PREBIOTICS, PROBIOTICS AND SYNBIOTICS AS FUNCTIONAL FOODS FOR DOGS

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“Let Food be Your Medicine”

Hippocrates

The Philosophy behind is:

“Prevention is better than cure”

Preface

- Food and nutrition science has moved from identifying and correcting nutritional deficiencies to designing foods that promote optimal health and reduce risk of disease
- Functional food: the term has been coined based on the observation that selected foods might promote health
- Aims at maximizing physiological as well as the psychological functions through nutrition

Functional foods Concept

- Any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains (IOM/FNB), may provide demonstratable physiological benefits or reduce the risk of chronic diseases

- Foods in which one or more ingredients

1. conc. have been manipulated or modified

   e.g. protein hydrolysates in infant formulas

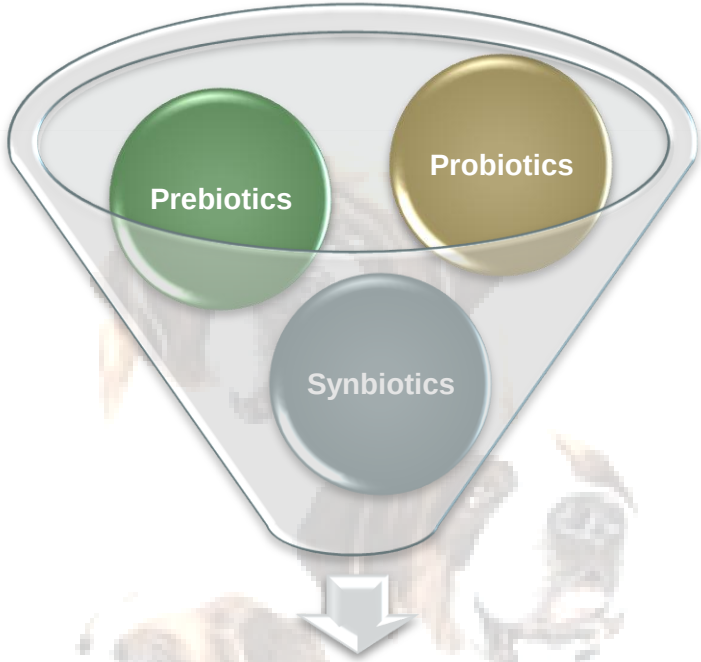
2. have been added or removed

   e.g. addition of selected probiotic bacteria to improve gut health

3. bioavailability has been increased

   e.g. yeast-mineral chelates to increase bioavailability of minerals

4. any combination of the above possibilities



Functional food for dogs

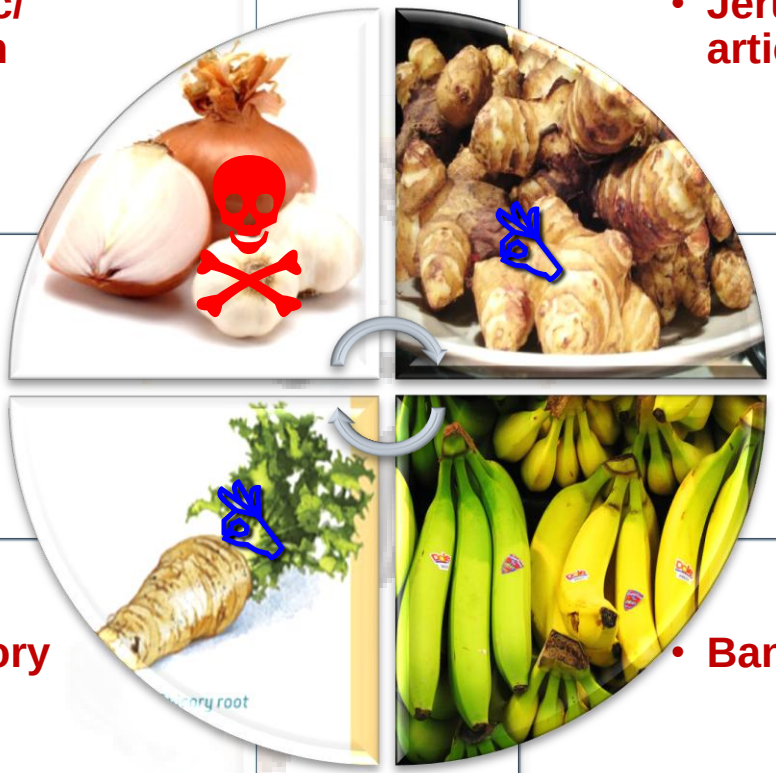
Prebiotics ?

- A prebiotic is a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon thus improving host health
- Prebiotics concept revisited (Gibson *et al.* 2004)

  A prebiotic is a selectively fermented ingredient that allows specific changes, both in the composition and/ or activity in the gastrointestinal microflora that confers benefits upon host wellbeing and health

