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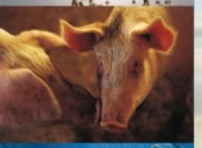


Feeding strategies

a prerequisite to animal health

March 13-14th 2019
XXIV FEED CONFERENCE
Brno

Predrag Persak DVM
Chairman of the FEFAC Animal Nutrition Committee

EFSA-EMA opinion on AMR (January 2017)

- **Primary prevention** reduces the introduction and spread of microorganisms between farms (biosecurity measures)
- **Secondary prevention** reduces the transmission or spread of microorganisms within a farm (farming practices)
- **Tertiary prevention** increases the ability of animals to cope with these pathogens (animal resilience to stressors)

EFSA-EMA opinion on AMR (January 2017)

- Recognition of Animal Nutrition as a key prevention tool of AMR

- Purpose is **to help animals cope with pathogens**
  - Importance of nutritional balance and management of diet transitions (especially piglets)
  - Use of highly digestible protein sources, with proper balance in amino acids
  - Feed additives such as organic acids or probiotics

FEFAC vision on Animal Nutrition

Animal Nutrition is now much more than just increasing animals' performance: it is also how to keep them healthy and feeling well and how to minimize their impact on the environment. It is also how to make them deliver the animal products that consumers want. In short, a compound feed is much more than the sum of its ingredients. Investing in research on Animal Nutrition is essential to help EU livestock farmers preserving the sustainability and resilience of animal husbandry.

A multifunctional science, delivering solutions to a sustainable livestock sector

TARGETS

- Resource efficiency
- Maintaining animals healthy for healthy food products
- Securing socially responsible livestock farming.

FeedStrategy challenge's survey 2018

NO ANTIBIOTICS **43** %

Greatest impact on their company's feed formulation program and, feed costs.

Eighty percent involved in antibiotic-free poultry production:
22 percent are 100 percent antibiotic free
24 percent 50 and 99 percent production is ABF
24 percent falls between less than 50 percent

Eighty percent of survey participants report having at least some degree of ABF production. Compared with 2017 figures, there was an 8 percent increase in respondents working in 100 percent ABF production.

Source: Watt Global Media – March 2018

Ban of AGP's in the EU
What did we learn?

01 January 1999
Tylosin, Spiramycin, Virginiamycin, Zinc-Bacitracin

01 January 2006
Avilamycin, Flavophospholipol, Salinomycin, Monensin

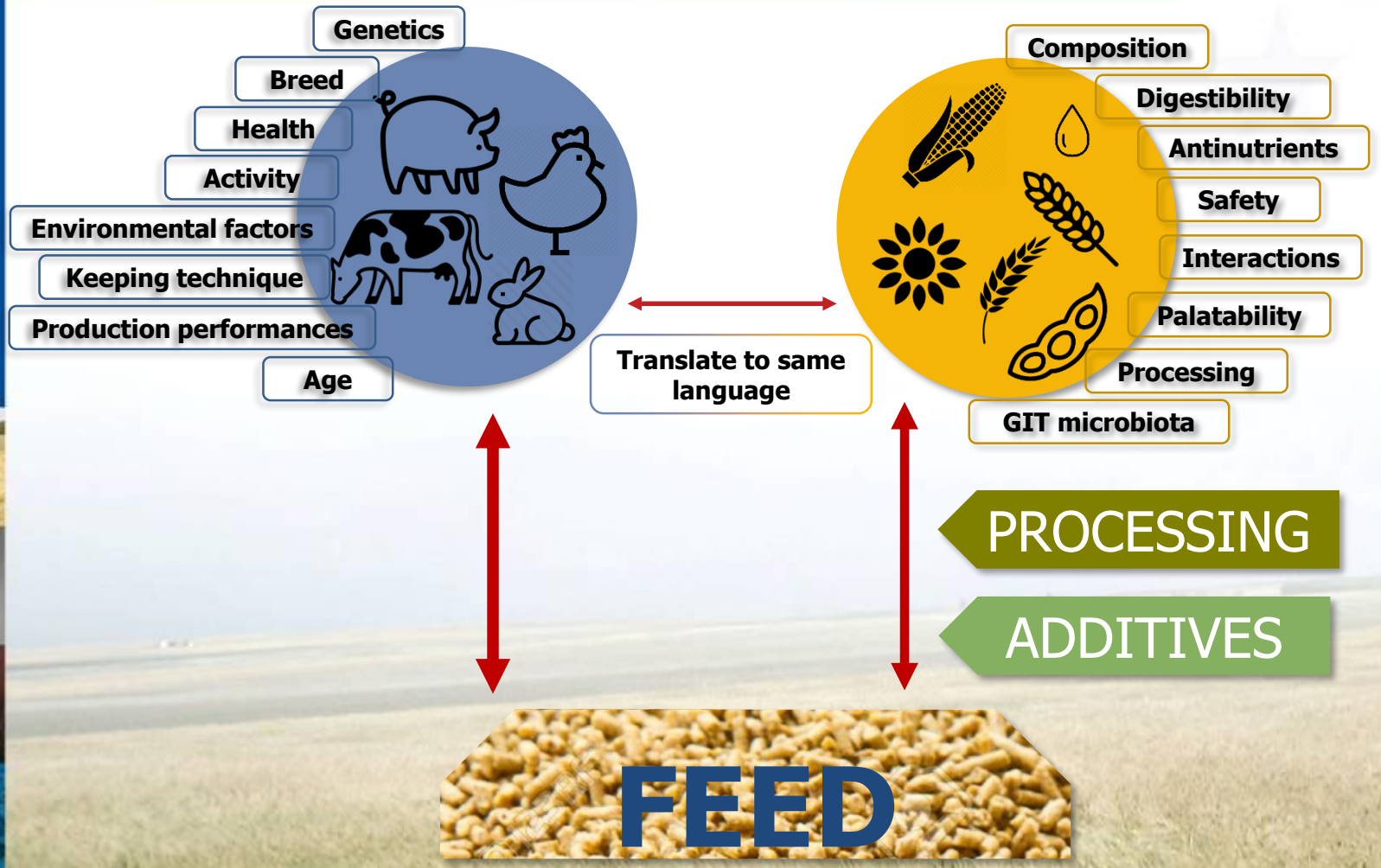
Only **38%** of Europeans is aware of the EU **ban** on the use of antibiotics to stimulate growth in farm animals.

