Nature, Nurture and the Case for Nutrition

Abstracts

Bangkok, Thailand

October 28-31, 2003
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Nature, Nurture and the Case for Nutrition

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Foreword

NATURE, NURTURE AND THE CASE FOR NUTRITION

NATURE - ‘The forces and processes that produce and control all the phenomena of the material world: the laws of nature.’

NURTURE - ‘The sum of environmental influences and conditions acting on an organism.’

NUTRITION - ‘The process of nourishing or being nourished, especially the process by which a living organism assimilates food and uses it for growth and for replacement of tissues.’

- Merriam-Webster Dictionary

Once again WALTHAM is delighted to be able to bring together so many renowned and respected faces from the world of companion animal medicine, science and nutrition; to share interests, recent research outputs and breakthroughs in the field. This year our major focus is on nature versus nurture and how nutrition can have an over-riding influence on both.

There is indisputable evidence that nutrition will influence health and barriers to disease. In addition to a review of how nutritional intervention can influence the balance of gut flora, recent WALTHAM research showing that nutrition can significantly enhance epidermal barrier function will be presented. As the symposium progresses, we will seek to understand how not only genetics but also nutrition and the environment can significantly influence the health of our pets. We will discuss topics as varied as nutritional factors influencing obesity, body composition and mucosal immunity, right through to antioxidant effects in recurrent airway obstruction in horses.

We sincerely hope that you enjoy this WALTHAM International Science Symposium and this celebration of scientific discovery. We are confident the programme will be stimulating and you will all find something to grab your interest over the next few days, leaving you enlightened as you leave Bangkok and with a passion to continue to share your knowledge and expertise.

Pauline Devlin, BSc (Hons) PhD
Scientific Communications Executive, WALTHAM

Karyl Hurley, BSc, DVM, DACVIM, DECVIM-CA
WALTHAM, Global Academic Affairs, WALTHAM

Helen Munday, BSc (Hons) MSc
Head of Research, WALTHAM
The WALTHAM International Science Symposium
October 28 – 31 2003, Bangkok, Thailand

Nature, Nurture and the Case for Nutrition

TUESDAY, 28 October
18:00 - 21:00 WELCOME RECEPTION - Cocktail reception, buffet and registration
Plaza Atheneé Poolside

WEDNESDAY, 29 October - Day 1 - Scientific Sessions
07:00 - 08:30 Breakfast: Plaza Atheneé Restaurant

HEALTH AND BARRIERS TO DISEASE
08:45 - 09:00 Welcome and Introduction: Helen Munday, Head of Research, WALTHAM
09:00 - 10:00 STRATUM CORNEUM - THE FINAL FRONTIER, Prof. Ronald Marks
10:00 - 10:20 Dietary Constituents Can Increase Epidermal Lipid Synthesis By Canine Keratinocytes In Vitro
10:20 - 10:40 Dietary Constituents Can Improve Canine Epidermal Barrier Function In Vitro
10:40 - 11:00 Coffee break
11:00 - 11:20 Peripheral Blood Antioxidant Status And Oxidative Stress In Canine Osteosarcoma, Lymphoma And Oral Melanoma
Marlin, D.J., Murphy, S., Smith, N.C. and Hayes, A.
11:20 - 12:20 BACTERIA IN THE GUT: FRIEND AND FOE AND HOW TO ALTER THE BALANCE, Dr. Bob Rastall
12:20 - 12:30 Discussion and close of session
12:30 - 13:30 LUNCH

GENERAL NUTRITION
13:30 - 13:40 Introduction
13:40 - 14:00 Change in Bodyweight of Puppies of Different Breeds During Growth
Hawthorne, A.J., Booles, D., Nugent, P. and Wilkinson, J.
14:00 - 14:20 Influence of Body Size On Intestinal Permeability And Electrolyte Net Absorption In Adult Dogs
Hernot, D., Weber, M., Martin, L., Dumon, H., Biourge, V.C. and Nguyen, P.
14:20 - 14:40  Maternal Diet Alpha-Linolenic Acid During Gestation And Lactation Does Not Increase Canine Milk Docosahexaenoic Acid Content
   Bauer, J.E., Heinemann, K.M., Bigley, K.E. and Waldron, M.K.

14:40 - 15:00  Body Weight Influences Gastric Emptying Time Assessed By Sodium $^{13}$C Octanoate Test In Dogs
   Bourreau, J., Weber, M., Bailhache, E., Martin, L., Maugere, P., Biourge, V.C.,
   Dumon, H. and Nguyen, P.

15:00 - 15:30  Coffee break

15:30 - 15:50  Failure Of Excess Dietary Lysine To Antagonise Plasma Arginine In Adult Cats
   Fascetti, A.J., Maggs, D.J., Kanchuk, M.L., Clarke, H.E. and Rogers, Q.R.

15:50 - 16:10  Cats Select For Dietary Methionine But Not For Threonine
   Rogers, Q.R., Wigle, A.R., Lauffer, A., Castellanos, V.H. and Morris, J.G.

16:10 - 16:30  Nutritional Status Of Canine And Feline Patients Admitted To A Referral Internal Medicine Service
   Chandler, M.L. and Gunn-Moore, D.

16:30 - 16:50  Exogenous Influences On The Hair Colour Of Dogs
   Zentek, J., Busch-Kschiewan, K., Wortmann, F.J. and Biourge, V.C.

16:50 - 17:00  Discussion and close of session

18:00 - 19:30  POSTER SESSION – Drinks and hors d’oeuvres

19:30 - 22:00  CELEBRATION OF THE ORCHID – Traditional Food and Thai entertainment in the Plaza Atheneé Ballroom

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Thursday, 30 October - Day 2 - Scientific Sessions

07:00 - 08:30  Breakfast: Plaza Athené Restaurant

08:45 - 09:00  PROGRAMMING FOR LIFE. NUTRITION GENETICS AND THE ENVIRONMENT

09:00 - 10:00  Introduction

09:00 - 10:00  ATOPY AND ALLERGIES: LIFE’S AN ITCH, Prof. Douglas DeBoer

10:00 - 10:20  Dietary Intervention Can Improve Clinical Signs In Dogs With Atopy
   Markwell, P.J., Svoboda, M., and Fray, T.R.

10:20 - 10:40  Diagnoses Of Adverse Reactions In Dogs: Efficacy Of A Soy Hydrolysate-Based Diet
   Biourge, V.C., Fontaine, J. and Vroom, M.

10:40 - 11:10  Coffee break

11:10 - 11:30  Antioxidant Supplements In Horses Affected By Recurrent Airway Obstruction

11:30 - 11:50  Carbohydrate Malabsorption Is A Feature Of Feline Inflammatory Bowel Disease
   But Does Not Increase Clinical Gastrointestinal Signs
   Ugarte, C., Guilford, G.C., Markwell, P.J. and Lupton, E.
11:50 - 12:00 Discussion And Close Of Session

12:00 - 13:00 LUNCH

13:00 - 13:05 Introduction

13:05 - 14:05 **DIABETES MELLITUS: A QUIRK OF NATURE OR NURTURE**

*Prof. Jacquie Rand*

14:05 - 14:25 *Does End Stage Chronic Pancreatitis Play A Role In The Aetiology Of Disease? Use Of Glucagon Stimulation Tests To Assess Beta Cell Function In Affected Dogs*

*Watson, P.* and *Herritage, M.*

14:25 - 14:45 *Protein Intake Affects Body Composition But Not Energy Expenditure in Cats*

*Nguyen, P.*, *Leray, V.*, *Dumon, H.*, *Martin, L.*, *Siliart, B.* and *Biourge, VC.*

14:45 - 15:10 Coffee break

15:10 - 15:30 *The Effect Of High Protein Diets And Conjugated Linoleic Acid On Weight Loss In Dogs*

*Bierer, T.L.* and *Bui, L.M.*

15:30 - 15:50 *Dietary Linseed Oil Supplementation Affects Body Weight and Adipose Fatty Acid Composition Of Normal And Lipoprotein Lipase (LPL) Deficient Cats Differently*

*Veltri, B.C.*, *Backus, R.C.*, *DePeters, E.J.* and *Rogers, Q.R.*

15:50 - 16:50 **OBESITY – DO YOUR GENES FIT?**, *Prof. John Speakman*

16:00 - 17:00 Discussion and Close of Session

18:00 *Transport Departs from Plaza Atheneé for evening event*

18:15 - 22:00 **GALA DINNER** – Post-symposium celebration Thai style at the Siam Society in the heart of Bangkok

Friday, 31 October (All Day - Agenda to follow)

**U.S. National Academies Dialogue on Nutrient Requirements of Dog and Cats**

(Lunch and Refreshments will be provided)

**SCIENTIFIC POSTER Session with Authors** - Wednesday evening: 18:00 - 19:30

(Available for viewing throughout conference)

1. **THE EFFECT OF IMMUNOSTIMULATORY INGREDIENTS ON FAECES QUALITY AND MUCOSAL IMMUNITY IN GERMAN SHEPHERD DOGS (GSDs)**

*Butterwick, R.B.*, *Calvert, E.L.* and *Adams, C.A.*

2. **CHARACTERISTICS OF FOAL FEEDING BEHAVIOUR**

*Harris, P.A.*, *Ordakowski, A.L.*, *Davidson, H.P.B.*, *Redgate, S.E.* and *Kronfeld, D.S.*

3. **ANALYSIS AND CHARACTERISATION OF SEBACEOUS AND CERAMIDE LIPIDS OF CANINE SKIN**

*Watson, A.*, *Fray, T.R.* and *Markwell, P.J.*

4. **MATERNAL DIET FATTY ACIDS MODIFY CANINE PUPPY PLASMA LIPOPROTEIN DISTRIBUTION DURING THE SUCKLING PERIOD**

*Bauer, J.E.*, *Wright, A.S.*, *Bigley, K.E.*, and *Waldron, M.K.*
5. EVALUATION OF CORNEOMETRY (SKIN HYDRATION) AND TRANSEPIDERMAL WATER LOSS MEASUREMENTS IN DOGS AND COMPARISON OF TWO CANINE BREEDS Hester, S.L., Rees, C.A. and Bauer, J.E.

6. THE SURVEY OF DIETARY TYPES FREQUENTLY FED TO DOGS WITH AND WITHOUT MAMMARY GLAND TUMORS Sirivaidyapong, S.

7. ISovalThine Excretion in Adult Cats: Preliminary Data Hendriks, W.H., Vather, R., Weidgraaf, K. and Rutherford-Markwick, K.J.


9. CHANGES TO LEVELS OF DNA DAMAGE AND APOPTOTIC RESISTANCE IN PERIPHERAL BLOOD MONONUCLEAR CELLS AND THE PLASMA ANTIOXIDANT POTENTIAL OF SERUM WITH AGE IN LABRADOR RETRIEVER DOGS Blount, D.G., Heaton, P.R. and Pritchard, D.I.

10. A NUTRITIONAL PROPHYLACTIC FOR THE REDUCTION OF FELINE HAIRBALL SYMPTOMS Dann, J., Adler, M., Duffy, K. and Giffard, C.

11. THE BENEFITS OF BOVINE COLOSTRUM FOR GASTROINTESTINAL HEALTH Giffard, C., Seino, M., Markwell, P.J. and Bektash, R.

12. THE EFFECT OF DIETARY SODIUM CONTENT ON WATER INTAKE AND URINE COMPOSITION IN CATS Hawthorne, A.J. and Markwell, P.J.

13. EFFECT OF OBESITY ON APO B100 METABOLISM IN DOGS Bailhache, E., Ouguerram, K., Briand, F., Krempf, M., Magot, T. and Nguyen, P.


15. EFFECTS OF SUPPLEMENTAL SPRAY DRIED PLASMA ON FOOD INTAKE, GASTROINTESTINAL MICROFLORA, AND IMMUNE RESPONSE OF SENIOR DOGS Grieshop, C.M., Flickinger, E.A., Dust, J.M., Scherba, G., Quigley III, J.D. and Fahey Jr., G.C.

16. NATURAL STABILIZATION OF HIGH Ω-3 OILS FOR PETFOODS USING ROSEMARY EXTRACT Deffenbaugh, L.B.

17. THE EFFECT OF BODY SIZE AND ANTIBIOTIC TREATMENT ON TAURINE STATUS OF ADULT DOGS Törres, C.L., Backus, R.C., Biourge, V.C. and Rogers, Q.R.

18. EFFECT OF DIETARY FAT CONCENTRATION OF QUEENS ON FOOD INTAKE AND WEIGHT GAIN DURING GESTATION AND WEIGHT LOSS DURING LACTATION Jayawickrama, L., Rogers, Q.R., Kelley, R.L., Lepine, A.J. and Lönnerdal, B.

19. OXIDATIVE DNA DAMAGE IN EQUINE PERIPHERAL BLOOD MONONUCLEAR CELLS (PBMC) FROM HEALTHY AND RAO-AFFECTED ANIMALS ASSESSED BY COMET Marlin, D.J., Johnson, L., Kingston, D.A., Smith, N.C., Deaton, C.M., Mann, S., Van Vugt, F. and Harris, P.A.

20. RADIO-IODINE THERAPY OF FELINE HYPERTHYROIDISM REDUCES PLASMA ASCORBIC ACID OXIDATION Sparkes, A.H., Smith, N.C., Mardell, E.J. and Marlin, D.J.

21. EFFECT OF ACUTE AIRWAY INFLAMMATION ON PULMONARY ASCORBIC ACID IN HORSES Deaton, C.M., Marlin, D.J., Smith, N.C., Harris, P.A., Schroter, R.C. and Kelly, F.J.

22. NUTRIENT DIGESTIBILITY OF COMMERCIAL DOG FOODS Krogdahl, Å., Ahlstrøm, Ø. and Skrede, A.
23. FATTY ACID COMPOSITION IN COMMERCIAL DOG FOODS Ahlstrøm, Ø., Krogdahl, Å., Gregersen Vhile, S. and Skrede, A.

