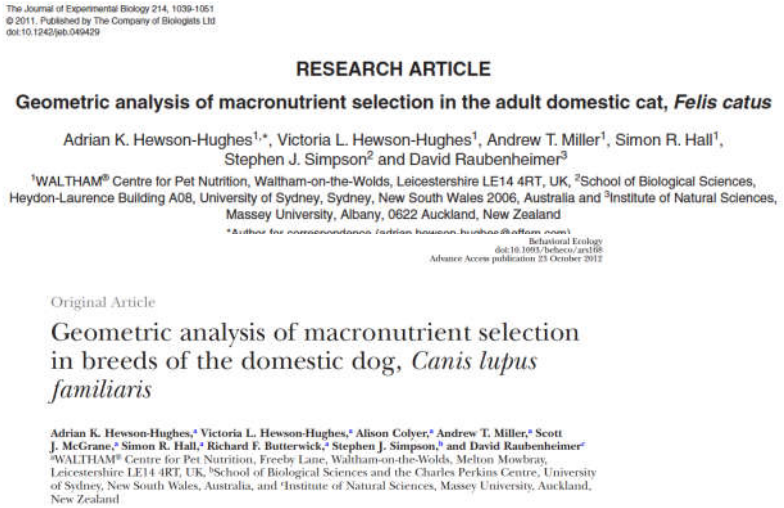
Science and publications



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RESEARCH ARTICLE

Geometric analysis of macronutrient selection in the adult domestic cat, *Felis catus*

Adrian K. Hewson-Hughes[1,*], Victoria L. Hewson-Hughes[1], Andrew T. Miller[1], Simon R. Hall[1], Stephen J. Simpson[2] and David Raubenheimer[3]

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Behavioral Ecology
doi:10.1093/beheco/ars168
Advance Access publication 23 October 2012

Original Article

Geometric analysis of macronutrient selection in breeds of the domestic dog, *Canis lupus familiaris*

Adrian K. Hewson-Hughes,[a] Victoria L. Hewson-Hughes,[a] Alison Colyer,[a] Andrew T. Miller,[a] Scott J. McGrane,[a] Simon R. Hall,[a] Richard F. Butterwick,[a] Stephen J. Simpson,[b] and David Raubenheimer[c]
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OPEN ACCESS Freely available online

PLoS one

The Canine Oral Microbiome

Floyd E. Dewhirst[1,2]*, Erin A. Klein[1], Emily C. Thompson[1], Jessica M. Blanton[1], Tsute Chen[1], Lisa Milella[3], Catherine M. F. Buckley[4], Ian J. Davis[4], Marie-Lousie Bennett[5], Zoe V. Marshall-Jones[4]

British Journal of Nutrition (2008), **99**, 793–805
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doi: 10.1017/S0007114507871686

Diet restriction and ageing in the dog: major observations over two decades

Dennis F. Lawler[1]*, Brian T. Larson[1]†, Joan M. Ballam[1]‡, Gail K. Smith[2], Darryl N. Biery[2], Richard H. Evans[3], Elizabeth H. Greeley[4], Mariangela Segre[4], Howard D. Stowe[5] and Richard D. Kealy[1]

WHAT IS THE CONSEQUENCE (among others):

- Dog turned out to be carnivorous (?!)
- Dog learned how to digest starch
- We know diet of ancient dogs and ancient cats (natural food??)
- Oral cavity hygiene in dogs and humans are to separate worlds
- How to manufacture dry food with scant amounts of carbohydrate?

Searching for the information / science by owners

Where the owner looks for the information about dogs and cats nutrition	Dog owners	Cat owners
Internet	47%	46%
Veterinarian	46%	41%
Product label	36%	37%
Label attached to the packaging	22%	23%
TV advert	17%	13%
Journal	14%	12%
Social media (Facebook, Twitter itp)	13%	12%
Mail	7%	6%
Mobile applications	5%	3%
I am not looking for information about nutrition of my animal	5%	7%

Flores, pet food forum 2017

Development of technology :
Thermal twin as a possibility of manufacturing of dry food with fresh meat

- Extrusion (still), but …….
- Possibility of production of feeds with fresh meat and fresh vegetables
- Significant improvement of digestibility
- Significant change of palatability
- “fresh-meat” as leading marketing trend

Comparison of Vitamin Retention in Pet Food Processes

% Retained	Vitamin A	Vitamin D_3	Vitamin E	Beta-carotene
Standard Process	67	61	57	60
Thermal Process	88	75	58	95

