



Update nutrition technology that's made poultry growth without antibiotic growth promoter or without additional hormone

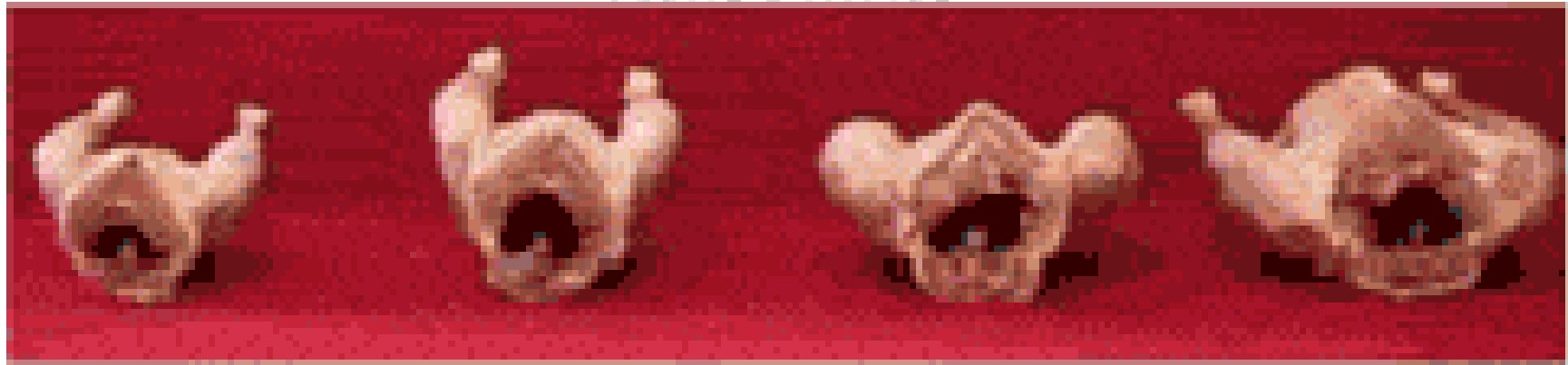
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Broiler carcasses from Ross 308 in 2001 compared to unselected controls representing performance in 1957

(Source: G. B. Havenstein 2006, Lohmann Information)

ACRBC Males



Ross 308 Males



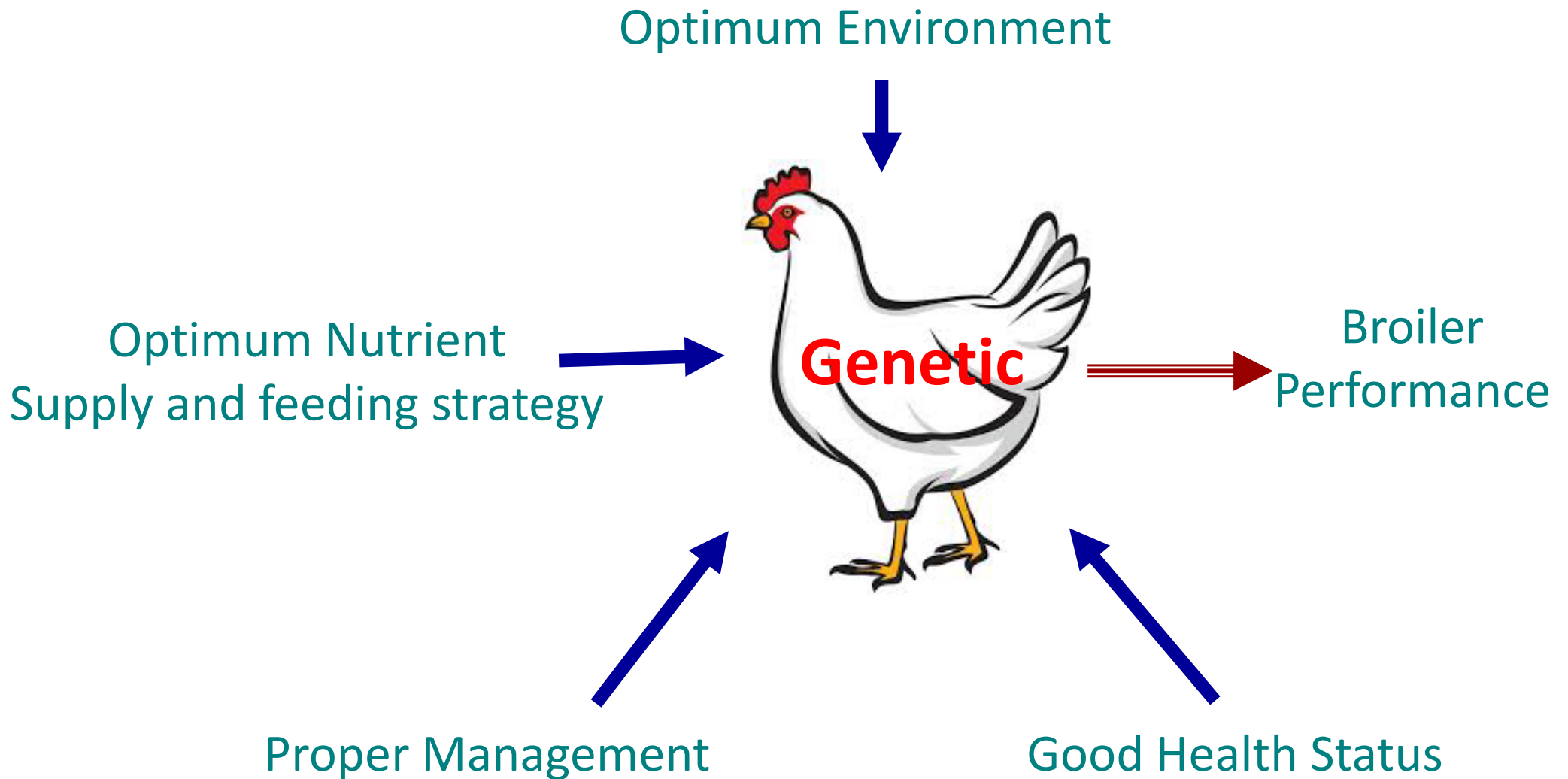
Day 43

Day 57

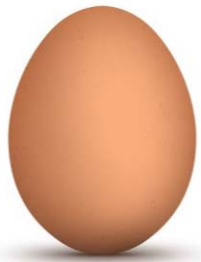
Day 71

Day 84

Genetic Potential for Broiler Production



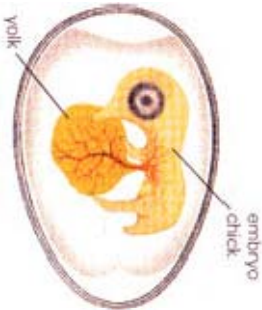
Feeding Management to Maximize Growth Development of Broiler



Before hatch

+ Early feeding (In Ovo feeding)

