Functional foods for Dogs

PREBIOTICS, PROBIOTICS AND SYNBIOTICS AS FUNCTIONAL FOODS FOR DOGS

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Outline

- Preface
- Functional food concept
- Prebiotics
- Probiotics
- Synbiotics
- Our study
- Future research

Preface

The term "*Functional Foods*" was first introduced in Japan in the mid-1980s

'Japan explores the boundary between food and medicine'

a news in 'Nature' in 1993

'physiological functional food' (Swinbanks & O'Brien, 1993)

- **Food and nutrition science has moved from identifying and correcting nutritional deficiencies (improving life expectancy) to designing foods that promote optimal health and reduce risk of disease (improving life quality/wellness)**

Functional food: the term has been coined based on the observation: selected foods might promote health

In past food was means to get rid of hunger

"Let your food be your first medicine"
'Hippocrates'

In Present foods are used to reduce the risk of disease besides nutritional need

This is recently being integrated into human and animal nutrition in the face of increased global demands for a more "natural" food

Functional food: Concept

- Aims at maximizing physiological as well as the psychological functions through nutrition

- The term “functional food” in use today conveys health benefits that extend far beyond mere survival

- A food can be regarded as functional, if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body beyond the traditional nutrients in a way that is relevant to either improved stage of health and well being and/or reduction of risk of disease

Functional food: Concept

- Foods in which one or more ingredients /components

1. conc. have been manipulated or modified

   e.g. protein hydrolysates in infant formulas

2. have been added or removed

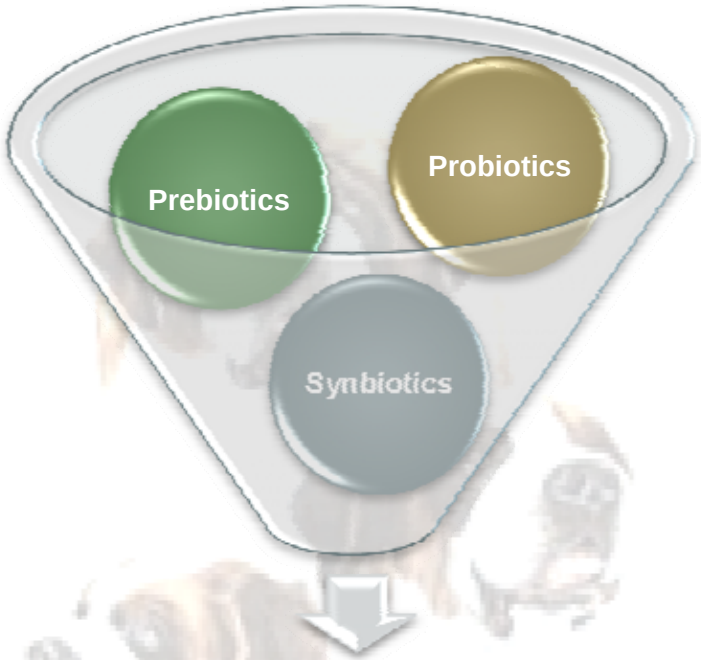
   e.g. addition of selected probiotic bacteria to improve gut health

3. bioavailability has been increased

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

4. any combination of the above possibilities

Increasing consumer awareness, health consciousness and expenditure are the socio-economic factors responsible for the expanding world-wide interest in functional foods.



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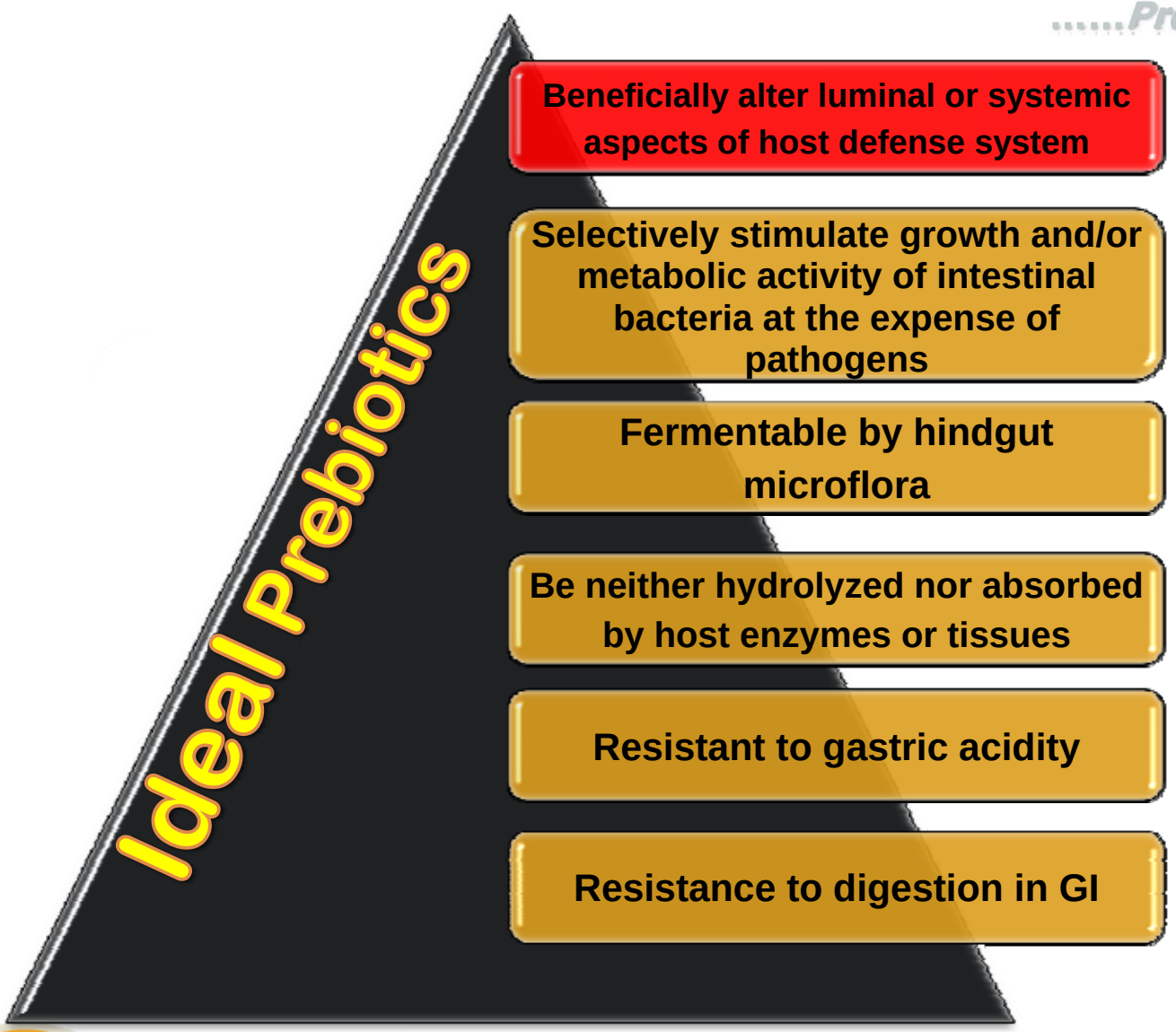
Prebiotics ?