Factors influencing trends

„Animals anthropomorphising”

- Specific expectations of owners towards product
- Feeding philosophies – vegan,
- Food as a form of relation establishment – treats

Expectations of the owners towards products

What is the most important factor influencing decision making related with feed choice	Dog owners	Cat owners
Assurance of more natural feeding	84%	84%
Ingredients used	80%	81%
Feed containing functional ingredients required by my pet	79%	79%
No artificial colourants and additives	72%	71%
Type of protein used	69%	67%
High protein content	68%	66%
Ingredients form sustainable production	65%	62%
Ability to select from different tastes of product	56%	**64%**
Price per kg	52%	50%
Brand	44%	42%
Country of origin	42%	41%
Grain-free	41%	38%
Gluten-free	40%	37%

Flores, pet food forum 2017

What is the conclusion?

- New nutritional trend on the marker reflects mainly growing knowledge and awareness of owners and anthropomorphising of animals

- New trend appear mainly in premium sector of the pet food

What is our concept?

- Dog food based on scientific study results
  - Reflection of natural food ingested by dogs
  - Less means better – one source of animal protein, no preservatives
  - Comprehensive evaluation of dogs fed with the feed

- Dog food based on client expectations
  - Simple composition, ingredients obvious for everyone
  - Fresh ingredients as main source of protein and vegetables
  - Palatability above everything

What is dog eating behaviour?

What dogs prefer?

- Dog – omnivorous?
- As omnivorous accepts both animal-based and plant-based diets
- Ability to adapt to dietary starch level

Źródło: Hylmarowa, 2003

Is meat palatable?

Taste – individual sensation of each subject

vs.

Palatability – evaluation of feed attractiveness based on on amount ingested by animal

Features of palatability :

- smell
- Taste
- shape (texture)

Palatability

Measurement of palatability – most frequently based on amount of ingested food, but: this feature says nothing about the feed – only about willingness of dog to food ingestion – subjective!

Palatability features :

- Smell – most important (what is the smell of feeds most frequently selected by animals?)
- Taste – main taste stimulus could be the content of proper ingredients in the feed
- Shape – dogs and cats react do feed shape

