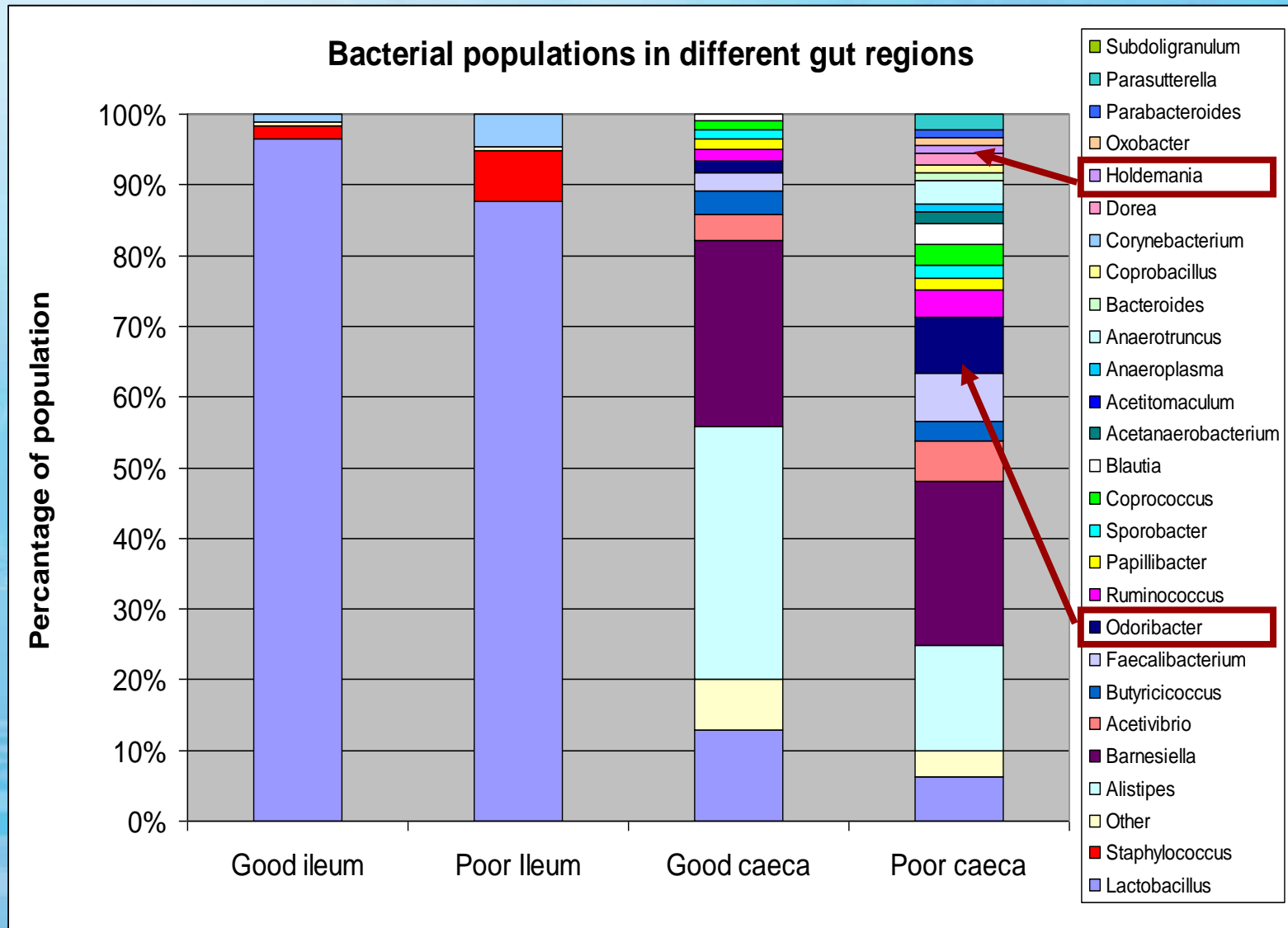
- Small intestine
  - Dominated by lactic acid producing bacteria (Lactobacillus and enterococcus)
  - These dominate the gut throughout the life of the bird but the species differ as the birds age
- Large intestine
  - Early in life lactic acid producers and bacteroides
  - Later in life fermentative clostridia and bacteroides