- 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)

  It 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


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 in GI

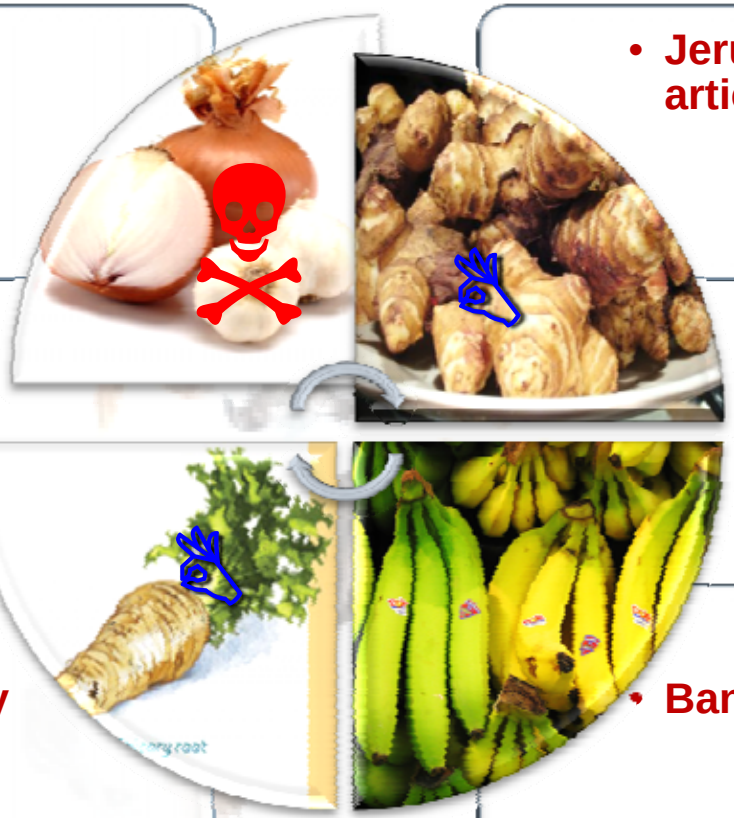
Some of the Prebiotics

- Inulin
- Oligofructose (scFOS)
- Fructoloigosaccharide (FOS)
- Galacto-oligisaccharides (GOS)
- Lactulose
- Xylo-oligosachharides ?
- Isomaltooligosaccharides ?
- Soybean oligosaccharides ?

Gibson & Roberfroid, 2008

Sources of prebiotics

- Garlic/ onion
- Jerusalem artichoke



- Chicory
- Banana

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

Ideal Probiotics

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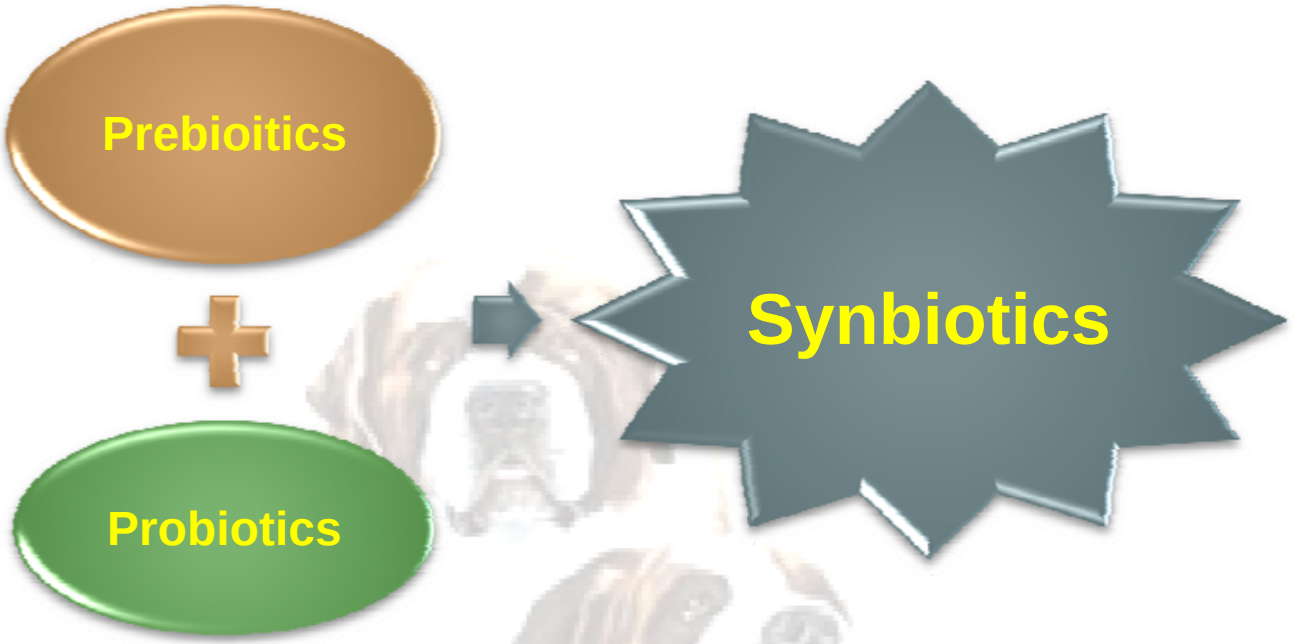
Microbial species used as probiotics

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*

Potential health benefits of Pre & Probiotics

- Modulation of hindgut health (mainly colon)
  - Maintenance of intestinal microbial balance
  - Lowering pH, production of organic acids, decrease in ammonia etc.
- Resistant to intestinal infection
- Improvement in bioavailability and absorption of minerals
- Hypoglycemic and Hypolipidemic actions
- Management of infectious diarrhoea
- Obesity
- Osteoporosis
- Colon cancer
- Inflammatory bowel disease

Synbiotics ?



