A white adult chicken with a prominent red comb and wattle is shown in profile on the left. To its right, a small, fluffy yellow chick is also shown in profile. The background is a soft, out-of-focus grey. A diagonal white line separates the two birds.

How Alternatives to Antimicrobials Function in the Gut

Dr. Kayla Price, PhD
Canadian Poultry Technical &
Research Manager
Alltech





What will we talk about?

- Where are we with antibiotic reduction
- What should be thought about with antibiotic reduction
 - What are examples of alternatives being used?
 - How to build a program

Pillars of an in-feed preventative drug program



Anticoccidial

- **Ionophore**

- May kill parasites in the gut in the short-term and decrease parasite development in the gut in long-term; leaky
- Can get resistance, more difficult but not impossible

- **Chemical coccidiostat**

- Stops parasite development in the gut (can continue if drug taken away); kills parasite in the gut
- Easy to get resistance

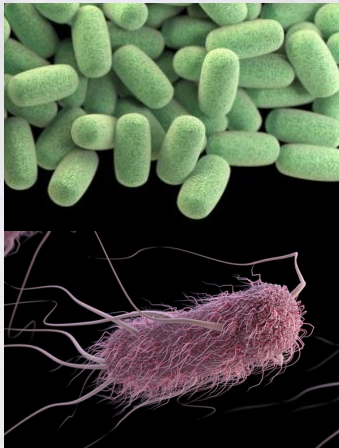
- **EU has kept this**

Antibiotics

- **Most preventative programs**

- Prevention of gram positive bacteria (e.g. *Clostridium perfringens*)
- Treatments for either gram negative (e.g. *E. coli*) or gram positive bacteria (e.g. *Clostridium perfringens*)

- **Treatment still remains (EU, USA, Canada)**



US and Canadian Direction



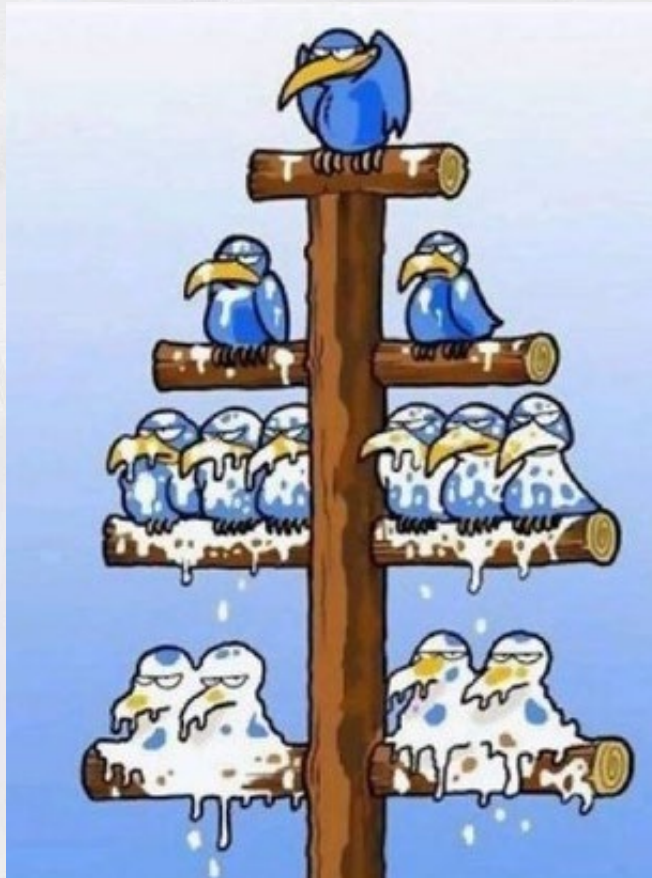
US

- **Veterinary Feed Directive → 2017 due date**
 - Judicious antibiotic use – veterinary oversight
 - Treatment still allowed
 - Allow ionophores, chemicals, BMD
- **Never ever 3 → NO antibiotics, NO growth promotants, NO animal byproducts**

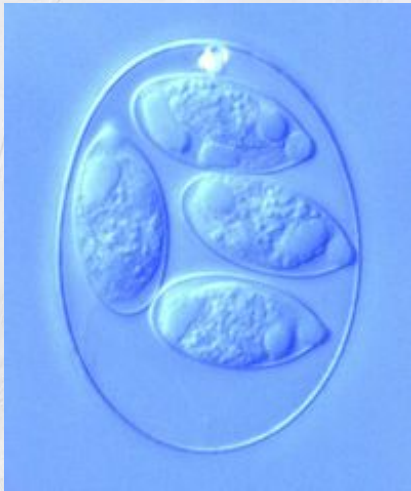
Canada

- **Veterinary Drug Directive → 2018 due date**
 - Judicious antibiotic use – veterinary oversight
 - As producer only able to access through vet prescription and purchase through commercial feed mill, vet, pharmacy
 - Treatment still allowed
 - CFC/TFC position will allow ionophores, chemicals
- **Raised Without Antibiotics → NO antibiotics, NO ionophores, YES chemicals, YES live coccidiosis vaccines, YES animal byproducts**
- **Treatment still remains (EU, USA, Canada)**