24. BODY COMPOSITION AND INSULIN SENSITIVITY BEFORE AND AFTER A RAPID WEIGHT LOSS IN DOGS FED A HIGH PROTEIN LOW ENERGY DENSITY DIET Blanchard, G., Nguyen, P., Siliart, B. and Paragon, B.

25. CALCIUM REGULATION IN GROWING DOGS OF 2 DIFFERENT BREEDS Dobenecker, B.

26. MODULATION OF UNCOUPLING PROTEIN 1 AND PEROXISOME PROLIFERATOR ACTIVATED RECEPTOR γ EXPRESSION IN ADIPOSE TISSUE IN OBESE INSULIN RESISTANT DOG Leray, V., Gayet, C., Siliart, B. and Nguyen, P.

27. THE EFFECTS OF MICROENTERAL NUTRITION IN PUPPIES WITH GASTROENTERITIS Garcia, M.

28. INFLUENCE OF DIETARY PROTEIN SOURCE (POULTRY, BEEF) AND MANUFACTURING PROCESS (CANNING, EXTRUSION) ON THE COMPATIBILITY AND DIGESTIBILITY OF MIXED DIETS AND SOME INTESTINAL PARAMETERS IN DOGS Zentec, J., Fricke, S., Hewicker-Trautwein, M, Ehinger, B., Amtsberg, G. and Baums, C.

29. INFLUENCE OF DIETARY PROTEIN QUALITY AND CONCENTRATION ON URINE COMPOSITION OF CATS Zentek, J. and Schulz, A.

30. EXOCRINE PanCREATIC INSUFFICIENCY (EPI) AND ADVERSE REACTION TO FOOD: A POSITIVE RESPONSE TO A HIGH FAT, SOY ISOLATE HYDROLYSATE-BASED DIET Biourge, V.C. and Fontaine, J.

Computer Demonstration

DEVELOPMENT IN COMPUTER-AIDED DIET CALCULATION FOR DOGS AND CATS Dobenecker, B. and Kienzle, E.
**Professor Ronald Marks**

Ronald Marks was awarded an M.B., BS(Hons) from Guy's Hospital Medical School in 1959. After pre-registration positions, and some time in the army (where he gained the rank of Major), Prof. Marks had several posts at London hospitals and then at the Institute of Dermatology where he developed a laboratory for experimental pathology of the skin. In 1973 he joined the Department of Dermatology at the University of Wales, where he rose to the position of Professor. His research has had several focal points, with major interests being the epidermis and stratum corneum, the pathophysiology of disease affecting these structures and the design of non-invasive instrumentation for the study of skin. Prof. Marks has been President of the European Society for Dermatological Research and is Life President of the International Society of Bioengineering and the Skin. He has been invited to deliver many notable public lectures and has contributed to hundreds of scientific papers and a number of books. Although having retired in 1998 (when he also became Professor Emeritus), Prof. Marks is still active in professional work.

**Doctor Bob Rastall**

Bob Rastall is Senior Lecturer in Food Biotechnology and head of the Food and Bioprocessing Sciences Research Group within the School of Food Biosciences at the University of Reading. He is working on the development of carbohydrate-based functional food ingredients for human and companion animal application. His aim is to develop enhanced prebiotics, symbiotics and anti-adhesive oligosaccharides through the use of biotechnological methods. He has over 60 publications in the area of carbohydrate biotechnology and functional foods and has attracted over a million pounds in research income. Dr Rastall currently has a research team of ten PhD students and four postdoctoral research fellows.

**Professor Jacquie Rand**

Jacquie Rand is Professor of Companion Animal Health at the University of Queensland, and is recognised internationally as a leader in feline diabetes and nutrition research. Prof. Rand is the author of over fifty publications in the area. She has been invited to speak at numerous international conferences including the North American Veterinary Association, British Small Animal Veterinary Association and the World Small Animal Veterinary Association Conference. She has attracted over $1.5 million in industry funding for research. Prof. Rand currently has a team of five PhD or Master's candidates working in diabetes, obesity and nutrition research in companion animals.

**Professor Douglas DeBoer**

Douglas DeBoer is Associate Professor of Dermatology at the School of Veterinary Medicine, University of Wisconsin in Madison, USA. Prof. DeBoer's principle research interests are the immunological basis of recurrent skin diseases, including canine staphylococcal skin infection and feline dermatophytosis and the role of immediate-type hypersensitivity in animal skin diseases. A diplomate of the American College of Veterinary Dermatology since 1987, his clinical interests include allergic skin disease, recurrent staphylococcal infections and dermatophyte infections. Prof. DeBoer has authored a number of scientific papers, including those covering his current research interest: the feasibility of vaccinating against Feline ringworm.

**Professor John Speakman**

John Speakman has been working in Aberdeen since 1984 and was appointed to head the Appetite and Energy Balance Group in July 2000, as a joint Rowett/Aberdeen University appointee. Prof. Speakman's research interests principally concern the quantification of energy expenditure and body composition using isotope based methodologies, providing novel insights into the functioning of free-living animals. As well as writing and editing books on his research methodologies, Prof Speakman's work in zoology has yielded several Nature publications and in 1996 he was awarded the Zoological Society of London's Scientific Medal. His future work will bring to bear these isotope methodologies and his insights from the zoological evolutionary perspective on the causes of the international obesity epidemic.
Abstracts of oral presentations are arranged in chronological order, followed by poster abstracts.
DIETARY CONSTITUENTS CAN INCREASE EPIDERMAL LIPID SYNTHESIS BY CANINE KERATINOCYTES IN VITRO
WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
A major role of the mammalian epidermis is to provide a barrier protecting the body from harmful environmental influences. A critical part of the epidermal barrier is the lamellar lipid of the stratum corneum, which is primarily composed of ceramides, sterols (cholesterol plus derivatives) and free fatty acids. The aim of this study was to assess the ability of selected nutrients to increase production of these lipid components by canine keratinocytes in vitro.

Materials and Methods
Canine keratinocytes were cultured in proliferation media for 4 days, differentiation promoting media for 6 days followed by a further 2 days in the latter with the addition of radio labelled precursors of lipids (\(^{14}\text{C}\)-serine for ceramides and \(^{14}\text{C}\)-acetate for total lipids). Lipid was extracted by the method devised by Bligh and Dyer and quantified by scintillation counting. Lipid production in control samples was compared with media supplemented with one of 26 nutrients.

Results
Significant increases in ceramide synthesis were seen when the keratinocytes were cultured with nicotinamide (\(P<0.01\)), pantothenic acid (\(P<0.01\)), histidine (\(P<0.05\)), choline and inositol (the latter two only when combined, \(P<0.01\)). Significant increases in synthesis of total epidermal lipid were found with pantothenic acid (\(P<0.01\)), nicotinamide (\(P<0.01\)) and histidine (\(P<0.01\)).

Conclusion
Supplementation with five nutrients, alone or in combination, resulted in significant increases in synthesis of lipid components of the epidermal barrier in vitro. These nutrients have the potential to enhance skin barrier function if similar effects occur in vivo.
DIETARY CONSTITUENTS CAN IMPROVE CANINE EPIDERMAL BARRIER FUNCTION IN VITRO
WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, U.K.

Introduction
Epidermal barrier function is a critical property of mammalian skin, protecting the body from detrimental environmental factors. Enhancing barrier function will, therefore, benefit overall health. Previous studies have shown that supplementation with specific nutrients can augment the biosynthesis of epidermal barrier lipids by canine keratinocytes in vitro. The aim of this study was to assess the effect of these supplements on the barrier properties of epidermal ‘equivalent’ constructs.

Materials & methods
Epidermal constructs were generated through terminal differentiation of canine primary keratinocytes cultured in the presence or absence of the supplements at the air–liquid interface on a polycarbonate disc substratum. Electron and light microscopy demonstrated that the constructs achieved an advanced stage of keratinisation and stratification. The barrier function assay measured the transit time of tritiated water across the in vitro epidermis in a Costar vertical diffusion chamber. Samples were collected at 3-minute intervals for a total of 90 minutes. All experiments were run with a minimum of two replicates.

Results
Significant reductions of the transit rate of radiolabelled water were observed when the epidermal constructs were formed in the presence of pantothenic acid (10µM) (P=2.8x10⁻⁸ by regression analysis), nicotinamide (10µM) (P=2.2x10⁻¹⁵), and a combination of inositol and choline (both 50 µM) (P=6.9x10⁻⁵). Neither inositol nor choline influenced transit time when used alone.

Conclusion
Supplementation with these nutrients enhanced barrier function in vitro. This improvement in barrier function is likely, at least in part, to have resulted from the enhanced lamellar lipid synthesis shown previously to occur with these nutrients.

References
PERIPHERAL BLOOD ANTIOXIDANT STATUS AND OXIDATIVE STRESS IN CANINE OSTEOSARCOMA, LYMPHOMA AND ORAL MELANOMA

Murphy, S.¹, Smith, N.C.², Hayes, A.¹ and Marlin, D.J.²
1 Centre for Small Animal Studies, Animal Health Trust, Newmarket, UK
2 Centre for Equine Studies, Animal Health Trust, Newmarket, UK

Introduction
Cancer is estimated to affect approximately 40% of dogs over 10 years of age. Many of these cancers are curable with surgery alone, however a significant proportion of neoplasia will present with or result in disseminated disease. There is increasing evidence free radicals play a role in the pathogenesis of cancer. The aim of the present study was to determine the systemic antioxidant status and a marker of oxidative stress in red blood cells (RBC) from dogs with three aggressive cancers: osteosarcoma, lymphoma and oral melanoma.

Materials and Methods
Blood samples were collected from dogs presented at the clinic for treatment of osteosarcoma (n=3), lymphoma (n=3) and malignant melanoma (n=1). In addition, blood samples were collected from 8 healthy control dogs with no history or evidence of neoplasia. Reduced (GSH), oxidised (GSGG) and total glutathione (TGSH) and glutathione redox ratio (GRR = GSSG/TGSH*100) were measured in RBC haemolysates by HPLC.

Results
There was no significant difference between the tumour group and the control group for GSH or TGSH. However, dogs in the tumour group had significantly higher GSSG (tumour 52±25 versus control 29±12 umol/l RBC; P=0.034) and GRR (tumour 5.2±3.0 versus control 2.7±0.9 %; P=0.039).

Conclusion
As far as we are aware this is the first report of oxidative stress in peripheral blood of dogs with aggressive tumors. Further studies are indicated to determine if the oxidative stress is a cause or effect of these conditions and whether dietary or other forms of antioxidant supplementation may be beneficial in the management of these conditions.
The different breeds of dog vary greatly in their adult bodyweight, and the age at which this weight is reached. However, there is a paucity of published information available on full growth-curves, particularly comparing breeds of different sizes. This paper presents changes in bodyweight for 12 breeds of dog (toy to giant breeds) measured at a single facility (WALTHAM Centre for Pet Nutrition, UK).

Puppies were weighed weekly using calibrated scales from birth (or soon after weaning) until they were approx. 12 months of age (toy to medium) or 18 months of age (large and giant). Throughout, they were fed nutritionally complete puppy foods at a level to maintain optimum body composition. Adult weight, exponential growth rate and time to reach 50 % and 99 % of adult weight was determined by fitting logistic curves. The toy to medium breeds took 39.6 – 46.5 weeks and the large and giant breeds 46.1 – 65.2 weeks to reach 99% of adult weight.

This study demonstrates a longer period of growth in large and giant breeds compared to smaller dogs.

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>mean adult weight (kg)</th>
<th>Exponential growth rate</th>
<th>Time to reach 50% of adult weight (weeks)</th>
<th>Time to reach 99% of adult weight (weeks)</th>
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</table>
INFLUENCE OF BODY SIZE ON INTESTINAL PERMEABILITY AND ELECTROLYTE NET ABSORPTION IN ADULT DOGS
Hernot, D.1, Weber, M.1, Martin, L.1, Dumon, H.1, Biourge, V.C.2, and Nguyen, P.1
1 Nantes National Veterinary School, Nantes, France
2 Royal Canin Research Centre, Aimargues, France

Introduction
Observations on food tolerance have shown that large dogs have higher faecal water contents and a greater frequency of soft stools. This could be explained, at least in part, by a lower intestinal water absorption. This can be estimated as measured by electrolyte net absorption and intestinal permeability. The objective of the study was to assess both these variables in small and large dogs and to determine whether they correlated together and with faecal quality.

Materials and Methods
Twenty four dogs varying in body size were studied including 6 Miniature Poodles (MP), 6 Standard Schnauzers (SS), 6 Giant Schnauzers (GS) and 6 Great Danes (GD). Intestinal permeability was assessed by measuring the ratio of urinary lactulose to rhamnose (L:R) after oral administration. Electrolyte net absorption was evaluated through sodium and potassium apparent digestibility and faecal concentration. Faecal moisture and consistency were scored during the same period.

Results
The urinary L:R ratio was significantly higher in large than in small dogs (0.31:0.08 for GD and 0.16:0.04 for MP). Higher electrolyte faecal concentrations and lower electrolyte digestibilities were observed in GS and GD. Strong correlations were found between L:R ratio and sodium digestibility and faecal concentration (R=-0.84 and 0.76 respectively, p<0.0001). Moreover these variables were strongly correlated with faecal quality.