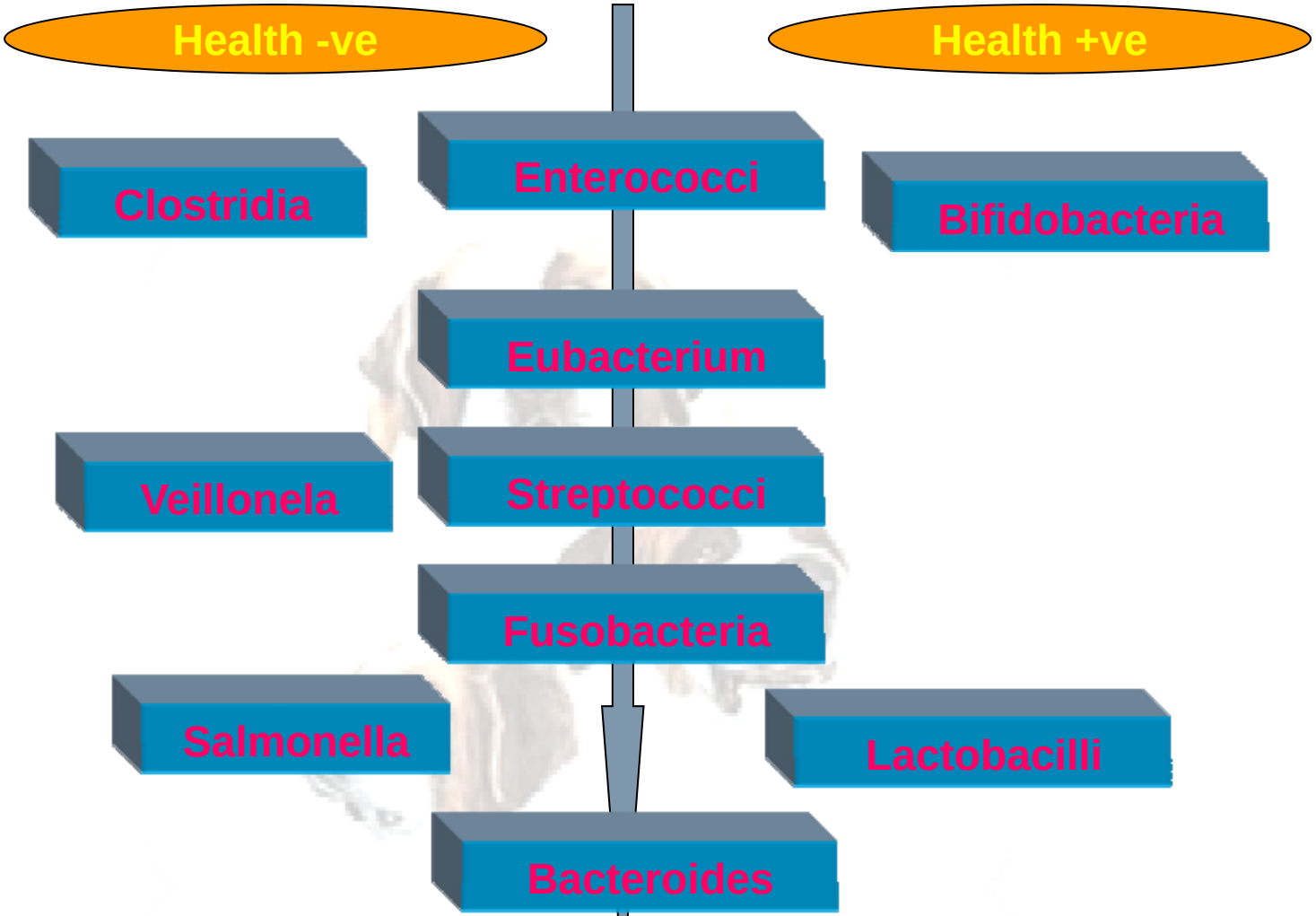
- **Recent advances in pet/companion animal nutrition targeting towards exploring the potential combinations of PRE & PRO as synbiotics**