Source: Special Eurobarometer 478 – Report Antimicrobial Resistance, September 2018

Challenge: how to support health in GIT and performance?

Solution: Bundle of different actions have to be considered.

Animal nutrition – dynamic science



Animal nutrition – dynamic science

Animal nutrition(ist) = orchestra conductor
How to harmonize the different elements into a harmonious and pleases to the ear piece of music which will result in a positive experience of the audience.

Auckland Symphony Orchestra – conductor Gary Daverne, 11/2012

Meaning of Animal Health

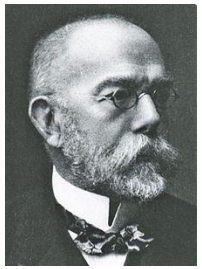
Animal Health is a concept in Agricultural Science that ensures farm animals are **healthy, free from diseases and well catered for**.

Animal health is very important because healthy animals make the world a better place.

Animals play significant roles in the lives of people and communities through being livestock for food production and pets for companionship.

In human medicine health is often associated with the "**absence of clinical diseases**".

This definition cannot be applied to farm animals since animal **performance can be impaired without any clinical signs of disease**.



Koch's Postulates

1) The specific organism should be shown to be present in all cases of animals suffering from a specific disease but should not be found in healthy animals.
2) The specific microorganism should be isolated from the diseased animal and grown in pure culture on artificial laboratory media.
3) This freshly isolated microorganism, when inoculated into a healthy laboratory animal, should cause the same disease seen in the original animal.
4) The microorganism should be reisolated in pure culture from the experimental infection.

Causes of diseases in animals

Disease (also known as sickness) is any process that interferes with the normal functioning of the body.

1. Parasites
2. Microbes (germs)
3. Viruses
4. Bacteria
5. Fungi
6. Protozoa
7. Poisoning
8. Dietary problems
9. Metabolic diseases
10. Congenital diseases
11. Environmental Condition
12. Cancer
13. Allergies
14. Degenerative disease

Health = Gut health

Gut health encompasses a number of **physiological** and **functional features** including **nutrient digestion** and **absorption**, **host metabolism** and **energy generation**, a stable and appropriate **microbiota/microbiome, defense mechanisms** including **barrier function** and **mucosal immune mechanisms**, and the **interactions** between these components.

Source: Kogut MH, Arsenault RJ. Editorial: Gut health: the new paradigm in food animal production. Front Vet Sci 2016; 3:71. doi: 10.3389/fvets.2016.00071

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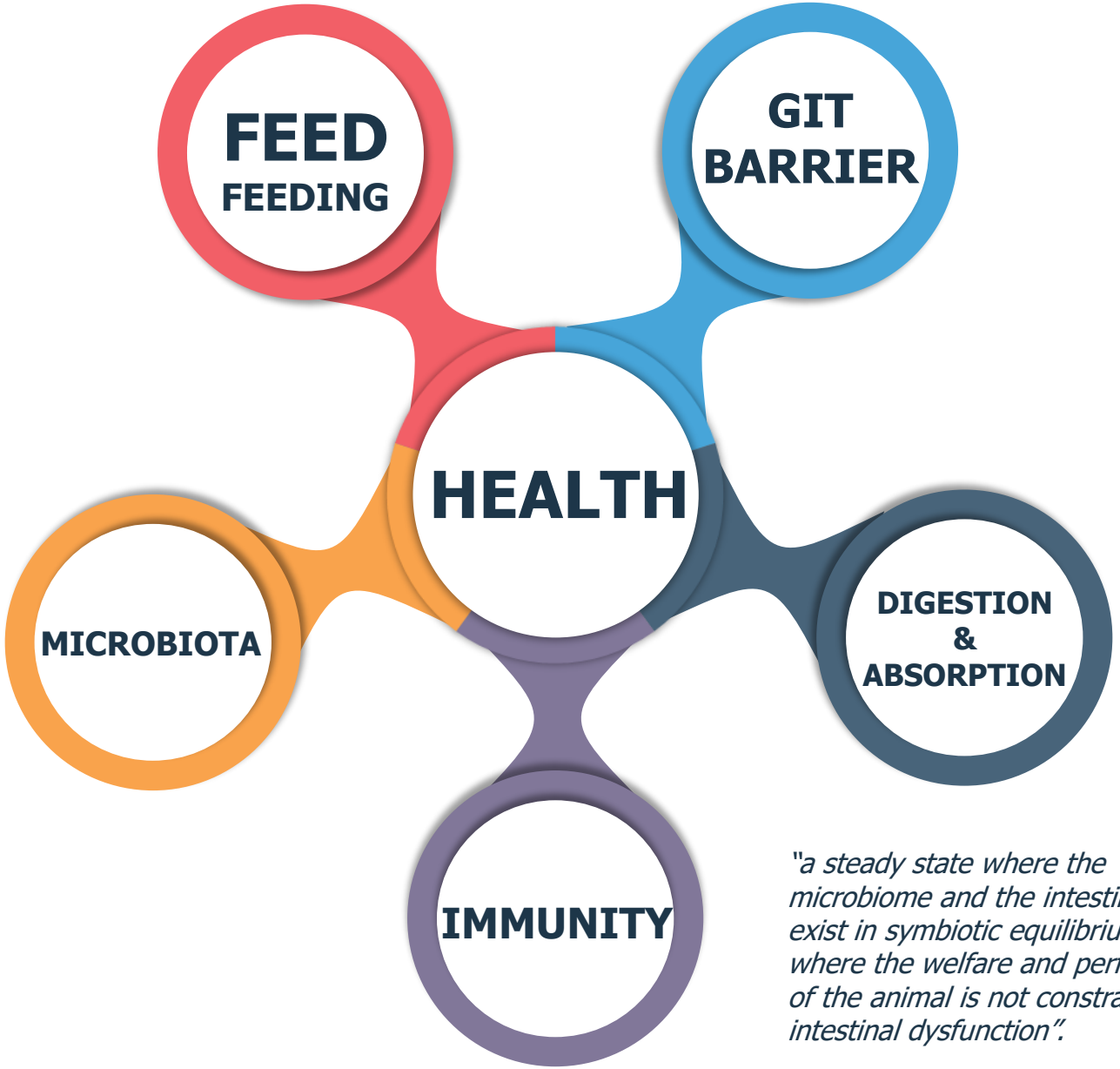


"a steady state where the microbiome and the intestinal tract exist in symbiotic equilibrium and where the welfare and performance of the animal is not constrained by intestinal dysfunction".