Sources of prebiotics

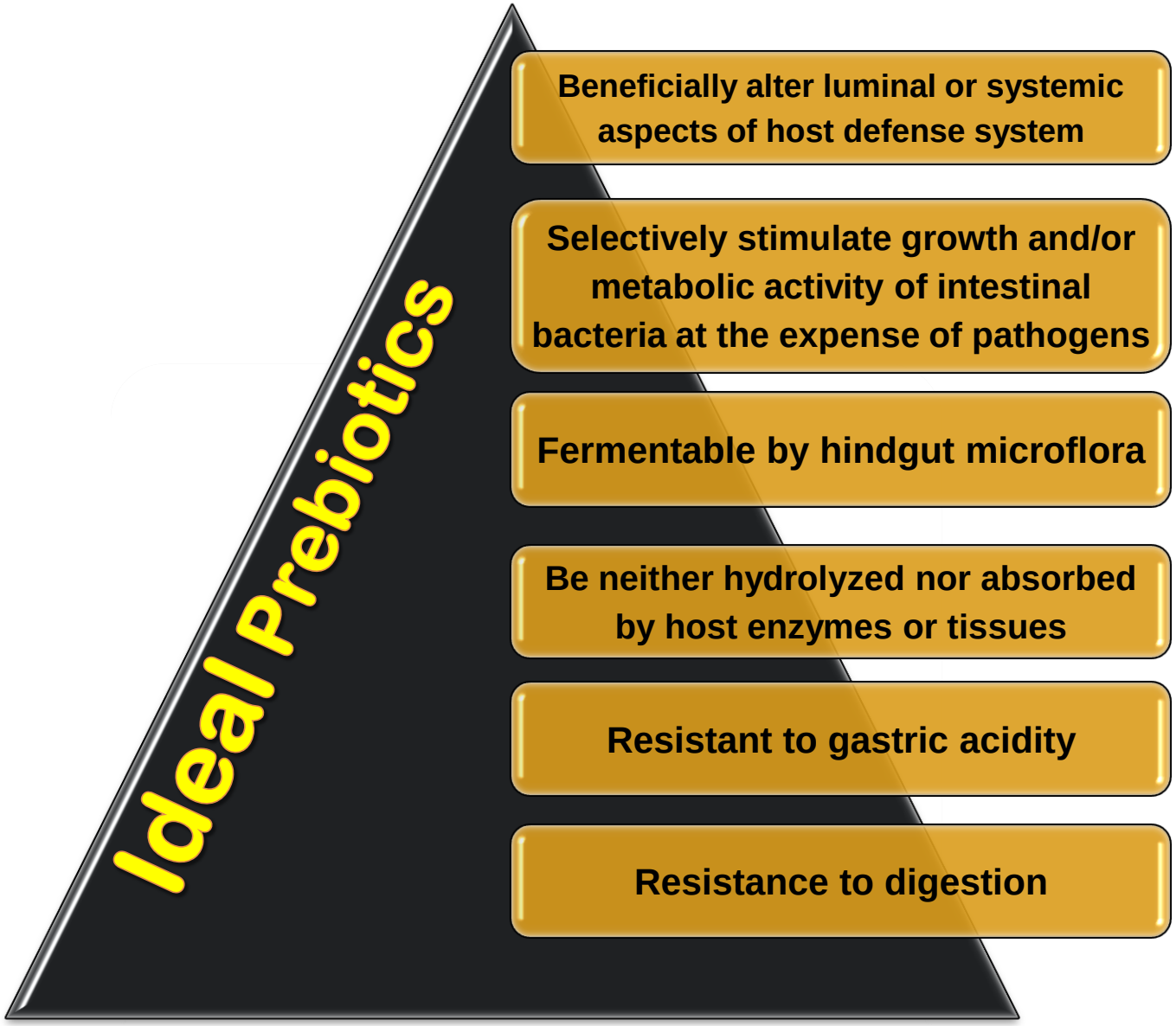
- Garlic/ onion
- Jerusalem artichoke



- Chicory
- Banana

Some of the Prebiotics

- Inulin
- Oligofructose
- Mannanoligisaccharide (MOS)
- Fructans/fructoloigosaccharide (FOS)
- Galacto-oligisaccharides (GOS)
- Lactulose
- Xylo-oligosachharides


Ideal Prebiotics
Beneficially alter luminal or systemic aspects of host defense system
Selectively stimulate growth and/or metabolic activity of intestinal bacteria at the expense of pathogens
Fermentable by hindgut microflora
Be neither hydrolyzed nor absorbed by host enzymes or tissues
Resistant to gastric acidity
Resistance to digestion

Probiotics ?

- According to Joint FAO/WHO Working Group

  "Live microorganism which when administered in adequate amounts confer health benefit to the host"

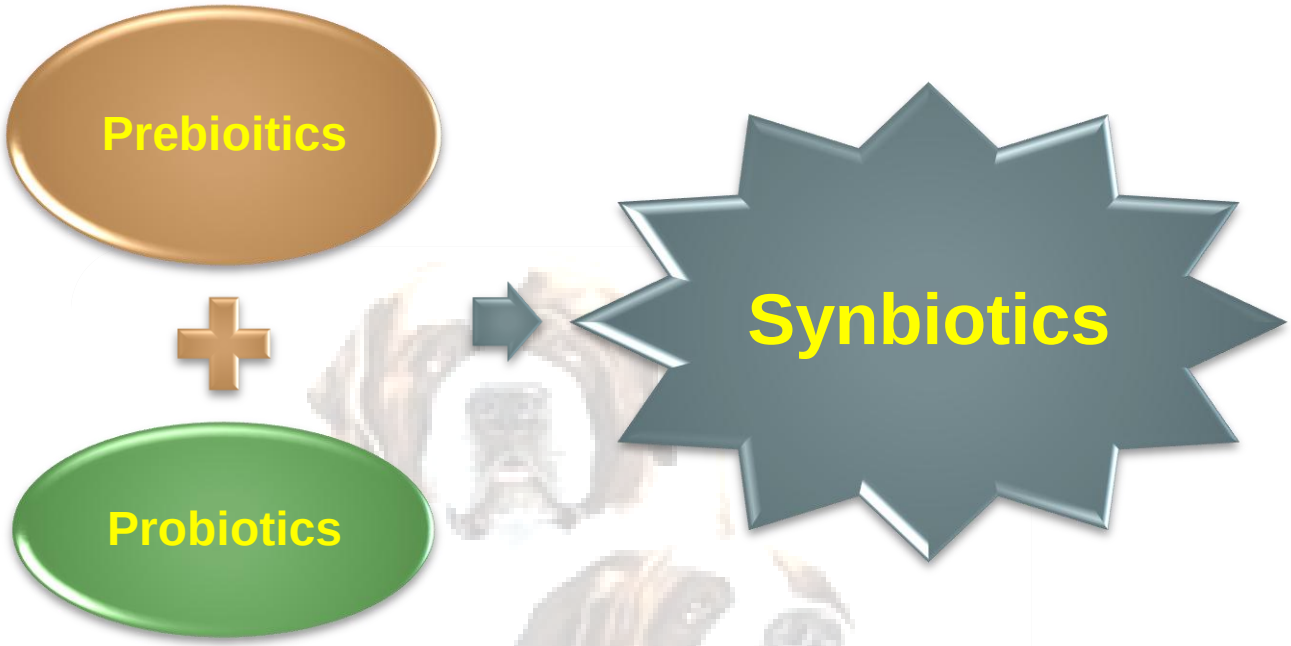
- A preparation or product containing viable, defined micro-organisms in sufficient numbers, which alter the microflora of intestine and by that exert beneficial health effects on the host

What is Ideal ?

Microbial species used as probiotics

Species	Strain
Lactobacilli	***L. acidophilus***, *L. casei*, ***L. rhamnosus***, *L. reuteri*, *L. plantarum*, ***L. faecium***, *L. johnsoni LA1*, *L. brevis*. *L.delbrueckii subp. Bulgaricus*, ***L. fermentum***, *L. helveticus*, *L. cellobiosus*, *L. curvatus*
Bifidobacteria	*B. longum*, *B. bifidum*, *B. breve*, *B. infantis*, *B. animalis*, *B. adolescentis*, *B. thermophilum*
Gram-positive cocci	*Lactococcus lactis*, ***Enterococcus faecium***, *Streptococcus theromophilus*
Yeast	*Saccharomyces cerevisiae*, *Saccharomyces boulardii*
Fungi	*Aspergillus orizae*, *Scytalidium acidophilum*

Synbiotics ?