Synbiotics

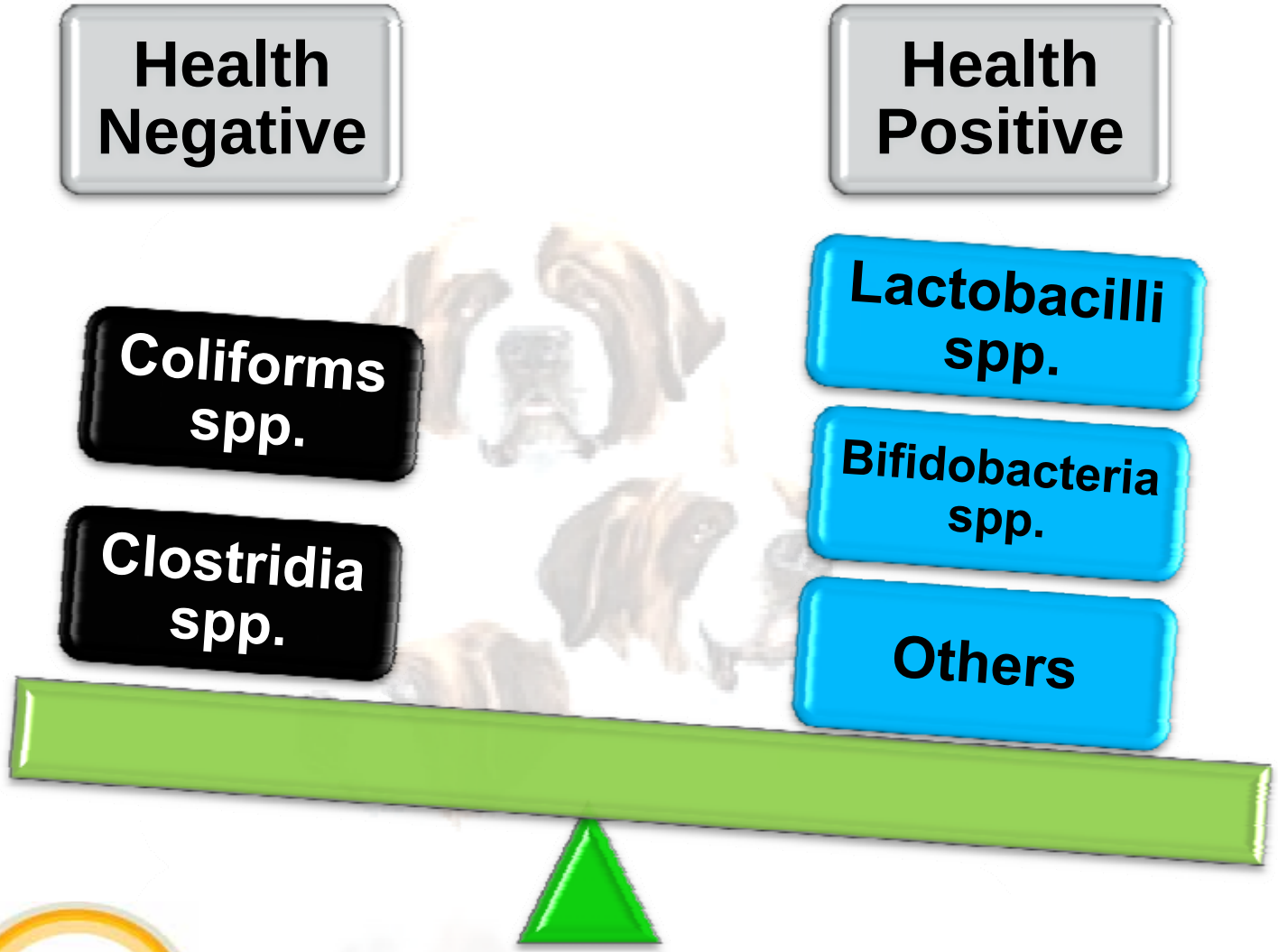
- A mixture of a Pre- and probiotics that helps to improve survival and implantation of live microbes in the GI tract by selectively stimulating the growth and/or activating the metabolism of one or a limited number of health-promoting bacteria

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

Overview of hindgut microflora



What is desired ?



Our Study

INDIAN VETERINARY RESEARCH INSTITUTE

By:
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& 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

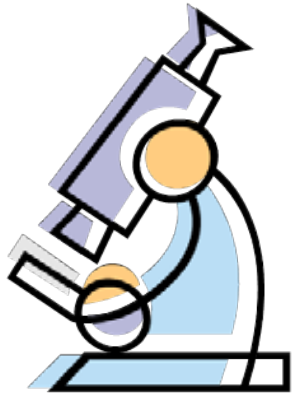
Experimental design

- The study was carried out at the Clinical and Pet Nutrition Laboratory, Centre of Advanced 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
- 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
- ✓ Food and nutrient 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