21 d



+ Balance nutrient diet

+ Good quality and Safety feed

+ Suitable feeding program

+ Feeding to improve gut health and immune function

After hatch



37-39 d



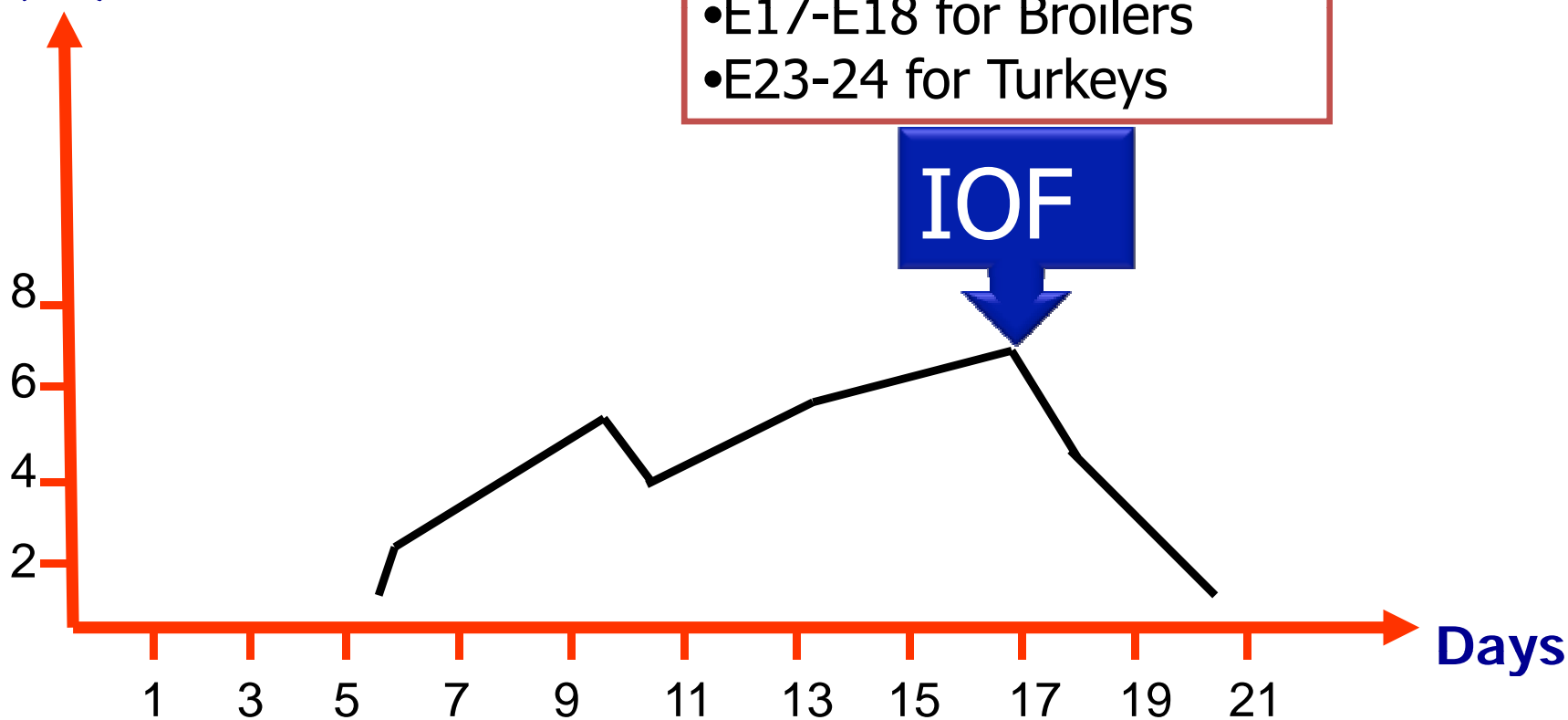


Before Hatch Strategy - In-Ovo Feeding



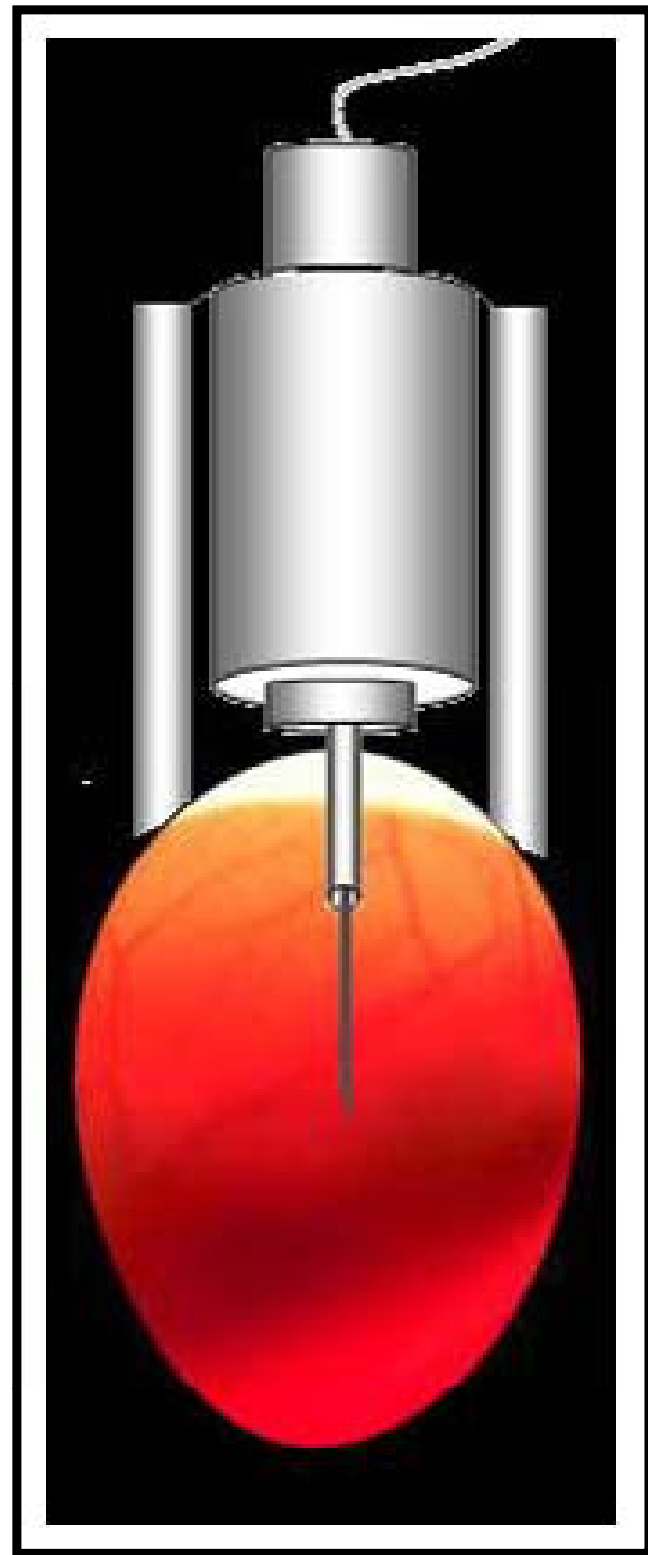
Synchronize in-ovo feeding when the embryo begins to imbibe amniotic fluid

Volume of amniotic fluid (ml)



("The Avian Embryo", Romanoff 1960)

Uni and Ferket, 2003. US Patent No. 6592878.



