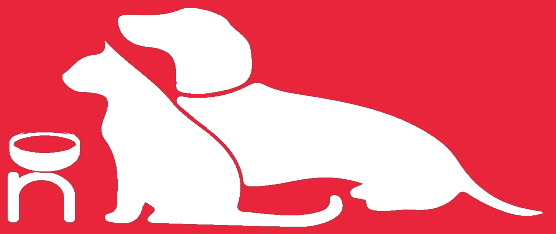
Nutritional management of canine and feline diabetes mellitus

Cecilia Villaverde, BVSc, PhD, DACVN, DECVCN

Residency class, Tuesday 19th of September, 2017



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Outline

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- Introduction
- Key nutrients
- Feeding plan
- Summary

Diabetes mellitus

- Absolute or relative insulin deficiency resulting in hyperglycemia and glucosuria
- Treatment: insulin replacement therapy + supportive treatment

> Type I

> Type II

Risk factors CANINE

- Genetic predisposition
- Chronic pancreatitis
- Medication induced (steroids, progestogens)
- Gestation (temporary)
- Female
- More common middle aged

Risk factors FELINE

Male cats (60-70%)

Obesity

Burmese (in some countries)

Increasing age (>7 yrs)

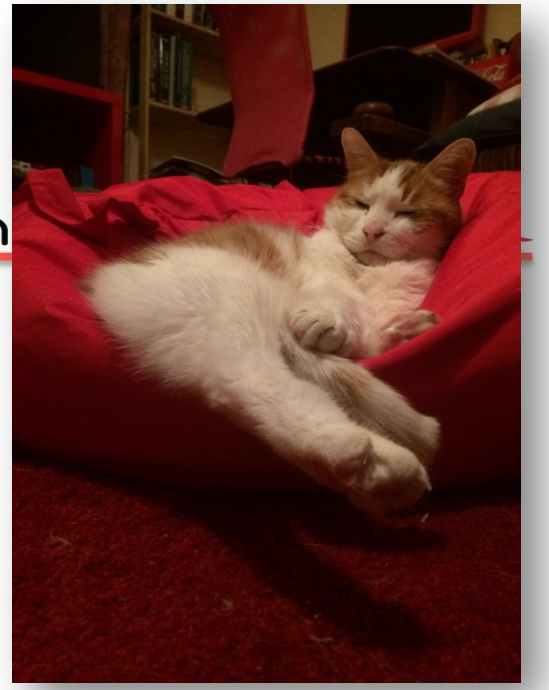
Concurrent diseases

Some medications

Inactivity/sedentarism

Diet?

Diabetes mellitus: dietary management

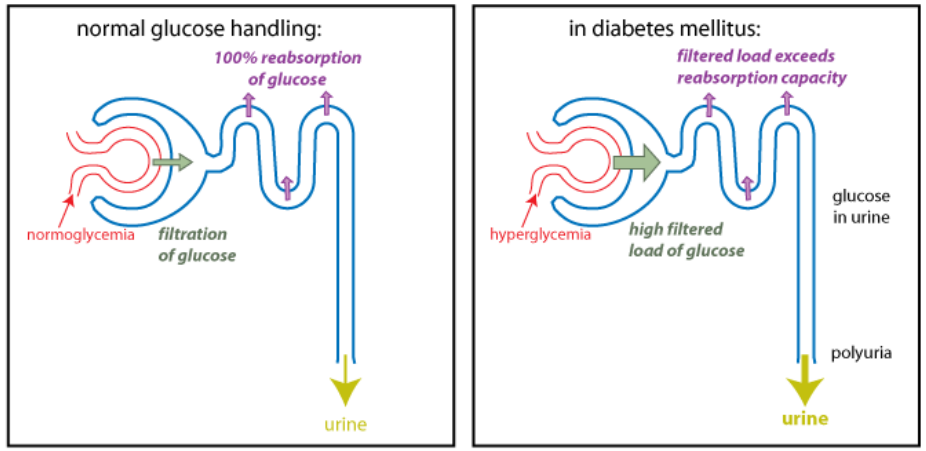


Goals:

1) Provide energy and nutrients to maintain a stable body weight and an ideal body condition score
   - Ensure palatability!
2) Help manage blood glucose concentrations to
   1) Reduce insulin dose
   2) Stop insulin treatment (remission)

✓ Nutrient profile?
✓ Feeding method?