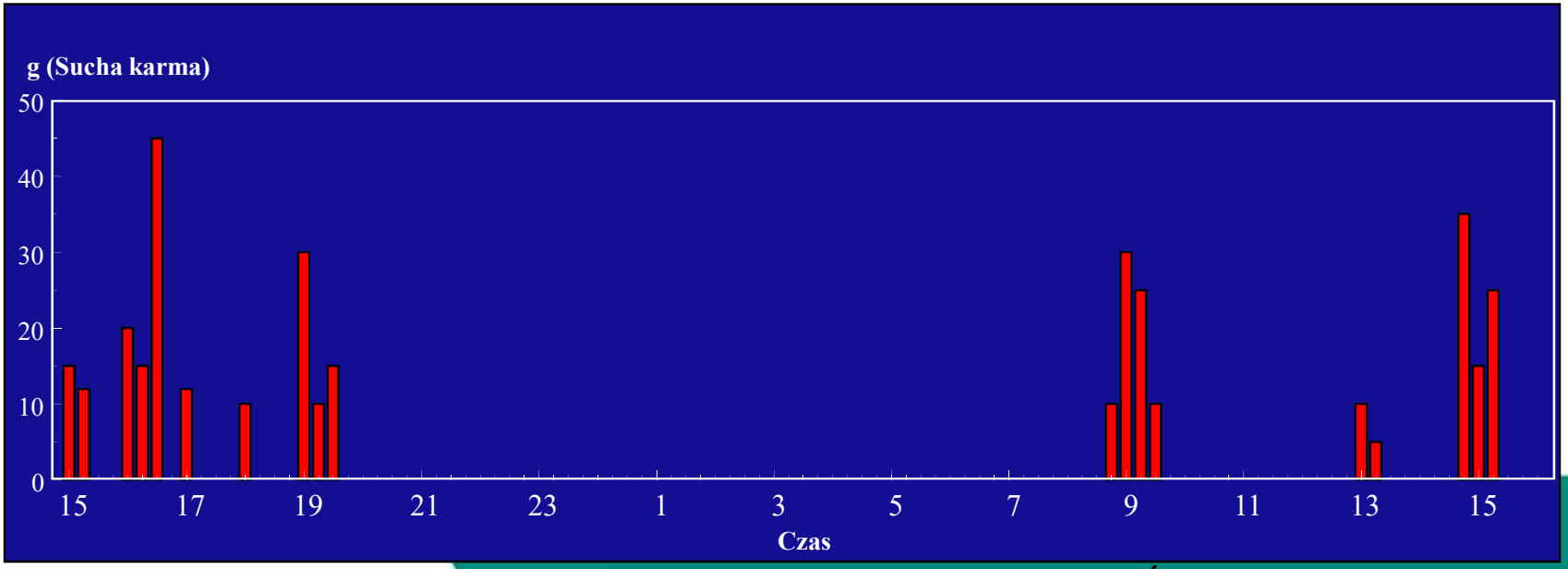
Taste sensation in dogs

- Number of taste buds – 1700 (human 9000)
- Differentiates five tastes
  - Bitter – very susceptible, adverse taste
  - Sweet – very attractive, could be enhanced by frequent administration of sweet feed
  - Sour
  - Salty – attractive
  - umami (generated by the presence of specific ingredient – glutamate - in feed and is related with the presence of ”meaty” taste)
  - Eat the food very fast – no enough time to stimulate all taste buds

Food ingestion in dogs

Dog

- Over-eating
- Rare but large meals
- Mainly during the day



Źródło: Hylmarowa, 2003

EVOLUTIONARY FEEDING

- Dog is genetically adapted to digestion of feeds with higher starch content
  - Comparative analyses of genomes from domesticated dogs and wild dogs (wolves) showed adaptation of domesticated dogs to starch digestion, since during evolution they started to use three genes (AMY2B, MGAM and SGLT1) involved in starch digestion and glucose uptake (Axelsson et al., 2013)

- Evolution of dogs is few-times faster than humans (number of generations of dog in time is 10-times higher than in case of human).
- Dogs adapted to several-times more effective use and digestion of starch than wolves,
- Speed of changes and level of adaptation is easily seen in studies on farm foxes, achieving features of domestication typical for dogs after only several generations

Nutritional habits of dog

- Relation with wolves
- Eats extremely fast
- Over-eating, east more than stomach volume
- Presence of other dogs stimulates “finicky eaters” to larger food intake (but dominative behaviours also possible)
- „Hiding” of for for future
- Dogs with constant access to the food will be eating smaller meals but only during the day

Is self-limiting of food ingestion in dogs possible?

- Rather NOT (is able to ingest during one meal even up to 20% of body weight)

- Labradors – why eat so much?
  - Mutation of POMC (proopiomelanocortin) gene which causes obesity in humans in Labradors (2016), especially working Labradors
  - Nutritional rewards (treats) after proper doing of tasks helped to adapt to increased hunger …..

Whta should be the ideal dog food developed in accordance to natural dog requirements?

RAW PALEO formulation

- One source of animal protein – TURKEY
- GRAIN-FREE
- Functional additives adjusted to animals' age
- Fresh ingredients – meat and vegetables
- Potatoes and sweet potatoes as a starch sources

Why TURKEY in feed?

- **Features of turkey meat:**
  - Very good source of protein. Belong to meats of highest content of protein and relatively low amount of fat, what makes it **easy-digestible**

Why TURKEY in feed?

- **Features of turkey meat :**
  - Low sodium content – prevents from heart and kidney disorders. Reduces hypertension **in dogs with chronic kidney failure**.

Why TURKEY in feed?

- **Features of turkey meat :**
  - Very high selenium content. Selenium plays important role in antioxidant system scavenging free radicals, **supports immune system and improves fertility**. Necessary for proper thyroid gland function

Why TURKEY in feed?

- **Features of turkey meat :**
  - Good source of niacin (vitamin PP or B3) and vitamin B6. Vitamin B6 plays a role in glucose production and **proper function of red blood cells and immune mechanism**. Niacin plays important enzymatic functions and is necessary for protein, fat and carbohydrate oxidation.

Why TURKEY in feed?

- **Features of turkey meat :**
  - Important source of tryptophan. Tryptophan is a precursor of serotonin which is responsible for behaviour and mood. Increased serotonin level **easies puppies training and has calming effect**, reducing dogs aggression.

Why GRAIN FREE?