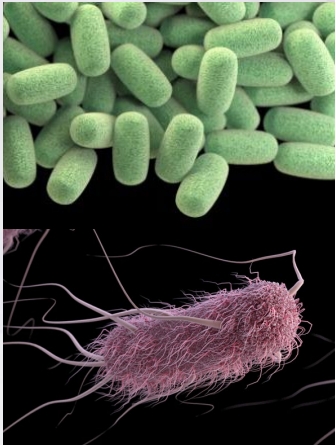
Let's be the leader of the pack



**Whether you agree
or don't agree, let's
at least be the leader
of the pack**



Anticoccidial



Preventative antibiotics

Most common: *C. perfringens*

Alternatives



The gut is an ecosystem

Microbes

Villi and microvilli

Gut health is balance

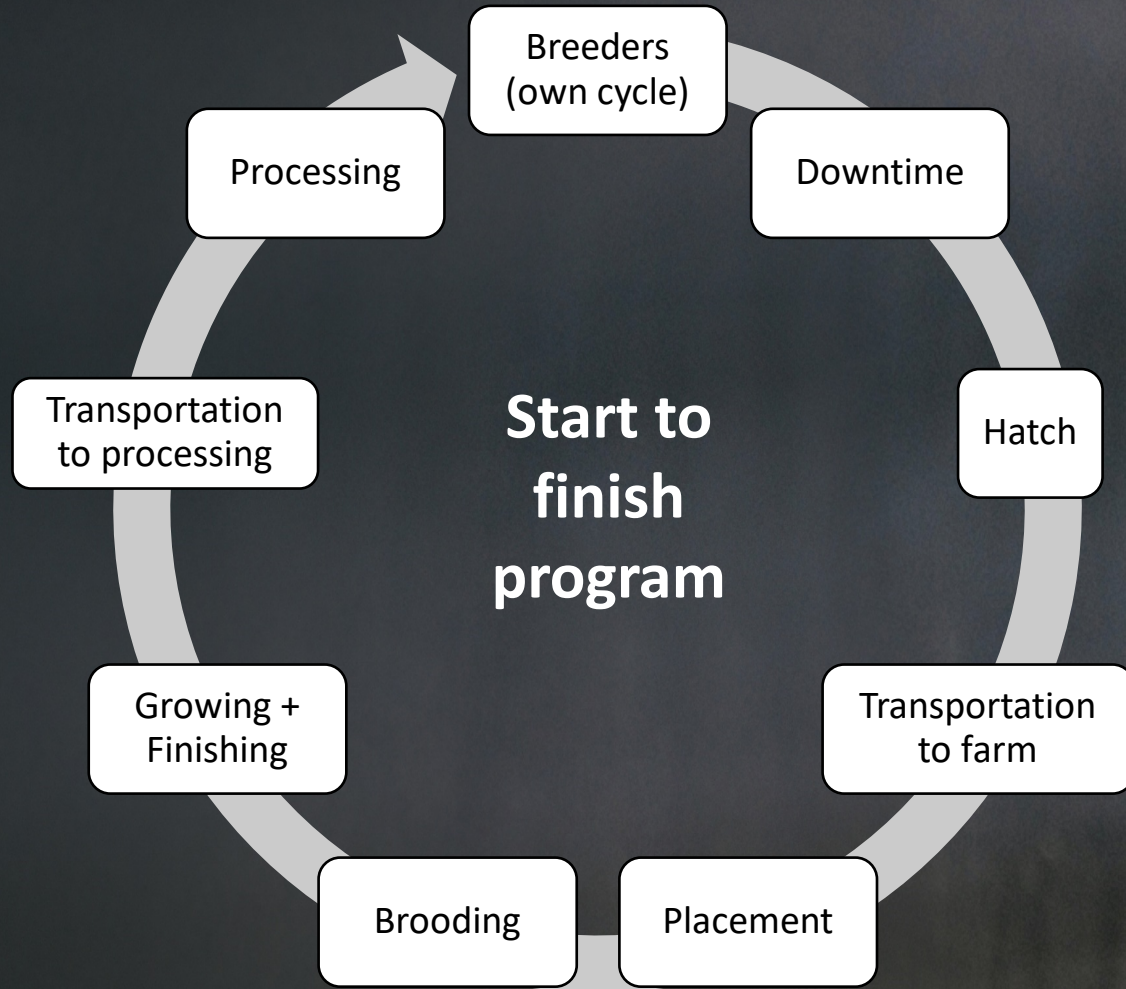
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A program approach needed



No silver bullet

- ✓ Feed management
- ✓ Water management
- ✓ Management on farm
- ✓ Additive program



A Program Approach: Feed



Nutrition Goal

1. Optimal nutrient digestibility
2. Optimal performance
3. Minimal Digestive upsets
4. Optimal return

Your nutritionist helps you...

Ingredient selection & levels
Ingredient quality
Digestibility
Amino acid balance
Fatty acid levels and ratios
Vitamins
Minerals
Avoid mycotoxin contamination

A Program Approach: Water



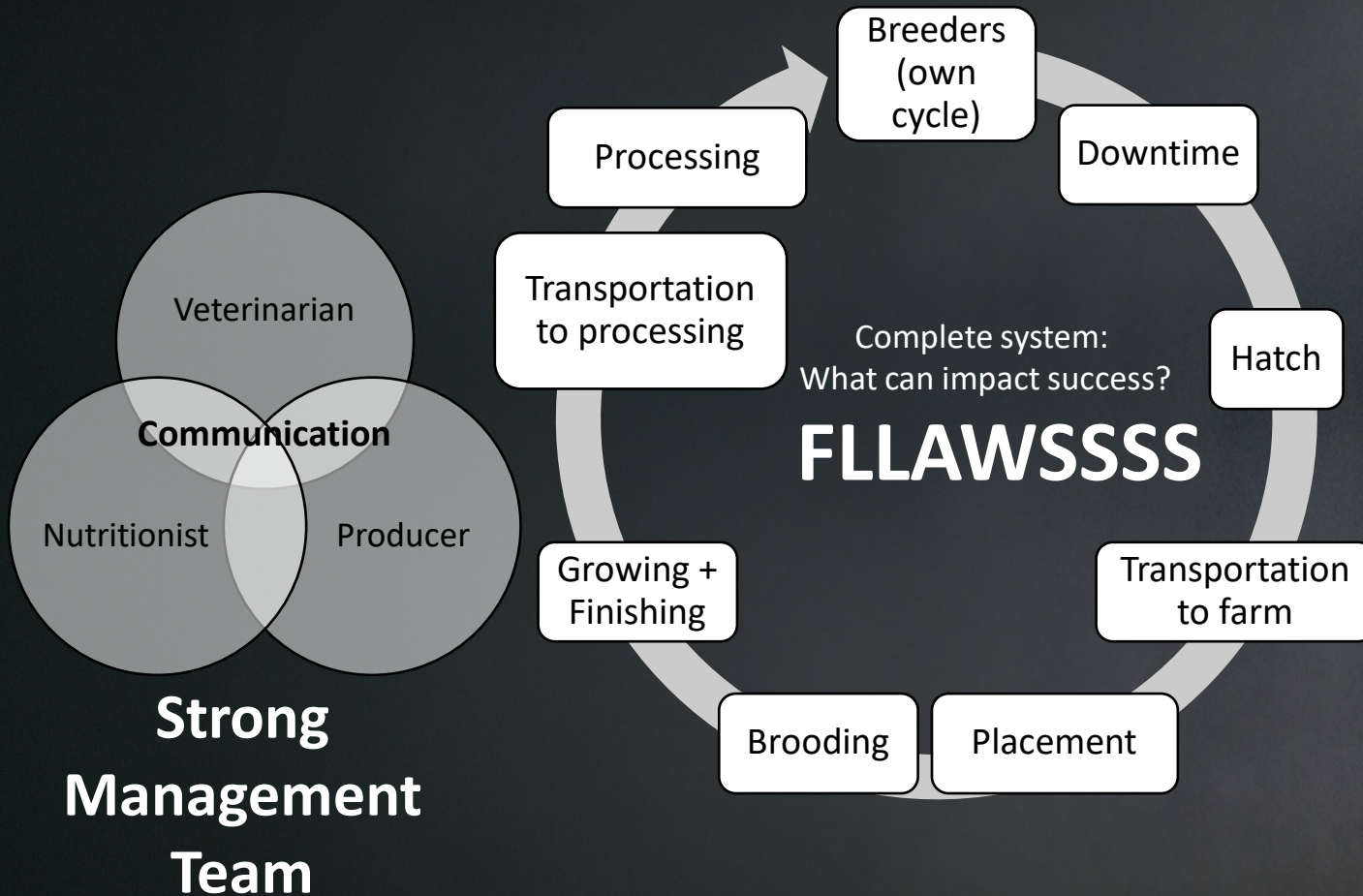
- Water is the forgotten nutrient
- Poultry ingest ~2X more water than feed
- Bad quality water → negatively impacts production
- Also have to look at:
 - Water management
 - Water equipment