Injection of Feeding Solution
into the Amnion Few Days
Before Hatch

Nutrient supplement amnion is
orally consumed by the embryo
and presented in the enteric
tissues

Elevated
available energy
(or stored)

Enhances intestinal
gene expression and
function

Support development and growth

Embryo Jejunum at Hatch



Oliveira et al. (2008)

Control

In-ovo Fed

**IOF effects on villus integrity
of day-old poult**

850X 15 kV

10u

850X 10 kV

10u

Effect of In-Ovo Feeding on Body and Breast muscle Weights (g) of Ross Broilers

	Day of Hatch		Day 10		Day 25	
	Control	In Ovo	Control	In Ovo	Control	In Ovo
BW (g)	45.3	47.0*	243	254*	943	997*
BW Diff. (%)		+3.7		+ 4.2		+ 5.7
Breast muscle % of BW	1.93	2.05*	11.4	12.3*	12.0	13.0*
Diff. (%) in Breast Muscle		+6.2		+5.2		+8.3

- 1ml of Primary IOF solution given at 17 E.
- Age of breeding flock: 35 weeks

Uni et al. (2005)



After Hatch-Market Strategies

- Nutrition and feeding technology that enable us to maximize broiler growth
 - Precise feed formulation
 - Correct nutrient requirement
 - Using concept of ideal protein
 - Precise nutrient digestibility value
 - Good quality and safety feed
 - Good feed quality assurance and quality control
 - Use feed processing technology to improve feed quality, safety and nutritional availability
 - Suitable feeding program
 - Feeding to improve gut health



Correct Nutrient Requirement for Feed Formulation

- Breed
- Stage of life
- Final product-whole bird, cut-up, further processing
- Yield and carcass quality
- Target weight
- Management condition
- Environmental condition
- Health condition

Nutrient Requirements - Ross 308

Metabolizable energy

Digestible amino acid

Age fed	Energy	Total	Digest ¹	Total	Digest ¹	Total	Digest ¹
1-10	3025						
11-20	3150						
21-40	3400						
	MJ	12.65		13.20		14.40	
AMINO ACIDS		Total	Digest ¹	Total	Digest ¹	Total	Digest ¹
Lysine	%	1.43	1.27	1.24	1.10	1.09	0.97
Methionine & Cystine	%	1.07	0.94	0.95	0.84	0.86	0.76
Methionine	%	0.51	0.47	0.41	0.38	0.41	0.38
Threonine	%	0.94	0.83	0.74	0.65	0.74	0.65
Valine	%	1.09	0.95	0.96	0.84	0.86	0.75
iso-Leucine	%	0.97	0.85	0.85	0.75	0.76	0.67
Arginine	%	1.45	1.31	1.27	1.14	1.13	1.02
Tryptophan	%	0.24	0.20	0.20	0.18	0.18	0.16
Crude Protein	%	22-25		21-23		19-23	

Ideal protein

For optimal portions margin it is recommended that amino acid density be increased up to 5% in all diets

MINERALS

Calcium	%	1.05	0.90	0.85
Available Phosphorus	%	0.50	0.45	0.42
Magnesium	%	0.05-0.50	0.05-0.50	0.05-0.50
Sodium	%	0.16-0.23	0.16-0.23	0.16-0.20
Chloride	%	0.16-0.23	0.16-0.23	0.16-0.23
Potassium	%	0.40-1.00	0.40-0.90	0.40-0.90

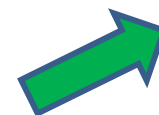
ADDED TRACE MINERALS PER KG		Starter		Grower		Finisher	
Copper	mg	16		16		16	
Iodine	mg	1.25		1.25		1.25	
Iron	mg	40		40		40	
Manganese	mg	120		120		120	
Selenium	mg	0.30		0.30		0.30	
Zinc	mg	100		100		100	
ADDED VITAMINS PER KG		Wheat based feed	Maize based feed	Wheat based feed	Maize based feed	Wheat based feed	Maize based feed
Vitamin A	iu	12000	11000	10000	9000	10000	9000
Vitamin D3	iu	5000	5000	5000	5000	4000	4000
Vitamin E	iu	75	75	50	50	50	50
Vitamin K (Menadione)	mg	3	3	3	3	2	2
Thiamin (B1)	mg	3	3	2	2	2	2
Riboflavin (B2)	mg	8	8	6	6	5	5
Nicotinic Acid	mg	55	60	55	60	35	40
Pantothenic Acid	mg	13	15	13	15	13	15
Pyridoxine (B6)	mg	5	4	4	3	3	2
Biotin	mg	0.20	0.15	0.20	0.10	0.10	0.10
Folic Acid	mg	2.00	2.00	1.75	1.75	1.50	1.50
Vitamin B12	mg	0.016	0.016	0.016	0.016	0.010	0.010
MINIMUM SPECIFICATION							
Choline per kg	mg	1600		1500		1400	
Linoleic Acid	%	1.25		1.20		1.00	