Feed composition

Feed ingredients, nutrients and additives influence:

- Development of the digestive system
- Functionality of digestive system
- Development and functionality of immune system
- Development of microbiome

Factors that negatively impact the Gut health:

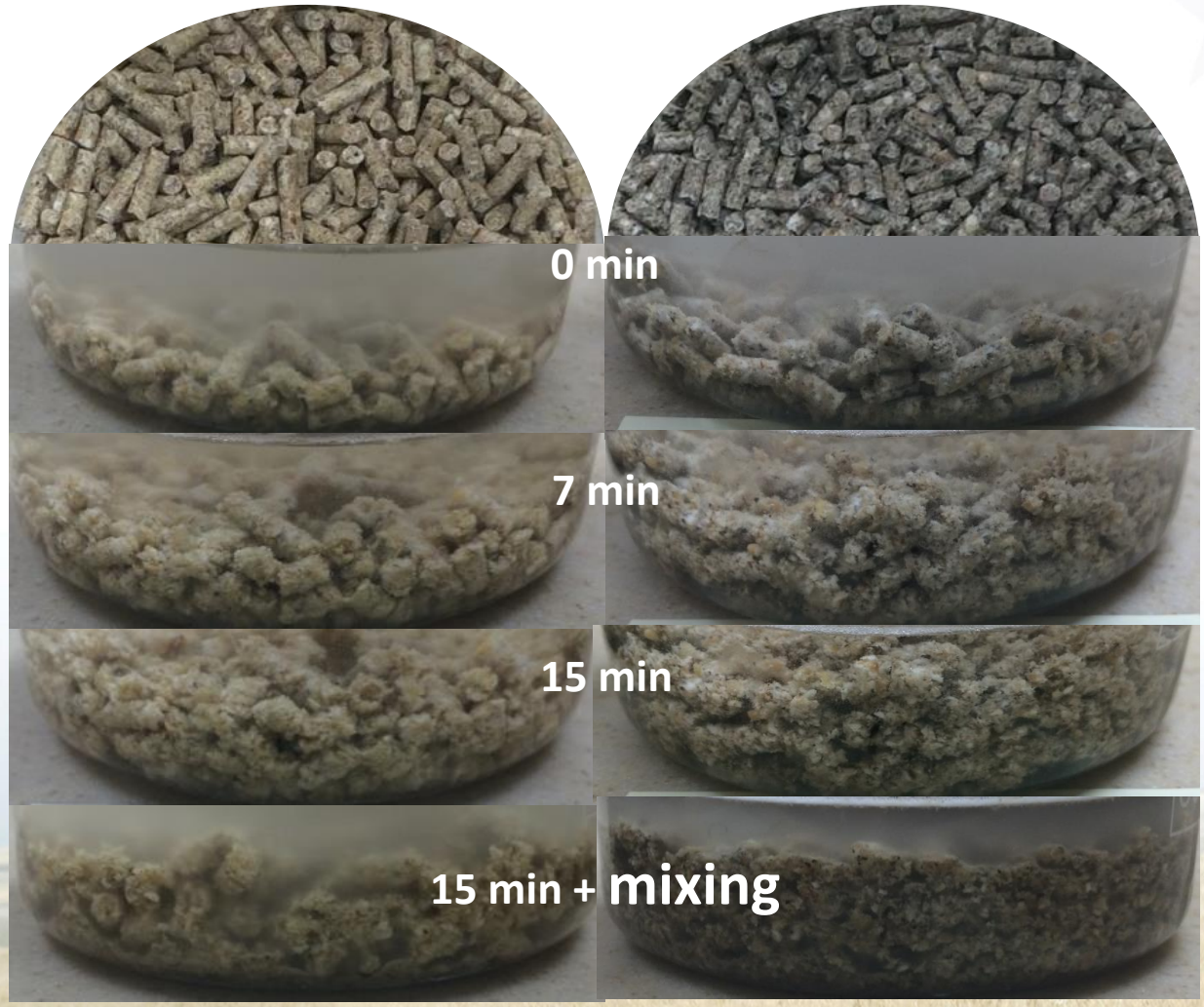
- Certain types of dietary fiber
- Trypsin inhibitor
- Phytate
- Lectins
- Undigested protein in the distal GI tract
- Mycotoxins
- Pathogenic and putrefactive microorganisms
- Diets with poor nutrient balance

Feed composition

Gut friendly diets are:

- reduced levels of fermentable protein in the hindgut,
- apropriate level of fermentable fibers in the hindgut,
- minimal buffering capacity,
- negligible content of anti-nutritional factors (phytate, arabinoxylans, beta-glucans, lectins, protease inhibitors, saponins, tannins)
- supply of beneficial compounds such as functional proteins and peptides (IgG, EGF, lactoferrin)

Feed composition



Quick and complete hydration important to digest protein

Corn, wheat, barley, soybean meal

Corn, wheat, barley, ProFiFerm

Source: FANON doo, 2015, Protokol 2015-15-10 Universuty BoKu, Wien, Austria

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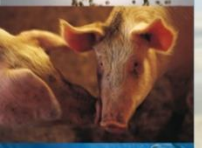


„Not all feed materials are created equal”

PERANT: ŽEGLO PISIĆ
JM ULAZA PILIĆA: 21.03.2016
JEKLO PILIĆA: MAĐARSKA
I KOMADA: 15390
JEKLO SMJESE: FANON-PETR

ATUM	DOB	UGINUĆE - kom	Potpis pri obilasku
22.03	1	8/kom trovp	
23.03	2	41	
24.03	3	28	
25.03	4	24	
26.03	5	18	
27.03	6	12	
28.03	7	11	
EDAN		Σ142 % 0,1	ϕ TEŽ 140gr
29.03	8	4	
30.03	9	3	
31.03	10	3	
01.04	11	4	
02.04	12	8	
03.04	13	6	
04.04	14	7	
EDAN		Σ35 %	ϕ TEŽ 380
05.04	15	9	
06.04	16	8	
07.04	17		