Grain protein could contain significant amounts of allergens	GRAIN FREE is hypoallergenic
Grains could contain significant amounts of mycotoxins	GRAIN FREE reduces risk of mycotoxin intoxications

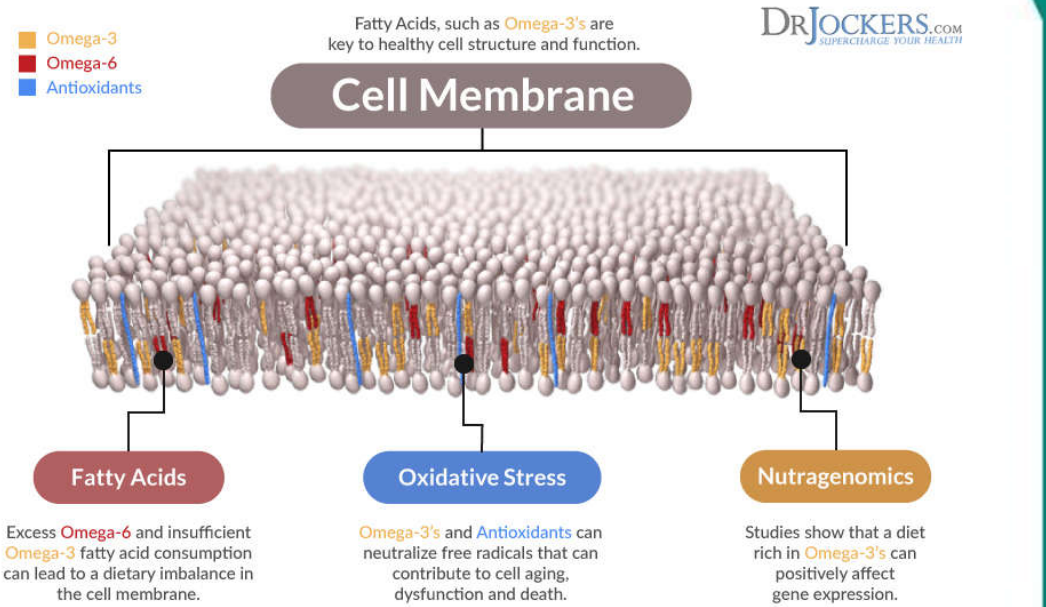
Why functional ingredients?

- Some food ingredients play not only nutritional functions
  - Adjusted to age, physiological state etc.
- Biologically active substances of plant origin
  - Plant extracts or isolated pure substances
- Constant administration of specific substances could have pro-healthy action and supports natural protective mechanisms of the body

Functional ingredients in feed:
DHA – docosahexaenoic acid

Omega-3 fatty acid

- Development of vision and nerves.
- Improves learning ability.
- Supports neural system in older dogs.
- Exerts anti-inflammatory action



Functional ingredients in feed :

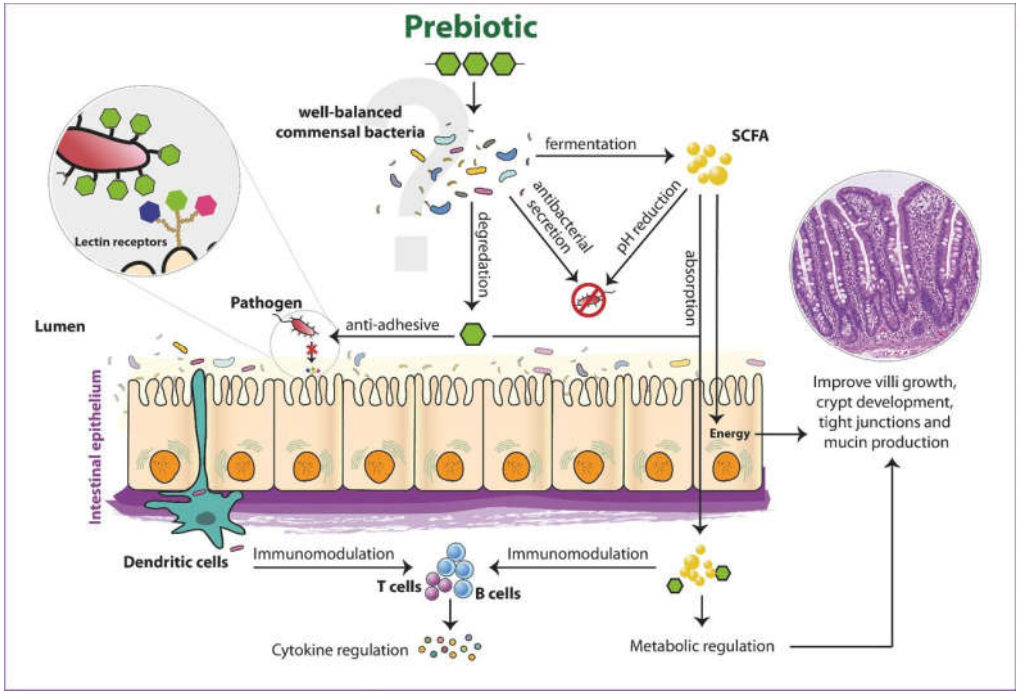
PREBIOTICS: Fructooligosaccharides and mannooligosaccharides