Conclusion
Our results suggest 1) that the lower electrolyte net absorption observed in large dogs could be explained by the higher intestinal permeability and 2) that both these variables could be important explanations for higher faecal moisture in large dogs.
MATERNAL DIET ALPHA-LINOLENIC ACID DURING GESTATION AND LACTATION DOES NOT INCREASE CANINE MILK DOCOSAHEXAENOIC ACID CONTENT

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The effect of feeding alpha-linolenic acid-rich diets on docosahexaenoic acid enrichment of mammary gland milk was investigated in canine bitches. 12 bitches (three dogs each per diet group) were fed one of four experimental diets from the time of breeding via artificial insemination and throughout gestation, parturition, and lactation. The diets, which differed in their fatty acid composition, were sufficient in linoleic acid and contained 14 % total fat using either beef tallow (TAL), linseed oil (LIN), or higher and lower amounts of menhaden fish oil (HMH and LMH respectively) as primary fat source. Total protein, fat, nitrogen-free extract, vitamins, and minerals were the same in all four dry, extruded type diets.

After normal parturition, milk samples were collected from all bitches by manual expression on lactation days 4, 10, 16, and 28. Milk total lipids were extracted using chloroform:methanol (2:1, v/v), fatty acid methyl esters prepared, and fatty acid profiles determined via gas chromatography. Blood samples were also collected at these times, plasma harvested and total phospholipid fatty acid profiles determined after thin-layer chromatography and gas chromatography of methyl ester derivatives. Canine milk contained, on average approximately 9-10 % total fat on an as-is basis and no differences due to diet were found in this value. However, differences in individual fatty acids were observed. At all time points, milk linolenic acid was highest in dogs fed the LIN diet compared to the other groups. Arachidonic acid content was moderately decreased in the LMH and HMH diets especially during later lactation compared with the TAL and LIN groups. As expected, eicosapentaenoic acid content of milk from dogs fed both the LMH and HMH diets was increased compared with either TAL and LIN. Also dogs fed the menhaden oil diets resulted in milk enriched in docosahexaenoic acid (DHA) in a dose dependent fashion. Changes in plasma phospholipid fatty acid profiles mimicked those seen in canine milk. Most striking was that no enrichment in milk DHA was observed in animals fed the LIN diet.

These findings are similar to those recently reported in lactating human subjects supplemented with flaxseed oil on a short term basis during their lactation period. By contrast the dogs in this study had been fed a diet high in linseed oil at the onset of breeding and throughout their gestation and lactation periods. It appears that dietary alpha-linolenic is an ineffective means of increasing milk DHA content for neonatal nutritional modification.
BODY WEIGHT INFLUENCES GASTRIC EMPTYING TIME ASSESSED BY SODIUM $^{13}$C-OCTANOATE TEST IN DOGS

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The sodium $^{13}$C-octanoate breath test (OBT) has been described for assessment of gastric emptying (GE) in the dog. Studies in humans have shown a negative linear relationship between rate of GE and body weight (BW). A weak relationship has been observed in dogs but using an artificial meal. The aim of this study was to investigate the relationship of BW and GE in the dog using both the OBT and a standard dog food.

Twenty-one healthy dogs of varying body weight and size were used. 24-h unfed dogs were fed a commercial food (half of their daily estimated energy requirement) labelled with 7.5 mg/kgBW$^{0.75}$ sodium $^{13}$C-octanoate. Breath samples were collected prior to the meal and at frequent intervals thereafter for 6h. Analysis was performed by isotope ratio mass spectrometry. For each dog times taken for recovery of a quarter (T1/4), half (T1/2) and three quarters (T3/4) of the total amount of $^{13}$C recovered for the period of measurement and time of peak excretion (Tmax) were calculated and their relationship to BW investigated. While results showed wide variations, there was a correlation between BW and T1/4 (87 ± 22 min, p=0.001), and BW and T1/2 (156 ± 30 min, p=0.026) but not between BW and T3/4 (239 ± 31 min). Tmax was also shorter in smaller animals (p=0.0005).

These results demonstrate that initial gastric emptying rate would be higher in small dogs without significant effect on total gastric emptying time. These observations could have physiological (satiety...) as well as clinical (gastric dilation-volvulus...) implications.
FAILURE OF EXCESS DIETARY LYSINE TO ANTAGONIZE PLASMA ARGININE IN ADULT CATS

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Oral lysine administration to cats latently infected with feline herpesvirus type 1 significantly reduces basal viral shedding compared with placebo-treated controls. In other species, excess dietary lysine can antagonize plasma arginine. The amount of dietary lysine necessary to antagonize plasma arginine concentrations in adult cats is unknown.

Thirty-five adult, specific-pathogen free cats were randomly assigned to 6 dietary treatment groups. The control group (n=5) was fed a basal, commercial-type dry maintenance diet containing 1.3% (DM) lysine and 1.6% (DM) arginine. The 5 other treatment groups (n=6) were also fed the basal diet, but with lysine added as lysine acetate dissolved in water to yield a final concentration of 3.8, 6.3, 8.8, 11.3 or 13.3% lysine in the diet. Cats had free access to food and water throughout the study. Food and lysine intake were determined daily. Blood was collected for plasma amino acid analysis on day 14. Food intake was significantly reduced in the cats consuming diets containing 11.3 and 13.3% lysine (P < 0.04). Lysine intake and plasma lysine concentrations increased with supplementation, and were significantly increased in all treatment groups compared to controls (P < 0.02). However, there was no difference in mean lysine intake or plasma lysine concentration among cats consuming diets containing 8.8, 11.3 and 13.3% lysine. Plasma arginine concentrations did not differ among dietary treatment groups.

These results indicate that 13.3% dietary lysine does not antagonize plasma arginine in cats and that lysine can be fed as high as 8.8% without recognized adverse effects.
CATS SELECT FOR DIETARY METHIONINE BUT NOT FOR THREONINE
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Cats, unlike rats and dogs do not select for protein, NaCl, or sugars. We tested whether cats would select a diet least deficient (def) in an essential amino acid (AA).

Kittens (1.7 ± 0.1 kg, n = 9), were offered AA diets containing 0.4 (def) vs 0.6% (barely adequate) threonine (thr) for 9 d. Adult cats (5.1 ± 0.4 kg, n = 12) were tested in 3 choice paradigms: AA diets containing 1) 0.0 vs 0.2% (barely adequate) L-methionine (met); 2) 0.2 vs 0.4% met; or 3) 40 % protein diet containing 0.0 vs 0.2 % added met. All were fed for 16 h/d for 7-11 d. Kittens did not select (P > 0.10) between the 0.4 and 0.6 % thr-containing diets (30.3 vs 29.6 g/d, respectively over 9 d). Cats chose 0.2 % over 0.0 met by hour 1 (P = 0.04) on d 1 and continued this selection through d 7 (P = 0.04-.001). Cats chose 0.4 over 0.2 % met only on d 3 (P = 0.003). When diets had 40 % protein, 0.2 % met was selected over 0.0 % only on days 4-8 (P= 0.003).

These results indicate that cats do not select for thr when fed a thr-def diet, but do select for 0.2 % met whether the cats are def or not. Further work needs to be carried out to determine whether the choice for met is the result of palatability or of a learned taste aversion.
The rate of malnutrition in human medical patients has been estimated to be 30 to 50%. These figures are often used in estimating the number of malnourished dogs and cats admitted to veterinary hospitals.

The objective of this study was to assess the nutritional status of a sample population of the dogs and cats admitted to a referral internal medicine service. Criteria for inclusion were: age over six months, presentation for a new disorder, and hospitalisation of at least one night. Body condition scores (BCSs) were determined at admission using a one to nine point scale previously validated by dual absorption x-ray absorptiometry. A score of 5 was considered optimal, with lower numbers indicating thinness, and higher ones indicating an overweight condition. The anamnesis included questions on recent weight loss and adequate food intake. There were BCS data for 82 dogs and 67 cats, and appetite and weight loss data for 76 dogs and 61 cats.

The mean BCS for the dogs was 5.2 (SD = 1.81), and 29.3% of the dogs had a BCS of < 5. There were 35.7% of the dogs with a history of decreased appetite, and recent weight loss in 44.7%. The mean BCS for the cats was 4.18 (SD = 1.28), with 62.6% of them scoring < 5. Of the cats, 55.7% had a recent weight loss, and 53.2% had decreased appetite.

These data support the concept that 30 to 50% of hospitalised small animal internal medicine patients require nutritional support.
EXOGENOUS INFLUENCES ON THE HAIR COLOUR OF DOGS
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Introduction
Discoloration of the coat is a problem of practical importance in canines. This includes general fading of hair colour but also yellowish or reddish hairs in white or black individuals. Pigmentation depends on the presence and the relation of reddish eu- and black pheomelanin, and the density and distribution of the melanins in the hair cortex and medulla. The present study investigates some exogenous factors like UV light, temperature, and humidity on hair discoloration in West Highland White Terriers and American Canadian Shepherds.

Materials and methods
Hair samples were collected from dogs with different signs of discolouration of white hair (yellowish or reddish colour). By microscopy, the presence of pigments was studied and a method (CIEL colour measurement) was adapted to measure hair colour in canine specimen. Exposure to UV light, increased temperature and humidity was investigated with regards to the colour measurements.

Results
The presence of pigments in white haired dogs was confirmed by light microscopy. UV light and increased temperature and humidity had influences on hair colour that could be measured objectively and reproducibly by CIEL*a*b*-colour measurements.

Conclusion
The methods were able to demonstrate the effects of factors like UV light, humidity and temperature on hair colour. The procedures may prove to be useful also for nutritional studies.
Introduction
Atopy is the second most common canine allergic skin disease. Most atopic patients require long-term therapy with glucocorticoids. Diet provides one option for adjunctive therapy that may improve clinical signs and reduce the requirement for glucocorticoids. The aim of this study was to evaluate a commercial selected protein source diet supplemented with Aloe vera, curcumin, vitamin C, taurine and n-3 PUFA (SSD) in atopic dogs.

Materials and methods
19 confirmed atopic dogs completed a blinded, crossover study. Dogs were randomised to receive either SSD or a nutritionally complete, control diet for 12 weeks, followed by crossover to the other diet. Structured, regional evaluations of erythema, lichenification, excoriation and alopecia were conducted at baseline and subsequently at approximately four-week intervals during the study, with severity assessed using a four-point score. Summation of values provided a total clinical score (TCS) for each dog at each time point. Statistical comparisons were made using the Wilcoxon signed rank test.

Results
TCS decreased (P=0.004) in the dogs fed SSD first, then increased (P=0.007) towards baseline after crossover. TCS did not change significantly (P=0.14) in dogs fed the control diet first, then decreased after crossover to SSD (P=0.042) (Figure).

Conclusion
SSD resulted in improvements in clinical signs in atopic dogs, compared with a nutritionally complete diet. SSD may be considered a useful adjunct to the management of atopy in dogs.

References
A) WALTHAM® Veterinary Diet Canine Skin Support™
DIAGNOSIS OF ADVERSE REACTIONS TO FOOD IN DOGS: EFFICACY OF A SOY ISOLATE HYDROLYSATE BASED DIET

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Introduction
Adverse reaction to food is a nonseasonal, pruritic skin disorder of dogs that is associated with the ingestion of a substance found in the diet. Currently, its definitive diagnosis can only be made on the basis of elimination diets (i.e. diets made of novel ingredients) for the dog. Because they are easily customized and free of food additives, homemade diets have often been recommended by veterinary dermatologists for the diagnosis and the management of food hypersensitivity. However, owners are often reluctant to feed homemade diets because they are time consuming and expensive. Moreover, they are difficult to balance. Lately, elimination diets based on protein hydrolysates have become available to veterinarians. Protein hydrolysates have been used with success to prevent and treat milk allergies in babies. The purpose of this study was therefore to assess the efficacy of a diet containing soy isolate hydrolysate for the diagnosis of adverse reaction to food in a multicentric field study.

Materials and methods
Sixty dogs, 34 males-26 females, age ranging from 3 months to 11 years from 26 different breeds, all showing signs compatible with non seasonal skin hypersensitivity and presented at 2 dermatology specialty practices, were entered in the study. Clinical signs included localized or generalized pruritus, self-trauma, recurrent pyoderma and/or malassezia dermatitis as well as otitis. Dietary histories were taken, animals thoroughly examined for clinical signs (erythema, broken hair, scale), the pruritus was scored on a scale 1-5, and ectoparasites were excluded. Owners were instructed to feed exclusively a soy hydrolysate and rice based dietA over a 2 month-period. No medication was allowed during the trial. Following the trial, if the clinical signs as well as pruritus improved, a challenge with the old diet was performed. If there was major improvement but no complete recovery, dogs were worked up for atopy. If there was no or little improvement, dogs were tested with other diets as well as for atopy.

Results
Two cases were excluded from the trial because of non-compliance with the protocol. Thirty-six dogs significantly improved following the hypoallergenic challenge and relapsed when a regular diet was reintroduced. Sixteen out of these 36 dogs were also diagnosed with atopy. Twenty-two dogs that did not respond to the hypoallergenic diet were diagnosed with atopy exclusively. Two dogs that did not improve on the soy hydrolysate based diet did improve on other elimination diets.

Conclusion
This study suggests that adverse reaction to food might be a common cause of pruritus in dogs. A diet based on soy hydrolysate is a practical and efficient way to diagnose adverse reaction to food in dogs. To definitively rule out an adverse reaction to food, a challenge with a second diet is recommended.

References
A) Veterinary Diet Canine Hypoallergenic, Royal Canin, Aimargues, France
INTRODUCTION

Recurrent airway obstruction (RAO) is characterised by periods of acute airway inflammation, pulmonary oxidative stress and bronchoconstriction, interspersed with periods of remission. Ascorbic acid is quantitatively the most important antioxidant in equine bronchoalveolar lavage fluid (BALF). The ascorbic acid concentration in plasma and BALF is significantly reduced in RAO-affected horses with airway inflammation and when in remission, compared to healthy controls. The aim of this study was to investigate the effects of antioxidant supplementation on pulmonary and systemic antioxidant status and exercise-induced oxidative stress in RAO-affected horses.