Organism	Minimum pH	Optimum pH	Maximum pH
<i>Bacillus acidocaldarius</i>	2.0	4.0	6.0
<i>Lactobacillus acidophilus</i>	4.0-4.6	5.8-6.6	6.8
<i>Escherichia coli</i>	4.4	6.0-7.0	9.0
<i>Pseudomonas aeruginosa</i>	5.6	6.6-7.0	8.0
<i>Clostridium perfringens</i>	--	6.0-7.6	8.5

Good
bacteria

Potentially
bad & bad
bacteria

Operational Excellence



- Birds more sensitive to changes in environment
- Barn cleanliness prior to flock
- Down time between flocks
- Dry clean?
- Biosecurity
- Importance of brooding
- Stocking density
- Water consumption
- Access to water
- Water quality
- Feed consumption
- Access to feed
- Supplemental feed & water during brooding
- Litter quality
- Litter moisture
- Lighting intensity
- Lighting schedule
- Barn temperature
- Barn humidity
- Ventilation
- Etc...

A Program Approach: Additives



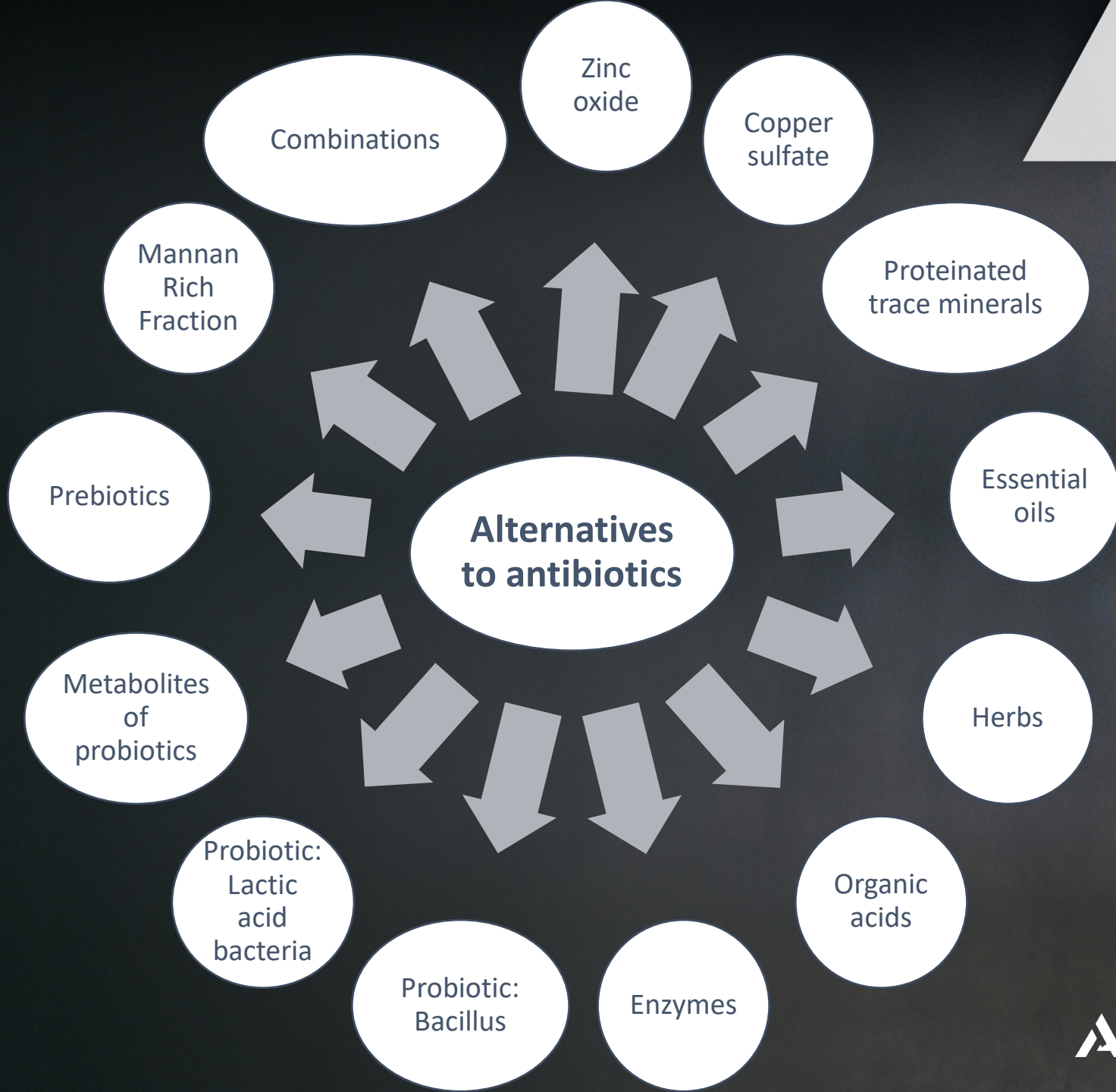
No silver bullet

Antibiotic reduction & elimination

→ Need a combination of additives

Different uses for different additives







What is already in the feed?