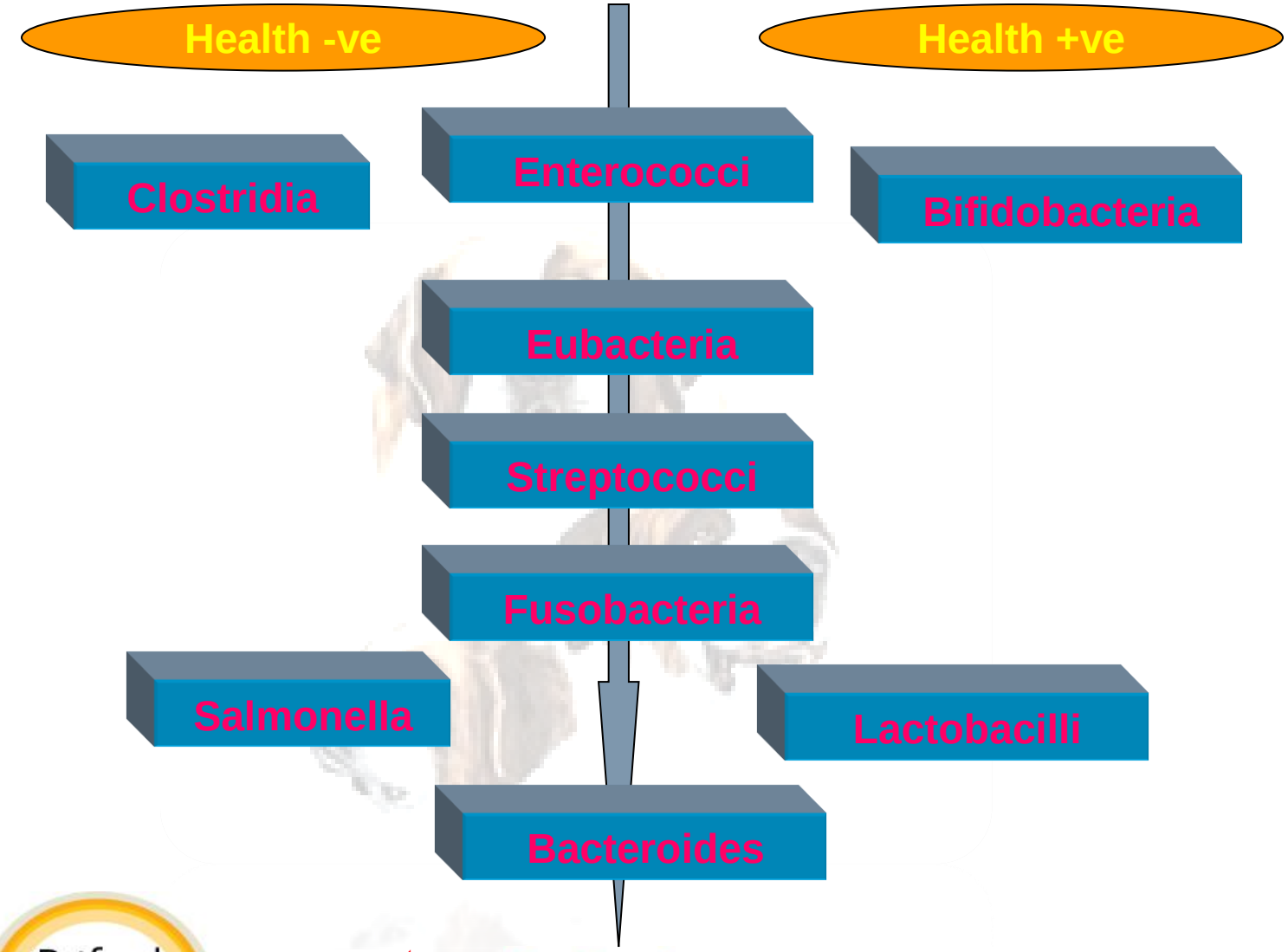
- **With the development of proven health benefits of prebioitics and probiotics, the recent advances in pet/companion animal nutrition targeting towards exploring their potential combinations as synbiotics for nutritional health**

Synbiotics

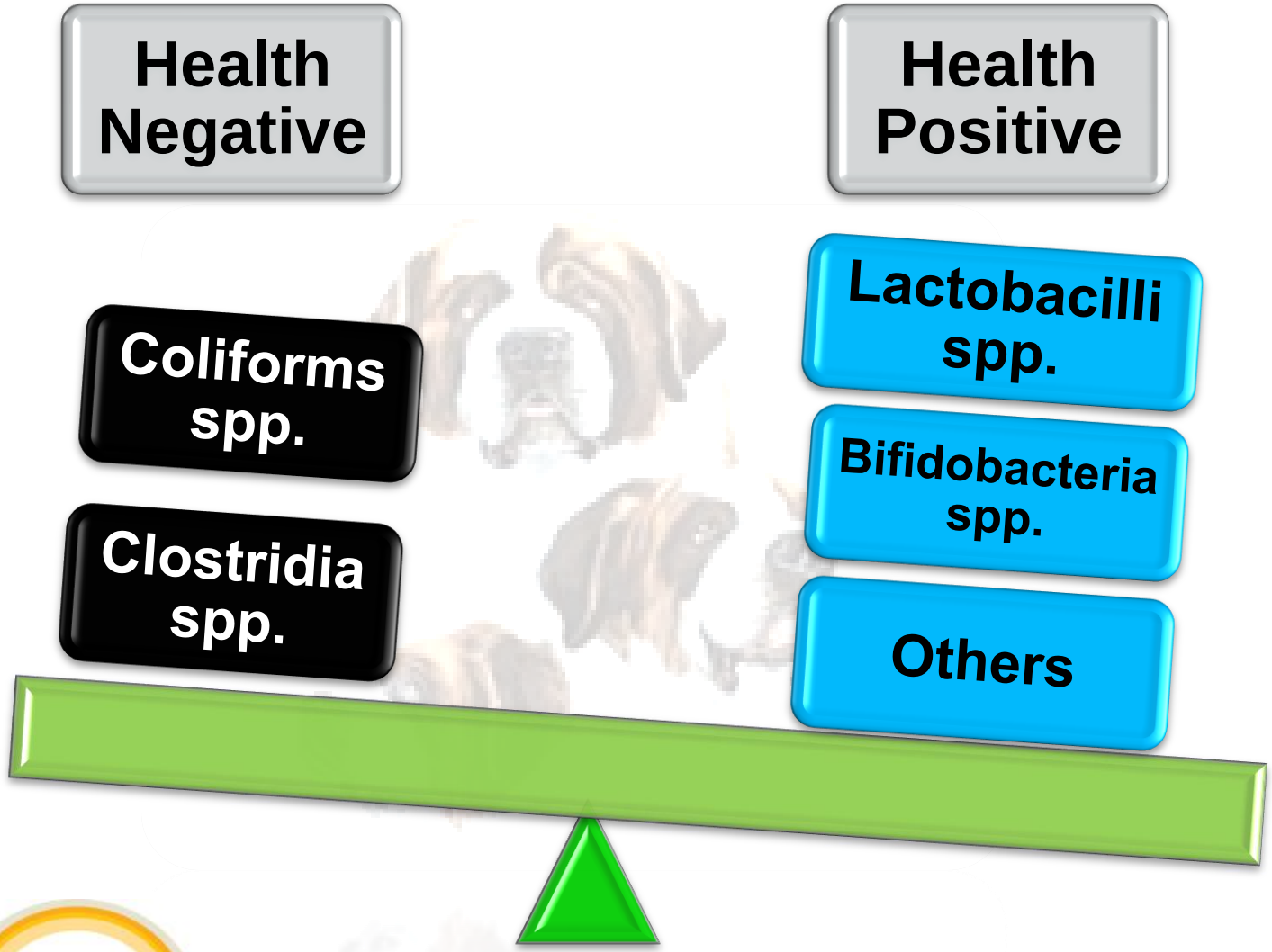
- A mixture of a Pre- and probiotics that helps to improve survival and implantation of live microbes in the GI tract by selectively stimulating the growth and/or activating the metabolism of one or a limited number of health-promoting bacteria