MATERIALS AND METHODS

Five RAO-affected horses were supplemented with either a mixture of natural antioxidants including vitamin E, ascorbic acid and selenium (WINERGY VENTIL-ATETM) or a placebo, for four weeks in a crossover design followed by a washout period of four weeks. At the end of each period BALF and blood samples were collected before and after a thirty-minute sub-maximal exercise test (up to 90%VO2max).

RESULTS

Antioxidant supplementation significantly increased the plasma ascorbic acid concentration (P<0.01), and increased the BALF and BALF cell pellet ascorbic acid concentrations in four out of five horses. The BALF concentration of oxidised glutathione (GSSG) was reduced after supplementation, but not significantly (P=0.07). Exercise did not induce the oxidation of ascorbic acid or glutathione or increase lipid peroxidation (i.e. no change in MDA) prior to or after antioxidant supplementation.

CONCLUSION

As in normal horses (Deaton et al., 2002, Equine Vet. J. (34), 58-65), this intensity of exercise did not induce significant oxidative stress, despite RAO-affected horses having a low antioxidant capacity. However, dietary antioxidant supplementation appears to increase both the plasma and pulmonary concentrations of ascorbic acid and decrease the concentration of GSSG in BALF, indicative of increased antioxidant capacity and a trend towards reduced oxidative stress. Increased pulmonary and systemic antioxidant capacity as a result of supplementation therefore may be beneficial in circumstances where oxidative stress does occur, such as airway inflammation or more strenuous exercise.
CARBOHYDRATE MALABSORPTION IS A FEATURE OF FELINE INFLAMMATORY BOWEL DISEASE BUT DOES NOT INCREASE CLINICAL GASTROINTESTINAL SIGNS

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2 WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
Carbohydrate malassimilation is a common, but poorly studied, complication of feline gastrointestinal disease. Optimising the digestibility and utilisation of dietary carbohydrates might improve the outcome of dietary management during feline inflammatory bowel disease (IBD).

Materials and methods
Fifteen healthy cats and seven cats with IBD participated in a blinded, randomized, controlled dietary trial using a crossover design. Total and peak breath hydrogen production was compared when a control diet (boiled chicken), or test diets (chicken with rice, barley, tapioca or corn) were fed. Faecal characteristics (grade, water content and osmolar gap) were also studied. SAS software was used for all statistical analysis.

Results
IBD cats showed increased breath hydrogen production (p=0.0001) for all diets when compared with healthy cats. There were no significant differences in breath hydrogen production by the IBD cats when they were fed either the control or any of the carbohydrate supplemented diets. There were no differences in faecal grade, faecal fluid potassium concentration and osmolar gap between diets or between control and IBD cats. A significant increase in faecal fluid sodium concentration (p=0.046) and in the faecal fluid sodium/potassium ratio (p=0.001) was present when cats ate a rice based diet.

Conclusion
Cats with gastrointestinal disease show broad-spectrum sub-clinical carbohydrate malabsorption, as measured by breath hydrogen collection, but apparent clinical tolerance to carbohydrate intake. Faecal grade does not seem to be a reliable measure of dietary carbohydrate malabsorption in cats. Further studies should be undertaken to determine the optimal macronutrient profile of diets designed for the management of feline IBD.
DOES END STAGE CHRONIC PANCREATITIS PLAY A ROLE IN THE AETIOLOGY OF DIABETES MELLITUS IN DOGS? USE OF GLUCAGON STIMULATION TESTS TO ASSESS BETA CELL FUNCTION IN AFFECTED DOGS
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Introduction
The aetiology of canine diabetes mellitus (DM) is poorly understood. Immune-mediated disease and hormone antagonism are thought to play a role. The importance of end stage chronic pancreatitis (CP) as a cause of canine DM has never been investigated. Previous pathological studies suggest its involvement in up to 30% of cases. The aim of this study was to assess the response to dynamic testing in dogs with CP without overt DM.

Materials and Methods
Intravenous glucagon stimulation tests (GSTs) were performed in 3 dogs with biopsy confirmed CP and 3 dogs with strong ultrasonographic and clinicopathological evidence of CP. One dog had exocrine pancreatic insufficiency (EPI) and one dog had newly diagnosed DM at the time of testing. 1ml of glucagon was injected iv after an overnight fast and blood samples taken at time = 0, 10, 20 and 30 minutes for measurement of glucose and insulin concentrations. Results were compared with normals from the same institution and with published normals.

Results
Three dogs (including the one with EPI and the one with DM) developed marked hyperglycaemia together with very poor insulin response consistent with DM. Two dogs had high insulin peak responses and high post stimulation glucose values consistent with insulin resistance. One had an inappropriately low insulin response suggesting some loss of islet cell function.

Conclusion
This study shows dogs with CP have islet dysfunction, insulin resistance and DM. Further work on a large number of dogs is indicated. Recognition that CP can cause DM has important implications for dietary and other management of these dogs.
Diet composition influences the development of obesity. Moderately low-protein diets have been shown to increase caloric intake and body fat whereas protein could enhance satiety and diet-induced thermogenesis. The aim of this study was to compare the effects of high- vs. moderate-protein diet on body composition and energy expenditure in cats.

Nineteen cats (11 females, 8 males) were fed a commercial dry food (34%CP, 350 kcal ME/100g) for six months. They were then allotted to two groups and were fed for six other months either high-protein (52.8%CP, 394 kcal; 6 females, 3 males) or moderately low-protein (29.7%CP, 378 kcal; 5 females, 5 males) diet. Body composition and basal energy expenditure were assessed prior to and at the end of the test period. Body composition was determined from deuterium oxide dilution. Energy expenditure was calculated from gas exchange monitoring.

The fat free-mass increased in the high-protein group (3.30±0.53 vs. 2.97±0.31 kg, at the beginning and the end of the test period respectively, p=0.075) while it was not significantly affected in the other group. The energy expenditure expressed either per kg BW (35±5 kcal/d) or per kg fat-free mass (59±7 kcal/d) did not differ between groups or periods.

These results tend to confirm that like in other species, protein intake may affect body composition in cats. This species is known for its high protein requirement for maintenance based on nitrogen balance. Our results suggest that dietary protein allowance could be still higher in order to optimize body composition and avoid development of obesity.
THE EFFECT OF HIGH PROTEIN DIETS AND CONJUGATED LINOLEIC ACID ON WEIGHT LOSS IN DOGS
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WALTHAM USA, Vernon, California, USA

Obesity is a top health concern in pets. Moderate to severe calorie restriction using high carbohydrate/low fat diets is the most common method for reducing a pet's weight. In contrast, high protein diets are the trend in human weight loss, used to reduce body weight (BW) without severely reducing calories. The purpose of this study was to test the effects of high protein and/or conjugated linoleic acid (CLA) on weight loss in dogs using mild calorie restriction.

Forty Beagle dogs with body condition scores of 4-5/5 were divided into four groups and fed one of the following diets for 12 weeks at 85% of maintenance calories: 28% protein (CON), 28% protein + 1% CLA (CLA), 50% protein (HP) or 50% protein + 1% CLA (HPCLA). BW was recorded weekly. Body composition was evaluated using deuterium oxide at 0, 7 and 12 weeks. At 12 weeks, the HP and HPCLA groups had lost significantly more BW (10.9% and 10.2%) than the CON and CLA groups (4.4% and 4.9%). HP and HPCLA groups also lost a significantly greater % of fat (39.1% and 35.6%) as compared to the CON group (5.5%). The CLA group lost an average of 22.5% fat. Also at 12 weeks, BUN:creatinine rose significantly in the HP group while levels in the HPCLA group did not.

This study suggests that high protein diets can be used to promote weight loss in overweight dogs and that CLA may have a beneficial effect in lowering BUN:creatinine in dogs on these diets.
DIETARY LINSEED OIL SUPPLEMENTATION AFFECTS BODY WEIGHT AND ADIPOSE FATTY ACID COMPOSITION OF NORMAL AND LIPOPROTEIN LIPOASE (LPL) DEFICIENT CATS DIFFERENTLY
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The fatty acid (FA) composition of adipose triacylglycerol is variable and depends on rates of de novo FA synthesis and incorporation of dietary FA via LPL. In LPL-deficiency, differences are expected in adipose triacylglycerol FA composition.

Four normal and 4 LPL-deficient intact queens (1-5 γ) were continuously fed for > 12 mo a commercial “all-stages” dry-type diet. After collection of ~ 250 mg of inguinal subcutaneous adipose from the cats under anesthesia, 30 g of linseed oil (56 % C18:3 n-3) was added to every kg of the diet. Adipose biopsies were then repeated on d 38, 61 and 110. Before oil supplementation, LPL-deficient queens (3.7 ± 0.1 kg) weighed less (P < 0.05) than normal queens (3.9 ± 0.1 kg). After supplementation, mean body weight of LPL deficient queens increased (P < 0.05) for 4 wk to 3.9 ± 0.1 kg then plateaued, while mean weights of normal queens remained constant. At all sampling times, adipose triacylglycerol of normal queens was higher in polyunsaturated FAs (PUFA, 17-20% vs 9-10%) and mono-unsaturated FAs (MUFA, 44-46% vs 28-32%) and a lower in saturated FAs (SFA, 36-37% vs 58-63%) than that of LPL deficient queens (P< 0.0001). PUFA:SFA ratio increased with time in all cats following the oil supplementation.

The FA profile differences indicate that substantial de novo FA synthesis may occur in domestic cats and that storage of FA species may be altered in inherited or acquired LPL deficiencies. The linseed oil-induced weight gain in the normally lean LPL-deficient cats may indicate a high C18:3 n-3 requirement in LPL-deficiency.
THE EFFECT OF IMMUNOSTIMULATORY INGREDIENTS ON FAECES QUALITY AND MUCOSAL IMMUNITY IN GERMAN SHEPHERD DOGS (GSDS)

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Introduction
IgA is important in the immune system’s response to antigenic challenge. GSD’s are susceptible to immune mediated disorders and a subset have been demonstrated to have low IgA levels. The aim of this study was to assess the effect of immunostimulatory functional ingredients on faecal IgA levels in GSD’s.

Materials and Methods
28 GSD’s (groups A (n=14) & B (n=14)) were investigated in this study. Faeces quality was assessed (WALTHAM® Faeces Scoring System™ (1= diarrhoea; 5= hard faeces)) and faecal IgA measured (ELISA). The trial was divided into 4 phases (4 weeks duration)

Results
Diet nutritionals (%): Protein: 22, Oil: 8, Ash: 8, Fibre: 1.5. Energy density 329kcal/100g.
All dogs maintained body weight, ate recommended quantity of food and maintained similar level of exercise (training dogs at army camp) for the duration of the study. When dogs acted as their own controls IgA levels were higher pre than after dietary supplementation during phase IV (pre: mean (range): 8.18 (3.2-13.7), post: 3.04 (1.5-5.8); p=0.04) and phase II (pre: 7.7 (3.2-13.5), post: 4.3 (1.2-9); p=0.08), table shows total results for each phase.

<table>
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<th>Diet</th>
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<th>Group B (-)</th>
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<tbody>
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<td>Group A (-)</td>
<td>Group B (-)</td>
</tr>
<tr>
<td>GSD Advance® (+ 1% L-glutamine) (PII)</td>
<td>Group B (+)</td>
<td>Group A (-)</td>
</tr>
<tr>
<td>GSD Advance® (+0.05% yeast β-glucans) (PIII)</td>
<td>Group A (+)</td>
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<tr>
<td>GSD Advance® (+ oat β-glucans) (PIV)</td>
<td>Group B (+)</td>
<td>Group A (-)</td>
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(+)= diet supplemented with active ingredient (-)= No active ingredient

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<th></th>
<th>IgA: mean (range)</th>
<th>Faeces score: mean (range)</th>
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<tr>
<td></td>
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<td>Placebo</td>
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<tr>
<td>Phase I</td>
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<tr>
<td>Phase IV</td>
<td>2.96(0.7-5.8)</td>
<td>3.09(1.1-6.5)</td>
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Conclusion
Immunostimulatory ingredients (glutamine and oat glucans) reduced faecal IgA within but not between dogs in this study. This work needs repeating in a larger sample size to determine reproducibility.
CHARACTERISTICS OF FOAL FEEDING BEHAVIOUR
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3 Virginia Polytechnic Institute, Blacksburg, USA

Introduction
This study investigated the feeding behaviour of foals presented with six different textured diets.

Materials and Methods
Twenty Thoroughbred foals were given ad libitum access to pasture and their dam’s pasture supplement (DPS). Dams were fed either a starch and sugar rich supplement (SS) or a fat and fibre supplement (FF) for four months before parturition and during lactation. Preference tests (duration, 10-minutes) were conducted at one and three months of age as well as after weaning at six months. During testing the dam or a familiar weanling was always present. Approximately 2kg of each diet was offered: DPS, DPS plus water, low fibre pellets, whole oats, sweet feed, and soaked beet pulp. The amount eaten was recorded (kg). Behaviour was observed using continuous sampling.

Results
The majority of feed was ingested when the foals were 6 months old (median 608g, range 0-1.177kg). Foals consumed more of their dam’s particular pasture supplement when presented with or without water (P<0.001). Very little of the other feeds were eaten suggesting possible neophobia. When the total amount eaten was compared the foals with access to the FF diet ate more than the SS fed foals at 6 months (P<0.05). Behavioural observations suggest that the FF fed foals were more confident in their environment than the SS fed foals.

Conclusion
Feeding a FF supplement can help improve foal health⁰,¹ and according to these results behavioural well-being may also be improved.