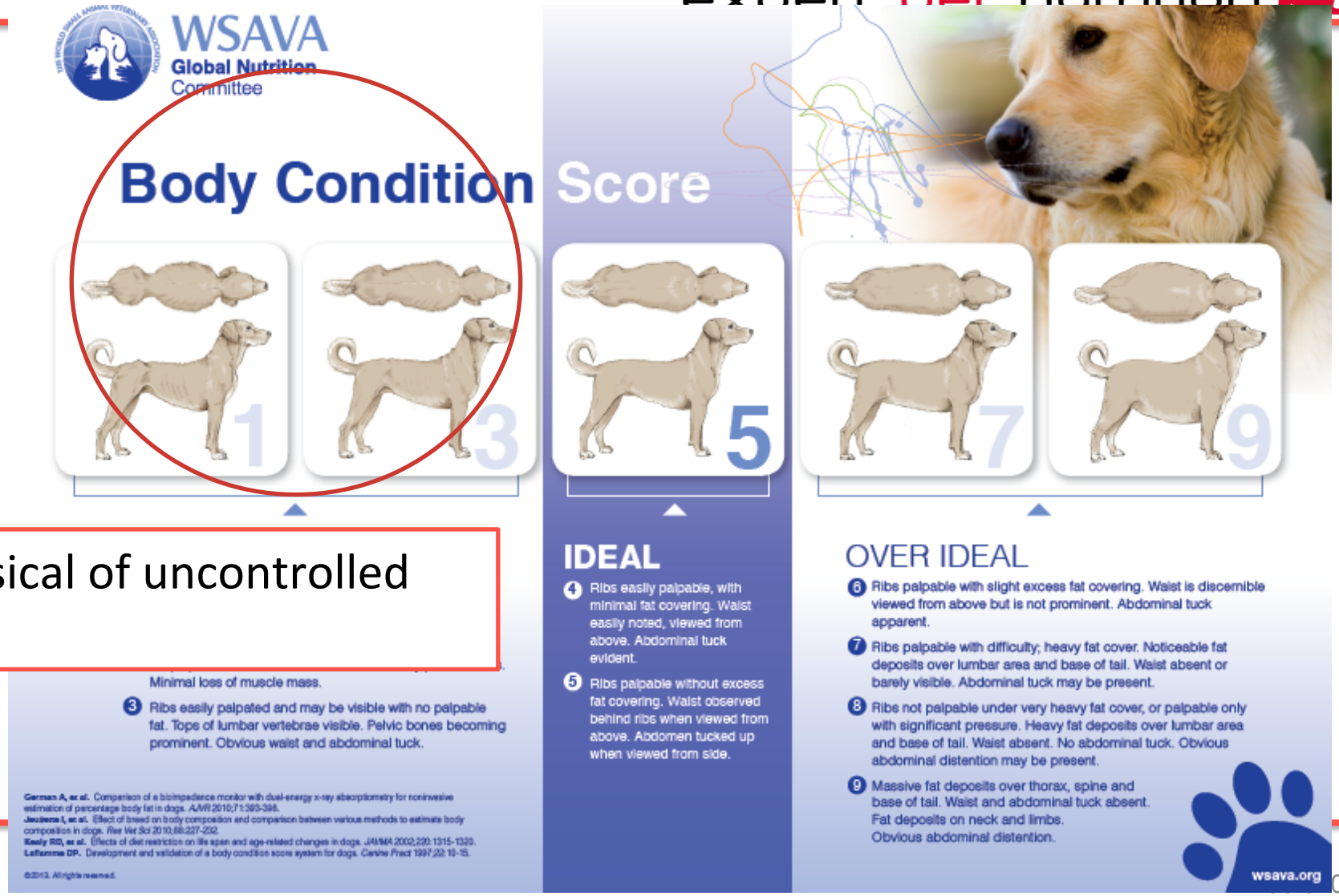
Key nutrients: water



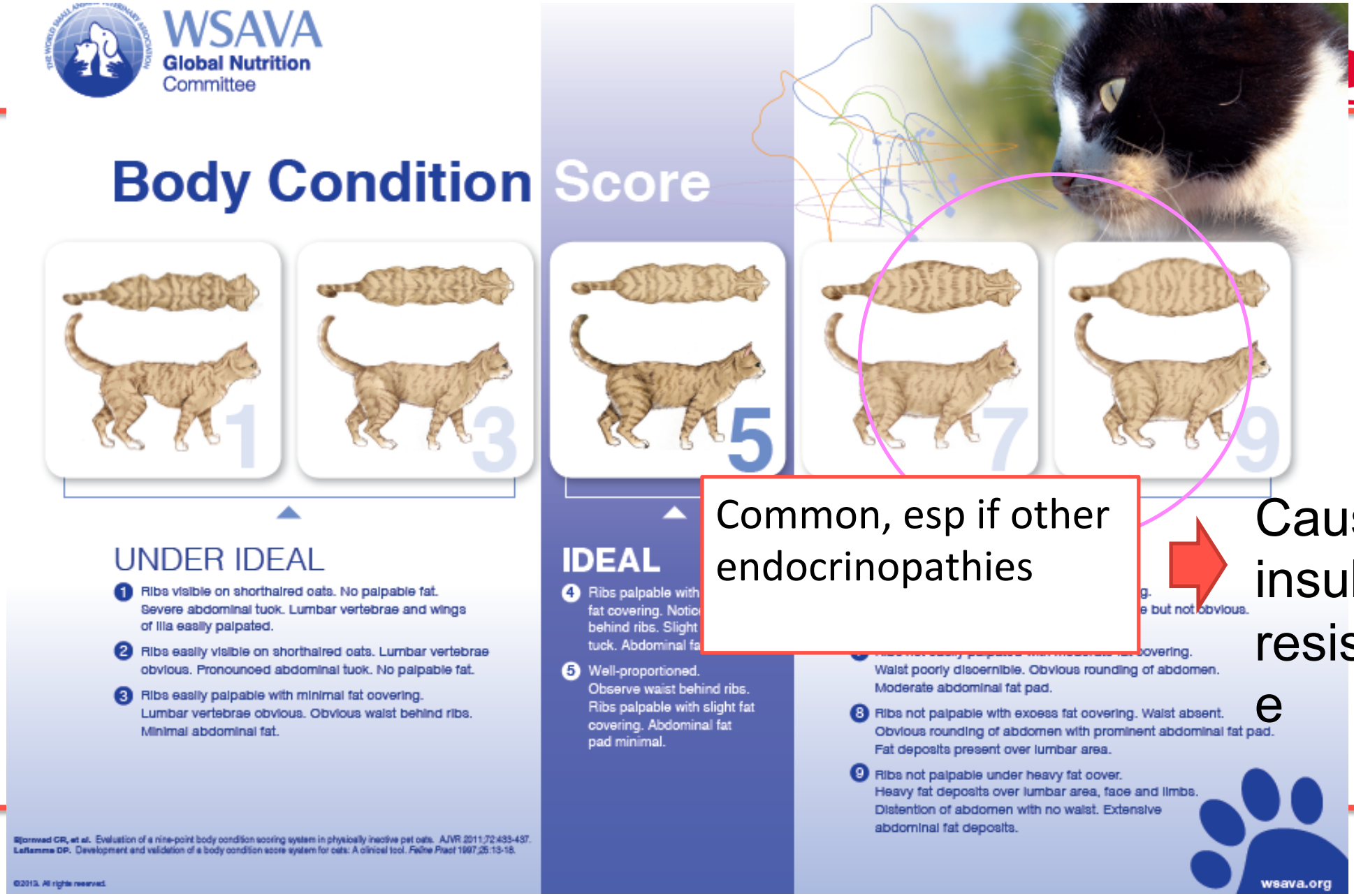
https://courses.washington.edu/conj/bess/polyuria/nephron-diabetes.png

- Fresh water always available
- Multiple water stations
- Water fountains
- Canned food