- Some of the synbiotic are
  - Bifidobacteria + FOS
  - Lactobacillus + FOS
  - Lactobacillus + Inulins
  - Bifidobacteria + Inulins

Overview of canine hindgut microflora



What is desired ?



Our Study

INDIAN VETERINARY RESEARCH INSTITUTE

By:
Kore K.B. , Pattanaik, A.K.
& Sharma, K.

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✓Objective

- To study the effect of prebiotics, probiotics and synbiotics as functional foods on nutrient utilization, hindgut health and faecal flora in Labrador dogs

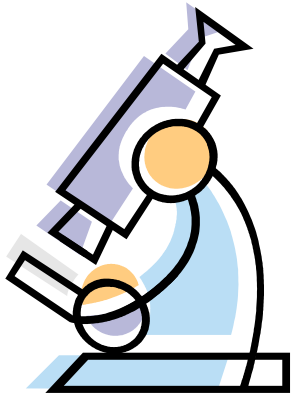
Experimental design

- The study was carried out at the Clinical and Pet Nutrition Laboratory, Centre of Faculty Training in Animal Nutrition, Indian Veterinary Research Institute, India
- Sixteen Labrador dogs divided into four groups in completely randomized design (CRD)
- Experimental period: 11 weeks
- Dietary treatments:
  - CON – Experimental diet without PRE &/ PRO
  - PRE: 1.0% of chicory (*Chichorium intybus*) inulin on DM basis
  - PRO: 5% of diet DM, providing 1×10^9 of *L. acidophilus* NCDC 15
  - SYN: PRE+PRO

Feeding & Experiment Protocol

- The experimental diet was fed twice a day to meet the nutrient requirements of the dogs (NRC, 2006)
- A four-days digestion trial was conducted after 45 days of feeding trial
- Hindgut health attributes were studied after digestion trial
- Faecal microbial population was enumerated at the end of experimental period

Observations



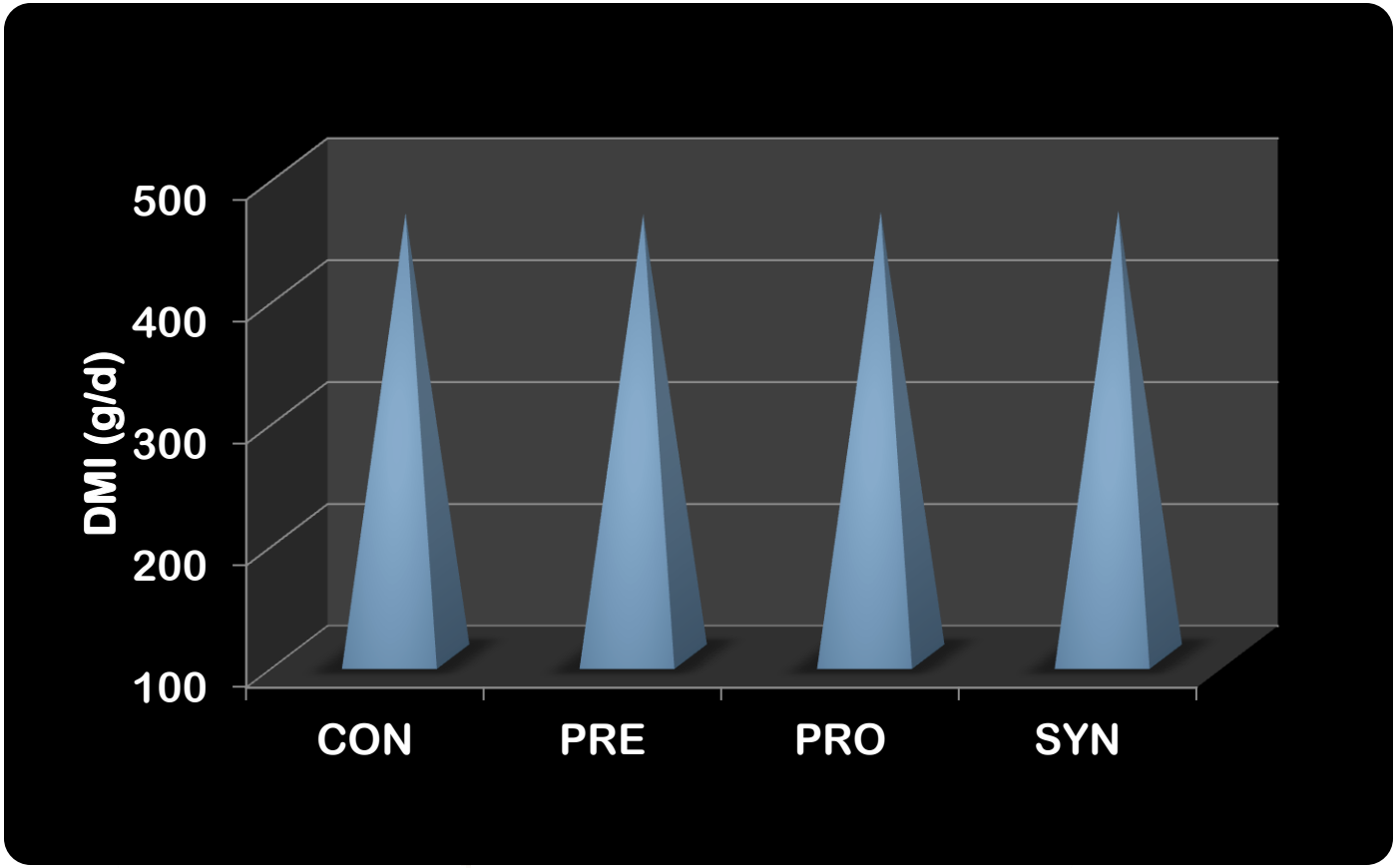
- ✓ Changes in live weight
- ✓ Palatability and food intake
- ✓ Digestibility of nutrients
- ✓ Hindgut health characteristics:
  - ✓ Physical: faecal score, DM, frequency of defecation
  - ✓ Chemical: pH, ammonia, lactic acid, short chain fatty acids
  - ✓ Microbial: Lactobacillus, Coliform, Bifidobacteria, Clostridia