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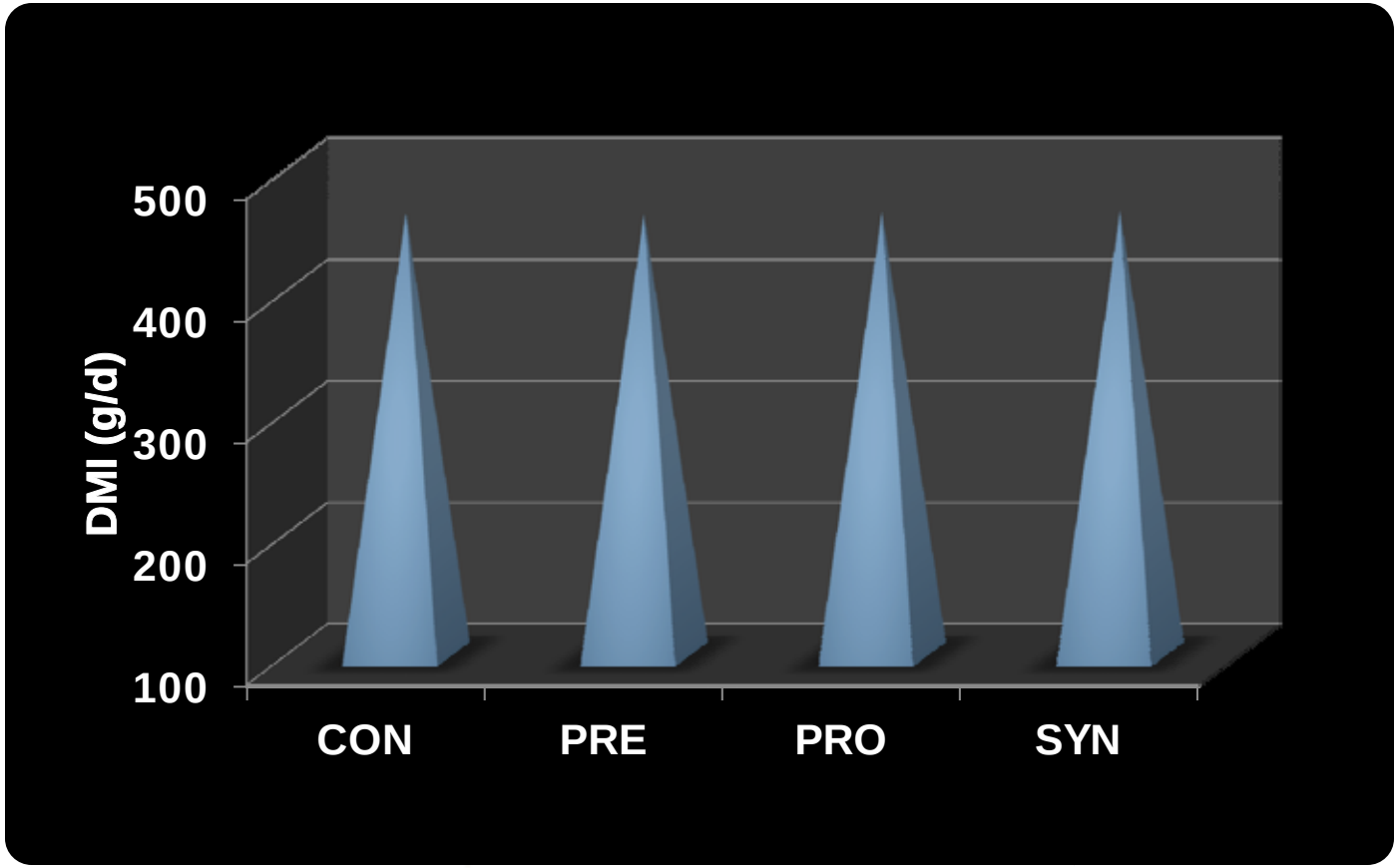
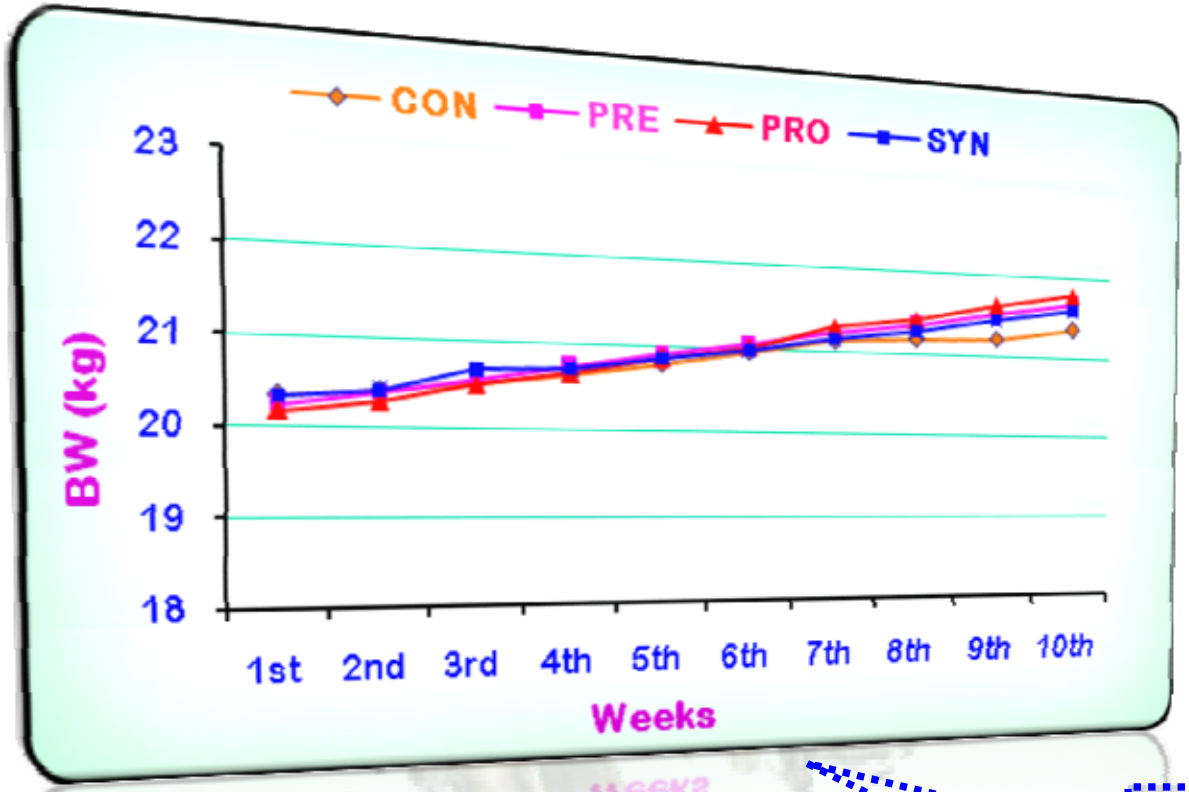
Chemical composition of the diet

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



Digestibility of nutrients in dogs

Attribute	Dietary groups				SEM	P value
	CON	PRE	PRO	SYN		
Dry matter	79.16^{ab}	78.13^{a}	80.45^{b}	80.08^{b}	0.523	*
Protein	77.31^{a}	76.08^{a}	77.65^{a}	80.44^{b}	0.538	**
Fat	87.85^{a}	89.72^{a}	92.67^{b}	92.97^{b}	0.792	**
Fibre	28.80^{a}	32.62^{ab}	35.60^{b}	37.37^{b}	1.529	*
CHO (NFE)	85.24	84.13	86.39	84.57	0.888	NS
Calcium	48.10^{a}	54.31^{b}	52.55^{b}	60.18^{c}	1.223	***
Phosphours	52.23	52.80	53.45	54.96	1.378	NS

^{abc}*Means bearing different superscripts in a row differ significantly, *p<0.05, **P<0.01, ***P>0.001*

Hindgut health (Physical) indices of dogs

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						
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, p<0.05, **P<0.01, ***P>0.001*

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, p<0.05, **P<0.01, ***P>0.001