Wasser	**12,9 %**
Methode: VO (EG) 152/2009, III, A	
Rohasche	**5,4 %**
Methode: VO (EG) 152/2009, III, M	
Rohprotein (N x 6,25)	**41,2 %**
Methode: VO (EG) 152/2009, III, C	
Rohfett B (mit HCL)	**2,5 %**
Methode: VO (EG) 152/2009, III, H	
Rohfaser	**Wert wird nachgereich**
Methode: VO (EG) 152/2009, III, I	
Urease-Aktivität	**0,33 mg N/g·min**
Methode: VDLUFA Bd.III, Kap. 20.1	

Source: FANON doo, Gut Health lecture tour, India 2018, Predrag Persak DVM

Feed composition

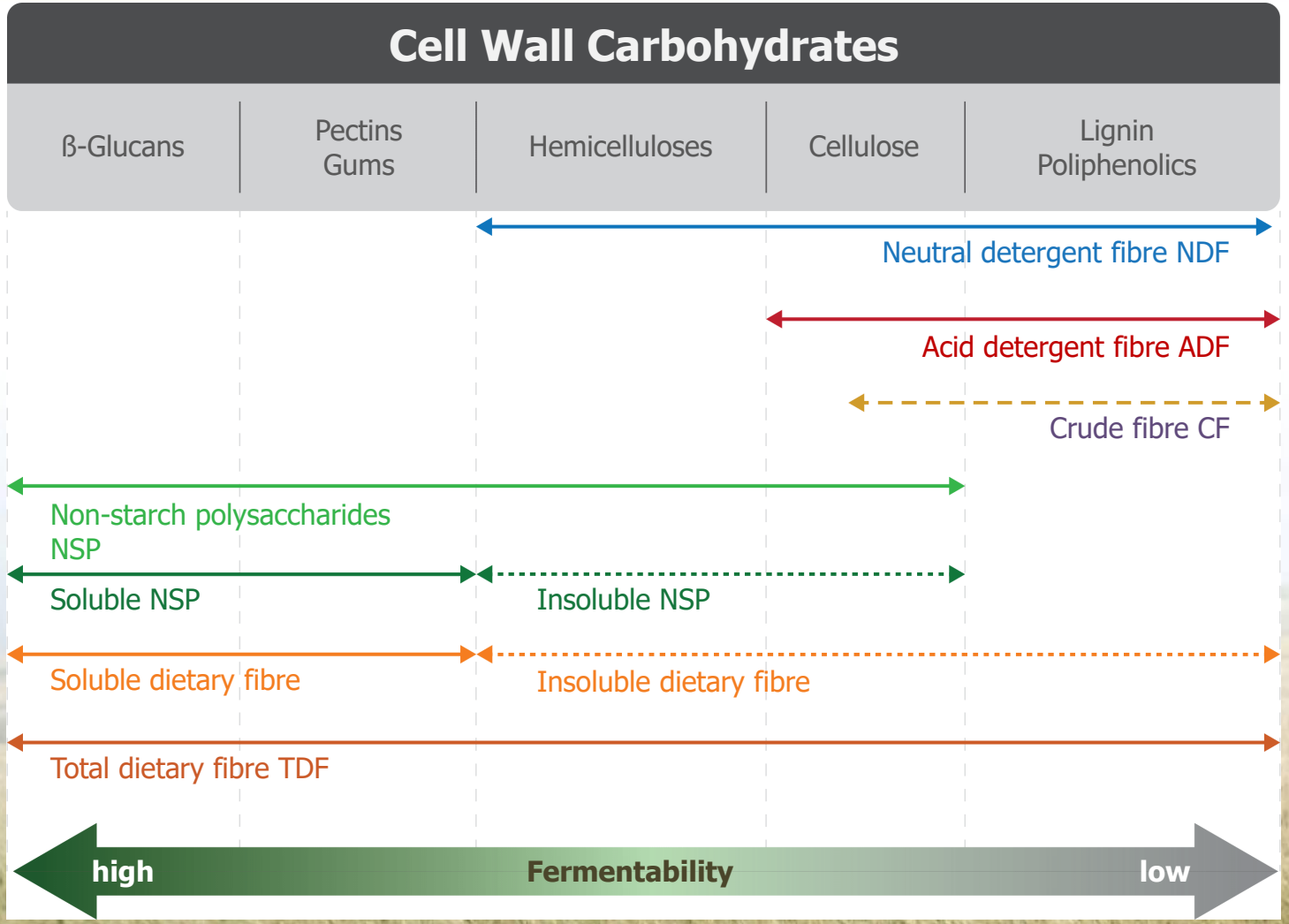
Dietary fiber comprises a group of heterogeneous fractions differing in chemical composition and physical properties
Not a well-defined chemical entity
Defined by the methods applied for its analysis.

As a consequence of its resistance to endogenous enzymes digestion in the small intestine, it is subject to bacterial fermentation in the large intestine. Hence DF is well known for its prebiotic effect. In addition to the known effect on the GIT microbiota, DF can also interact with host mucosa at all sites of the GIT, modulating the immune function

DF plays a crucial role in the complex interaction between the diet, endogenous enzyme and hence digestion and absorption, the host and the GIT microbiota, all of which are considered key components for optimal "gastrointestinal functionality"

Feed composition

Properties of soluble, insoluble and fermentable fibres



Source: Potthast (2018)

Feed composition

Properties of soluble, insoluble and fermentable fibres

Soluble fibre:

- Affinity for water to be dissolved for swell (gel-forming)
- Includes gums, pectins, mucilages, and some hemicelluloses
- Decreases the rate of stomach emptying, increase intestinal transit, binds bile acids, enhances intestinal viscosity, can partially be fermented in small intestine (pathogens can multiply)

Insoluble fibre:

- Not soluble in water – either inert or fermentable
- Composed mainly of lignin, cellulose, hemicelluloses
- Inert; fermentable: prebiotic

Source: Potthast (2018)

Fermentable fibre:

- Resistant to digestion and absorption in the small intestine
- Broken down partially or completely by bacteria in the large intestine
- Prebiotic