Results

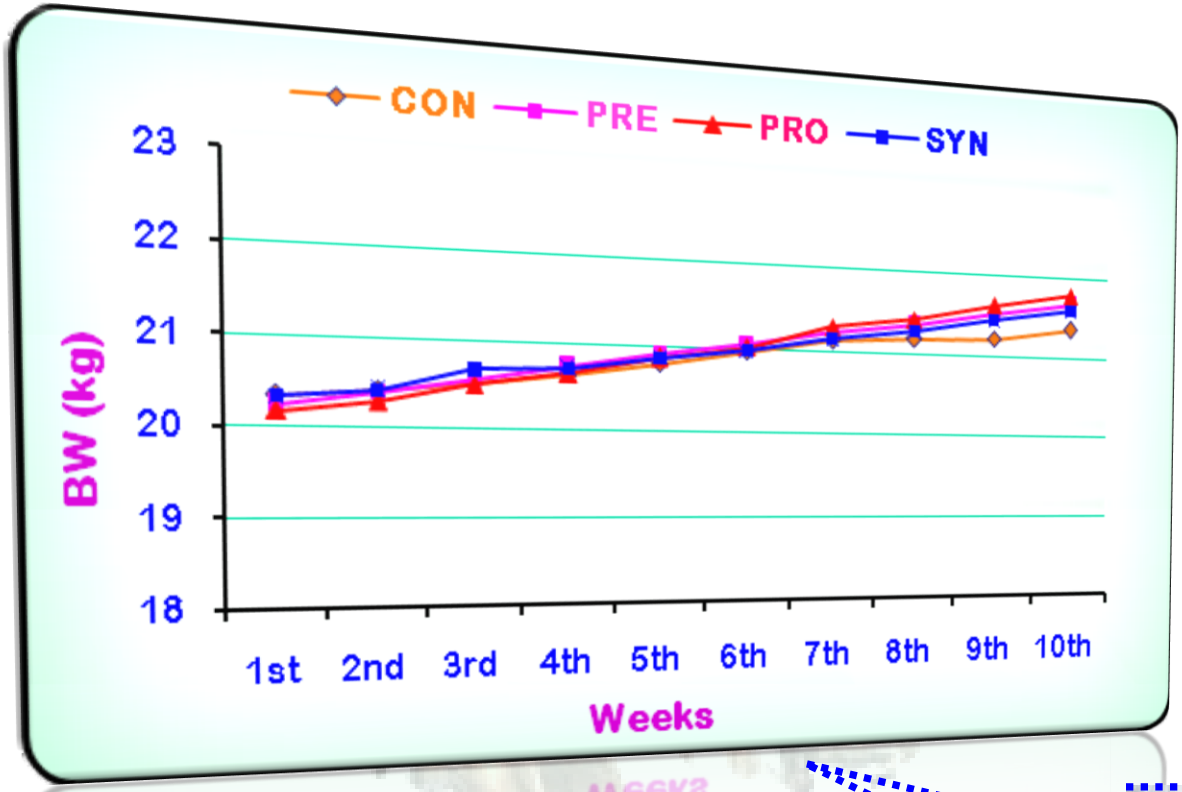
Chemical composition of the diet

Nutrient/component	Quantity
Dry matter	95.99
Crude Protein	22.66
Ether extract	4.94
Crude fibre	3.97
Nitrogen free extract	61.50
Total carbohydrate	65.47
Total ash	6.93
Calcium	1.24
Phosphorous	1.11

Dry Matter Intake of the Dogs



Body weight changes of dogs



.....Result

Digestibility of nutrients in dogs

Attribute	Dietary groups				SEM	P value
	CON	PRE	PRO	SYN		
DM	79.16^{ab}	78.13^{a}	80.45^{b}	80.08^{b}	0.523	*
CP	77.31^{a}	76.08^{a}	77.65^{a}	80.44^{b}	0.538	**
EE	87.85^{a}	89.72^{a}	92.67^{b}	92.97^{b}	0.792	**
CF	28.80^{a}	32.62^{ab}	35.60^{b}	37.37^{b}	1.529	*
NFE	85.24	84.13	86.39	84.57	0.888	NS
Ca	48.10^{a}	54.31^{b}	52.55^{b}	60.18^{c}	1.223	***
P	52.23	52.80	53.45	54.96	1.378	NS

^{abc}*Means bearing different superscripts in a row differ significantly*

Hindgut health (Physical) indices of dogs

.....Results

Attribute	Dietary groups				SEM	P value
	CON	PRE	PRO	SYN		
Faecal score†	2.75[a]	3.08[b]	2.75[a]	2.79[a]	0.071	*
Freq. of defecat.	4.00	4.25	3.84	4.59	0.368	NS
Faeces voided (g/d)						
As is	509.1[a]	559.6[b]	516.3[a]	533.9[a]	7.929	**
DM (%)	19.72[b]	18.58[ab]	18.63[ab]	17.97[a]	0.370	*
Faees g/100g DMI						
Dry faeces	20.84[ab]	21.87[b]	19.55[a]	19.93[ab]	0.660	NS
Wet faeces	105.7[a]	117.8[c]	105.8[a]	111.4[b]	1.544	***