✓ **Enzymes**

✓ **Minerals**

Often “inorganic” – salt form of mineral

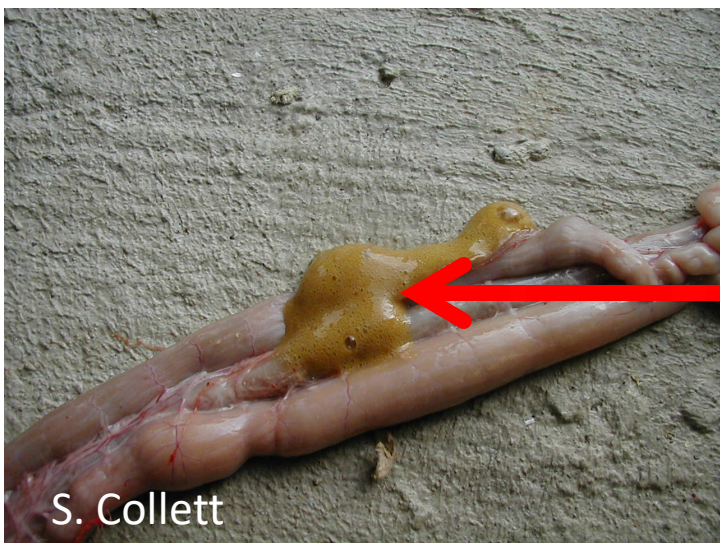
✓ **Vitamins**

Enzymes



Enzymes help to break down nutrient components so more accessible to bird

Promote intestinal health → most of digestion done by end of upper intestine and help to feed beneficial bacteria of upper intestine



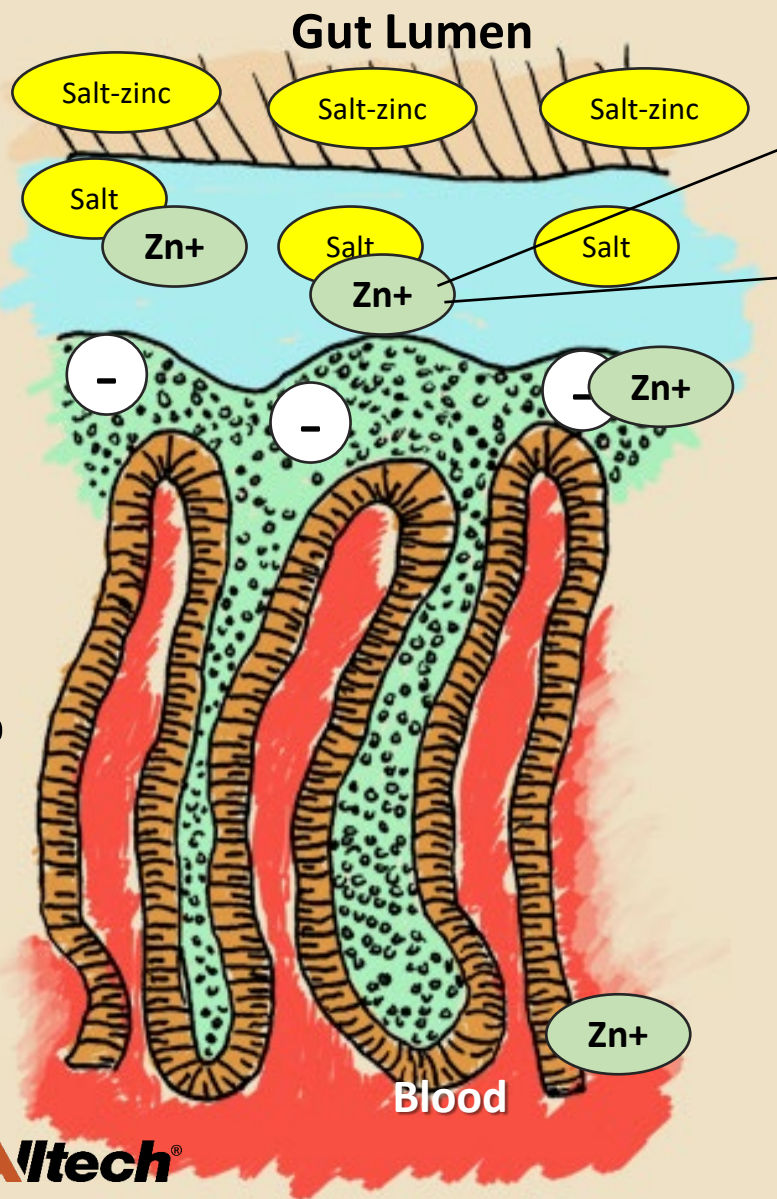
**Bubbles in ceca or
cecal droppings**
bacteria
fermentation