FOS

- Beneficial influence on alimentary tract microflora
- Improves faeces consistency and reduces bloat

MOS

- Stimulates immune processes in GIT
- Increases number of antibodies
- Prevents from harmful bacteria.



Functional ingredients in feed : Green—lipped muscle extract *Perna canaliculis*

Source of chondroprotective substances and omega-3 fatty acids

- Natural glucosamine and chondroitin
- Recommended for older dogs with osteoarthritis
- Recommended for growing dogs
- Recommended for orthopaedic patients

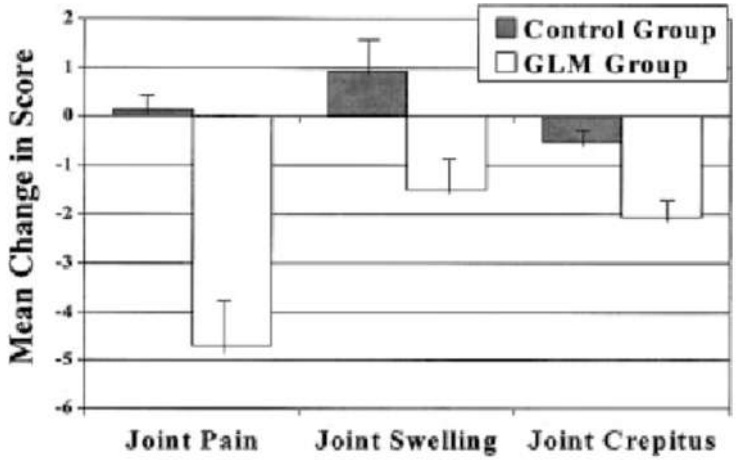


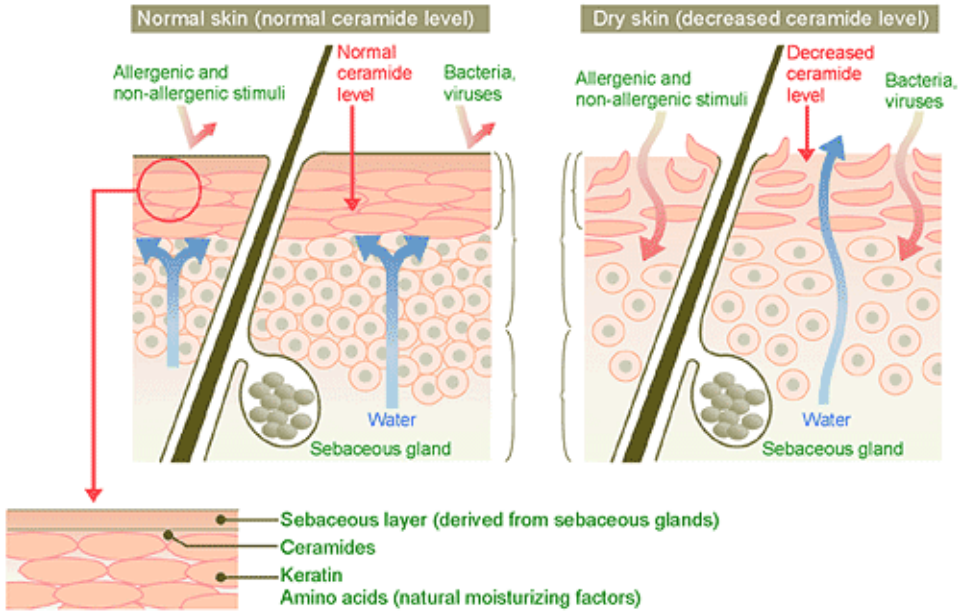
FIGURE 2 Study 1 scores/GLM Powder. Mean (SEM) changes in joint pain, joint swelling and crepitus scores between baseline and wk 6 for dogs fed either a standard diet (Control, n 15) or a diet supplemented with green-lipped mussel powder (n 17). The change in score was significantly different between the Control and GLM groups for all variables (P 0.05).