References
ANALYSIS AND CHARACTERISATION OF SEBACEOUS AND CERAMIDE LIPIDS OF CANINE SKIN
WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
Skin lipid analysis has demonstrated commonalities between different mammalian species, but also highlighted some significant interspecies differences which may influence characteristics of the skin like hydration and resistance to disease. Epidermal lipid is derived from sebaceous glands and keratinocytes. Sebaceous lipids commonly include sterol esters, cholesterol, wax esters/diesters, squalene, triglycerides and free fatty acids. Keratinocytes generate the lamellar lipids during differentiation. Ultimately, the lamellar lipid profile becomes restricted to three major groups: ceramides, sterols and free fatty acids. The complexity of ceramides is partly contributed to by esterification to fatty acids.

Materials and Methods
The common problem of cross-contamination between the two lipid sources was avoided by sequential micro-dissection of the sebaceous glands and epidermis of canine skin. HPLC, TLC and GC were then combined to obtain a complex lipid profile for sebum. The same process also facilitated a detailed description of the fatty acids esterified to ceramides in the lamellar lipid.

Results
The main lipid groups present in sebum were wax esters, wax diesters and triglycerides. Small quantities of free fatty acids, diglycerides, cholesterol and sterol esters were also detected. The predominant fatty acids esterified in skin ceramides were palmitic (15-20%), stearic (13-17%) and oleic (16-30%). Other fatty acids present in significant quantities included myristic (1-3%), linoleic (2-3%) and arachidic (1-1.5%). A variety of hydroxy acids were also detected.

Conclusion
In comparison with other species, sterols/sterol esters were largely absent from canine sebum and the lamellar lipids had a relatively low ratio of linoleic acid:oleic acid. The implications with respect to canine skin function will be discussed.
MATERNAL DIET FATTY ACIDS MODIFY CANINE PUPPY PLASMA LIPOPROTEIN DISTRIBUTION DURING THE SUCKLING PERIOD

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2 Nestle-Purina PetCare, St. Louis, Missouri. USA

Plasma total cholesterol concentrations (TC) and lipoprotein (LP) distributions of neonatal Labrador/hound mixed-breed dogs during the suckling period were investigated.

One of four complete and balanced diets varying only in fatty acid composition were fed to 12 bitches (three dogs in each diet group) from the time of breeding via artificial insemination and throughout gestation, parturition, and lactation. The diets were sufficient in linoleic acid and contained 14 % total fat (weight basis) using either beef tallow (TAL), linseed oil (LIN), or higher and lower amounts of menhaden fish oil (HMH and LMH respectively) as the primary fat source. All other components, including total protein, total fat, nitrogen-free extract, vitamins, and minerals were the same. All puppies used in the study were healthy, suckled normally, and ingested colostrum. Blood samples were collected into EDTA tubes on days 4, 10, 28 and 70 post-partum and plasma harvested. The puppies were weaned beginning on day 29 to their respective mothers’ diets. Prior to sampling, puppies were separated from their mothers for 2-3 hours (days 4, 10, 28) or fasted overnight (day 70). No other source of nutrition was provided to the dams. Bitches’ milk supplied sole nutrition for each litter during suckling. Fresh plasma was subjected to lipoprotein electrophoresis on each collection day.

Relative LP distributions were quantified by scanning densitometry and TC were determined. The LP-cholesterol concentrations were calculated which included values for chylomicrons, beta (LDL), pre-beta (VLDL), alpha1, and alpha2 fractions (HDLs). These values were compared by repeated measures ANOVA and both diet and time main effects were found (p<0.05). Time effects included significant TC and beta LP elevations observed early on both days 4 and 10 and chylomicra and pre-beta fractions were elevated on day 4. Alpha fractions were elevated during suckling; alpha-2 decreased at weaning while alpha-1 remained essentially unchanged. Diet effects seen were decreased TC and all LP fractions in puppies whose mothers were fed the menhaden oil (LMH and HMH) diets compared to those in the TAL or LIN groups. It is noteworthy that LP distributions of puppies during suckling in the two menhaden oil groups were more similar to those of normal adult dogs and that a menhaden oil dose response was noted.

This work is the first report of increased low density LP elevations in canine puppies during the early suckling period and their subsequent modification by maternal dietary fatty acids. The findings are consistent with the cholesterol lowering effects of dietary marine oils and reduction of post-prandial LP fractions reported in adult humans and other species.
EVALUATION OF CORNEOMETRY (SKIN HYDRATION) AND TRANSEPIDERMAL WATER LOSS MEASUREMENTS IN DOGS AND COMPARISON OF TWO CANINE BREEDS

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Corneometry refers to the measurement of skin hydration (HYDR) of the first 10-20 µm of the stratum corneum. Transepidermal water loss (TEWL) is a measure of the rate of water lost through the skin in g/hr-m² and is an index of the extent of possible damage of the skin’s water barrier function. Water loss through the skin normally occurs by passive diffusion through the epidermis. Higher TEWL values indicate greater water loss and are consistent with increased skin barrier damage.

A study was conducted to evaluate the use of the Corneometer® CM 825 and Tewameter® TM 300 (Courage & Khazaka Electronics, Koln, Germany) in 23 normal dogs and to compare these values in two breeds (8 normal female Beagle and 15 male hound-type dogs). The animals ranged in age from 1.5 years to 6.5 years with a median age of 4 years. The dogs were acclimated to a commercial, complete and balanced dry extruded-type dog food for 3 weeks prior to the initial evaluations. Measurements were then repeated after 7 weeks of feeding this same diet. The left inguinal regions of each dog were shaved 1 week before evaluation. Both HYDR and TEWL were determined on this anatomical site successively on the day of measurement. Animals were gently, but firmly restrained on their right side and given time to relax so that movements were minimized during data collection. The probes for each determination were held in place manually and readings were taken at 1 second intervals for 20 seconds each. Values representing the average of at least 10 determinations, after equilibrium was attained, were used to calculate the average TEWL and HYDR values. Each such measurement was replicated three times. The variance, and inter- and intra-animal coefficients of variation were calculated. The average intra-dog (within animal) CVs for the TEWL values were 17.6% and 18.0% at weeks 3 and 7 respectively. For HYDR, average CV values of 10.0 % at 3 weeks and 14.0 % at 7 weeks were observed. Inter-animal variability (between-animal) was considerably higher reflecting a wide range of individual variation between dogs and dog breeds especially for TEWL measurements. The overall mean TEWL values ranged from 2.8 to 51.9 g/hr-m² and mean HYDR values ranged from 12.0 to 48.1 units. A repeated measures ANOVA model with TEWL and HYDR as dependent variables was analyzed which resulted in a significant breed effect (p < 0.02) for TEWL but no main time effect or breed X time interactions. Analysis of HYDR data found neither a breed nor a time effect. No age effect was evaluated in this study because all dogs were adults with a median age of 4 years.

It is concluded that breed differences exist for TEWL measurements. Also, both TEWL and HYDR measurements appear to be reasonably stable personal characteristics with which to investigate treatment effects of diet or medications on canine skin condition. Between animal TEWL comparisons appear to be less reliable than within animal measurements. However, corneometry (HYDR) measurements appear useful for comparing differences both within and between animals under the conditions employed.
THE SURVEY OF DIETARY TYPES FREQUENTLY FED TO DOGS WITH AND WITHOUT MAMMARY GLAND TUMORS
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Canine mammary gland tumor has been used as a model for human breast cancer in several clinical trials. Mammary steroid receptors and Growth hormone have been indicated to cause the tumor. Feeding diet was suggested to be an associated factor that might be of etiologic importance in canine mammary tumor. The present study aimed to specifically investigate the types of diet fed to two populations of intact (non-spayed) female dogs in Bangkok: I) with and II) without mammary gland tumor. The study was organized during 2001-2002 by interviewing the owners of 275 dogs (2.6-15 years old) diagnosed with mammary gland tumors and the owners of 150 non-tumor dogs (3.3-18 years old). Average main nutritional values of homemade diet (31.6% fat, 40.4% carbohydrate and 24.9% protein), commercial moist canned diet (16.0% fat, 50.0% carbohydrate and 24.0% protein) and commercial dry diet (13.0% fat, 54.5% carbohydrate and 21.5% protein) were evaluated.

Data showed that 91.3 % of the dogs with mammary tumor had been fed with homemade diet, 8.0 % fed with a combination of homemade and commercial diets and only 0.7 % fed with commercial dry diet. In contrast, in the non-tumor dogs, only 10.0% had been fed with homemade diet, 23.7 % fed with combination of homemade and commercial diets and 56.0 % strictly fed with commercial dried diet.

High fat in homemade diet, especially from grilled pork liver and fried pork meat, found to involve in or play a critical role on canine mammary gland tumor as reported in human breast cancer.
ISOVALTHINE EXCRETION IN ADULT CATS: PRELIMINARY DATA
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Institute of Food, Nutrition and Human Health, Massey University, Palmerston North, New Zealand

Introduction
Isovalthine is a sulphur amino acid, which has been found in the urine of normal cats. Reports have found that isovalthine excretion can be induced in other species (rats, rabbits, guinea pigs, humans, dogs) following the administration of certain inducing agents. In cats, Fukutome (1961) showed that administration to cats of 0.21 g/d of L-leucine for 3 days resulted in increased urinary isovalthine excretion. The aim of the present study was to determine normal daily urinary excretion concentrations of isovalthine in adult cats and the effect of leucine on urinary isovalthine excretion.

Materials and methods
 Twelve adult cats (four males, castrates and females each) from the Centre for Feline Nutrition (Massey University,) were housed in metabolism cages and fed to appetite an AAFCO tested moist diet. Water was provided ad libitum. Urine was quantitatively collected for 8 days. On days 3, 4 and 5 each cat was given 2 gelatine capsules each containing 0.3 g of L-leucine. Isovalthine was measured by HPLC after hydrolysis of samples. Data were analysed by repeated measures ANOVA.

Results
Urinary isovalthine concentrations ranged between 23-73 µmol/L. Daily excretion of isovalthine (Figure) was not significantly different between male, castrated male and female cats. There was no significant effect of leucine addition on isovalthine excretion.

Conclusion
Daily urinary isovalthine excretion in adult cats is low and is not increased by oral leucine administration. This is in direct conflict with the report of Fukutome who reported an increase in isovalthine excretion in cats administered leucine by stomach tube. The significance of isovalthine excretion in cats is unknown.

References
EFFECTS OF A NOVEL INGREDIENT BLEND ON CANINE FIBROBLAST MIGRATION AND CUTANEOUS BARRIER FUNCTION IN VITRO

WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
Skin diseases occur frequently in dogs presented to veterinary practices. To date, dietary intervention has focused mainly on the management of food sensitivity. The development of a novel synergistic blend of ingredients (comprising Aloe vera, curcumin, vitamin C and taurine) in a commercial selected protein source diet extends the potential benefits of dietary therapy to a much wider range of inflammatory and allergic skin diseases. The effect of these ingredients on fibroblast migration and cutaneous barrier function was investigated in vitro.

Materials and Methods
A two-dimensional assay was used to assess migration of canine fibroblasts. Cells were grown as a confluent monolayer in media supplemented with various concentrations of the ingredient blend, and the subsequent migration of fibroblasts into a space denuded of cells was compared. The effects of various concentrations of the blend on the development of a skin barrier in vitro were also assessed using a previously validated assay (Watson et al, 2003). Statistical comparisons were made using the Student-Newman-Keuls test.

Results
Culture with the ingredient blend significantly increased canine fibroblast migration and decreased the diffusion of radio-labelled water across the epidermal sheet (Table).

<table>
<thead>
<tr>
<th></th>
<th>Migration (Mean Cell Number)</th>
<th>In vitro Barrier Function (CPM/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (0mg/ml cocktail)</td>
<td>57.5 ± 21.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.87 ± 0.13&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Test (0.125mg/ml cocktail)</td>
<td>98.4 ± 22.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.47 ± 0.11&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Superscripts within a column indicate significant difference (P<0.05)

Conclusion
These results indicate that the ingredient blend has significant effects on canine fibroblasts and keratinocytes in vitro. Similar effects in vivo would help promote healing and improve skin barrier function.

References
A) WALTHAM ® Veterinary Diet™ Canine Skin Support™
CHANGES TO LEVELS OF DNA DAMAGE AND APOPTOTIC RESISTANCE IN
PERIPHERAL BLOOD MONONUCLEAR CELLS AND THE PLASMA
ANTIOXIDANT POTENTIAL OF SERUM WITH AGE IN LABRADOR RETRIEVER
DOGS
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1 School of Pharmaceutical Sciences, University of Nottingham, UK
2 WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
A lifetime’s exposure to oxidative stress is thought to cause an accumulation of DNA damage in
mammalian cells. This unrepaired damage has been implicated in a variety of degenerative
conditions associated with the process of ageing, such as cancer and arthritis. In order to identify
age-related changes in susceptibility to oxidative pressure, cellular resistance to DNA damage and
apoptosis were measured in the presence of oxidising substances. The antioxidant potential of the
serum was also measured to assess changes in protective properties with age.

Materials and Methods
Peripheral blood mononuclear cells from 34 Labrador retriever dogs, equally split into 2 age
groups, 1.1 to 3.1 years and 8.5 to 12.8 years, were subjected to oxidative stress. Hydrogen
peroxide-induced DNA damage was measured via the comet assay and apoptosis in the presence
of 2-deoxy-D-ribose using a FACS-based kit. Antioxidant potential of the serum was measured with
the ferric-reducing antioxidant power (FRAP) assay.

Results
Levels of both endogenous (p=0.019) and induced (p=0.029) DNA damage were seen to
significantly increase with age. Conversely, levels of induced (p=0.006), but not spontaneous,
apoptosis decreased with age. Although the FRAP value of serum showed an age-related decline,
this was not statistically significant.