[abc]*Means bearing different superscripts in a row differ significantly*

Hindgut health (Chemical) indices of dogs

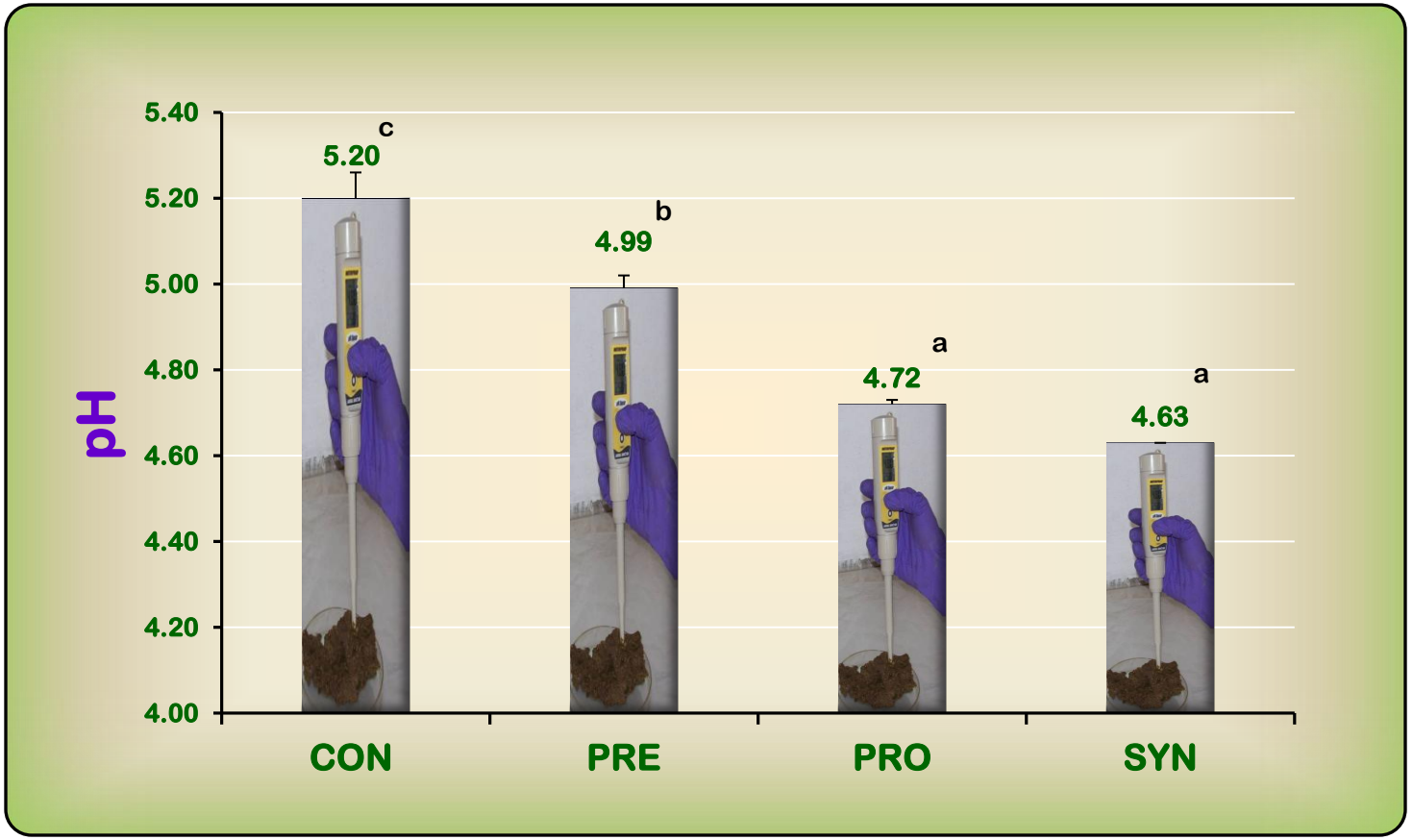
.....Results

Attribute	Dietary groups				SEM	P value
	CON	PRE	PRO	SYN		
pH	5.20^{c}	4.99^{b}	4.72^{a}	4.63^{a}	0.035	***
Ammonia µmol /g dry fcs	31.34^{b}	27.54^{ab}	26.46^{a}	23.98^{a}	1.235	**
Lactate µmol /g dry fcs	27.84^{a}	36.16^{b}	50.52^{c}	61.28^{d}	2.466	***
Microbial population (log_{10} cfu/g)						
Coliform	7.01^{c}	6.36^{b}	5.81^{a}	5.61^{a}	0.134	***
Clostridia	9.46^{c}	9.13^{bc}	8.82^{b}	8.38^{a}	0.133	**
Lactobacillus	8.17^{a}	8.80^{b}	9.09^{bc}	9.48^{c}	0.172	**
Bifidobacteria	9.24^{a}	9.78^{b}	9.90^{b}	10.12^{b}	0.109	**

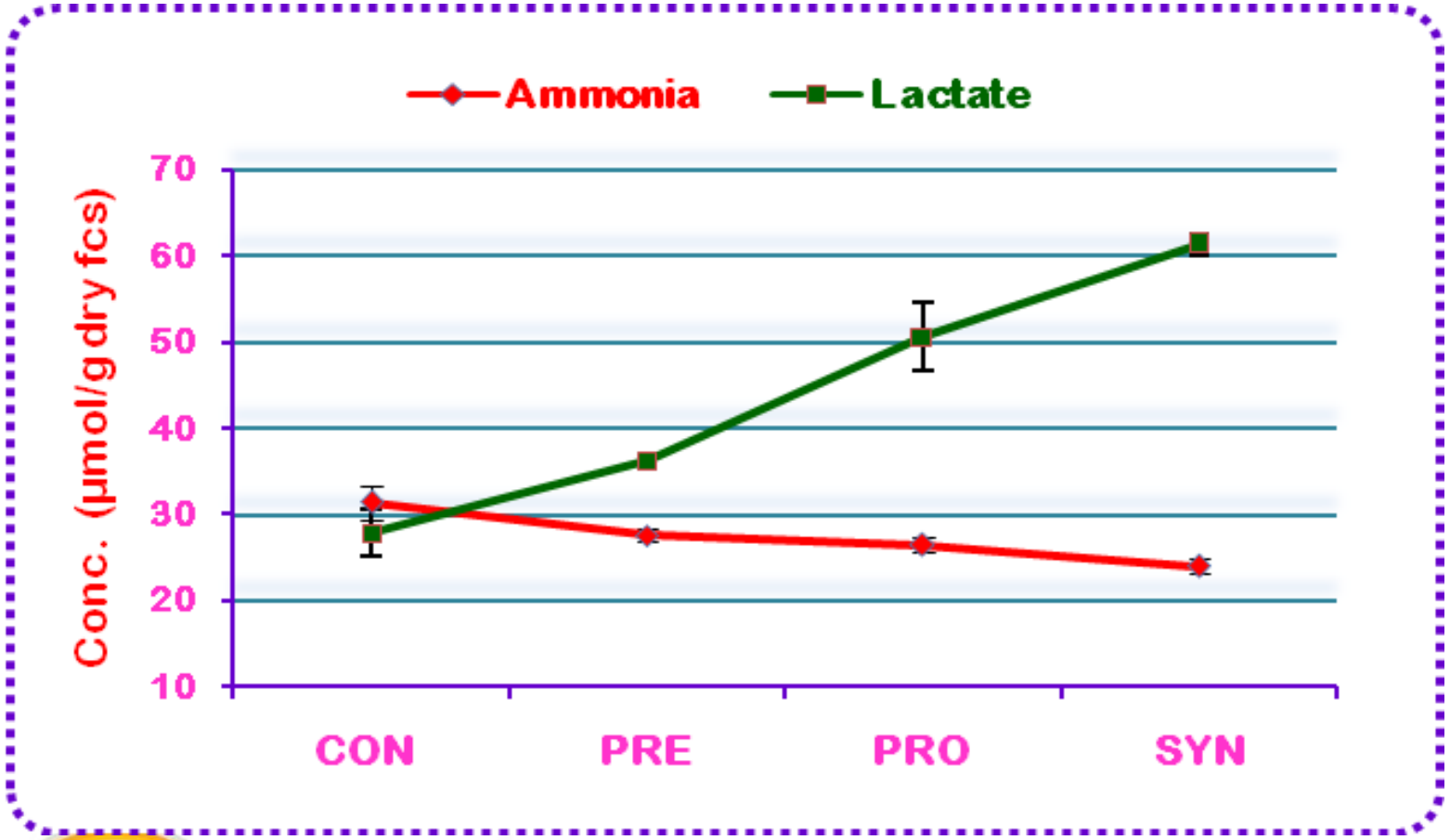
^{abc}***Means bearing different superscripts in a row differ significantly***