Non-fermentable fibre:

- Resistant to digestion and absorption in the small intestine
- Not been broken down by bacteria in the large intestine
- Supports peristalsis, increases faecal bulk

Feed structure

Table 1. Overview of the different dietary treatments tested throughout the different chapters, and how they affected digesta, excreta and litter characteristics

Diet	Chapter	Hypothesis	Jejunum viscosity	Digesta moisture		Colon Osmolality	Excreta, 14/15 d of age			Litter, 16 d of age		Excreta, 34/36 d of	
				Caeca	Colon		Moisture	A_w	Free water	Moisture	A_w	Moisture	Free water
Corn	1, 4	Good digestible, low NSP	=		=	=	↑	=	↑	↑	=	=	
Wheat	1, 4	Poor digestible, high NSP	↑		=	=	=	=	=	=	=	=	
Starch	1	Increase starch in hindgut										=	
Enzyme	1	Improved digestibility										=	
MCFA	1	Improved gut health										=	
$MgSO_4$	3, 4	Increase osmolality in hindgut	=	↑	↑	↑	↑ / =	=	↑ / =	=	=	↑	↑
MgO	3	Increase osmolality in hindgut		↑	↑		↑		↑			↑	↑
MgCl	3	Increase osmolality in hindgut		↑	↑		↑		↑			↑	↑
Coarse oat hulls	4	Improved digestibility	=		=		↓	=	=	↓	↓		
Fine oat hulls	4	Particle size fiber	=		↓		=	=	=	=	=		
Sepiolite	4	Water absorbent in hindgut	=		=		=	=	=	=	=		
Low viscous CMC	4	Low viscosity	=		=		↑	=	↑	=	=		
High viscous CMC	4	High viscosity, poor digestibility	↑		=		=	=	=	=	=		

= indicates no effect, ↑ indicates increased, ↓ indicates reduced.

BROILER EXCRETA COMPOSITION AND ITS EFFECT ON WET LITTER Aspects of nutrition, Evelin van der Hoeven – Hangoor, WIAS - 2014

Feed structure

1) Feeding broilers withot SBM meet performance
2) Positive influence – fermentable fibers
3) Locally sourced feed materials

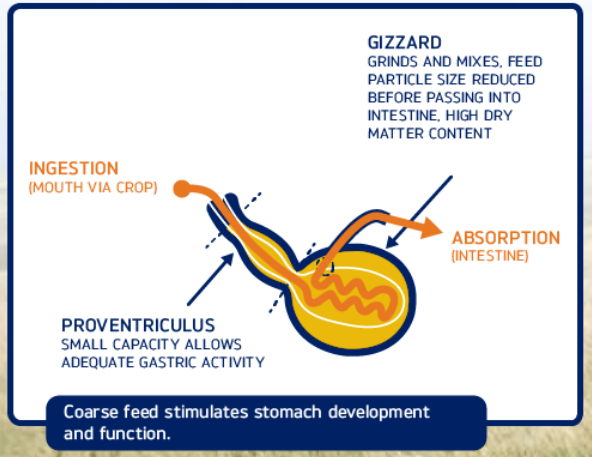
GROUP	1	2	3	4	5	6	7	8	9	10	11	12
SBM	++	+	+	+	+	+	-	-	-	+	-	+
PRODIGEST	-	+	+	+	+	+	++	++	++	+	++	+
FEATURE	POSITIVE CONTROL	OP	OP(u)	OF	OF(u)	P	OP	OF(u)	F(u)	P+E	F(u)+E	OP+E
ALW(42)	3,23	3,30	3,02	3,30	3,18	3,44	3,24	3,54	3,47	2,97	3,29	3,25
FCR(42)	1,49	1,48	1,50	1,51	1,51	1,43	1,58	1,49	1,52	1,56	1,52	1,53
MORTALITY	2	3		1		1		1	1	6	2	
pH(Caecum)	6,5	6,0	6,2	5,8	5,9	6	6,5	6,4	6,4	6,4	6,1	6,5
Crude fiber (1)	1,7	3,4	3,4	3,7	3,7	3,4	8,4	8,1	9,9	3,4	9,9	3,4
Crude fiber (3)	1,9	4,1	4,1	4,6	4,6	4,1	6,5	7,3	7,3	4,1	7,3	4,1

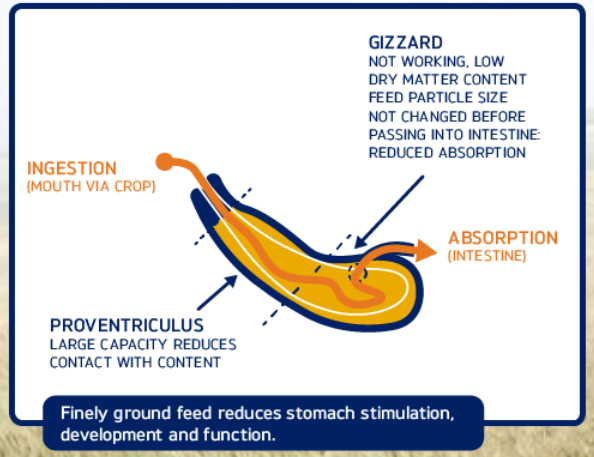
Source: FANON, Faculty of Agronomy, Persak & Grbesa; Zagreb, Croatia 2013

Particle size

- Large particles – retention time, gizzard development
- Small particles – rapid passage, gut health issues
- Pellet vs mash
- Coarse vs fine