Inorganic Zinc and Copper

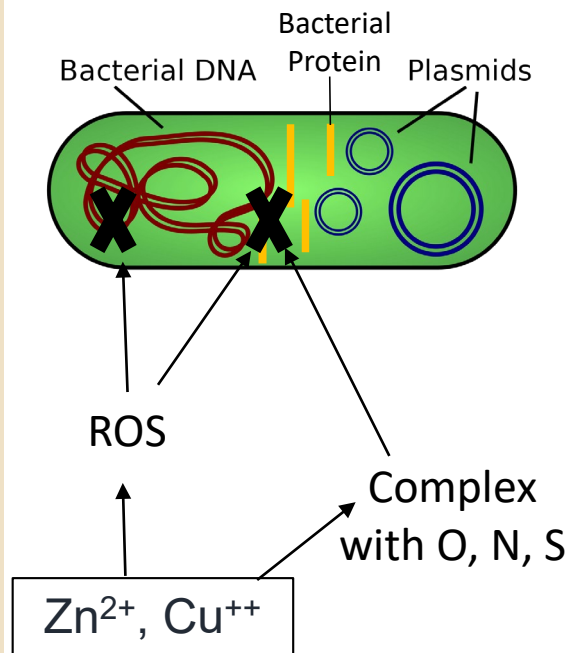
Willing et al., 2018

Inorganic Trace Minerals



Excess mineral in manure

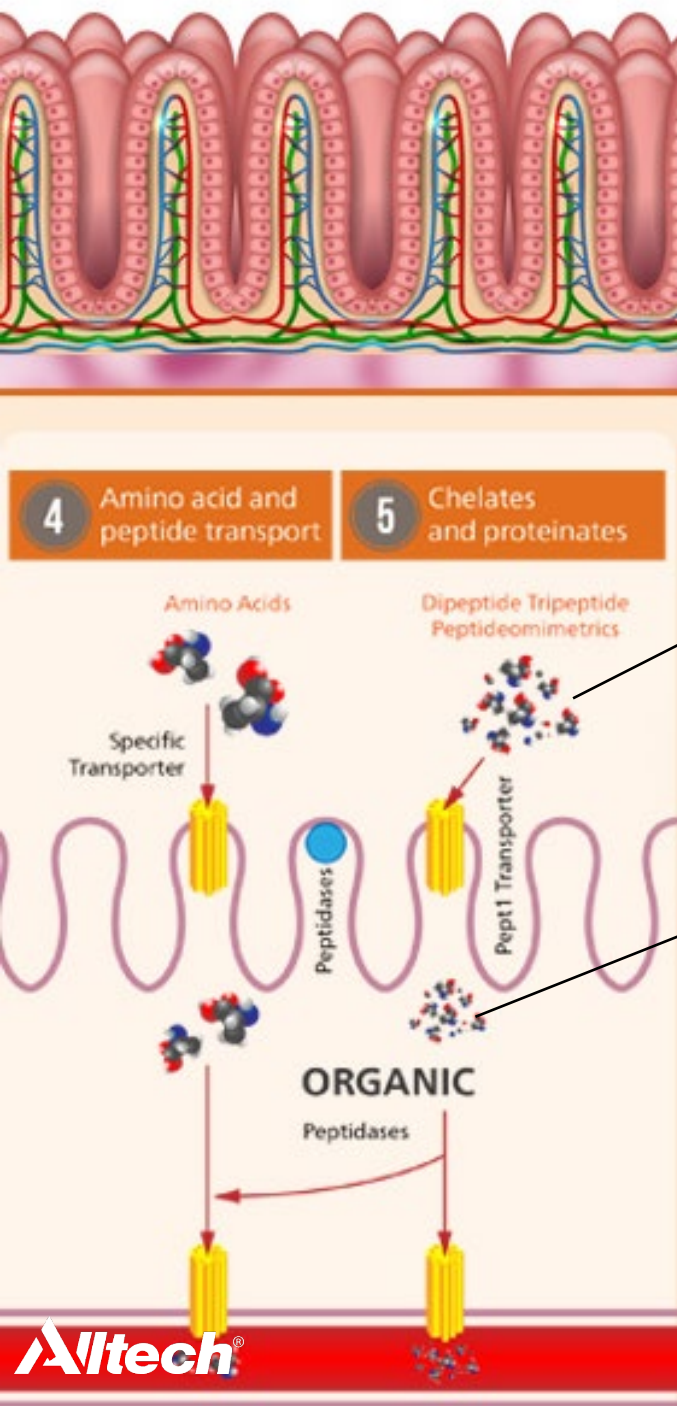
Action on bacteria in gut



Palza, 2015; Willing et al., 2018

- Used at high levels in the feed or sometimes water
 - Above what is required
- Copper sulfate – mouth lesions when levels too high
- Resistance issues
 - Plasmids
 - Transferred
 - Suggested \uparrow resistance to antibiotics

Presenting Minerals in Different Forms



- Replicate plant material forms in a manufacturing process
- Make the plant take up more mineral

Phytogenics



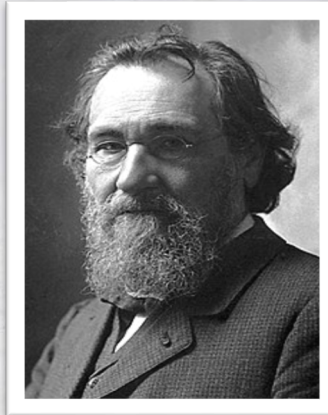
Plant derived compound from broad range of plant materials - Use of the actual plant (e.g. powder), use of extract (natural or synthetic), use of essential oil (e.g. hydrocarbons, oxygenated compounds, nonvolatile residues)

- **Potential for variation**
- **What is the dose?**
- **Various suggested mode of action depending on chemical compound used**

Historical Research with Alternatives: Probiotics



~4000 BCE



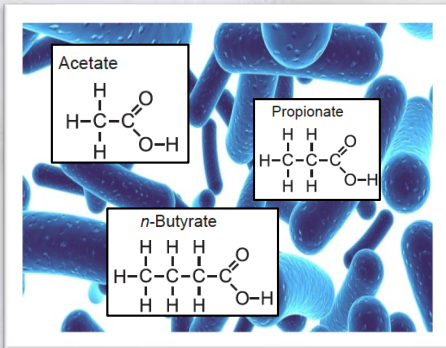
1907 - Elie Metchnikoff



1973 – Nurmi & Rantala



1965-2003+ – Redefining definitions of probiotics,
1989 USDA use “direct-fed
microbials”