Metabolizable Energy and Digestible Amino Acid



Digestibility study



Collect excreta for metabolizable energy



Collect ileal digesta for amino acid digestibility



Ideal Protein Concept



Amino acid
profile analysis

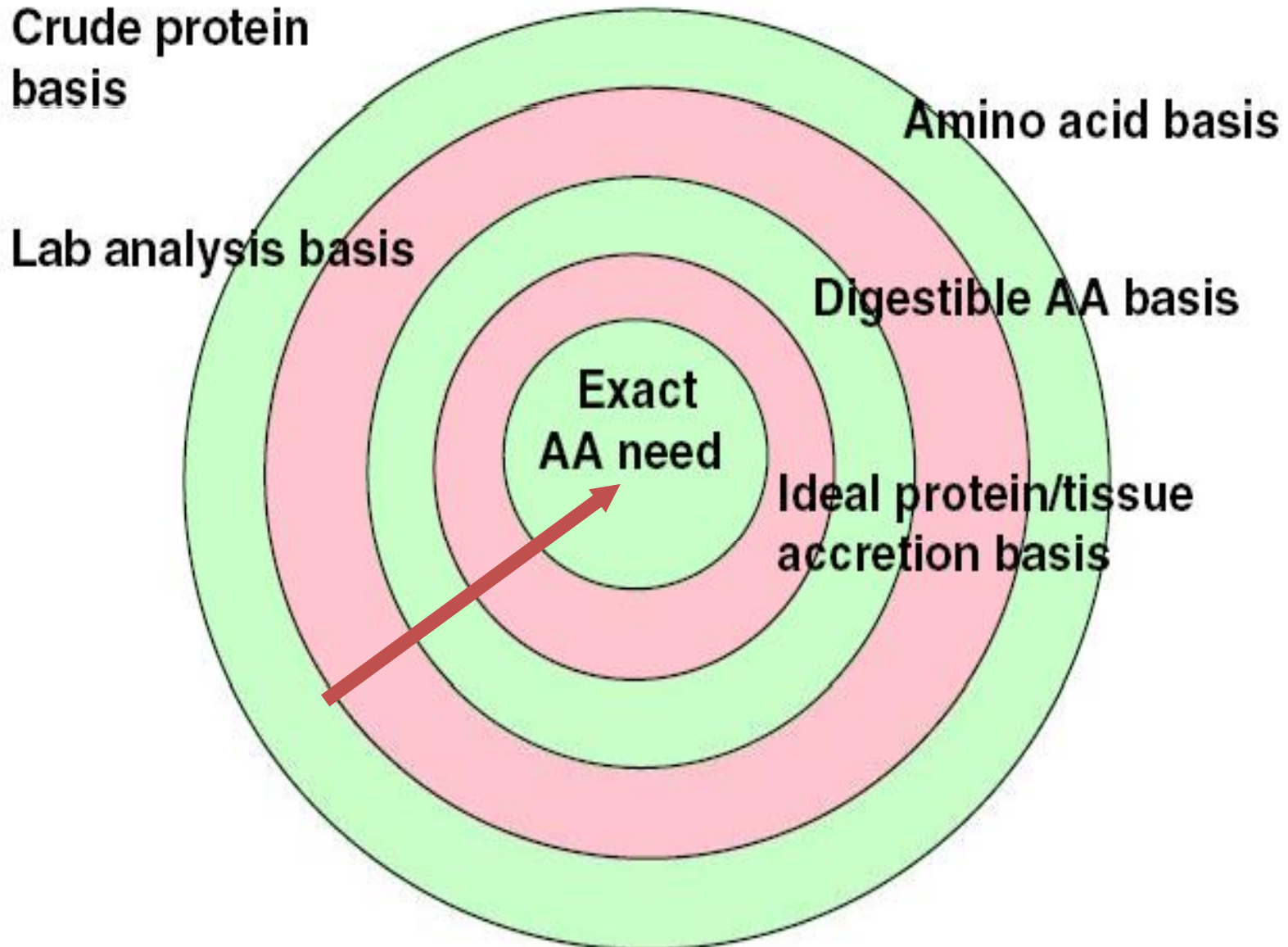


Balanced protein total amino acid profiles				
Amino Acid	Starter 0-10 days	Grower 11-22 days	Finisher 1 23-42 days	Finisher 2 43- days
Lysine*	100	100	100	100
Methionine	38	40	41	41
Methionine + Cystine	74	76	78	78
Tryptophan	16	16	18	18
Threonine	65	66	68	68
Arginine	105	105	108	108
Valine	75	76	77	77

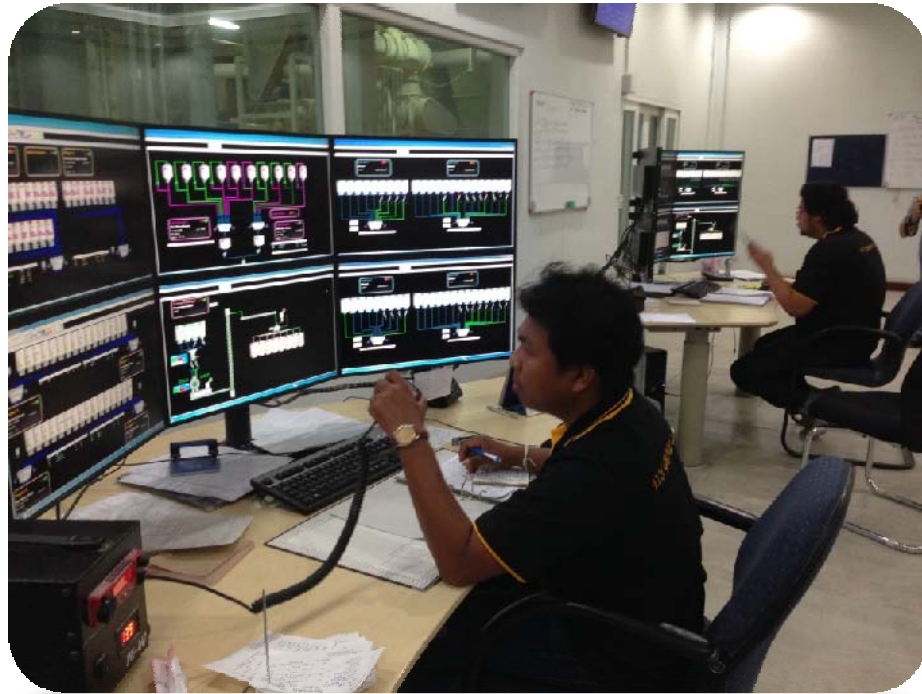
*In the profile Lysine is always the reference amino acid, and is shown at 100%.



Amino Acid Formulation Strategies



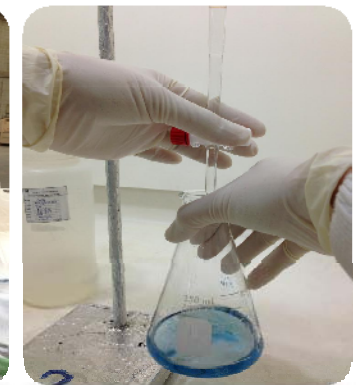
Good Quality and Safety Feed





Feed Quality Assurance

- Nutritional standard setting
 - For feed ingredient
 - For finished feed
- Technologies of feed manufacturing
- Quality control
 - For feed ingredient
 - For finished feed





Quality Assurance and Quality Control

Chemical

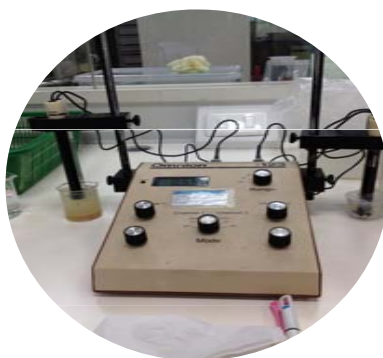
Acid Value
Ash
Fat
Fiber
Protein
Mineral (ISE)
Moisture
NIR
Total Hardness
TDS