DOI: 10.1093/jn/132.6.1634S

Functional ingredients in feed :
Borage oil

Source of omega-6 fatty acids

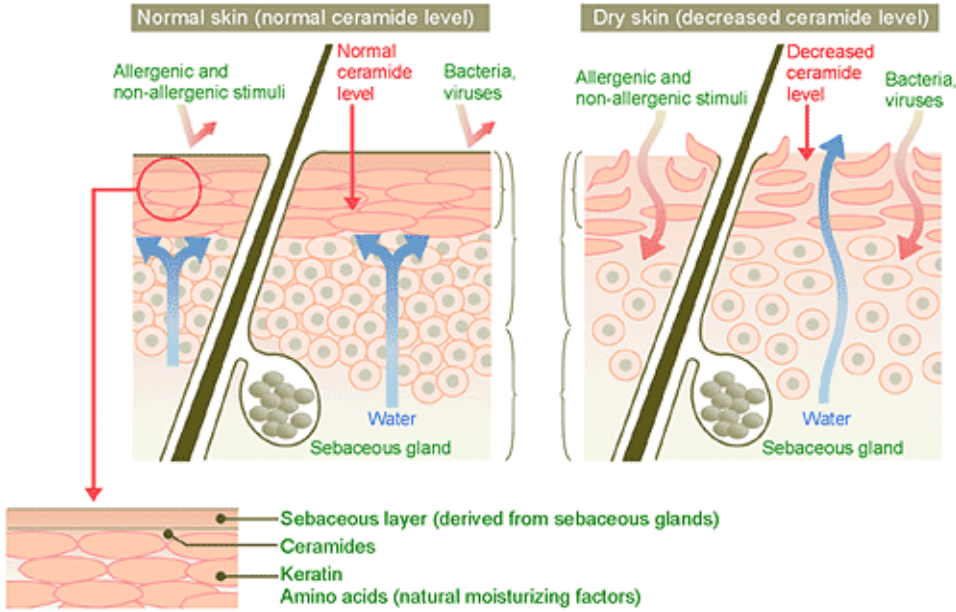
- Contains gamma-linolenoic acid (GLA)
- Supports skin and coat function
- Component of ceramides – responsible for water barrier of the skin
- Prevent from excessive drying of skin
- Prevents from environmental allergens and harmful substances



Functional ingredients in feed :
Salmon oil

Source of omega-3 fatty acids

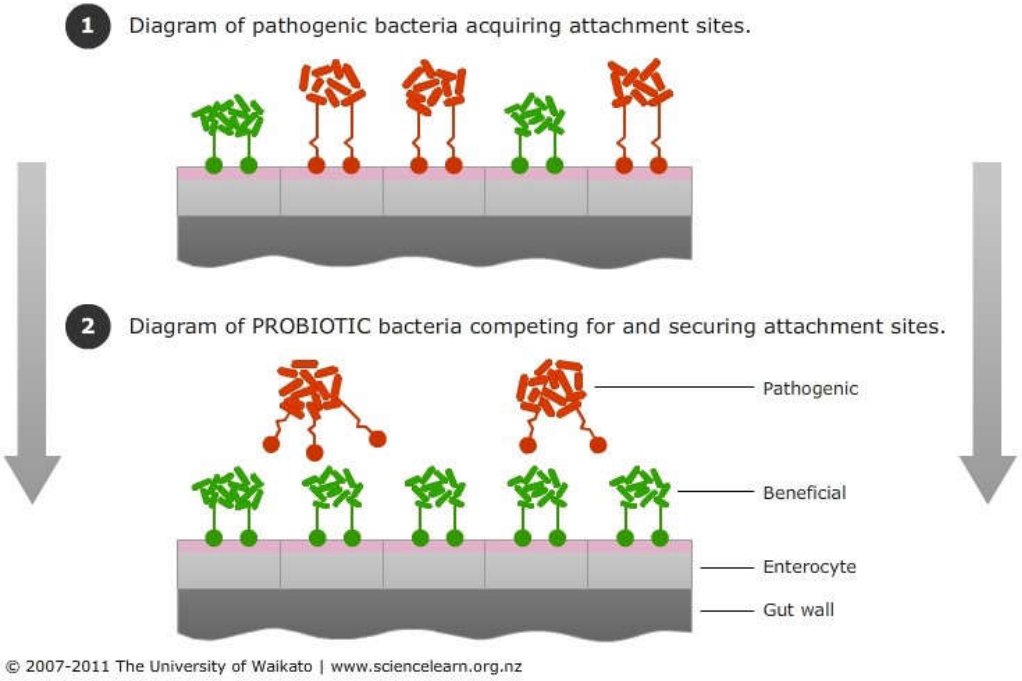
- Contains EPA and DHA
- Exerts strong anti-inflammatory action
- Beneficial in case of skin and joint disorders