Bacteria metabolites

Probiotics

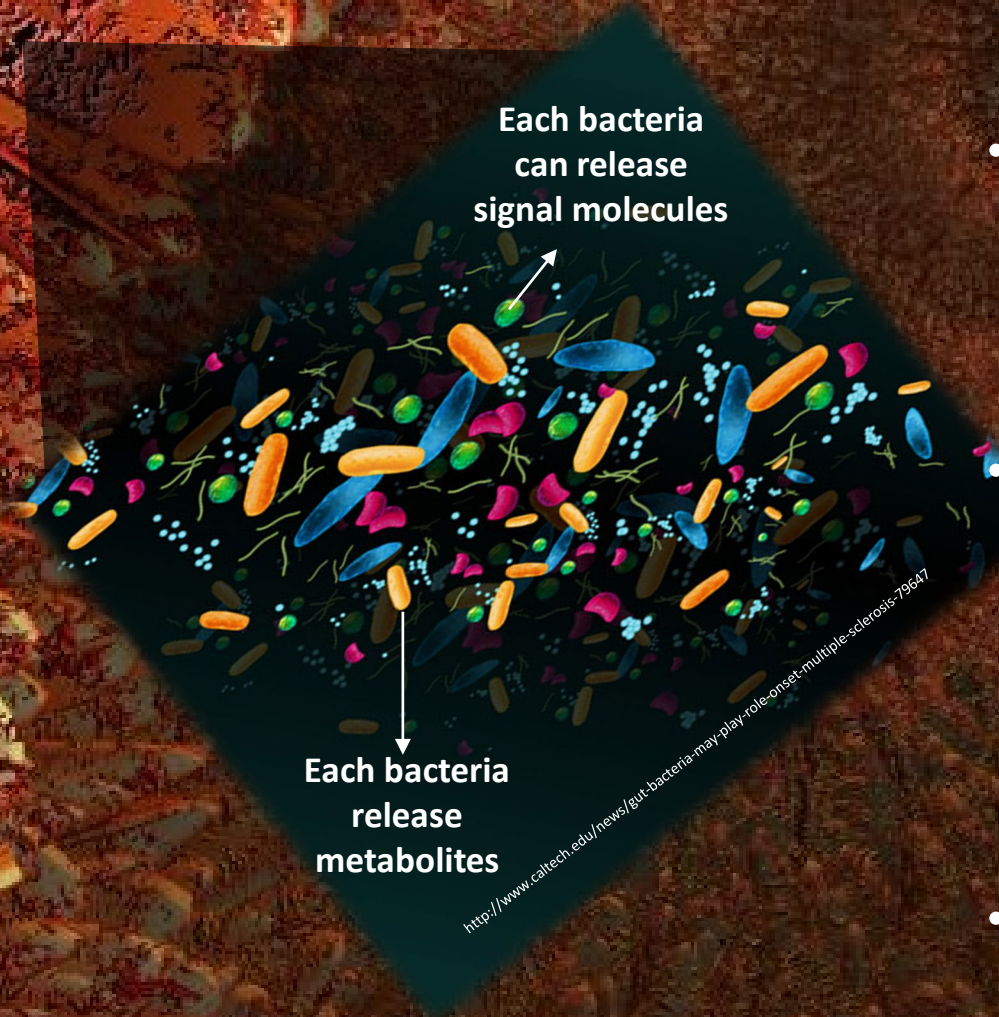


“Viable microorganisms that when ingested have a beneficial effect in the prevention & treatment of specific pathologic conditions”

- **Competitive exclusion**
- **Selection criteria**
- **Does it colonize the gut permanently (e.g. *Bacillus* vs. *Lactobacillus*)?**
- **Beneficial bacteria function? Altering communities? Metabolites working?**
- **Large proportion of use in neonatal animals**



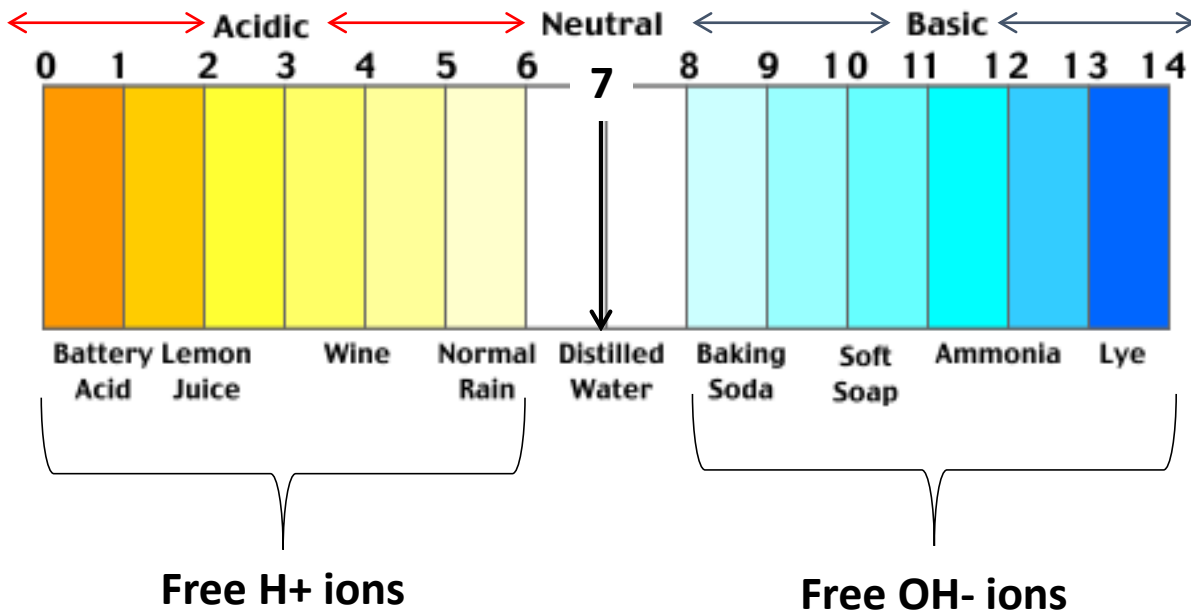
More than just the microbes there



- **Bacteria can:**
 - ✓ Make own environment
 - ✓ Make use of environment
 - ✓ Communicate
- **Bacterial metabolites impact the intestinal tract**
 - Fermentation of carbohydrates
 - Butyric acid, acetic acid, propionic acid, gas
- **Diversity of bacteria → diversity of metabolites**

Ricke, 2003; Gauthier, 2008; Kim and Kim 2015; Bedford and Gong, 2018; Deepa et al., 2018;

<https://mhrussel.wordpress.com/2013/07/18/new-meaning-to-the-term-gut-feeling-gut-bacteria-and-the-brain/>