Conclusion
These data suggest an apparent paradox in that oxidative stress induces increased DNA damage,
but not apoptosis in cells from older dogs. One possible explanation is that relatively low levels
of oxidative pressure may cause damage to cellular DNA, which in elderly subjects may trigger cells
to enter into a state of replicative senescence rather than undergoing apoptosis, thereby
increasing resistance to the transformation or oncogenesis of senescent cells.
A NUTRITIONAL PROPHYLACTIC FOR THE REDUCTION OF FELINE HAIRBALL SYMPTOMS
Dann, J., Adler, M., Duffy, K. and Giffard, C.
Research and Development, Masterfoods Australia and New Zealand, Wodonga, Australia

Introduction
Hairballs in cats are generally considered to arise as the result of routine grooming activity where cats ingest varying quantities of hair. Cats can rid themselves of this problem by retching until the hairball is vomited. Severe hairballs can lead to clinical symptoms that include vomiting, anorexia and abdominal pain. Common prophylactic approaches include the use of petroleum-based laxatives to induce vomiting, vitamin supplements, enzyme therapy and dietary fibre\textsuperscript{A,B}.

Materials and methods
Extensive screening of cat owners (n = 800) was carried out to determine the frequency with which cats suffer from common hairball symptoms. Cats with a high frequency of owner-perceived hairball symptoms (minimum of several hairballs per week, n = 24) were selected to trial a daily nutritional hairball treatment (WALTHAM, Feline HAIRBALL CONTROL\textsuperscript{TM} Tab). The treatment was formulated from highly palatable low allergenic ingredients that include psyllium husks, slippery elm and glutamine as active constituents. A four week randomized placebo controlled crossover study was conducted during which owners fed two HAIRBALL CONTROL\textsuperscript{TM} Tabs, or two placebo tabs, per cat per day and compiled a daily feeding diary that detailed hairball symptom frequency and acceptance of the treatment.

Results
A significant reduction (P = 0.041) of 29% was observed in the mean number of owner-perceived hairball symptoms when cats were fed the active tab compared to the placebo.

Conclusion
WALTHAM, Feline HAIRBALL CONTROL\textsuperscript{TM} Tab when fed daily helps to reduce the symptoms of feline hairballs.

References
THE BENEFITS OF BOVINE COLOSTRUM FOR GASTROINTESTINAL HEALTH
Giffard, C.1, Seino, M.2, Markwell, P.J.3 and Bektash, R.1
1 Research and Development, Masterfoods Australia and New Zealand, Wodonga, Australia
2 MasterFoods Research and Development, Yoshikawa, Tokyo, Japan
3 WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK

Introduction
Diarrhoea is a common problem in recently weaned puppies. The combined effects of changing environment and diet, separation from the dam, at a time when the immune system is not fully developed and passive immunity is starting to wane, increases the susceptibility of the puppy to a variety of infections and gastrointestinal disturbances. Colostrum is designed to transfer passive immunity to the neonate without the systemic transfer of antibodies. Bovine colostrum is a valuable source of bioactive compounds that include immunoglobulins, peptide-based nutrients, growth factors and other immune factors. This complex mixture provides passive immunity for other species that can help to control the growth and function of the gastrointestinal tract.

Materials and methods
A randomised placebo-controlled trial was conducted in Japan with 70 puppies (40-50 days old) to determine the impact of colostrum on faecal quality. Puppies received either 0.5g of colostrum powder daily, or 0.5g of skim milk powder daily, in addition to a standard puppy food for 10 days from the second after their arrival at a pet shop. Individual faecal scores were recorded for each puppy using the WALTHAM faecal scoring systemA.

Results
A significant improvement in faeces quality (P<0.05) was observed after 6 days for puppies fed colostrum compared with the skim milk placebo.

Conclusion
Supplementation with bovine colostrum can improve faecal quality in puppies during periods of environmental change. Further investigation is required to identify the efficacious components of colostrum.

References
THE EFFECT OF DIETARY SODIUM CONTENT ON WATER INTAKE AND
URINE COMPOSITION IN CATS
Hawthorne, A. J. and Markwell, P. J.
WALTHAM Centre for Pet Nutrition, Melton Mowbray. Leicestershire, UK

Introduction
Increasing water intake can help prevent lower urinary tract diseases by increasing urine volume and decreasing urinary concentrations of stone forming minerals. This study aimed to assess the effect of dietary sodium content on water intake and urine composition in healthy adult cats.

Materials and methods
Panels of 6 cats were fed 13 dry foods low in sodium (LS), or 10 dry foods with moderate sodium content (MS) for 21 day periods. Water intake, urine volume and specific gravity were measured daily. During the last 48 hours urine was frozen for assessment of urinary relative supersaturation (RSS) with calcium oxalate and struvite as previously described. Statistical comparisons were made by unpaired t-test.

Results
Cats fed MS had significantly higher water intake (P=0.01) and urine volume (P<0.001), lower urine specific gravity (P=0.003), calcium oxalate (P=0.4) and struvite RSS (P=0.03) than cats fed LS.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>LS diets (mean ± SE)</th>
<th>MS diets (mean ± SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary sodium content (g/400kcal)</td>
<td>0.42 ± 0.05</td>
<td>1.28 ± 0.04</td>
</tr>
<tr>
<td>Urine volume (mls/cat/day)</td>
<td>55 ± 2.6</td>
<td>78 ± 2.8</td>
</tr>
<tr>
<td>Water drunk (mls/cat/day)</td>
<td>110 ± 6.4</td>
<td>141 ± 4.9</td>
</tr>
<tr>
<td>Urine specific gravity</td>
<td>1.051 ± 0.001</td>
<td>1.045 ± 0.001</td>
</tr>
<tr>
<td>Struvite RSS</td>
<td>6.34 ± 1.23</td>
<td>3.66 ± 0.53</td>
</tr>
<tr>
<td>Calcium oxalate RSS</td>
<td>2.96 ± 0.23</td>
<td>2.41 ± 0.07</td>
</tr>
</tbody>
</table>

Conclusion
Dry diets with a higher sodium content resulted in significantly higher urine volume and lower saturation with stone-forming minerals than those with a lower sodium content. Addition of moderate levels of sodium to dry cat foods may help promote urinary tract health.
EFFECT OF OBESITY ON APO B100 METABOLISM IN DOGS
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1 USC INRA de Nutrition et Endocrinologie, Ecole nationale vétérinaire de Nantes, France
2 Centre de Recherche en Nutrition Humaine, Nantes, France

We developed a protocol of kinetic study of apoB100 metabolism in dogs, using the endogenous labeling with stable isotopes. D3-leucine as labeled precursor of apoB100 was infused intravenously over 8h to six healthy male beagle dogs. Blood samples were obtained during the perfusion and for 18h after it had been stopped. After purification of VLDL- and LDL-apoB100 by electrophoresis, isotopic enrichment in apoB100 was measured by GC-MS. Compartmental modeling (SAAM II) was used for the analysis of tracer data. The same protocol was applied when dogs had got obese (43 ± 5 percent increase in BW) by feeding a hyperenergetic high-fat diet (248 kcal EM/kgP0.75, 55% fat) for approximately 7 months.

Obese dogs were also insulin resistant, as assessed by the euglycemic hyperinsulinemic clamp technique. VLDL-triglycerides and -apoB100 increased in obese dogs (0.412 ± 0.261 mmol.L⁻¹ vs. 0.069 ± 0.022 mmol.L⁻¹, p<0.05 and 24.2 ± 3.0 mg.L⁻¹ vs. 9.7 ± 2.2 mg.L⁻¹, p<0.05, respectively). Likewise, VLDL-apoB100 production was higher (26.5 ± 10.9 mg.L⁻¹.h⁻¹ vs. 19.2 ± 5.3 mg.L⁻¹.h⁻¹). VLDL-apoB100 catabolic rate decreased, as a consequence of a 6-fold diminution of lipolysis (0.38 ± 0.07 h⁻¹ vs. 2.31 ± 1.36 h⁻¹, p<0.05). Obesity led to a direct synthesis of LDL-apoB100. On the other hand, LDL-apoB100 concentration decreased (192 ± 64 mg.L⁻¹ vs. 376 ± 85 mg.L⁻¹, p<0.05) due to unchanged production and increased catabolic rate (0.068 ± 0.017 h⁻¹ vs. 0.031 ± 0.05 h⁻¹).

Obesity is responsible for dramatic changes (similar to those observed in humans) in VLDL-apoB100 metabolism in dogs.
Intestinal concentrations of immunoglobulin (Ig) A are a commonly used indicator of immune status, but the collection procedure is rather invasive. In order to find a suitable alternative to this method, our objective was to elucidate the relationship between IgA concentrations in selected biological specimens.

Seven female adult dogs previously fitted with simple T cannulas in the terminal ileum were fed a premium, kibbled diet for 10 d prior to collection of blood, ileal fluid, feces, and saliva on 3 consecutive days. On the third day, samples were collected after a 16 h fast and at 2 and 6 h postprandial. Also, saliva was collected from the mouth using two methods: a cotton swab and a soft rubber scraper. Concentrations of IgA were greatest in ileal fluid and lowest in serum, and did not differ among the three days, among the fasted or fed sampling times, or due to saliva collection method. Saliva concentrations of IgA tended to be more variable than serum or ileal effluent. Serum IgA concentrations were most highly correlated with ileal concentrations, while IgA in saliva collected with a spatula or cotton swab was not well correlated with serum values. This was unexpected as both salivary and ileal IgA are secretory in nature, while serum IgA is not.

Future research should address the efficacy of salivary and serum IgA in detecting changes in immune status and determine the best method to standardize IgA concentrations in biological specimens.
EFFECTS OF SUPPLEMENTAL SPRAY DRIED PLASMA ON FOOD INTAKE, GASTROINTESTINAL MICROFLORA, AND IMMUNE RESPONSE OF SENIOR DOGS

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² Department of Veterinary Pathobiology, University of Illinois, Urbana, USA
³ APC Inc., Ames, USA

As improvements are made in companion animal diet quality and health care, life expectancy is increased. Unfortunately, the geriatric pet population tends to have several health problems, including a less desirable intestinal microbial balance and diminished immune capacity. Alleviating these health problems through dietary modulation is one possible way to improve longevity and quality of life of senior companion animals.

Senior dogs (11-12 yr old beagles; 7-12 yr old pointers) were used to evaluate the effects of spray dried plasma (SDP) on gastrointestinal tract microbial ecology (n = 40) and immune response to a parvovirus vaccine challenge (n = 12). Spray dried plasma was solubilized in poultry fat and applied to the exterior of extruded kibbles at 0, 0.5, 1, or 2% concentrations. Inclusion of SDP did not affect (P > 0.05) food intake during the immune challenge period. Dietary supplementation with SDP did not affect (P > 0.05) fecal concentrations of bifidobacteria, lactobacilli, E. coli, or C. perfringens, although supplementation tended (P = 0.06) to linearly decrease total fecal aerobic bacteria concentrations. Although SDP supplementation did not affect canine parvovirus hemagglutination inhibition titers, supplementation increased (P < 0.05) peripheral white blood cell concentrations on d 0, 2, 6, 8, and 21 post-vaccination, and inconsistently affected neutrophil, lymphocyte, and monocyte concentrations.

In conclusion, SDP significantly enhanced the ability of senior dogs' immune systems to respond to a vaccine challenge.
Oils high in long chain fatty acids, especially ω-3 polyunsaturated fatty acids (PUFA), are used in pet foods designed to enhance companion animal health. Commercial diets providing for heart health, regulation of body weight and treatment of cancer patients are formulated with ω-3 PUFA. Fish, vegetable and seed oils can be used as sources of ω-3 PUFA or long chain fatty acids, but are inherently very unstable. The unsaturation that makes these oils nutritionally valuable also makes the oils very susceptible to autoxidation. Traditional synthetic (e.g., BHA) and natural (e.g. tocopherols) antioxidants improve stability of ω-3 PUFA only to a limited extent. A rosemary extract obtained via a patented extraction method has been found to dramatically improve stability of ω-3 PUFA oils used in petfoods. Induction time of menhaden and flax oils were measured in the Oxygen Stability Instrument (OSI) at 80 and 100°C.

<table>
<thead>
<tr>
<th>Antioxidant</th>
<th>Menhaden Oil OSI Induction Time (hrs)</th>
<th>Flax Oil OSI Induction Time (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80°C</td>
<td>100°C</td>
</tr>
<tr>
<td>None</td>
<td>2.6</td>
<td>0.50</td>
</tr>
<tr>
<td>Tocopherols</td>
<td>6.3</td>
<td>0.55</td>
</tr>
<tr>
<td>Rosemary Extract</td>
<td>25</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Untreated oil samples were compared to samples treated with equivalent activity of either a blend of mixed and delta tocopherols or rosemary extract. Rosemary extract improved stability > 5X compared to a tocopherol blend.

Rosemary extract is effective in protecting ω-3 PUFA oils from autoxidation. Impact in petfoods will be further discussed. Stabilization of these oils allows for their use in petfood diets with enhanced nutritional health benefits.
THE EFFECT OF BODY SIZE AND ANTIBIOTIC TREATMENT ON TAURINE STATUS OF ADULT DOGS
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2 Royal Canin Research Center, Aimargues, France

With the exception of the American Cocker Spaniel, taurine (tau) deficiencies have been mostly reported in large breed dogs.

To study the influence of body size on tau homeostasis, 6 small dogs (SD), 14 ± 0.4 kg, and 6 large dogs (LD), 36 ± 2 kg, were meal-fed a dry expanded diet for 12 months to maintain body condition score between 4 and 6 (9-point scale). Then, ampicillin, neomycin and metronidazole (22, 20, and 15 mg/Kg, respectively) were given twice a day. SD consumed about half as much of the diet compared to LD, but both groups ingested similar amounts of diet per Kg^{0.67} (180 and 175 Kcal, respectively). Plasma and whole blood tau concentrations were higher in SD (89 ± 7 and 294 ± 23 nmol/mL, respectively) than in LD (63 ± 8 and 241 ± 15 nmol/mL, respectively). Urinary tau:creatinine (Molar ratio) varied greatly among the dogs but were not different between SD and LD (0.123 ± 0.061 and 0.048 ± 0.021, respectively; p = 0.135). SD muscle tau concentrations (7.5 ± 0.7 µmol/g) were greater than the LD (3.9 ± 0.6 µmol/g) (p = 0.002). After 1 month of antibiotic treatment, plasma and whole blood tau concentrations remained unchanged, while urinary tau:creatinine ratio increased from 0.123 ± 0.061 to 0.324 ± 0.082 (p = 0.007) for SD but did not increase for the LD group. Relative to SD, LD had a lower tau status.