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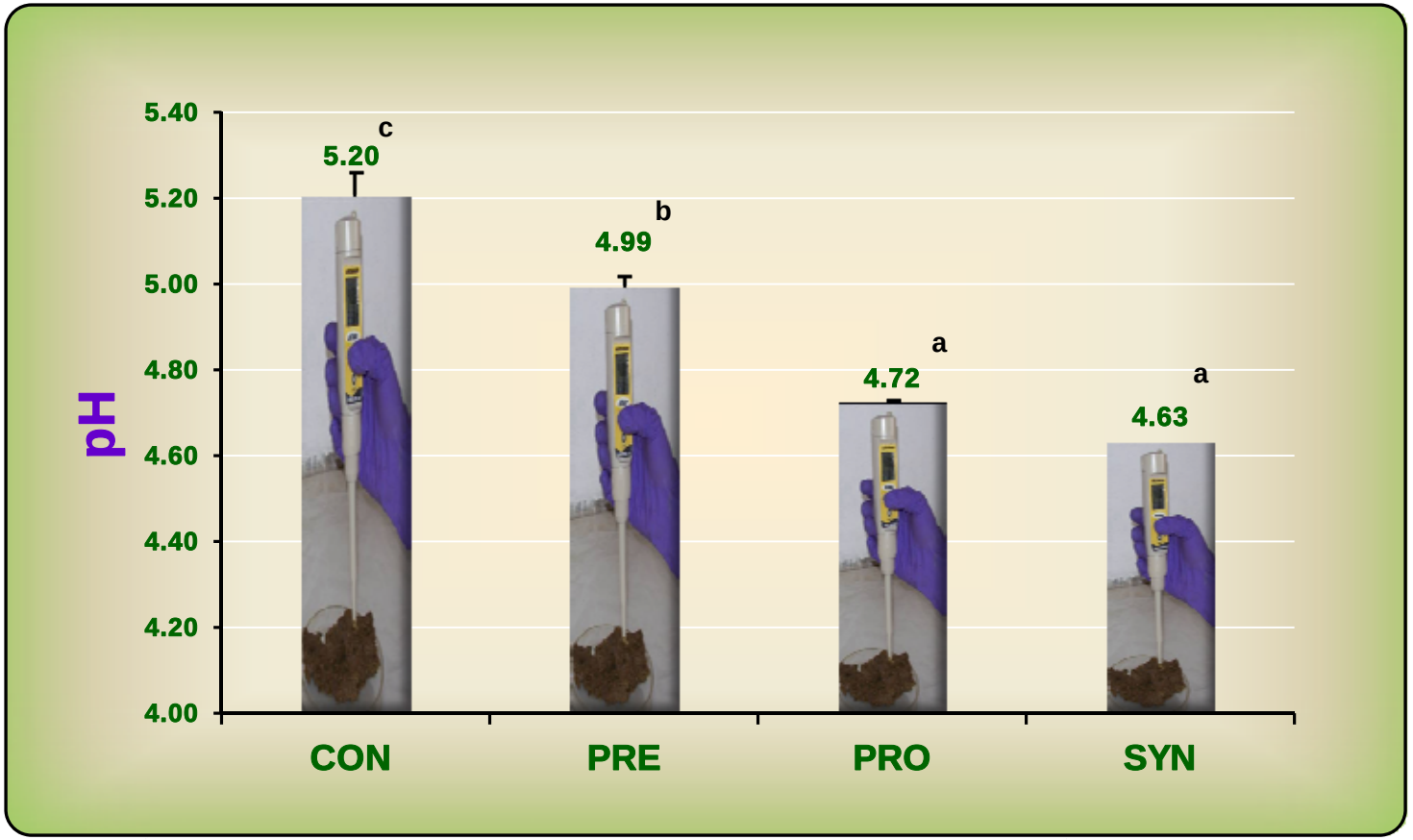
Comparative faecal pH



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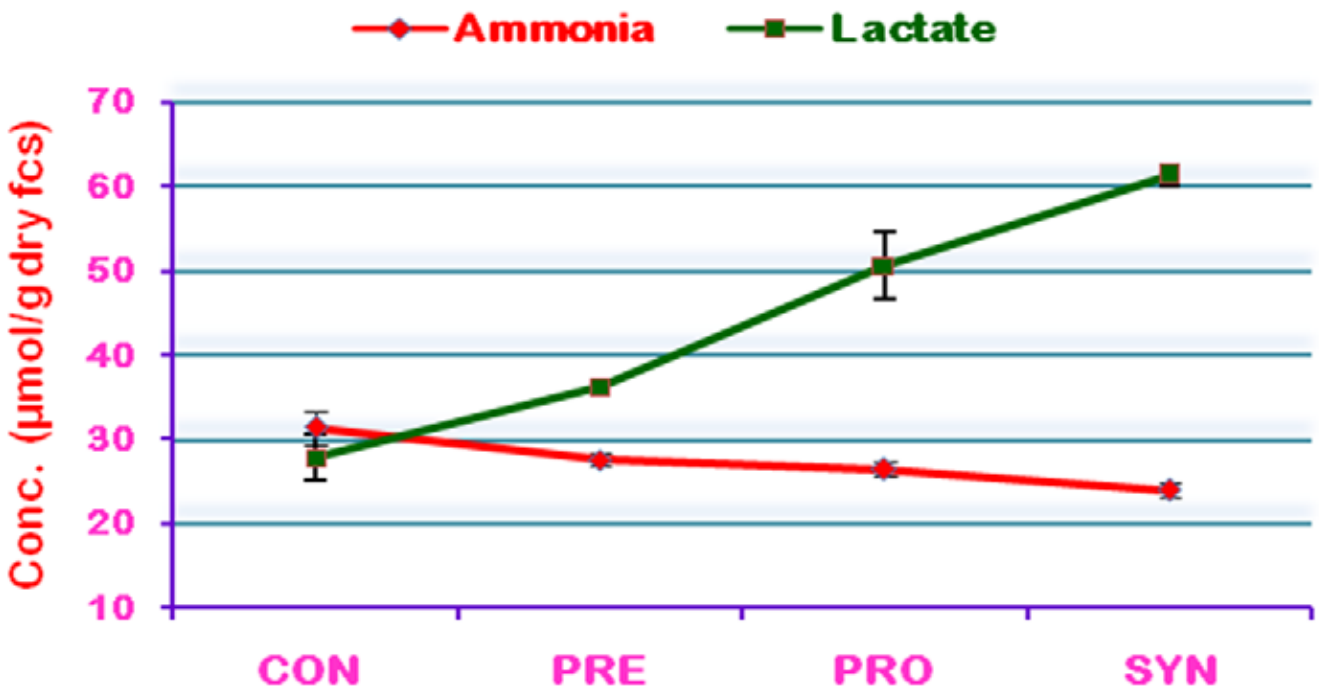
Comparative faecal ammonia and lactate concentration