Physical

Odor
Flavor
Appearance
Particle size

Biological

Total bacteria count
E. Coli
Salmonella
Toxin





Corn-Quality Assurance



Sampling



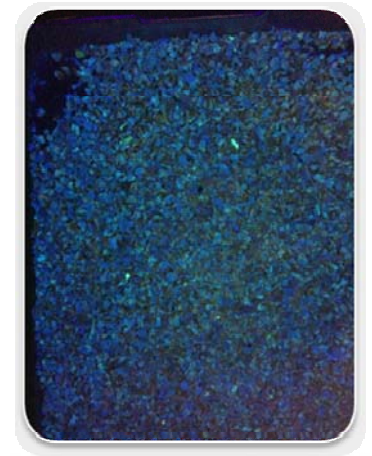
Temperature Measurement



Moisture measurement



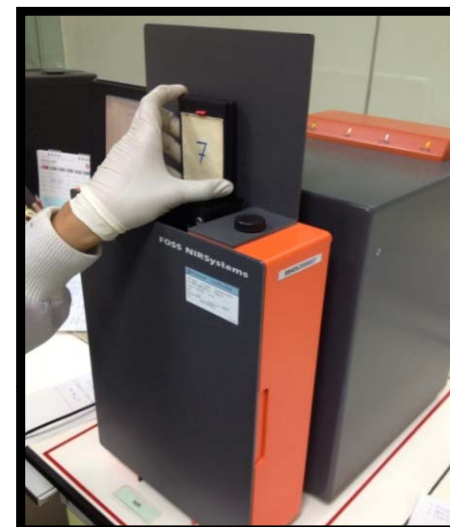
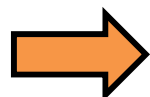
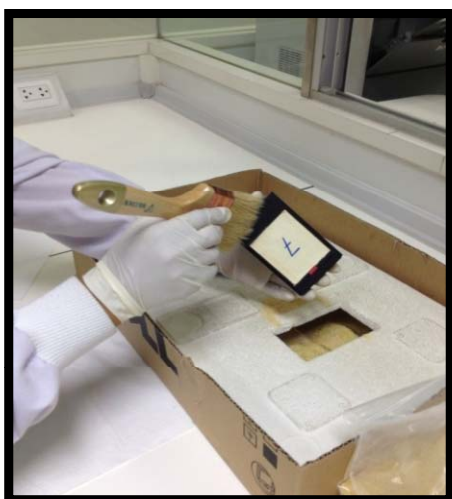
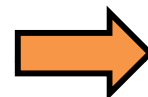
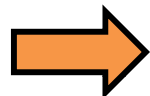
Aflatoxin-Bright Greenish Yellow Fluorescence



Grading corn-Seiving-defected, damaged, cracked, rotten, fine



NIR-Near Infrared Reflectance Nutrient Composition Analysis





Reference Samples





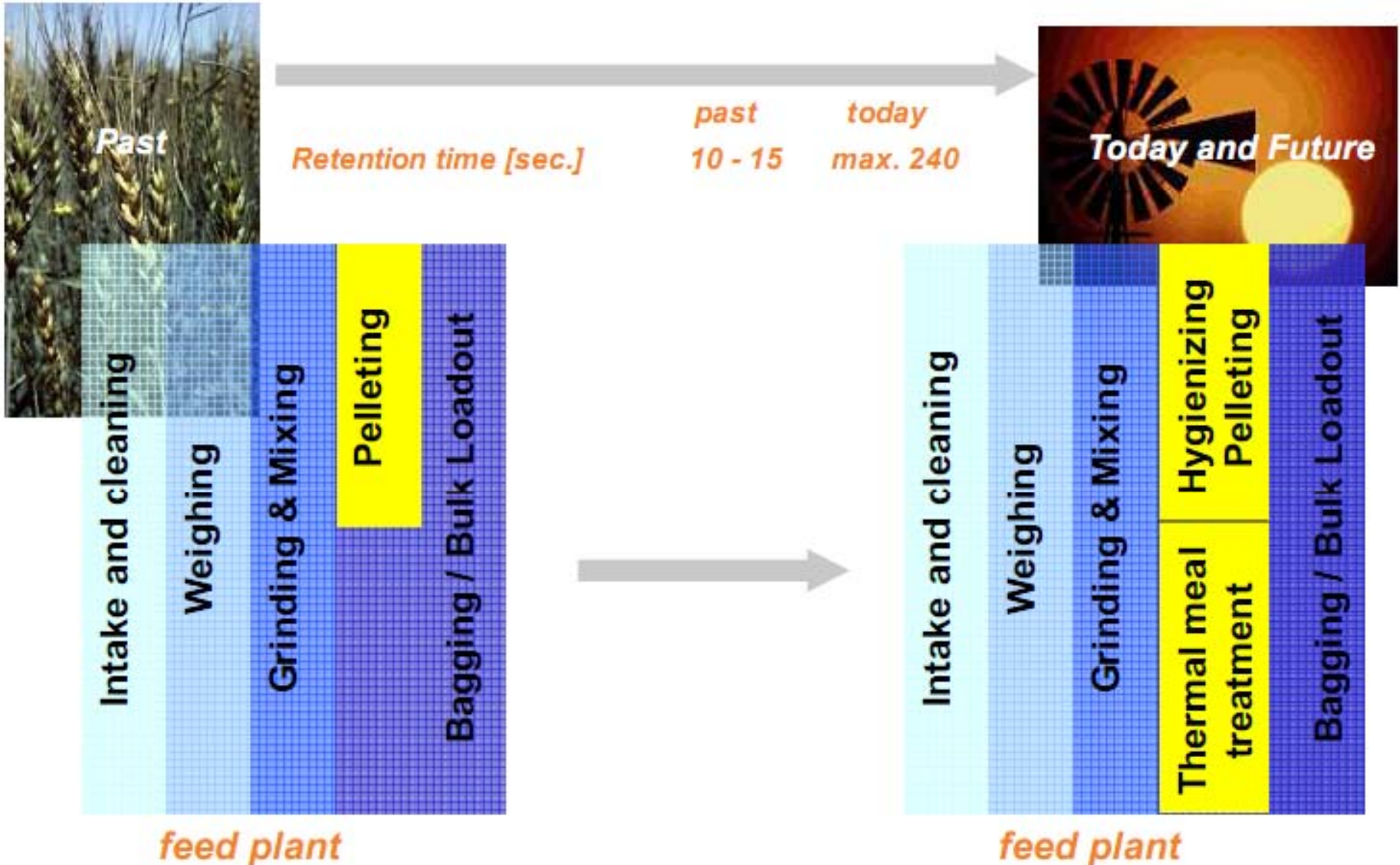
Technology for Feed Manufacturing

- HACCP in many processes
 - Raw material receiving
 - Raw Product Storage
 - Raw Product Processing
 - Weighing and Mixing
 - Pelleting and Cooling
 - Feed Storage and Delivery of Feeds
 - Cross Contamination



Hygienizing Pelleting

Modern feed plant – change of process with hygienizing

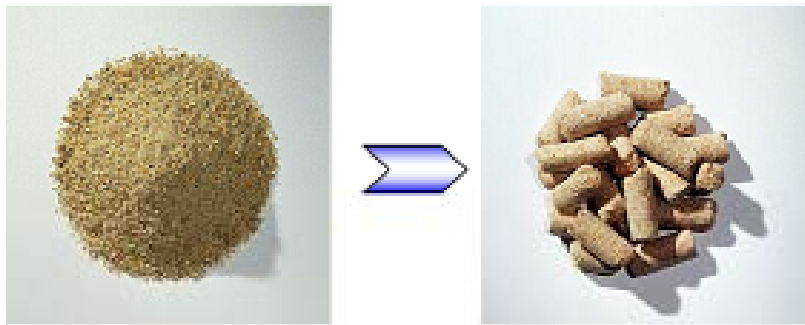




Beneficial Effect of Hygienization

Feed process benefits

- Improvement of pellet quality
- Lower specific energy consumption
- Higher throughput rates
- Longer life time of dies and rolls
- Improvement of product flow characteristics