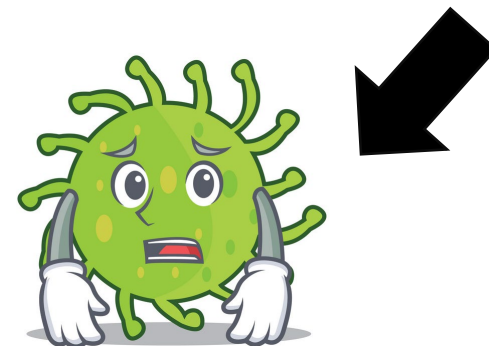
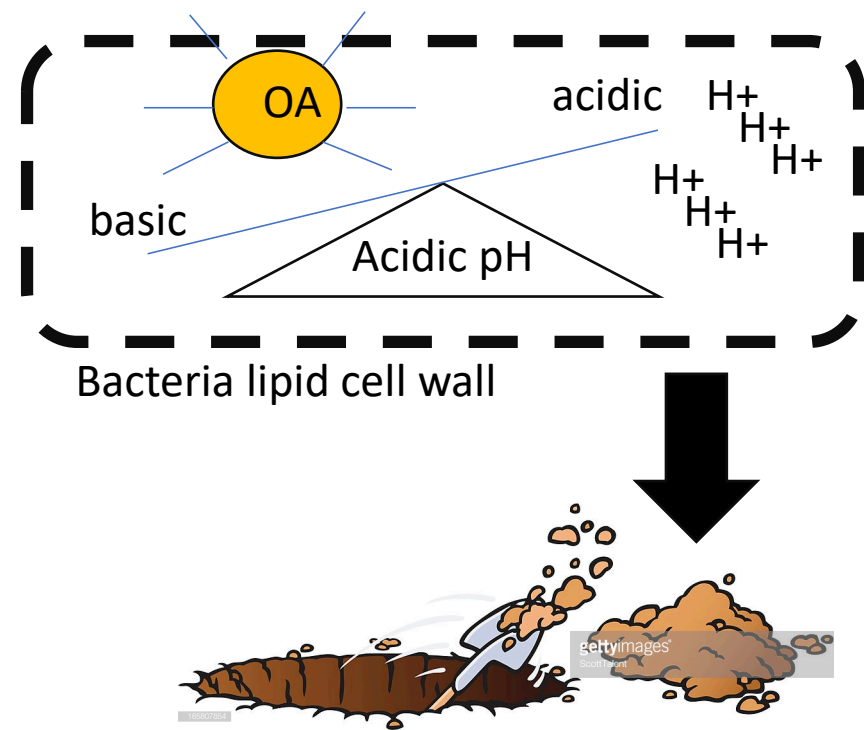
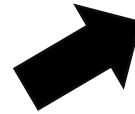
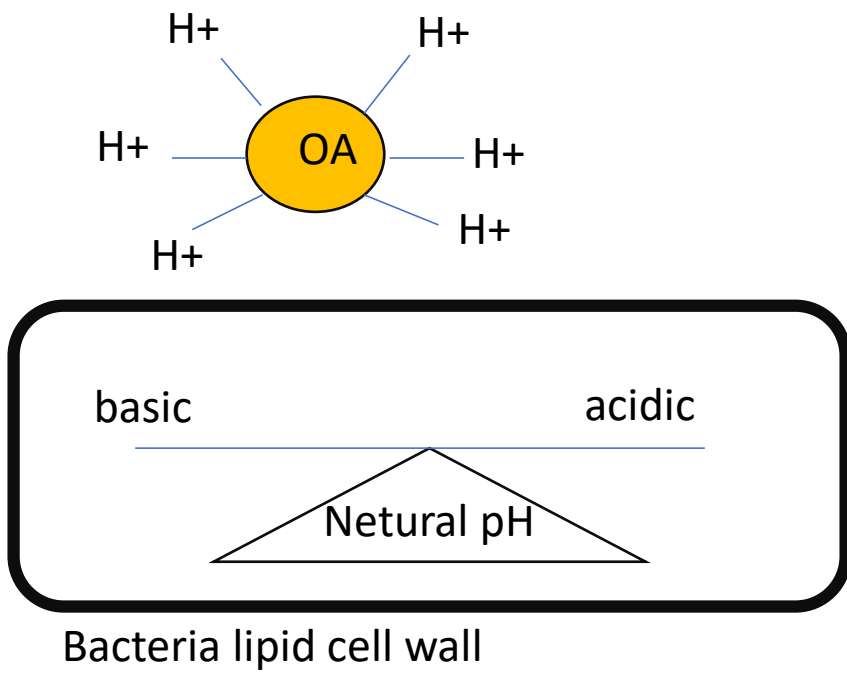
Generally...
Good bacteria like
acidic pH and bad
bacteria like basic
pH

Organic Acids

- Eg. Citric, acetic

Inorganic Acids

- Eg. Phosphoric



KR Price

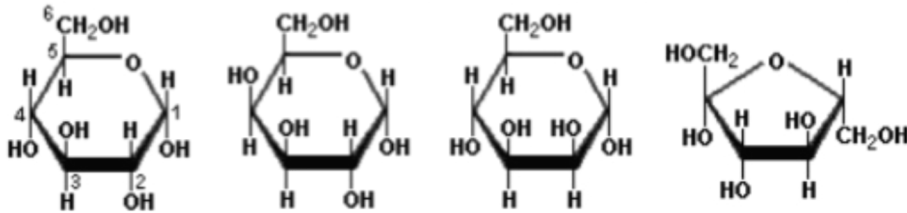
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Prebiotics

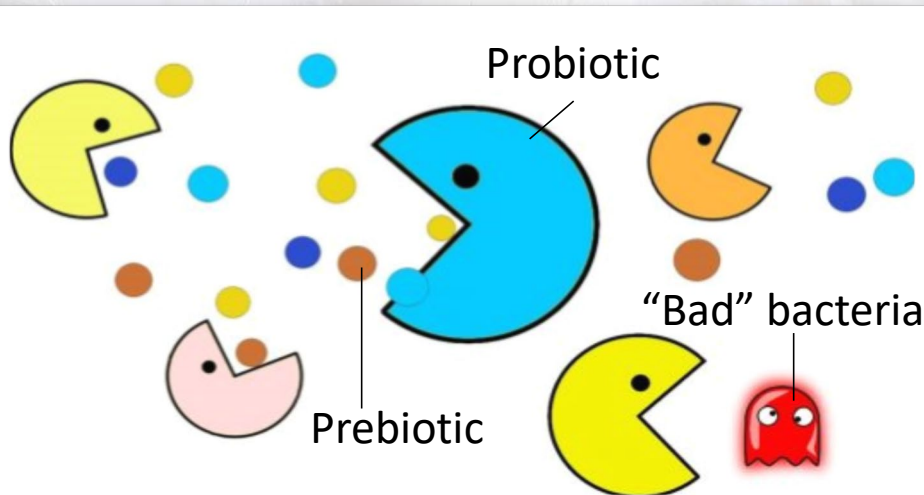


“Non-digestible food ingredients with selective effects on GIT microbiota”

Glucose Galactose Mannose Fructose



Can be between 2 & 20 monosaccharides combined together



- **1995 – Gibson & Roberfoid**

- Initial definition & gained attention from medical community

- **Qualifiers**

- Not broken down or absorbed in upper GIT
- Selective substance for one or limited beneficial commensal bacteria & stimulate them to grow &/or be activated
- Alter GIT flora for healthier composition
- (Induce luminal/systemic effects beneficial to host health)

- **Eg. FOS, Inulin, Galato.., MOS is different**

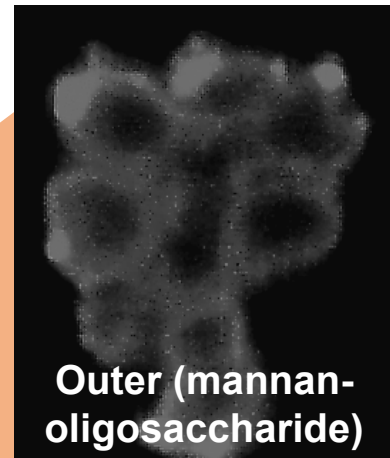
Different uses?