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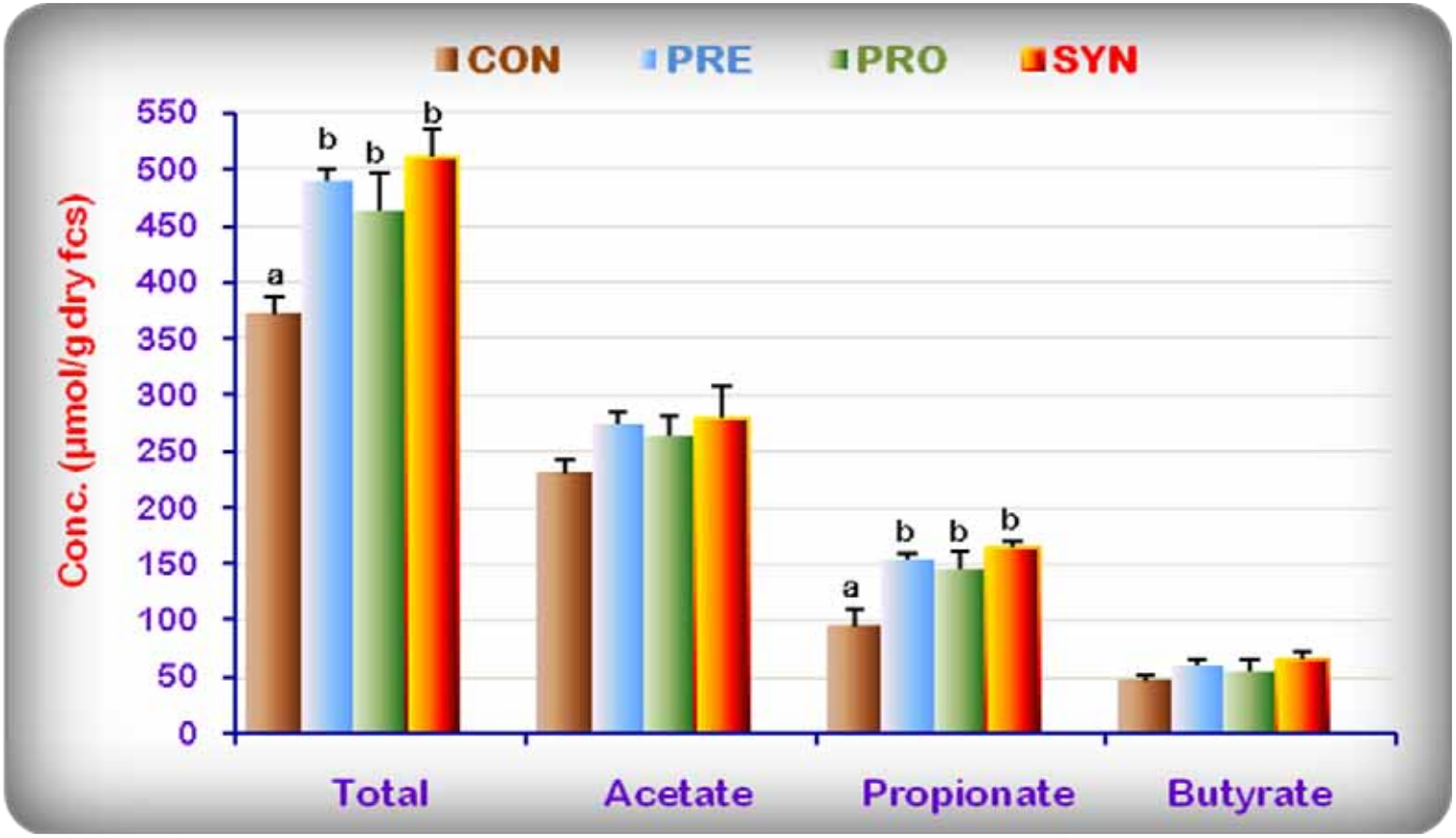
Comparative faecal SCFAs concentration



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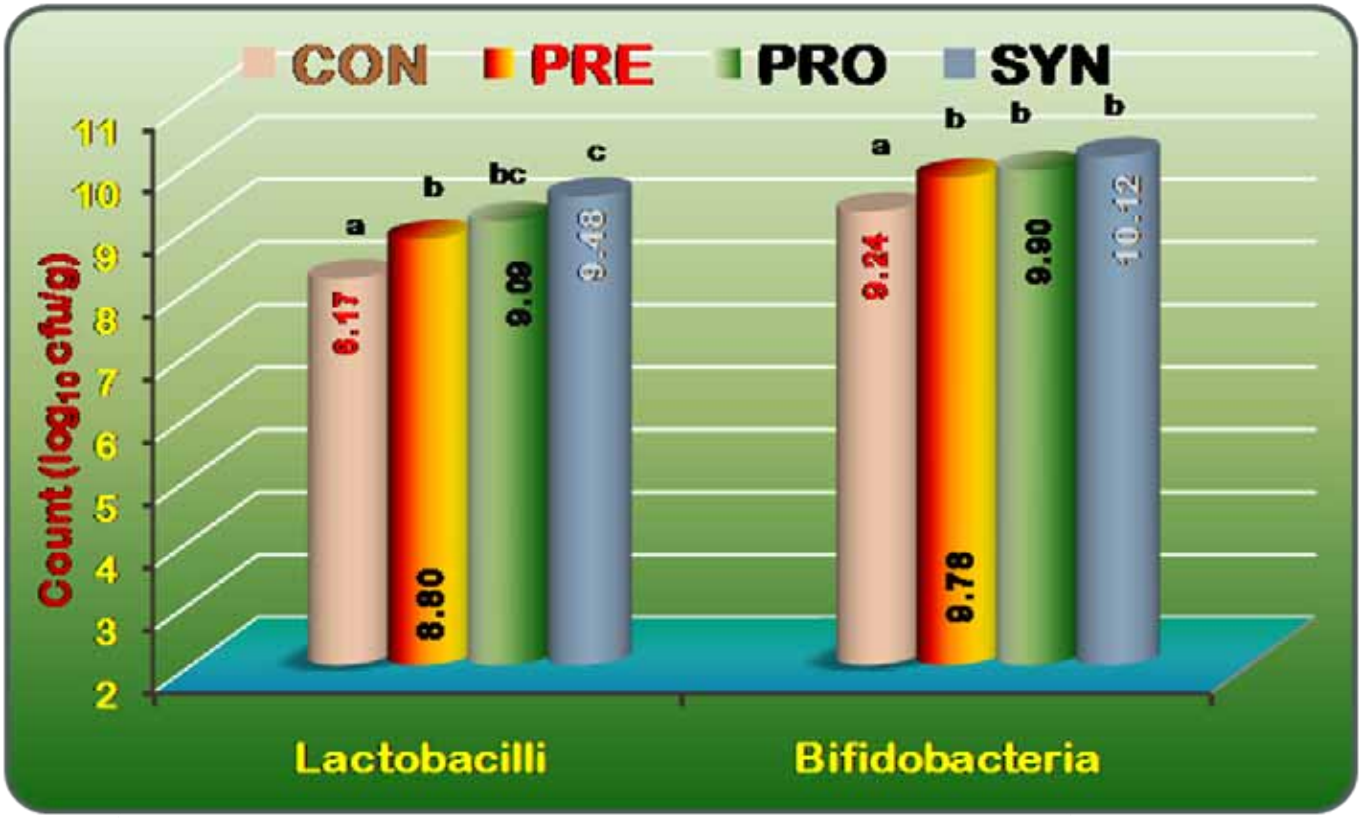
Comparative faecal Lactobacilli and Bifidobacteria (health positive bacteria) count