Animal benefits

- Reduction of pathogenic germs / salmonellas
- Improved digestability



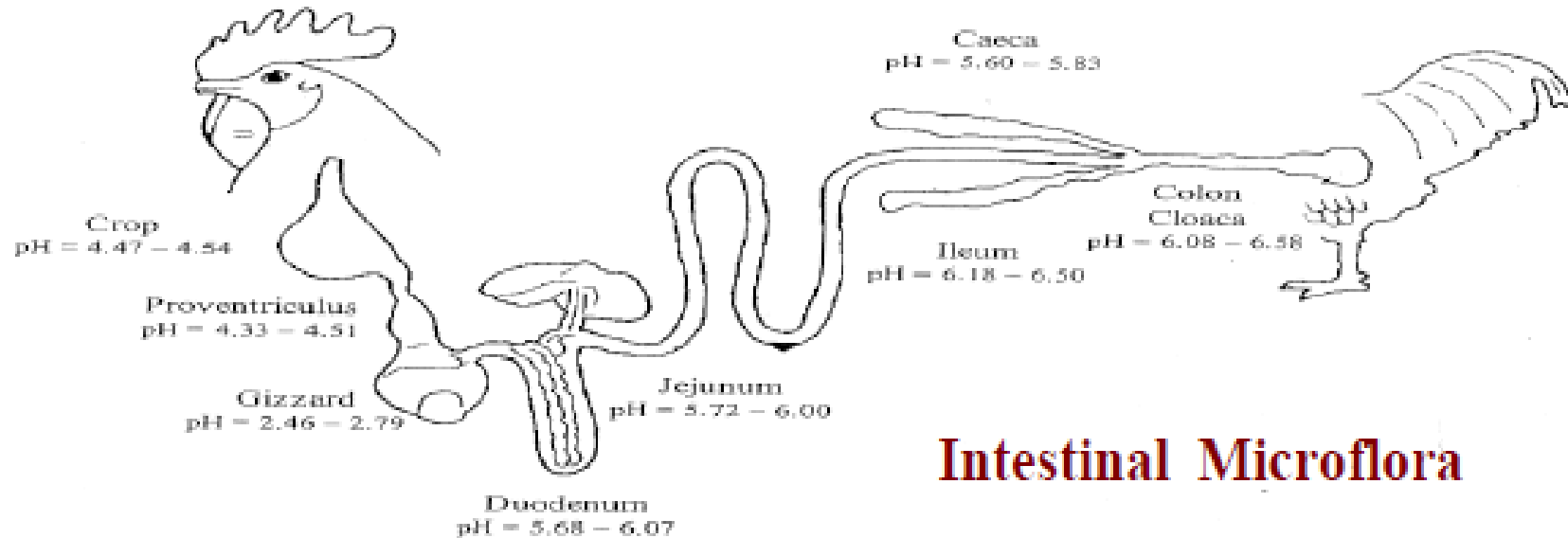
Feeding Programs for Broilers



- Starter feed (21-23% CP; 3000-3300 kcal/kg)
 - Pre-starter sometimes fed 1 to 10 days
 - 1 to 18 or 21 days of age;
- Grower feed (19 – 20% CP; 3000-3200 kcal/kg)
 - 18 or 21 to 35 or 42 days.
- Finisher feed (17 – 18% CP; 3000-3200 kcal/kg)
 - 35 or 42 to 42 or 49 or 56 days of age.
- Withdrawal feed (17-18% CP)
 - Finisher feed without drugs for 5 or 7 days



Feeding to improve gut health



	Proximal GIT	Small Intestine	Distal GIT
pH	3 - 5	6 - 7	7
Bacterial density cfu/g	10^3 to 10^5	10^8 to 10^9	10^{10} to 10^{12}
Microbial population	Acid tolerant	Gm+ Facultative Aerobes	Anaerobes
Digesta passage rate	+++	++	+
Main species	Lactobacilli	Lactobacilli Clostridium perfringens Streptococcus Enterococcus	Clostridia Lactobacilli Bacteroides Coliforms Fecal Strep