Under normal circumstances the flora contains favourable and less favourable bacterial species

# Development of the microbiota

- Where do the pioneering bacterial species come from?
  - Hatchery environment
  - Hatchery staff
  - Farm environment
  - Feed
- On the farm chicks will be exposed to the remaining flora from the previous flock
  - Impact on chicks
  - Wet vs dry cleaning

# Intestinal microbiota fluctuations





## Microflora during upset

- Shifts in microbiota are indicative of malabsorption
  - Poor fat absorption
  - Sugar, fat and protein available in the caeca
- More nutrients for bacteria
- Bacterial overgrowth
  - $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{H}_2\text{S}$  produced
  - Toxic amines (irritates gut and causes growth depression)
  - Bile acid inactivation (impairs fat absorption)
- Leads to further digestive upset

- Gut health and microbial community affected by
  - Feed substrate – Cereal, protein and fat type
  - Feed form – mash/crumb/pellet
  - pH
  - Viscosity and water content
  - Nutrient density
  - Overall bird health – stress, immuno-suppression etc.
  - Early gut development

## Gut microbiota and gut health

- It is easy to simply focus on which bacteria are in the guts
  - Gut health is based on the dynamic between many factors
  - Gut microbiota will fluctuate naturally
  - Often the microbiota seen in a gut upset is a secondary affect
  - In the absence of a properly developed gut the bacterial population will never be stable



The background is a collage of images related to poultry science and farming, all tinted with a light blue color. It includes a laboratory setting with a person in a white lab coat and a rack of test tubes, a group of people in a meeting room looking at a presentation, and several chickens in the foreground.

## *Influencing gut health*

# Influencing gut health

- On the farm gut health can be influenced from day 1
  - Key aspect is to get feed into the chick to feed the gut
  - Correct brooding temperatures
    - Too hot the chicks don't want to eat
    - Too cold and the chicks huddle and don't eat
  - Good access to feed and water
- By doing this the gut development is optimal
- Ensure the birds are equipped to cope with gut challenge



# Products to improve gut health

- Direct fed microbials

- Probiotics

- Defined bacterial products (<10 strains)
    - Lactic acid producers
      - Lactobacillus, enterococcus, pediococcus etc.
    - Bacillus products
      - Microbiota modulators
      - Fed in feed or added direct to litter

- Competitive exclusion agents

- Undefined bacterial products
      - Aviguard
      - Broilact



# Products to improve gut health

- Organic acids

- Often only active in the foregut (Crop, gizzard, duodenum)
- Lower pH
- Provide nutrients for other bacteria (Lactic acid)
- Antibacterial (Acetic, formic, benzoic)
- Stimulate gut tissues (Butyric, proprionic)

- Phytobiotics

- Essential oils (Oregano, thyme, clove, cinnamon)
- Antibacterial
- Gut stimulatory

*Interestingly organic acids and essential oils seem to work better together*

# Products to improve gut health

- Oligosaccharides
  - Fructo-oligosaccharides (FOS) – Prebiotics
    - Provide a dedicated nutrient source for fermentative bacteria
    - Chicory root , fruit pectin
    - Often included in probiotic mixes
  - Mannan-oligosaccharides (MOS)
    - Yeast cell wall
    - Block attachment of *E. coli*, *Salmonella spp.* to the gut wall
  - Lactulose
    - Sugar substitute
    - Fermented by bacteria
    - Often in probiotic mixes



# Reason for using these products

- Improve gut integrity
- Stimulate or provide a beneficial flora
- Improve gut function
- Inhibit pathogens
- Reduce antibiotic usage
- Alternative to Antibiotics?
  - Preventative rather than therapeutic
  - One product to fit all situations?