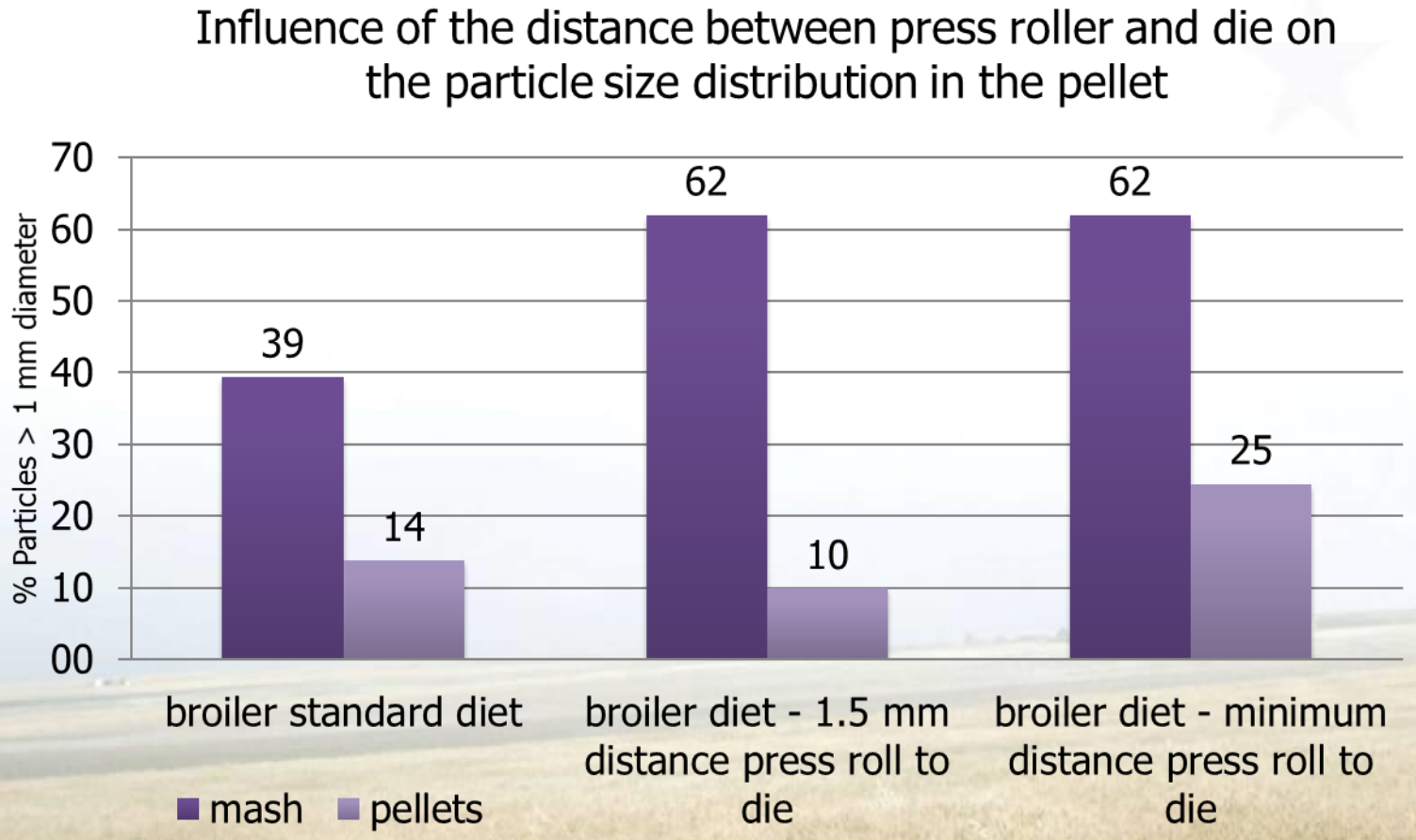
The muscle gizzard and its functionality are crucial for nutrient absorption, FVW and intestinal health.





Source: Van Desant (2011): The NutriOpt System

Particle size



Source: KLEINE KLAUSING, H. (2011): Aspects of feed structure and technological treatment of grain on intestinal health
IFF Feed Processing Conference at Victam International 2011 Cologne - 03 May 2011

Feed Form

EFFECTS OF PHYSICAL FORM OF DIET ON DUODENAL HISTOLOGY OF BROILERS

Patrícia Barbosa Lacerda[1], Alessandra Reigada Eliezer Gomes de Azevedo[2], Alexandre Lemos de Barros Moreira Filho[1], Patrícia Emília Naves Givisiez[3], José Humberto Vilar[4], Fernando Guilherme Perazzo Costa[3]

Table 1. Villus height (µm), crypt depth (µm) and villus:crypt ratio (µm/µm) of 42-day-old broilers fed mash, pelleted or expanded-pelleted diets. Each value is the mean and standard deviation of 60 readings.

Variable	Treatment			
	Mash	Pelleted	Expanded-pelleted	CV%
Villus height (µm)	947.1 ± 90.2 c	1046.5 ± 99.6 a	994.4 ± 94.7 b	9.52
Crypt depth (µm)	76.5 ± 8.5 a	77.8 ± 8.6 a	78.7 ± 8.7 a	11.07
Villus:crypt ratio (µm/µm)	12.5 ± 1.7 b	13.6 ± 1.8 a	12.8 ± 1.7 b	13.35

CONCLUSION

Pelleted and expanded-pelleted diets improved duodenum histology parameters in broilers at 42 days of age.