Feed Additives for Gut Health Improvement

- **Antibiotics**
- Herbs, spices and essential oil
- Organic Acids

- Enzymes
- Probiotics
- Prebiotics

Decrease
microbial load



Shift microflora
↓
Competitive exclusion
↓
Promote intestinal health

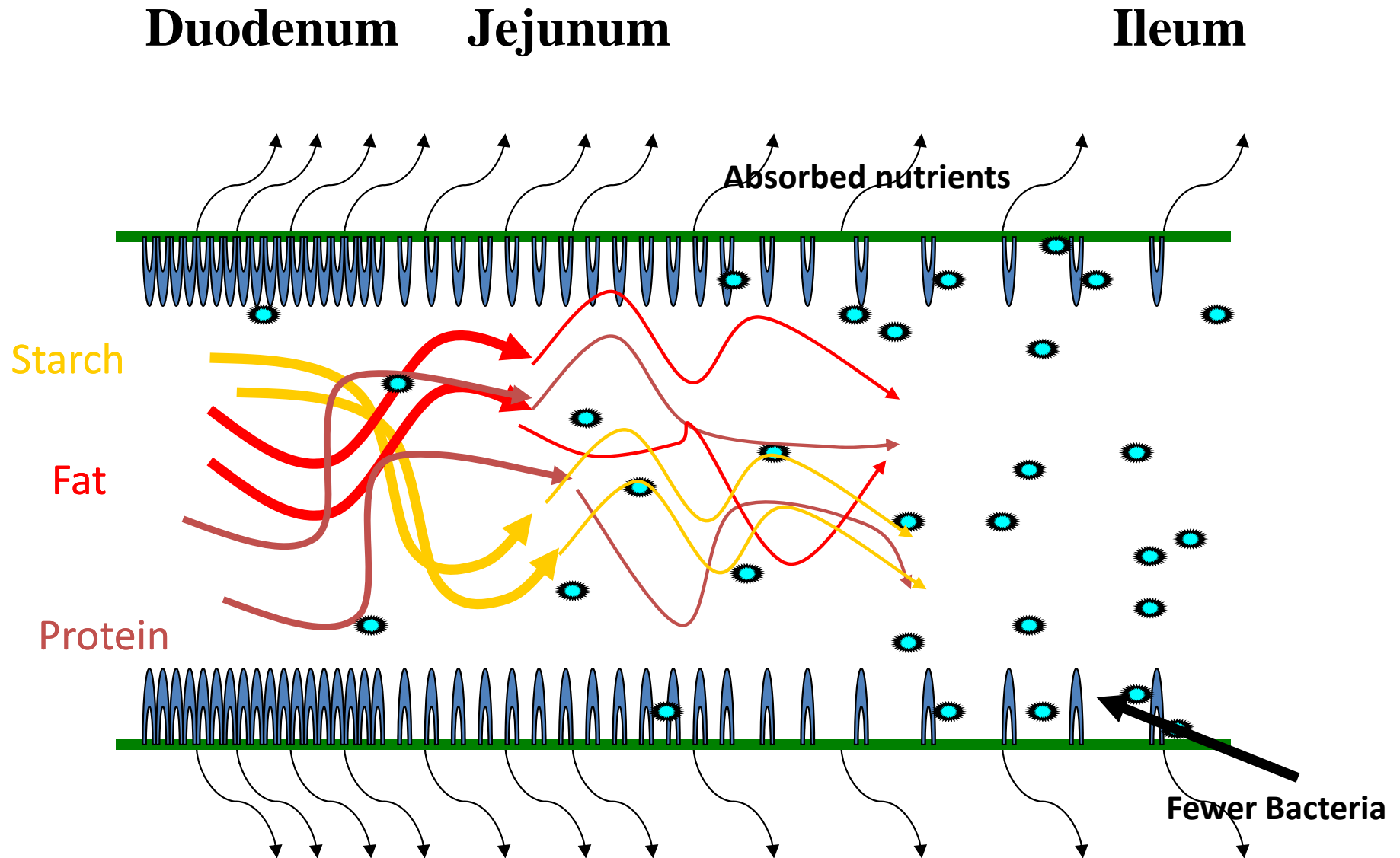


Gut Integrity Differences



Courtesy of Dr. Peter Ferket, NCSU

Optimal digestion \Rightarrow little need for control of microbial populations

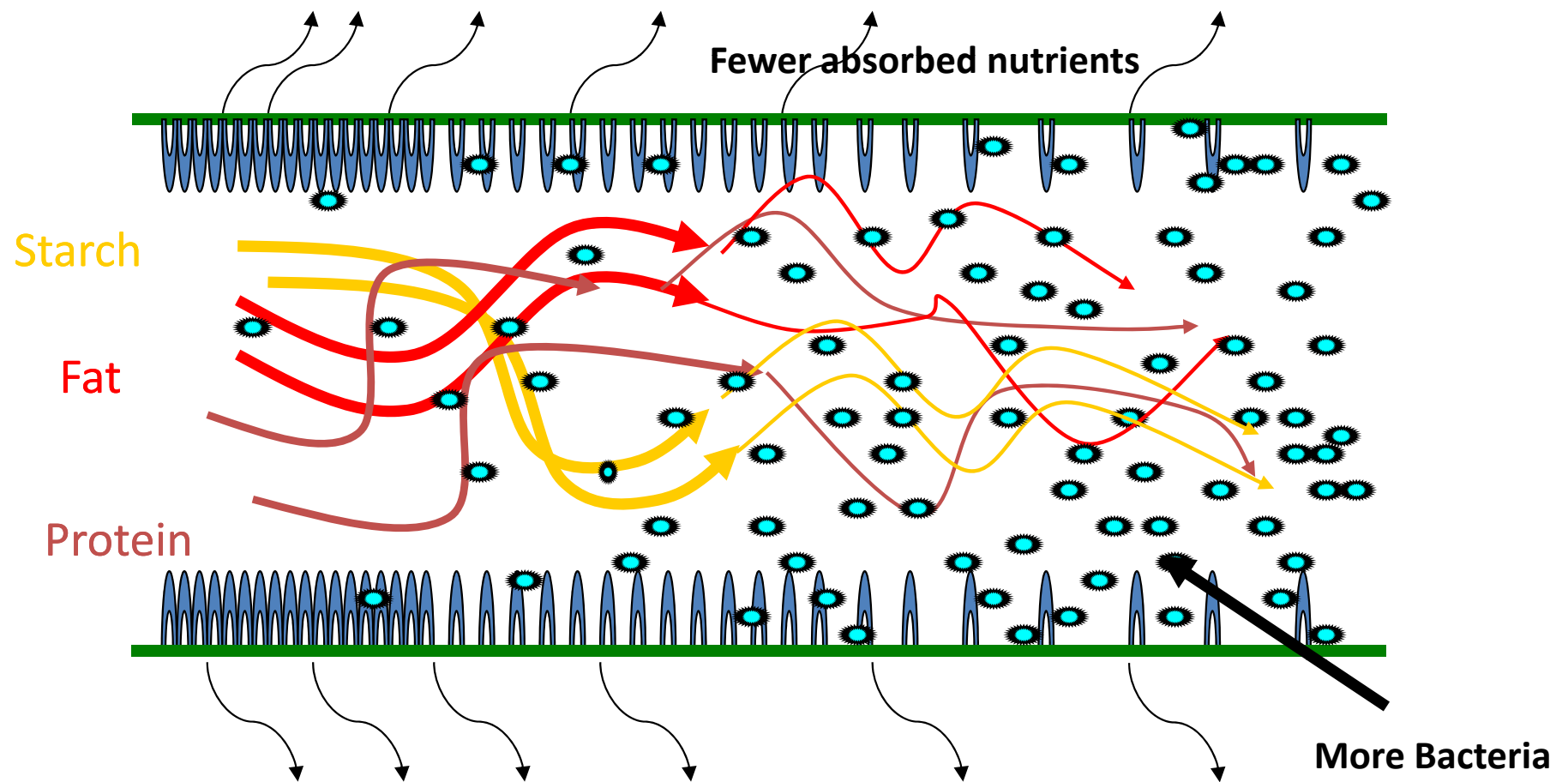


Sub-optimal digestion \Rightarrow increased microbial pressure on bird

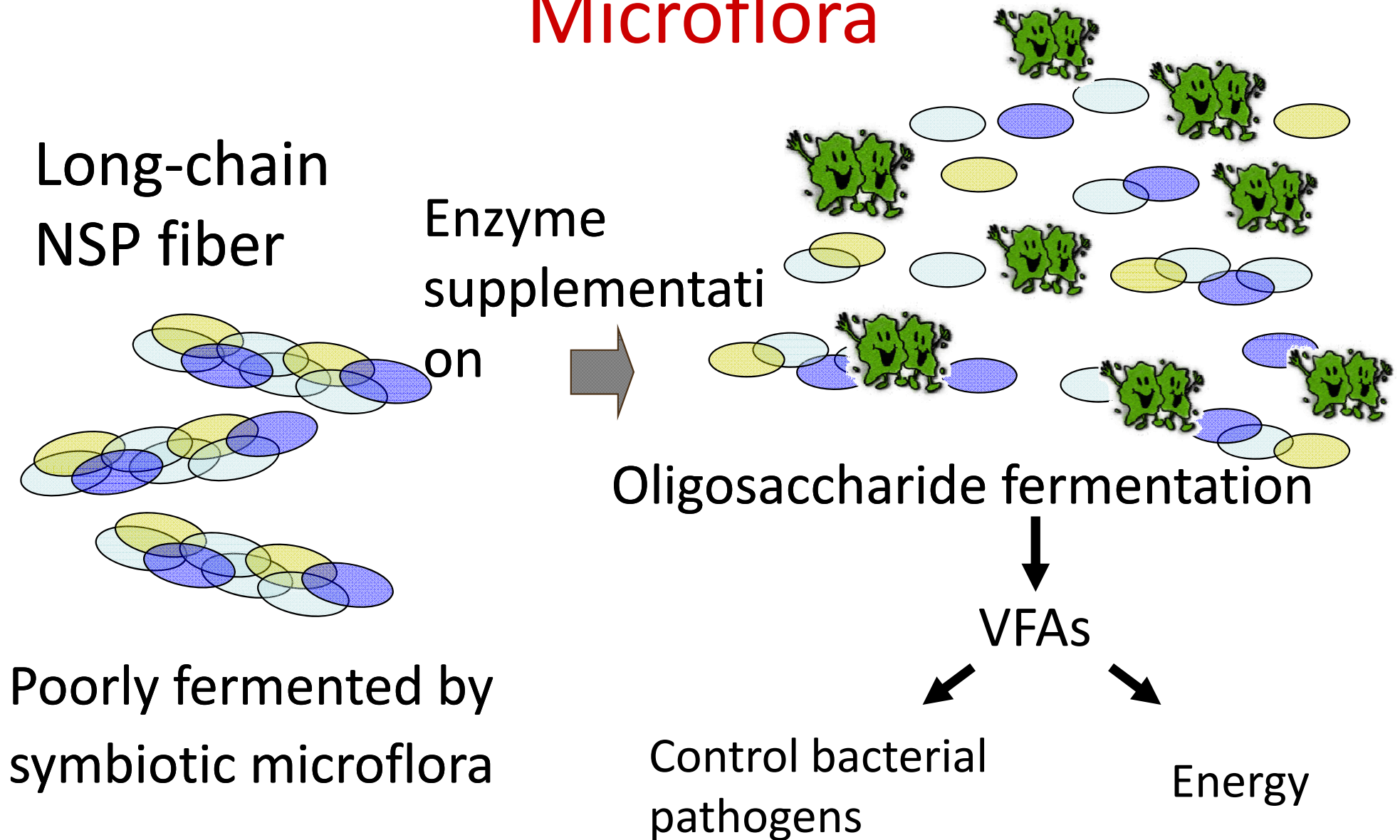
Duodenum

Jejunum

Ileum



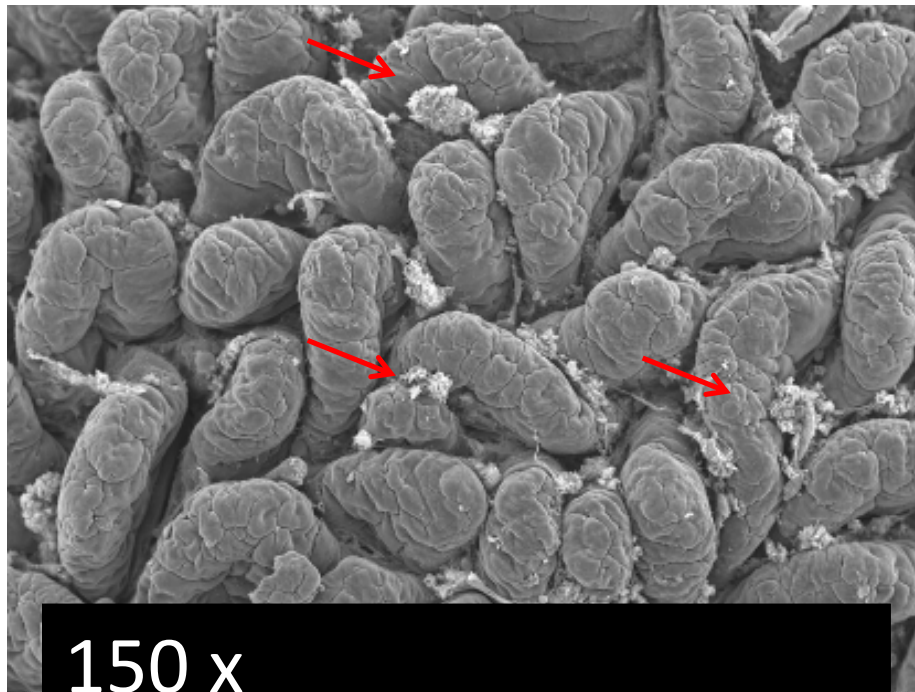
NSP-Enzymes and Symbiotic Cecal Microflora



Courtesy of Dr. Peter Ferket, NCSU

Dietary supplementation of Coated Butyric Acid Enhances Condition of Jejunum villi in Broilers at 3 days of age

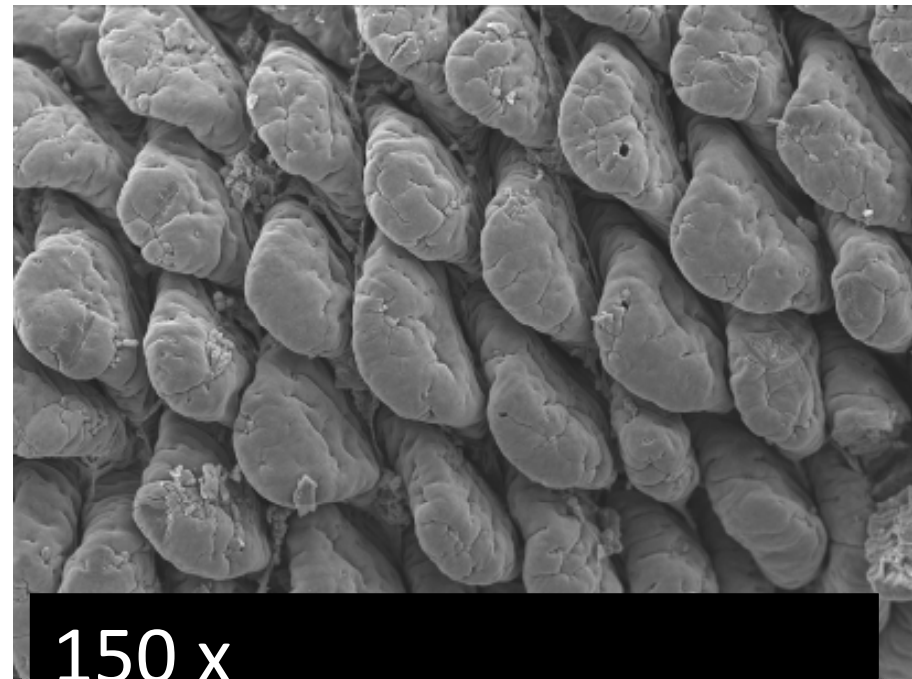
Control



150 x

Coated 30% Active Sodium Butyrate

0.06% Butyrate*



150 x

(Malheiros & Ferket, 2010)

Herbs, Spices, and Essential Oils



Thyme EO (3-60% Thymol and Carvacrol)

- Inhibits *E. coli* O157 & *Salmonella Typhimurium*



Cinnamon EO (60-75% Cinnamaldehyde)

- Inhibits *Clostridium perfringens*, *Bifidobacterium longum*, *Lactobacillus acidophilus*, *E. coli* O157 & *S. Typhimurium*.



Oregano (80% Carvacrol)

- Inhibits *Clostridium perfringens* & *Salmonella*



Conclusions

- Growth performance of broiler can be maximized without antibiotic supplementation or without additional hormone by
 - Precise feed formulation
 - Effective nutrition and feeding technology
 - Good feed manufacturing for better feed quality and safety
 - Suitable feeding program for all purposes of end product
 - Suitable strategies to improve gut health and immune status