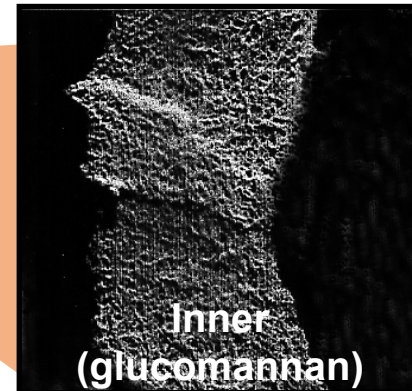
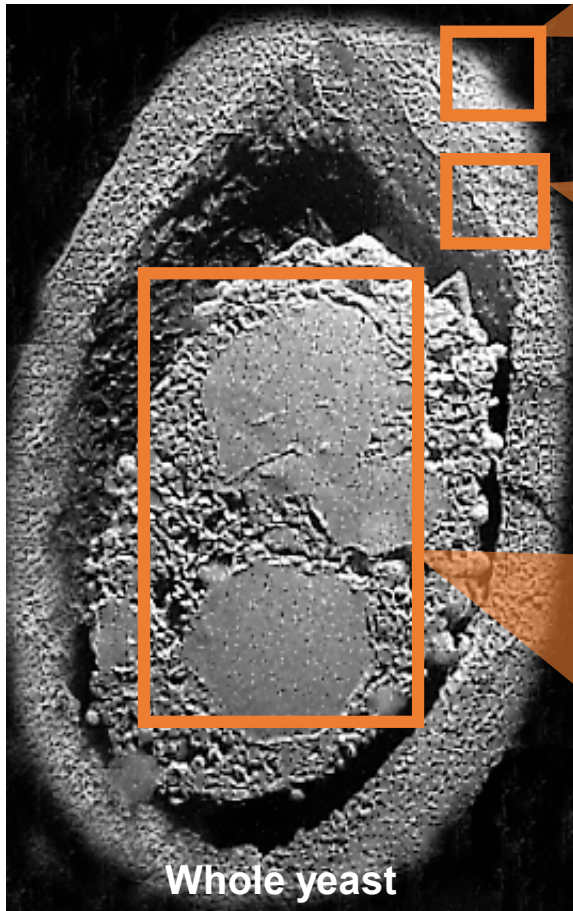
Yeast

Saccromyces cerevesia
(Brewer's yeast)

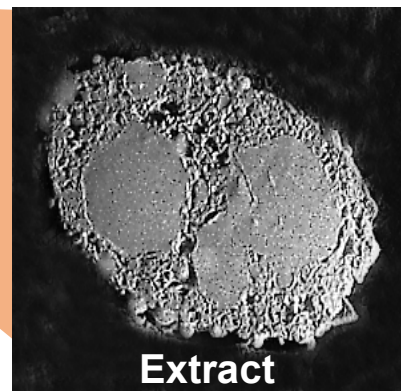
15-90%
mannose
(w/w)



- N- and O-glycosylations anchored to amino acids
- α -side chains mostly
- Agglutinate, antigenic, immunogenic



- β -glucans
- Porous structure
- “Sticky”+Stacking effect – Hydrogen bonds, van der Waals

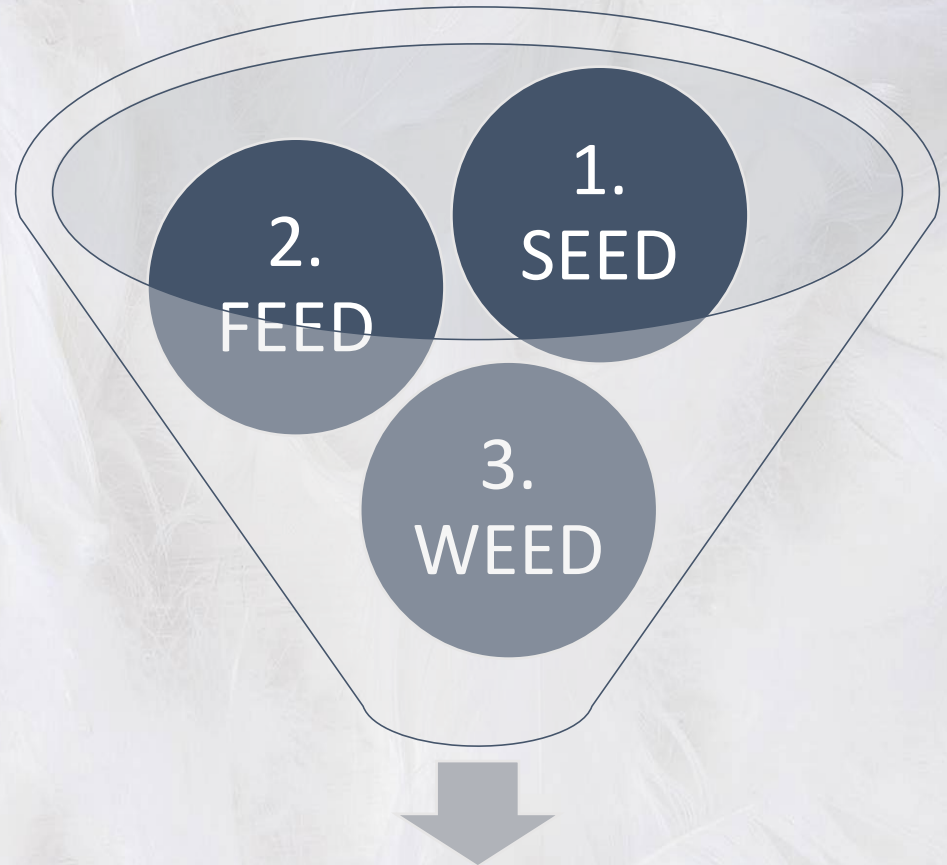


- Highly digestible proteins

Putting Programs together

3 steps as described by Dr. Steve Collett

Holistic approach: A “start to
finish” management system



Support for intestinal tract and
optimum conditions for digestion

New alternatives are popping up everyday



Be vigilant on the research &
background information of the technology

Key Criteria for the Selection of an Alternative

1. Consumer acceptance?
2. Safety?
3. Pellet stability?
4. Mode of action?
5. Consistency?

Zinc oxide
Copper sulfate
Essential oils
Herbs
Organic acids
Enzymes
Probiotic: Bacillus
Probiotic: Lactic acid
bacteria
Metabolites of probiotics
Prebiotic: FOS
Mannan Rich Fraction

...

Choosing the Right Combination or Program

1. What is your goal?
2. What is your challenge?
3. What can you fix/improve?
4. Product mode of action?
5. What should you use?



Take home message

1. **Alternatives to antibiotics appear to be “new norm” in developed world**
 - a) Varied harvesting & manufacturing
 - b) Varied mode of action
2. **Combination of alternatives is key**
 - a) Based on mode of action
 - b) Remember, no silver bullet
 - c) Avoid “a rose by any other name”
3. **Ask the question of your goal for an alternative program**
 - a) Goal? Challenge? To be fixed? Mode of action? To be used?

Thank You

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