Functional ingredients in feed : *Enterococcus faecium*

Probiotic bacteria

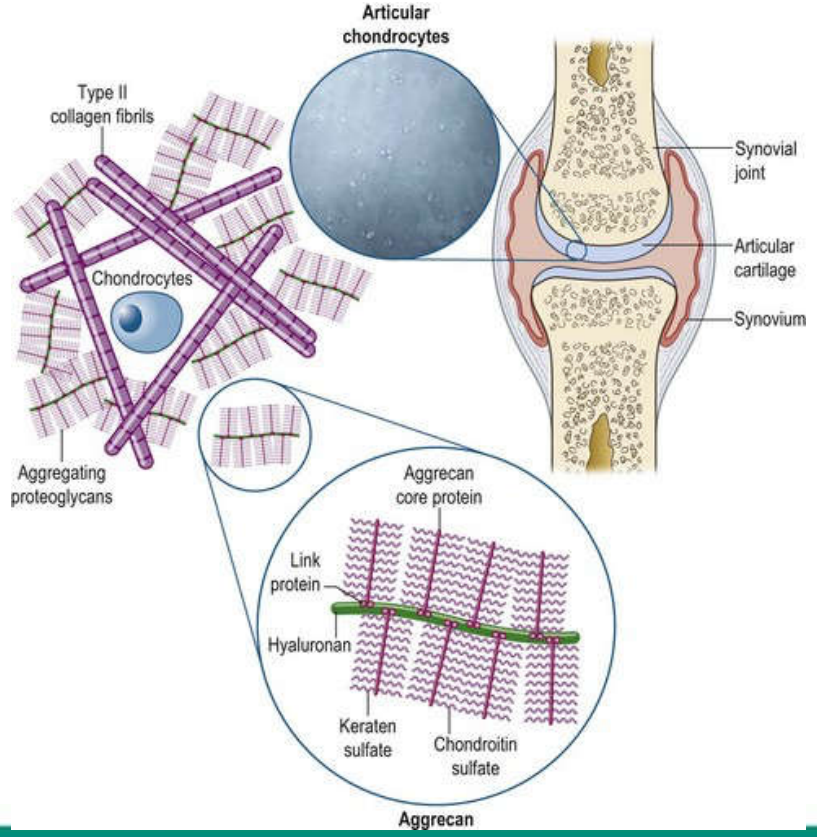
- Supports development of beneficial microflora of GIT.
- Helps to normalize faeces consistency
- Prevents from bloats
- Normalizes digestion and absorption of nutrients



Functional ingredients in feed :
Glucosamine and chondroitin

Two best known chondroprotective ingredients.

- Recommended for older dogs with osteoarthritis,
- Recommended for growing dogs, especially of large breed
- Recommended after all types of injuries within joints



Why such huge amount of fresh ingredients?

- There is no necessity of earlier processing of feed ingredients (i.e. production of meat meals)
- Raw materials are not long stored before production (higher nutritional value)
- Ingredients contained in fresh ingredients ensures incomparable better palatability
- Addition of fresh meat decreases bitter taste of feed and improves kibbles consistency (Koppel et al., 2014)

Why potatoes and sweet potatoes?

- Dry pet food cannot exist without addition of starch sources, ensuring proper consistency of kibbles
- High quality source of easy-digestible carbohydrates.
- Potato proteins is not significant cause of allergies.
- Very good source of vitamin C and pyridoxine (vitamin B6)

Raw Paleo – proven in nutritional studies

Studies conducted

UNIWERSYTET PRZYRODNICZY WE WROCŁAWIU

- Study conducted at Wrocław University of Life Sciences, Faculty of Veterinary Medicine
  - Feed digestibility and faeces quality evaluation
  - Blood morphology in dogs receiving the feed for 6 months
  - Palatability evaluation

Feed digestibility - definition

- Digestibility – amount of specific ingredient from the feed which is digested and absorbed – so is used by animal
  - Feed dry matter,
  - Crude fibre,
  - Crude fat
  - Nitrogen free extract (carbohydrate)

What digestibility depends on?