The difference in tau status between dog sizes does not appear to result from excessive urinary or gastrointestinal microbial-mediated losses of tau.
EFFECT OF DIETARY FAT CONCENTRATION OF QUEENS ON FOOD INTAKE AND WEIGHT GAIN DURING GESTATION AND WEIGHT LOSS DURING LACTATION

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Fat is an important source of dietary energy for the cat, an obligatory carnivore. To examine the effect of dietary fat concentration during gestation (ges) and lactation (lac), 32 primiparous queens were fed one of 4 experimental extruded diets: A-D, containing 9%, 16%, 23%, or 30% fat, respectively, keeping the protein:energy ratio constant. Queens were randomly assigned to treatments and fed diets at least 30 days before breeding and throughout ges and lac. At parturition, litter size was normalized to 4-5 kittens per queen. Food intakes of the queen and body weights of the kittens were measured daily; queens were weighed weekly. There were no significant differences among diet groups in weight gain between breeding and just before parturition nor in weight loss during lac. Although not significant, food intakes in all diet groups were higher during peak lac (d21-d28) as compared to d42 of lac.

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<tbody>
<tr>
<td>At-breeding BW (kg)</td>
<td>3.77±0.1</td>
<td>4.34±0.1</td>
<td>4.14±0.1</td>
<td>3.68±0.1</td>
</tr>
<tr>
<td>Wt gain during ges (kg/6wk)</td>
<td>1.57±0.03</td>
<td>1.67±0.1</td>
<td>1.81±0.03</td>
<td>1.85±0.1</td>
</tr>
<tr>
<td>Wt loss during lac (0-42d)(kg)</td>
<td>-0.28±0.02</td>
<td>-0.31±0.03</td>
<td>-0.23±0.03</td>
<td>-0.39±0.04</td>
</tr>
<tr>
<td>Kitten wt gain (0-42d)(g)</td>
<td>450±4.67</td>
<td>504±4.15</td>
<td>522±2.19</td>
<td>484±1.95</td>
</tr>
<tr>
<td>Queen Energy Intake, lac (0-42d) (megacal)</td>
<td>18.5±0.4</td>
<td>22.5±0.4</td>
<td>23.8±0.5</td>
<td>19.8±0.7</td>
</tr>
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</table>

Although the cumulative energy intakes during lac were not significantly different among diet groups nor were kitten body weight gains at d42 significantly different among diet groups, weight gains of kittens were highly correlated \( R^2 = 0.94 \) with the energy intakes of queens during lac.
OXIDATIVE DNA DAMAGE IN EQUINE PERIPHERAL BLOOD MONONUCLEAR CELLS (PBMC) FROM HEALTHY AND RECURRENT AIRWAY OBSTRUCTION (RAO)-AFFECTED ANIMALS ASSESSED BY COMET

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Introduction
Damage to DNA by reactive oxygen species (ROS) has been implicated in the ageing process, in the pathogenesis of diseases such as cancer and as a consequence of other inflammatory conditions. The aim of the present study was to validate the Comet assay for use in horses and to determine the effects of age and pulmonary disease (Recurrent Airway Obstruction, RAO) on DNA damage in peripheral PBMC.

Materials and Methods
Blood samples were collected from 6 young pony foals (0.3±0.1 years [mean±SD]), 6 mature ponies (age 4.7±0.8 years) and 6 aged ponies (age 25.8±4.5 years). All animals were considered to be healthy at the time of sampling based on history, clinical examination and routine haematology and biochemistry. In addition, blood samples were collected from 8 RAO affected animals (4 ponies, 4 horses; age 16.1±4.7 years) in clinical remission (i.e. absence of cytological evidence of airway inflammation). These were compared to breed matched controls (4 ponies, 4 horses; age 5.6±1.8 years). Enrichment of PBMC from whole blood was achieved by density gradient centrifugation. Comet assays were performed as described previously by Heaton et al (2002).

Results
There was no significant difference in endogenous or exogenous DNA damage expressed as % Tail DNA (%DNAT) between mature and aged ponies, but pony foals had significantly lower endogenous %DNAT (P<0.05) than the other age groups. There was no difference between any of the age groups in sensitivity to exogenous DNA damage. Endogenous %DNAT was significantly greater in the RAO horses in clinical remission compared with breed-matched controls (P=0.009).

Conclusion
1) The Comet assay can be used to assess DNA damage in equine PBMC; 2) Endogenous DNA damage was lowest in young pony foals, but not different between mature or aged ponies; 3) There is evidence of increased DNA damage in equine PBMC in RAO-affected horses in remission (i.e. without clinical or airway cytological evidence of concurrent disease) which may be important in understanding the pathogenesis of this condition.
RADIO-IODINE THERAPY OF FELINE HYPERTHYROIDISM REDUCES PLASMA ASCORBIC ACID OXIDATION
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1 Centre for Small Animal studies, The Animal Health Trust, Newmarket, UK
2 Centre for Equine Studies, The Animal Health Trust, Newmarket, UK

Introduction
Naturally occurring hyperthyroidism (HPT) in humans, and experimentally induced HPT in rodent models have been associated with profound oxidative stress. Various markers have been found to be altered in studies, which have demonstrate HPT is associated with a decrease in systemic antioxidant capacity and an increase in both lipid peroxidation and susceptibility to oxidative stress. There may be substantial clinical impacts from the oxidative stress, as this has been implicated as a cause of both hepatic and myocardial damage seen with this disease. It has also been demonstrated that successful treatment of HPT, dietary supplementation with antioxidants, or both, can help to reverse the oxidative stress.

Materials and Method
Blood samples were collected from 19 cats with naturally occurring hyperthyroidism referred for radio-iodine therapy (RIT). Samples were also collected from 12 of these cats after RIT. In addition, blood samples were collected from 8 healthy cats with no history or clinical signs of HPT as controls. Reduced, oxidised and total ascorbic acid, total iron, uric acid and alpha and gamma-tocopherol in plasma and reduced, oxidised and total glutathione in red blood cell haemolysate were measured.

Results
There were no significant differences between HPT cats before RIT and control cats for any variables measured except glutathione redox ratio (P<0.01). Plasma concentrations of oxidised ascorbic acid (DHA) and ascorbate redox ratio (ARR) were both reduced significantly following RIT in HPT cats (DHA, 2.3±1.8 versus 1.0±1.6, P<0.05; ARR, 15.8±15.6 versus 6.8±10.2, P<0.05).

Conclusion
Feline hyperthyroidism is associated with increased oxidation of ascorbic acid which is reduced following RIT.
**EFFECT OF ACUTE AIRWAY INFLAMMATION ON PULMONARY ASCORBIC ACID IN HORSES**

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2 Equine Studies Group, WALTHAM Centre for Pet Nutrition, Melton Mowbray, Leicestershire, UK
3 Department of Bioengineering, Imperial College of Science, Technology and Medicine, London, UK
4 School of Health & Life Sciences, Franklin-Wilkins Building, King's College, London, UK

**Introduction**

We have demonstrated that ascorbic acid is quantitatively the most important antioxidant in equine pulmonary lining fluid. Recurrent airway obstruction (RAO) is a condition with many similarities to human asthma and affected horses develop bronchoconstriction and neutrophilic airway inflammation when stabled on straw. With chronic inflammation, pulmonary ascorbic acid is markedly reduced in RAO horses. The aim of the present study was to investigate the effect of acute airway inflammation on the pulmonary ascorbic acid concentrations of RAO-affected horses.

**Materials and Method**

Five RAO-affected and five control horses were stabled for 24 hours in a stable with straw bedding. Ascorbic acid concentrations and neutrophil numbers in bronchoalveolar lavage fluid (BALF) were determined seven days prior to stabling and immediately, three and fourteen days post-stabling.

**Results**

None of the RAO-affected horses demonstrated more than mild signs of airway obstruction during or after stabling. Immediately after stabling, RAO-affected horses had an increased number of neutrophils in BALF (248±158/ul), which returned to pre-stabling levels (11±4/ul) by 3 and 14 days post-stabling. Control horses demonstrated no significant increase in neutrophil number following stabling.

In RAO-affected horses, BALF ascorbic acid decreased immediately after stabling (6±4umol/l) compared to prior to stabling (11±5umol/l; P<0.05). BALF ascorbic acid, three days after stabling (8±3umol/l), was not significantly different from prior to stabling. In the control group, BALF ascorbic acid decreased immediately after stabling, but not significantly (11±1umol/l versus 14±2umol/l).

**Conclusion**

Transient neutrophilic inflammation in RAO-affected horses is associated with a decrease in BALF ascorbic acid, which is rapidly replenished with the resolution of inflammation. Nutritional supplementation with antioxidants may provide an additional therapeutic opportunity for RAO-affected horses.
NUTRIENT DIGESTIBILITY OF COMMERCIAL DOG FOODS
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2 Department of Animal Science, Agricultural University of Norway, Ås, Norway

Introduction
Nutrient composition and digestibility are of crucial importance for health and wellbeing of animals. Even though nutritional quality is devoted great attention in the marketing of dog foods there is usually limited or no independent information on digestibilities. The present experiment was carried out to get objective information regarding nutrient digestibilities of dog food.

Materials and methods
Twelve brands of dry dog food available in Norway were included in the study. The foods were categorised according to market price. High price: Precept, Eukanuba, Proplan, Specific, Royal Canin, Hill’s, and low price: Pedigree, Doggy, Labb, Friskies, Troll and Kaisa. Three batches of each food were mixed and fed to four male mink. Mink was selected as model due to high accuracy and documented high correlation to digestibility in dogs. Digestibility of dry matter, ash, amino acids, fat, starch, total carbohydrates, calcium, phosphorus and magnesium was measured.

Results
All foods showed chemical content according to declaration, except for one having too high calcium content. Digestibility of main nutrients differed significantly among foods, also within each price category. No significant differences in digestibility of main nutrients between the “high price” and the “low price” food categories were found. Protein digestibility ranged from 72.7 to 79.7 % among “high price” foods and 73.9 to 80.5 among “low price” foods. Corresponding figures for fat digestibility were 76.2 to 95.8 % for “high price” and 83.9 to 91.7 for “low price foods”. Starch digestibilities were 82.2 to 97.9 % and 90.8 to 96.2 % for “high price” and “low price” foods, respectively. For all foods, digestible amino acids covered recommendations for growing dogs given by AFFCO.

Conclusion
Digestibility of main nutrients varied greatly among different commercial dog foods. Our experiment showed no significant difference in digestibility of nutrients in “high price” and “low price” dog foods offered in the Norwegian market.
FATTY ACID COMPOSITION IN COMMERCIAL DOG FOODS
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2 Department of Biochemistry, Physiology and Nutrition, Norwegian School of Veterinary Science, Oslo, Norway

Introduction
Dogs require n-6 fatty acids, and linoleic acid is established as essential. However, requirement for n-3 fatty acids has not been documented. Indications that diets may be deficient in essential fatty acids exist as skin defects in dogs may sometimes be alleviated or cured by changing food, or by supplementation with vegetable or marine oil. This suggests that both n-6 and n-3 fatty acids have positive effects in dogs, and that there may be large differences in fatty acid composition among different foods. In this study we monitored fatty composition in twelve commercial dry dog foods.

Materials and Methods
Twelve brands of dog food offered in Norway were included in the study: Precept, Eukanuba, Proplan, Specific, Royal Canin, Hill’s, Pedigree, Doggy, Labb, Friskies, Troll and Kaisa. Three batches of feed from each brand were mixed and analysed for contents of fatty acids.

Results
Saturated, monounsaturated and polyunsaturated fatty acid contents of the diets varied between 27.7-40.5 %, 31.6-45.0 % and 18.1-43.1 %, respectively. Levels of linoleic acid + arachidonic acid were 14.0-36.2 % and 0.2-0.7 % of total fat, respectively, and were sufficiently high to cover the requirement for essential n-6 fatty acids. For n-3 fatty acids, the levels varied between 1.4 and 6.3 % of total fat. The diet with the highest level of n-3, contained predominantly linolenic acid (C18:3 n-3), and not EPA (C20:5 n-3) or DHA (C22:6 n-3). Sum of EPA and DHA were found to be between 0 to 1.5 % of total fat. The n-3/n-6 relationships were between 1/5 and 1/17.

Conclusion
Fatty acid composition in dry dog foods varies substantially.
BODY COMPOSITION AND INSULIN SENSITIVITY BEFORE AND AFTER A RAPID WEIGHT LOSS IN DOGS FED A HIGH PROTEIN LOW ENERGY DENSITY DIET

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1 National Veterinary School of Alfort, France
2 National Veterinary School of Nantes, France

The aim of this study was to test the ability of a high protein low energy diet to enable a rapid weight loss while preserving the lean body mass.

Six adult Beagle dogs were used, which ideal body weight (iBW) and body composition had been previously determined. Obese dogs, which BW exceeded iBW by at least 25% (126%-179%), were fed a commercial hypoenergetic diet (as fed 26%CP 8%EE 14%CF - measured ME: 252 kcal/100g). The energy allowance was determined in order to induce a rapid weight loss (2-3 %/wk). Body composition (fat (FM) and fat-free mass (FFM)) was determined, in ideal dogs (T1), once obese (T2) and after weight loss (T3), from the dilution of deuterium oxide (0.5 g/kg). Insulin sensitivity was assessed by the euglycemic hyperinsulinic clamp technique.