- ***Do they work?***

- They work with the right product given at the right time in a bird's life in the right manner.
  - Early in life
  - 3-5 days over a stressful event
  - Feed vs water
- All experimental data will show they work
- Have to remember there is no one product that will help in all situations
- Choose a product that is suited to your management strategy and the problem you see

## Examples of improper use

### Giving a probiotic if:

- You regularly use antibiotic growth promoters
- If your water supply is heavily chlorinated (>5ppm)

**Why? These are likely to kill off any probiotic**

**Solution: Use a product to stimulate the gut such as a prebiotic or organic acid.**

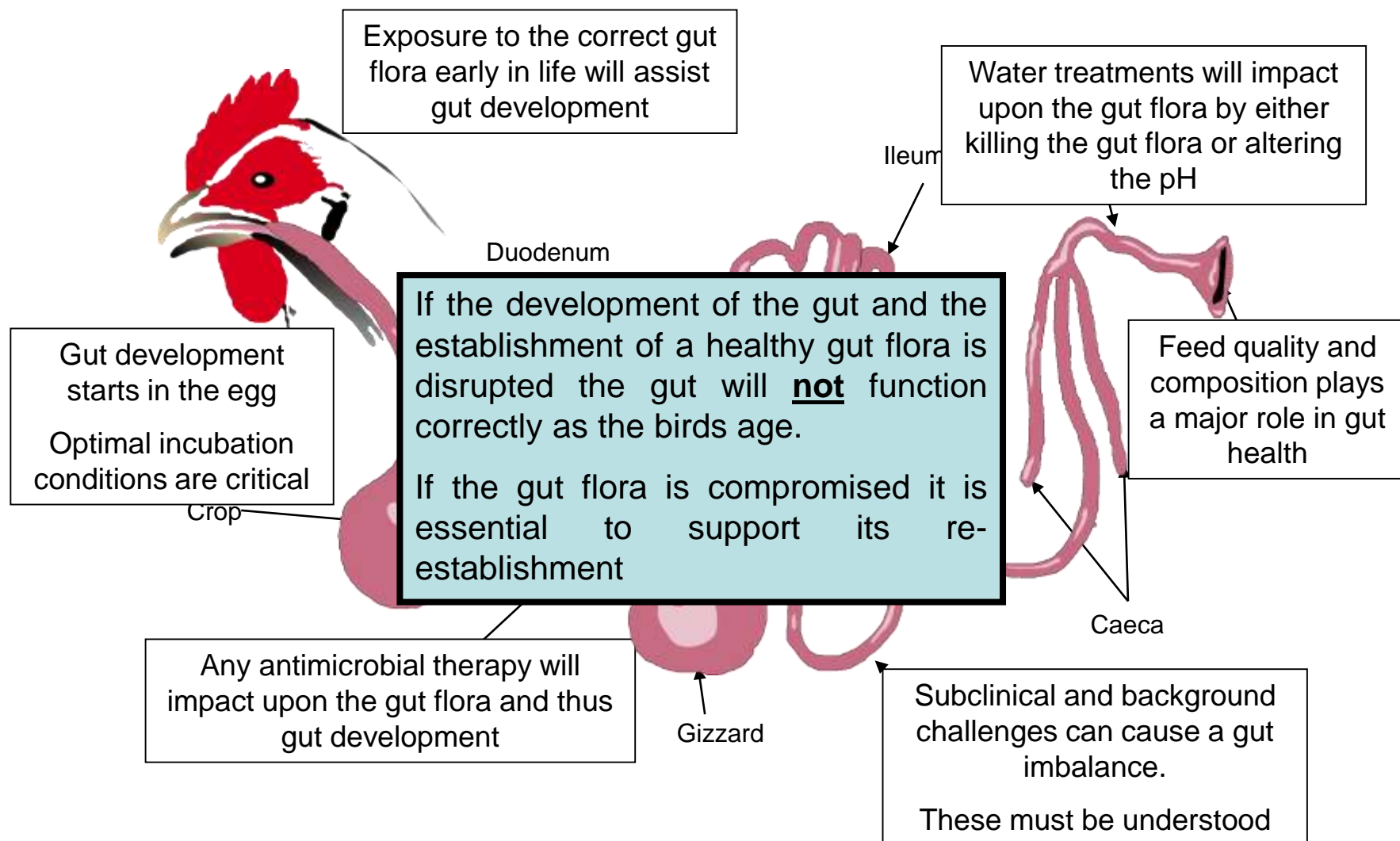
### Giving a probiotic at the hatchery with antibiotics

**Why? Probiotic bacteria will be killed by the antibiotic**

**Solution: Use a probiotic after any antibiotic use to repopulate the gut.**

**Use a prebiotic such as MOS to prevent attachment of less favourable bacteria**

# Summary





Thank you!

Questions?

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