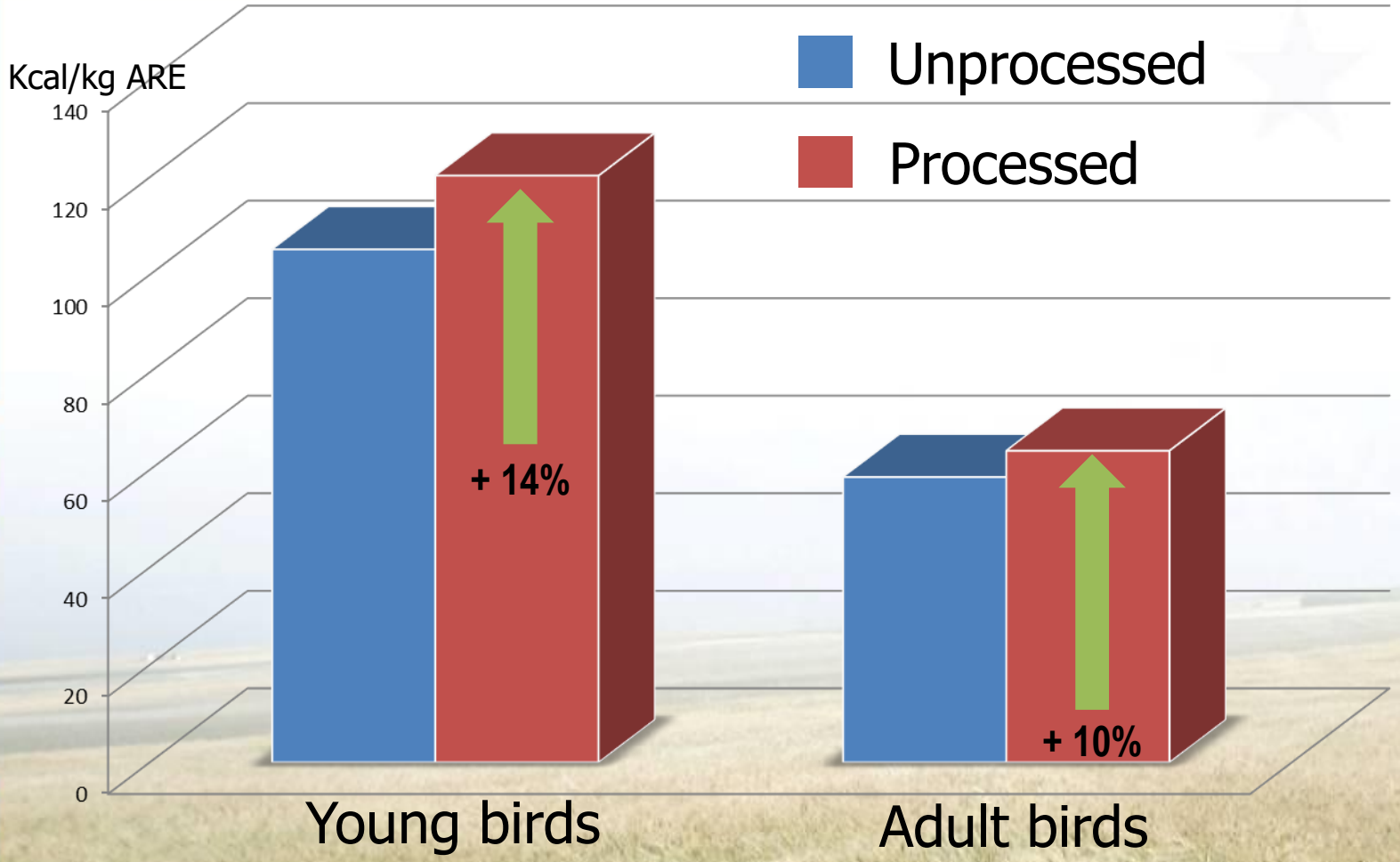
Evaluation of the effects of processing technologies on digestion of NSP is hampered by the potential shift of polysaccharides recovered in the fiber fractions of common, gravimetric, fiber analysis methods such as CF, NDF, or ADF.

Mechanical modification – up to **6 or 7** percentage units

Dry thermal processes – **minor impact** on physicochemical properties of feedstuffs.

Hydrothermal processes – **4 to 16** percentage units.

Digestion / Absorption



Source: FANON/Agrimex, Predrag Persak DVM, Belfeed B 1100 MP 0,01% 2016.

Microbiota

Early colonization !!!

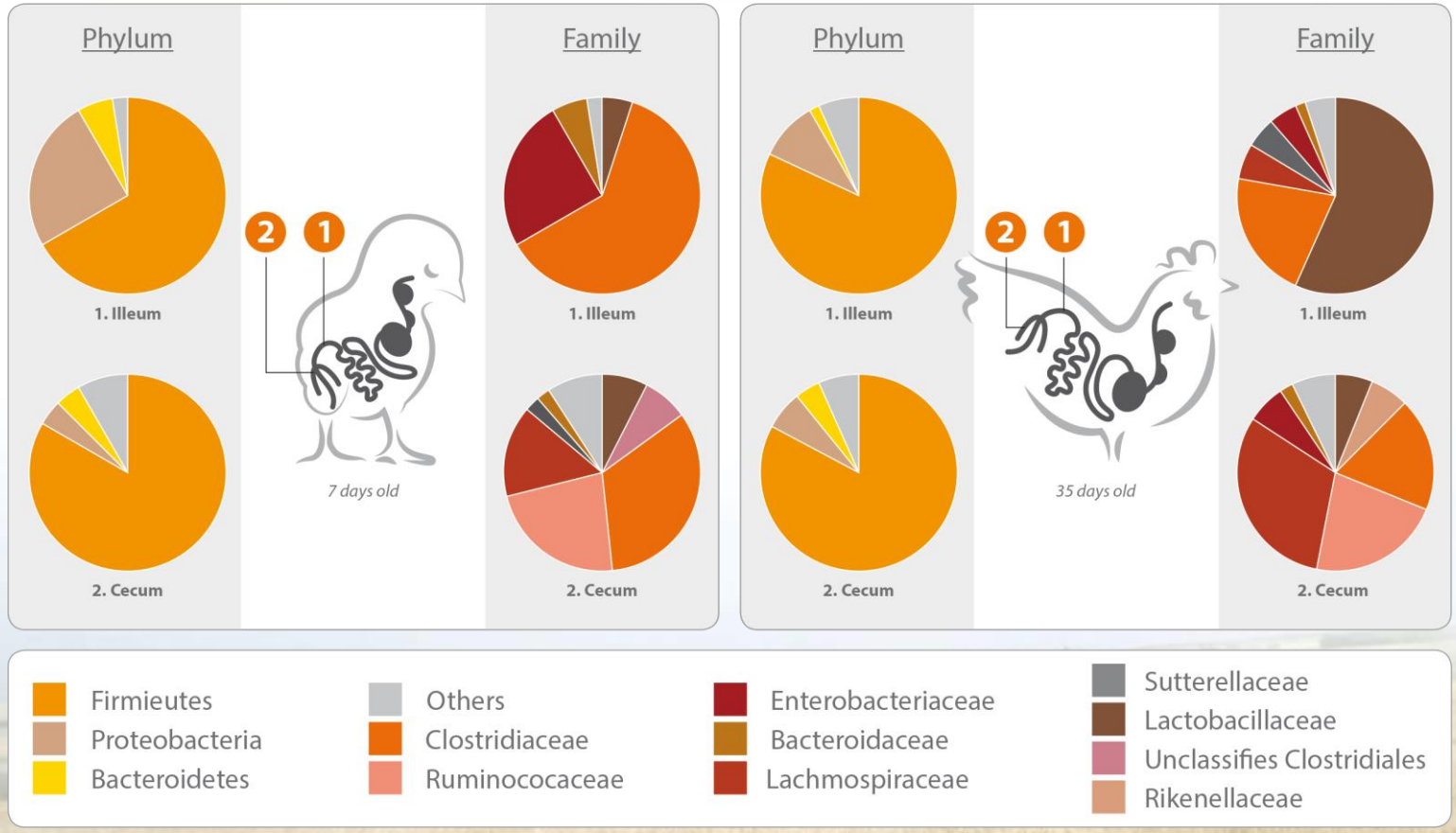
Factors that influence GIT microbiota …

- Feeding practices
- Imbalanced diet (excess of protein, starch or fructose)
- Stress (thermal, transport, regrouping, overcrowding)
- Poor management
- Poor hygiene conditions

While high microbiota diversity has been linked to higher resilience in adult animals, low diversity has been associated with gut health problems.