Functional foods for Dogs

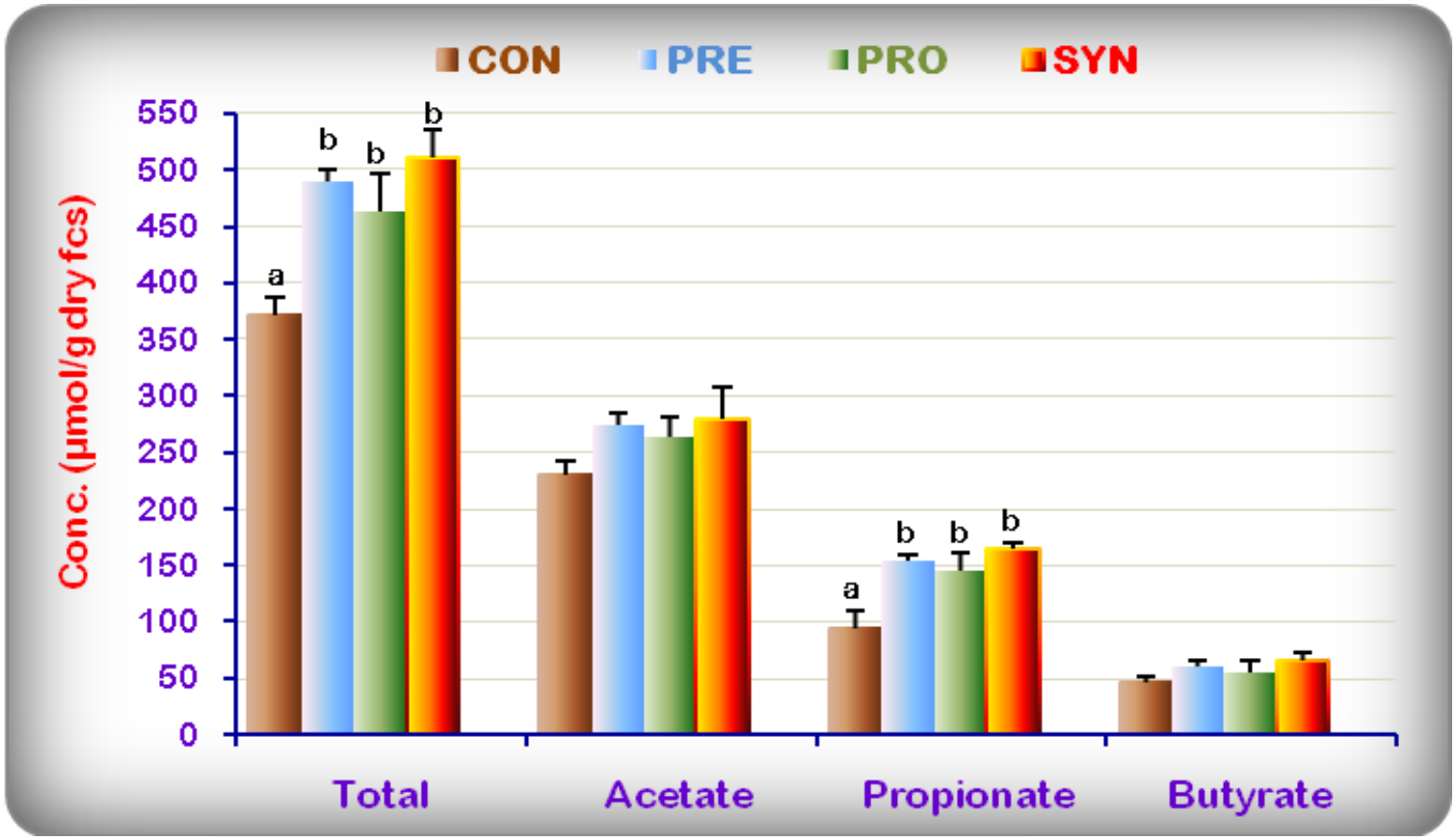
Comparative faecal pH of dogs



Comparative faecal ammonia and lactate concentration of dogs

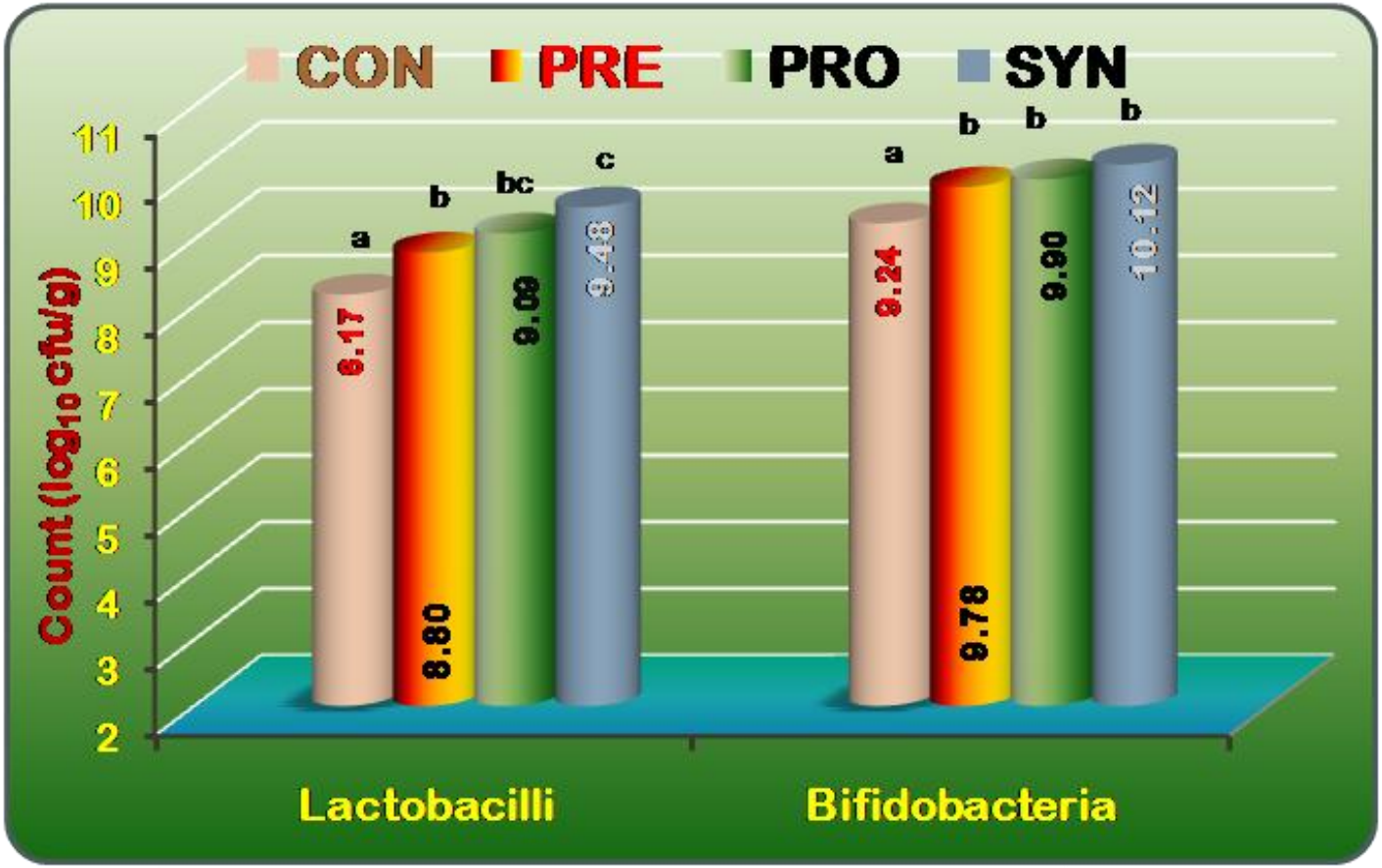


Comparative faecal SCFAs concentration of dogs



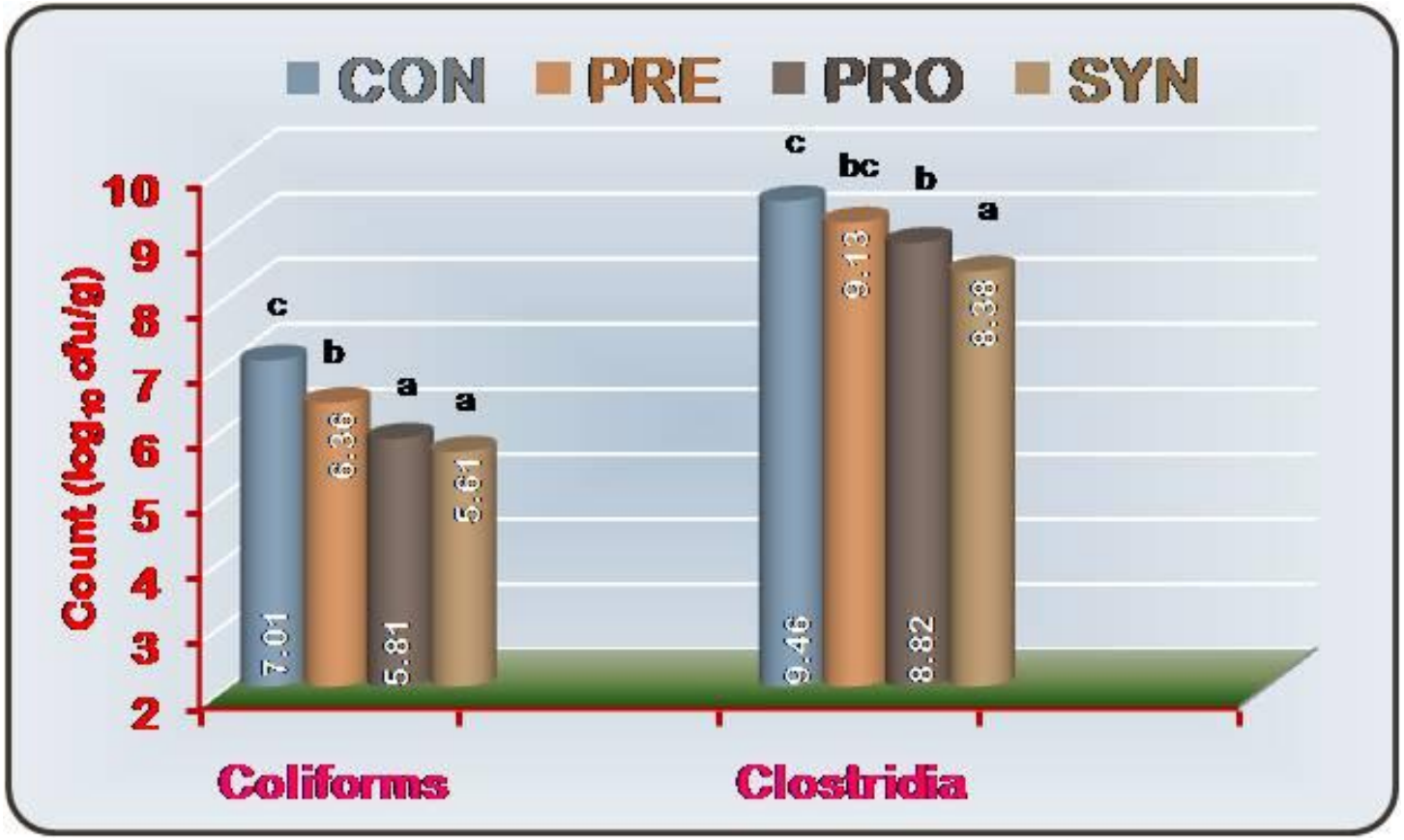
Functional foods for Dogs

Comparative faecal Lactobacilli and Bifidobacteria (health positive bacteria) count



Functional foods for Dogs

Comparative faecal Coliform and Clostridia (health negative bacteria) count



Conclusion

- **Prebiotics (Chicory inulin):** positively modified hindgut health indices and intestinal microflora
- **Probiotics (*Lactobacillus acidophilus*):** stimulating influence on nutrient utilization, hindgut health attributes and intestinal microbial balance
- **Synbiotics:** a healthier alternative, than their exclusive use individually, from all aspects of the functional properties typically ascribed to prebiotics and/or probiotics
- **The results should be carefully interpreted as animals age, health, diet type, environmental conditions etc. will influence the effect of dietary supplements**

Future research

- Future research endeavor should target to search for alternate sources of prebiotics, probiotics (and synbiotics) sourced from phytochemical (or natural) origin would add to the gamut of already existing and upcoming resources especially in terms of enhanced functional properties
- Product development: issues of viability/stability

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Thank Q

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