Key nutrients: energy



Classical of uncontrolled DM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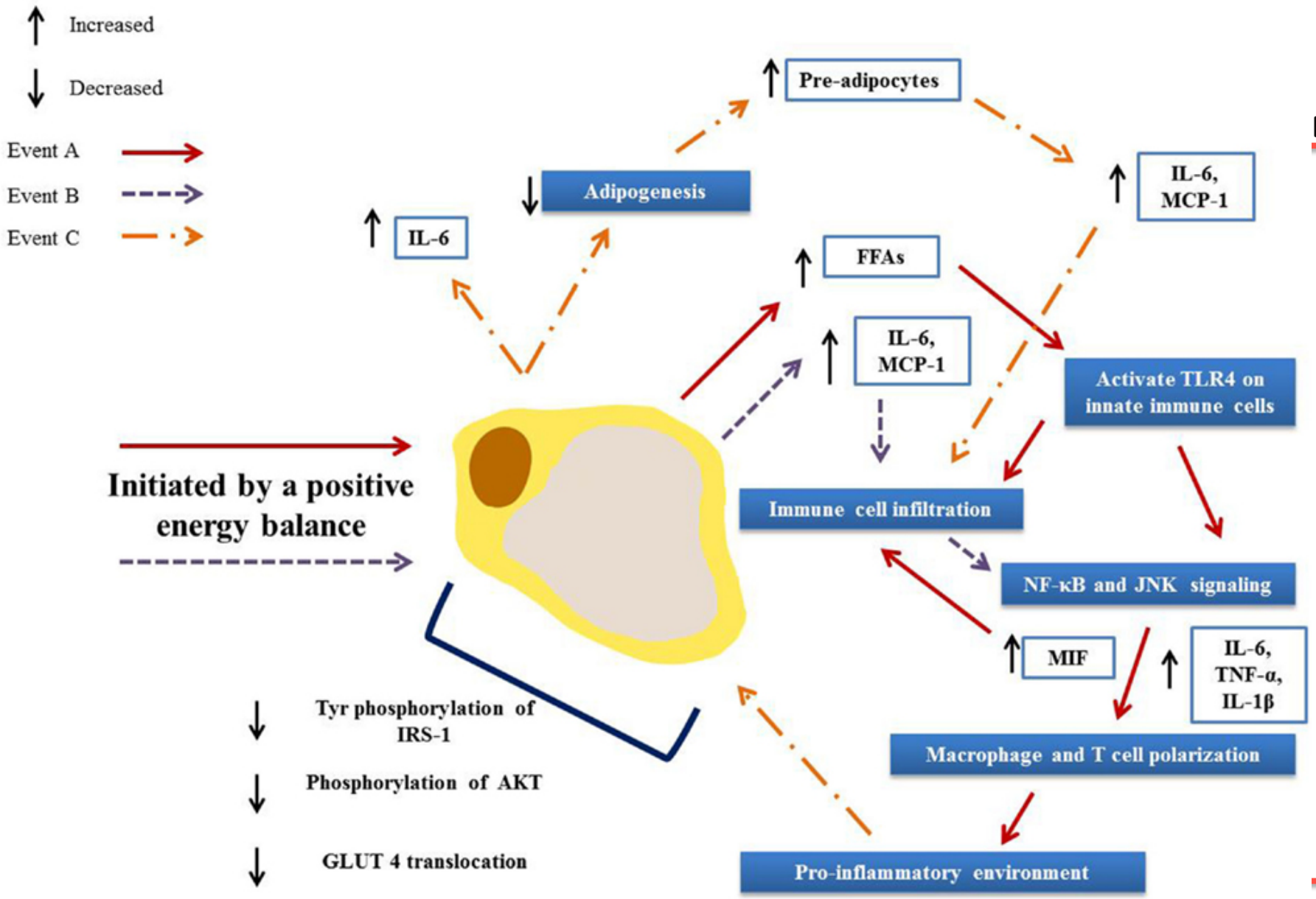
Body Condition Score
1
3
5
7
9
UNDER IDEAL
1 Ribs visible on shorthaired cats. No palpable fat. Severe abdominal tuck. Lumbar vertebrae and wings of ilia easily palpated.
2 Ribs easily visible on shorthaired cats. Lumbar vertebrae obvious. Pronounced abdominal tuck. No palpable fat.
3 Ribs easily palpable with minimal fat covering. Lumbar vertebrae obvious. Obvious waist behind ribs. Minimal abdominal fat.
IDEAL
4 Ribs palpable with
fat covering. Notic
behind ribs. Slight
tuck. Abdominal fa
5 Well-proportioned. Observe waist behind ribs. Ribs palpable with slight fat covering. Abdominal fat pad minimal.
but not obvious.
overing.
Waist poorly discernible. Obvious rounding of abdomen. Moderate abdominal fat pad.
8 Ribs not palpable with excess fat covering. Waist absent. Obvious rounding of abdomen with prominent abdominal fat pad. Fat deposits present over lumbar area.
9 Ribs not palpable under heavy fat cover. Heavy fat deposits over lumbar area, face and limbs. Distention of abdomen with no waist. Extensive abdominal fat deposits.
Common, esp if other endocrinopathies
Causes insulin resistance
wsava.org



nutrition

Less insulin receptors

Insulin receptors less functional

Obesity and DM in cats

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- Scarlett, Donoghue (1994): increase DM risk by
  - X2 (overweight)
  - X8 (obesity)
- All epidemiology studies found this association
- Obese cats after weight loss: increase[d] insulin sensitivity (Hoenig et al 2007)

Dogs?

Cats with DM and obesity should always undergo a weight loss feeding plan

Key nutrients: fat

- DM is commonly associated to dyslipemias: hypertriglyceridemia, hypercholesterolemia
- DM is a risk factor for pancreatitis (and viceversa), which is sensitive to dietary fat in dogs
- Palatability, E density

Careful evaluation for each patient!