Lower microbiota diversity in young animals seems to be beneficial for developing towards an adult status.

Gut microbiota



Source: Vortrag R. Bailey, Aviagen (2017) Aviagen Vet School India

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IMMUNITY

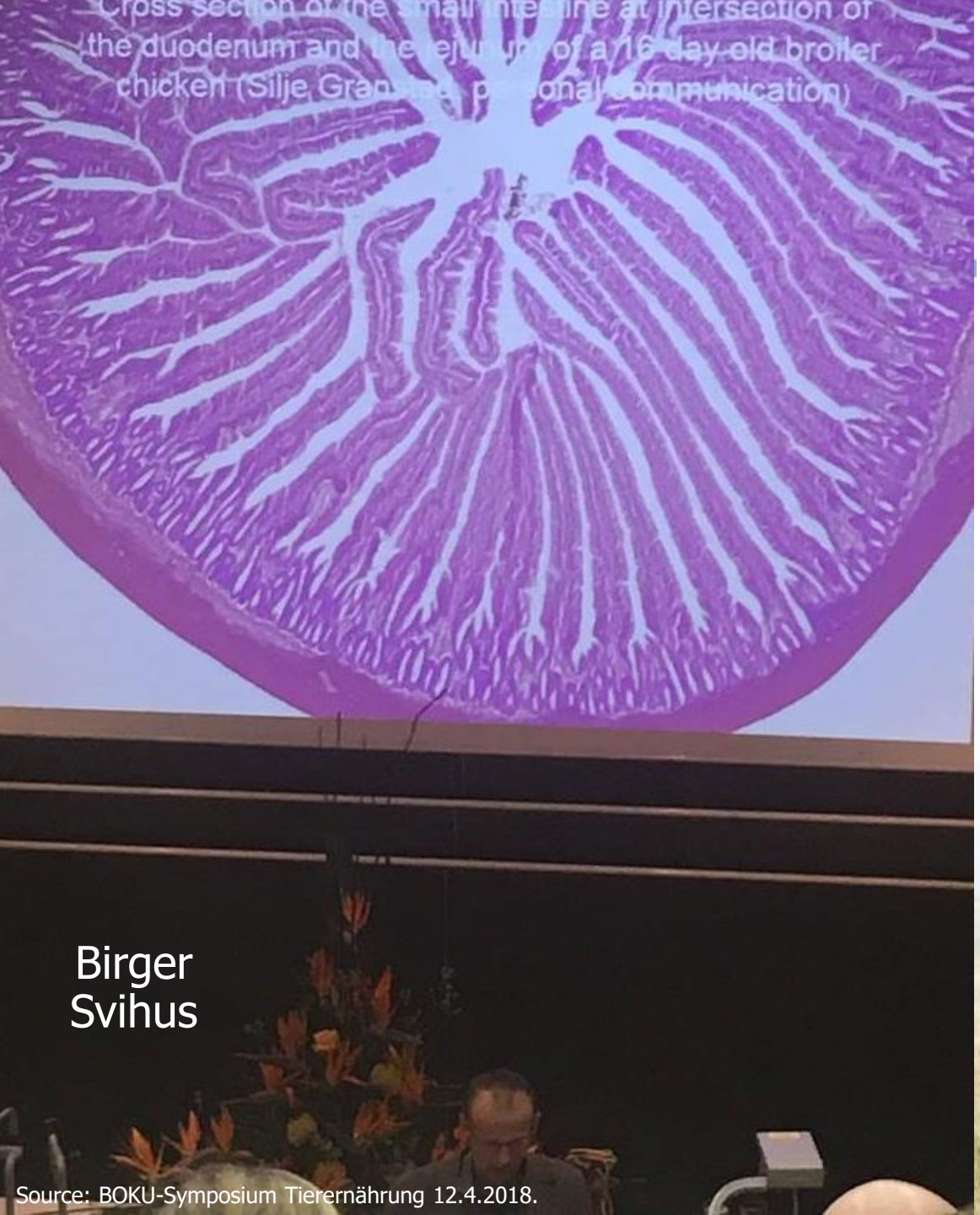
Animal and microbiota form a 'superorganism' and immune system is not a killer, but a force that shapes homeostasis in the superorganism.

Dietary protein important nutritional factor for maintaining immune homeostasis in the GIT.
Proteins and protein hydrolysates, originating from the digestion of various digestive enzymes, or from microbial fermentation, are absorbed by the intestinal epithelial cells and influence the GIT immune competence and immune homeostasis.

Feed can modify the GIT microbiota composition and metabolism modulating the production of antimicrobial peptides that can interfere with the growth and the adhesion of pathogens.

Feed have local and systemic effect on the immune function by:

- local activation of immune cells
- promoting the migration of immune cells in blood



Barrier

Enzymatic digestion

Absorption

United Microbiota

Transport (passage)

Y - Immune

Source: BOKU-Symposium Tierernährung 12.4.2018.

Key points

- **There is no one single, stand alone, effective solution which can replace ATB use in animal production.**
  - **Multidisciplinary approach** - everyone have to make additional efforts.
  - With proper animal nutrition, the right ingredients, processing and feeding programs we can have a weapon to ensure animals with **maximized natural resistance against pathogens**.
  - Feed solutions only make sense in farms with **good hygiene management**.

S… you can be proud of !

Thank you very much!