Increased digestibility	Decreased digestibility
• Products of animal origin (meat, by-products) • Mechanical processing of feed • Extrusion (dry food) • Longer time of food administration • Proper thermal processing	• Products of animal origin – hairs, feathers, skin, bones • Products of plant origin containing dietary fibre • High ash amount • Excessive thermal processing

Content of nutrients in 100g of feed, as % of dry matter and amount per 1000kcal ME

Nutrient	unit	Content in 100 as fed	% of dry matter	Content per 1000Kcal ME	FEDIAF: min requirement for nutrient (unit /100g d.m.)	FEDIAF: Min requirement for nutrient (unit/1000 kcal ME)
Protein	g	22,47	24,00	65,43	18-21	**45-52**
Fat	g	14,54	15,53	42,34	5,50	**13,75**
Ash	g	8,42	8,99	24,52		
Fibre	g	2,67	2,85	7,78		
NFE	g	45,51	48,62	132,53		
Water	g	6,39				
EM	**kcal/100g**	**343,4**				

Table 1. Amount of feed given, ingested (consumed) and % of consumption during the test (palatability study)

Name	FOX	LOLEK	BIGGI	YODA	RAKIETA	VADER	Average
Dose given (g/d)	280,00	280,00	280,00	260,00	260,00	280,00	**273,33**
Dose consumed (g/d)	280,00	280,00	280,00	260,00	260,00	280,00	**273,33**
% consuption	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

Faeces quality during digestibility test

No	Parameter	Value
1	Total number of defecations	**89,00**
2	% of normal defecations; including % of ideal defecations (index between 1.5 and 2.5)	**Normal: 100,00%; including ideal: 23.60%**
3	% of abnormal defecations (index 1.5 or > 3.5).	**0,00%**
4	**Average value of faeces quality**	**2.76**

Digestibility of specific nutrients

Digestibility (%):	Average	SE
Dry matter	79,4	1,57
Organic matter	84,6	1,15
Crude protein	77,4	5,16
Crude fat	89,7	0,82
Carbohydrate	90,2	2,27
Energy	94,9	0,39

Summary of digestibility studies :

- Feed consumption was 100% of offered daily dose
- Changes of dogs body weight during the study were within ranges acceptable for normal body weight changes measured once a week
- Faeces quality evaluated during the study were considered as acceptable in 100% of evaluated samples, including 23.60% considered as ideal. There were not unacceptable samples of faeces. Average value of faeces quality index was 2.76.
- The content of macronutrients in dry dog food is in accordance with FEDIAF requirements for minimum content of nutrients in products for adult dogs, (FEDIAF; Nutritional Guidelines. 2017)
- Digestibility of nutrients in investigated product was considered as good, whereas digestibility of energy was considered as very good.

Palatability of RAW PALEO

First Choice SMELL		1 dz.	2 dz.	AVARAGE
RC		29,0%	25,0%	27,0%
RAW PALEO		71,0%	75,0%	73,0%

First choice SMELL

First Choice EATEN		1 dz.	2 dz.	AVARAGE
RC		29,0%	25,0%	27,0%
RAW PALEO		71,0%	75,0%	73,0%

FirstChoice TASTE

PREFERENCE			1 dz.	2 dz.	AVARAGE
RC			27,3%	45,5%	36,4%
RAW PALEO			72,7%	54,5%	63,6%

PREFERENCE

In this studies better results were obtained for RAW PALEO since obtained values are repeatable better than in case of RC

Evaluation of selected parameters in dogs receiving for 6 months RAW PALEO feed

Parameter	range	Day 0	Day 180
Aspartate aminotransferase (U/l)	<90	29,3	37,6
Alanine aminotransferase (U/l)	<100	47,6	50,5
Plasma total protein (g/l)	48-78	55,6	59,1
Plasma albumins (g/l)	25-35	30,6	32,5
Blood glucose (mmol/l)	3,7-6,7	4,4	4,6
Red blood cells (T/l)	4,6-10,0	7,0	7,4
White blood cells (G/l)	6-16,5	8,35	8,45

Summary

- Concept – based on scientific studies
- Formula – fulfilling owners expectations
- Recipe – ensuring good health status of dogs
- Product – incomparable on market

RAW PALEO