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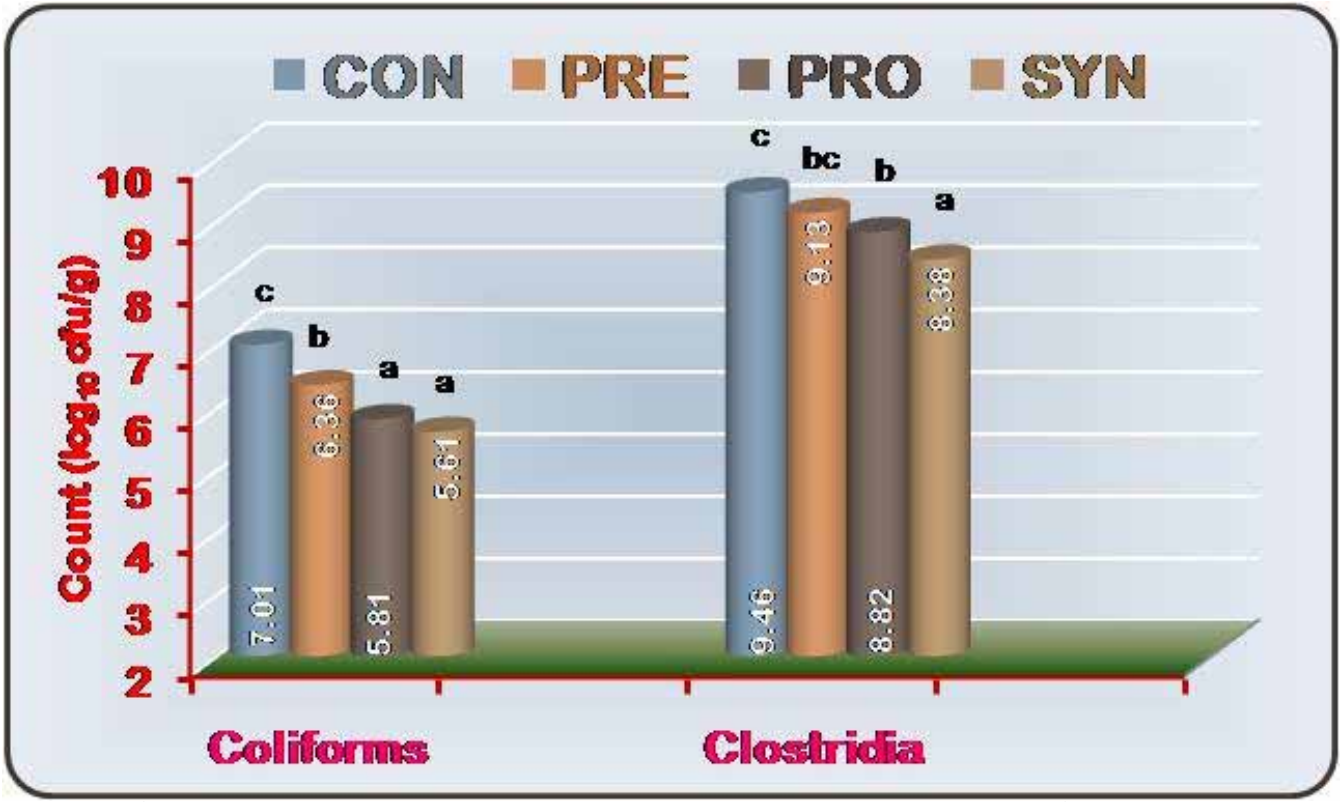
Comparative faecal Coliform and Clostridia (health negative bacteria) count



Conclusion

- **Prebiotics (Chicory inulin):** positively modified fibre digestion, calcium absorption, hindgut health indices and intestinal microflora
- **Probiotics (*Lactobacillus acidophilus*):** Improved some of the nutrients utilization (fat, fibre, Ca), hindgut health attributes and intestinal microbial balance
- **Synbiotics:** shown added or synergistic effect than using them (pre or probiotics) alone from all aspects of functional properties ascribed to prebiotics and/or probiotics
- **Animals age, health, diet type, environmental conditions, dose etc. may influence the effect of pre and/or probiotics**

Future research

From scientific view

- Search for alternate sources of prebiotics, probiotics (and synbiotics) would add to the gamut of already existing and upcoming resources for enhancing target function
- Future research should target to ascertain the influence of proven synbiotics combinations across the different feeding regimens, breeds and lifestyle
- Nutrigenomics approach to explore functional role of the food at genetic level i.e. diet-gene interrelationship

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From industrial view

- Natural sources of prebiotics
- Selecting new and more specific strains of probiotics for health & well-being of the host (age group, health of the population, disease specific)
- To develop technology for non-dairy probiotics (cereal based materials)
- Appropriate delivery vehicle for synbiotics
- Product development: Sensory properties, viability during processing and stability in the product as well as during storage

"Let food be thy medicine"

Thank Q

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