<table>
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<tr>
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<th>T1 (normal)</th>
<th>T2 (obese)</th>
<th>T3 (after weight loss)</th>
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<tbody>
<tr>
<td>IBW (kg)</td>
<td>12.1</td>
<td>17.4</td>
<td>11.8</td>
</tr>
<tr>
<td>FM (%)</td>
<td>17.4</td>
<td>9.8</td>
<td>16.1</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>9.8</td>
<td>2.1</td>
<td>16.1</td>
</tr>
<tr>
<td>BW (kg)</td>
<td>17.2</td>
<td>141</td>
<td>96</td>
</tr>
<tr>
<td>BW (%iBW)</td>
<td>2.1</td>
<td>32.9</td>
<td>4</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>3.5</td>
<td>11.4</td>
<td>3.5</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>1.2</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>△P/wk (%)</td>
<td>0.9</td>
<td>1.2</td>
<td>2.6</td>
</tr>
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</table>

Insulin sensitivity was lower (p<0.05) in obese dogs than in both the other states. It did not significantly differ after weight loss from normal value (28.8±0.9, 15.3±0.3, 22.7±0.7mg/kg BW/min, respectively at T1, T2 and T3).

These results show that a high protein hypoenergetic diet allowed a very rapid weight loss in obese dogs, without alteration in body composition compared to non obese state.
CALCIUM REGULATION IN GROWING DOGS OF 2 DIFFERENT BREEDS
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Institute for Animal Physiology, Physiological Chemistry and Animal Nutrition, Ludwig-Maximilians-University, Munich, Germany

The influence of the Ca supply on the health of the skeleton of growing dogs and their ability to adjust the digestibility of this element in cases of over- and under-supply was investigated by various authors. In most of the trials Great Danes represent the large breed dogs and Poodles or mongrels were used as small breed dogs.

Twenty-four Beagles with an adult body weight of 12 to 16 kg and 24 Foxhound-Boxer-Ingelheim Labradors (FBI) weighing between 30 and 38 kg when adult, were used in this feeding trial. After weaning at the age of 6 weeks all dogs received a diet based on tripe and rice supplemented individually with minerals and vitamins for 3 periods of 6 weeks each. The Ca supply was adjusted to an amount of 15 and 300 %, i.e. about 0.2 and 3.6% of dry matter, respectively, of the requirements given by MEYER and ZENTEK (1998). One group of each breed (7 Beagles, 9 FBI) was raised as a control group; they received a diet with a Ca content of around 11g Ca per kg dry matter (i.e. 100% of requirements). In balance trials at the end of each 6 week period the Ca balance was determined.

The Ca retention was higher in the Beagles compared to the FBI dogs (64 to 36 % of the intake), especially in cases of a high Ca intake. This suggests the possibility of breed differences in the regulation of Ca absorption in growing dogs.

References
MODULATION OF UNCOUPLING PROTEIN 1 AND PEROXISOME PROLIFERATOR ACTIVATED RECEPTOR γ EXPRESSION IN ADIPOSE TISSUE IN OBESE INSULIN RESISTANT DOGS

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Centre de Recherche en Nutrition Humaine, Nantes, France

Uncoupling protein 1 (UCP1) is a mitochondrial protein involved in the regulation of energy balance and pancreatic function. Its expression is altered by nutritional status, and metabolic disorders such as obesity and diabetes. Another protein, the nuclear peroxisome proliferator-activated receptor gamma (PPARγ) plays a key role in the regulation of lipid storage. In rats activation of PPAR reduces weight gain and improves insulin sensitivity. This might be related to the PPAR-activation-induced increase in UCP1 expression. Expression of UCP1 and PPARγ and their modulation by chronic adaptation to hyperlipidic hyperenergetic diet are not yet known in dog. Our aim was to examine the UCP1 and PPARγ mRNA levels in adipose tissue in obese insulin resistant dogs.

Obesity and insulin resistance were induced in 4 male Beagle dogs (3-9-γ old, 8.80-15 kg body weight) by feeding a hyperlipidic hyperenergetic diet for 7 months. Adipose tissue samples were taken before and after the diet. mRNA expression of UCP1 and PPARγ was quantified by real time RT-PCR by comparison with GAPdh expression as house-keeping gene. Results were expressed as the ratio [gene mRNA]/[GAPdh mRNA]. Expression of both UCP1 and PPARγ mRNA levels decreased in adipose tissue in obese dogs compared to lean animals (gene mRNA /GAPdh mRNA: 0.62±0.42 vs. 2.27±0.96 and 0.51±0.2 vs. 4.70±1.96, for UCP1 and PPARγ respectively).

These results suggest a link between PPARγ activation and UCP1 expression. The decrease of PPARγ expression could be responsible for that of UCP1 expression in obese animals. This modulation of UCP1 expression could contribute to the alteration of metabolic efficiency and the insulin resistance observed in these dogs.
Microenteral nutrition in puppies with gastroenteritis

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Mexico DF

Microenteral nutrition is a water, carbohydrates, short chain fatty acids, amino acids, vitamins and minerals supplementation in small amounts every 1-2 hours. The objective of its use is to increase the stomach and intestinal blood supply and reduce bacterial translocation and intestinal atrophy. The weight gain, mortality and intestinal atrophy were evaluated in 200 puppies with gastroenteritis from natural cases.

The dogs were divided in two groups (A and B) of 100 puppies each one. Group A were treated with fluid therapy (Hartmann) and antibiotics (such as Sulphonamides-trimetoprim 15 mg / kg / 12 hrs / IV). Group B were treated with fluid therapy, antibiotics (such as Sulphonamides-trimetoprim 15 mg / kg / 12 hrs / IV) and proton pump inhibitors (e.g. Pantoprazole 4 mg / kg / IV / single dose). Group A were fed 3 days after treatment ad libitum and Group B were fed 6 hours after treatment by microenteral nutrition every 2 hours orally. In both cases a WALTHAM CONCENTRATED DIET was used. The amount fed and the caloric demands were calculated using the REB, REM equations. After, all the patients were fed with the same diet for 10 days followed by a common puppy diet.

The weight gain in group A was 1.2 % daily and in group B, 10 % daily. The mortality in group A was 30 % and in group B was 5 %, and the postmortem samples obtained from those puppies which died in Group A showed intestinal atrophy, whereas no intestinal atrophy was observed in samples from Group B (p < 0.05). Intestinal biopsies by endoscopy were taken from the healthy puppies, showing a severe intestinal atrophy in group A and no intestinal atrophy in group B. The microenteral nutrition in group B prevents intestinal atrophy in puppies with gastroenteritis (p < 0.05).

The use of microenteral nutrition in puppies with gastroenteritis helps to avoid intestinal atrophy.
INFLUENCE OF DIETARY PROTEIN SOURCE (POULTRY, BEEF) AND MANUFACTURING PROCESS (CANNING, EXTRUSION) ON THE COMPATIBILITY AND DIGESTIBILITY OF MIXED DIETS AND SOME INTESTINAL PARAMETERS IN DOGS

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Introduction
Dietary protein sources can affect compatibility of mixed diets in dogs. In the present study we investigated effects of two different dietary protein sources (beef, poultry) that were used with an almost identical recipe in extruded or canned mixed diets in a group of healthy Beagles and German Shorthair Pointers.

Materials and Methods
Digestibility of organic matter, faecal concentrations of Cl. perfringens (culture on selective media, PCR technique for enterotoxigenic and β2-toxinogenic strains), some microbial metabolites (ammonia, volatile fatty acids) and the histology of colonic mucosa were investigated with two canned and two dry foods with identical ingredients and defined protein sources (beef or poultry). A commercial dry diet was used as reference. Each diet was fed for 7 days before digestibility trials were performed, samples for the microbiological traits were collected after a minimum of 14 days and biopsies were taken after 24 days. The investigations were performed with three German Shorthair Pointers and eight Beagles.

Results
The faecal consistency was considerably firmer in Beagles compared to German Shorthair Pointers, especially with the canned diets. Apparent digestibilities of organic nutrients were comparable in both breeds, higher faecal ammonia excretions and higher concentrations of i-butyric acid, n- and i-valeric acid indicate increased microbial fermentation in the intestine during the canned food periods. Cl. perfringens tended to increase when canned diets were fed but enterotoxigenic or β2-toxinogenic Cl. perfringens strains could not be identified. There was no distinct dietary effect on the microstructure of the colonic mucosa, changes were faint and did not indicate pathological effects.

Conclusion
Protein source and manufacturing process affect compatibility of mixed diets in dogs. Effects on the colonic microstructure were not obvious in this study.
INFLUENCE OF DIETARY PROTEIN QUALITY AND CONCENTRATION ON URINE COMPOSITION OF CATS
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Introduction
Urolithiasis is still an important and worldwide problem in cats. In the present investigation the influence of dietary protein quality and quantity was investigated with regards to the urine composition and the excretion of minerals, oxalate and crystals in cats.

Materials and methods
Six diets with two concentrations of protein sources (greaves meal, soybean protein isolate or horse meat) were sequentially fed to seven cats. Each diet was fed for at least 14 days before samples were collected. The urinary concentrations and excretion of minerals, nitrogen, urea, ammonia, protein, oxalate and creatinine, and additionally the pH, specific gravity and urinary sediment were investigated.

Results
The urine volume was determined mainly by total water intake. The specific gravity of urine was dependent on protein intake and the resulting urinary concentration of urea. The renal excretion of creatinine was affected by the dietary protein concentration and the protein source. The nitrogen intake was inversely correlated to the renal excretion of and the urinary concentration of oxalate, but calcium oxalate dihydrate crystals were observed only as an exception, while the number of struvite crystals depended on the intake of magnesium and the urinary pH.

Conclusion
Dietary protein intake determined urine composition in cats and the level and character of crystalluria.
EXOCRINE PANCREATIC INSUFFICIENCY (EPI) AND ADVERSE REACTION TO FOOD: A POSITIVE RESPONSE TO A HIGH FAT, SOY ISOLATE HYDROLYSATE BASED DIET

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2 Clinique Vétérinaire, 425 Av. Brugmann, Bruxelles, Belgium

Introduction
Dermatological signs of adverse reaction to food are more common in dogs suffering from EPI, especially in German Shepherd Dogs. Those signs respond poorly to enzyme supplementation. Recently, protein hydrolysate based diets have become available in the management of adverse reaction to food and could be beneficial in the management of both EPI and adverse reaction to food. Moderate to low fat, highly digestible diets are usually recommended in the management of EPI. However, a recent study suggests that a high fat diet could be better tolerated by dogs with EPI. This report describe the positive responses of 4 German Shepherd Dogs suffering from both EPI and skin disease to a 19 % fat, soy isolate hydrolysate based diet.

Materials and methods
Four male German Shepherd dogs, age range 2.5 - 9.0 yrs, body weight 31-40 kg, and suffering from EPI (TLI 0.88 to 5.08 µ/L) were included in this study. All dogs were suffering from recurrent diarrhea that was more or less controlled with highly digestible and/or hypoallergenic prescription diets as well as pancreatic enzyme supplementation. All dogs were lean (body condition score of 2 on a scale of 5) at presentation and showed various signs of skin diseases compatible with adverse reaction to food: pruritus, self-trauma, and recurrent pyoderma. Following clinical exams, all dogs were placed on a 21% protein, 19 % fat, 37.6 % starch, 5.4 % dietary fiber dry expanded diet (As fed basis, 4182 kcal ME/kg) formulated with rice and soy isolate hydrolysate. Two dogs presenting signs of deep pyoderma were treated with cefalexin (15 mg/kg bid for 30 days). The dogs did not receive any other medication except for pancreatic enzyme supplementation.

Results
Within 7 days, feces were normal in all 4 dogs and no dog showed any signs of diarrhea over a 3-month follow-up. Within 3 months, all 4 dogs were in optimal body condition after gaining 2 to 11 kg of body weight. Over the same period, 3 of the 4 dogs were completely controlled from their skin disease and 1 dog improved significantly.

Conclusion
This study suggest that a soy hydrolysate and rice based diet could significantly improve the clinical condition of dogs suffering from both EPI and skin disease, a condition reported difficult to control with only enzyme supplementation. A high level of fat (40.8 % of the calories) was very well tolerated by the dogs of this study and confirms earlier findings. This suggests that high fat and highly digestible diets not only are not contra-indicated in the management of EPI but could be beneficial to restore body condition.

References
C) Veterinary Diet Canine Hypoallergenic, Royal Canin, Aimargues, France.
DEVELOPMENT IN COMPUTER-AIDED DIET CALCULATION FOR DOGS AND CATS

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Working in the field of nutrition consultation for dogs and cats as well as everyday nutritional treatment calls for a fast and user-friendly method of diet calculation. Individual conditions of the patient or even owner might make the exclusive use of a commercial product difficult. Owners may want to know they have a choice or may combine the diet for example with treats. At least a diet consisting of various feedstuffs and treats makes an easy calculation without computer and therefore an optimal recommendation impossible. Demonstrating the best fitting product for the individual case makes it easier to achieve good compliance.

The advantages of the computer-aided method of diet calculation for dogs and cats are an automatic calculation of the patients requirements (maintenance, growth, pregnancy, lactation, special diseases like chronic renal failure), access to a large number of single feedstuffs and commercial products, an easy comparison between requirements and actual nutrients and therefore a possibility to give a quick judgement of existing rations as well as a recommendation. The software Diet-Check© also allows the prediction of the ME of a feedstuff, the print-out of an individual growth curve as well as a visual processing of the patients requirements and nutrient supply in case of disproportions between them. Because new or non-listed feedstuffs, respectively, can be added to the database, an assessment of new products as well as home-made diets is possible.

A demonstration of the software with all its functions will be given.
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