Key nutrients: protein

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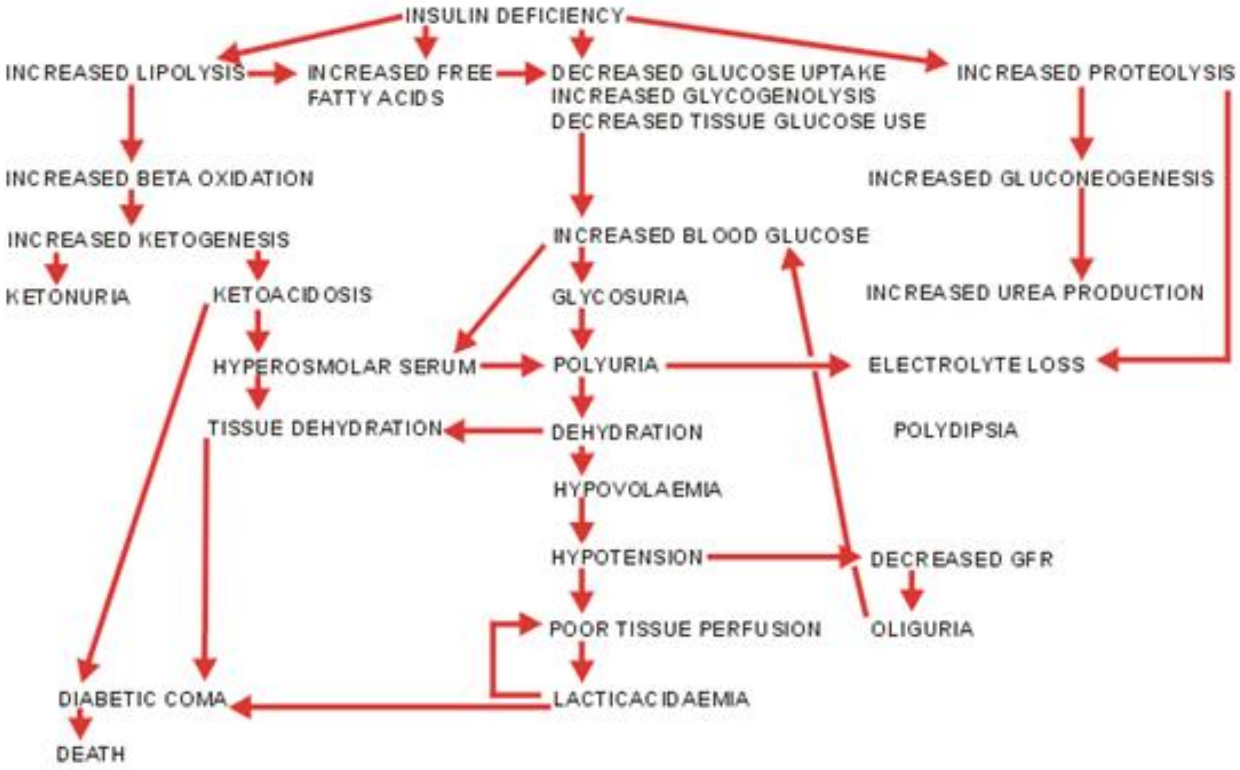
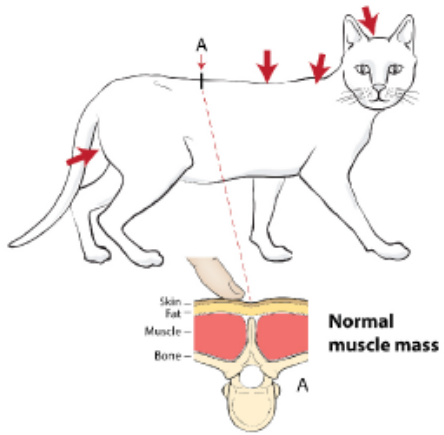
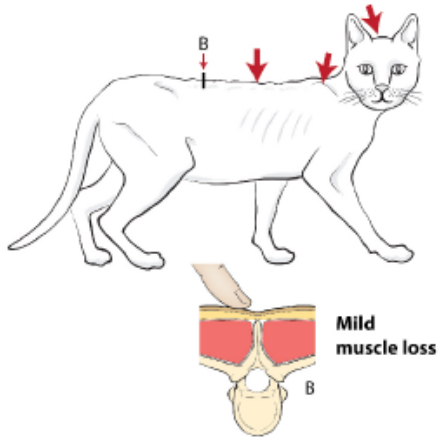
Muscle wasting is common in uncontrolled DM patients: ensure adequate intake



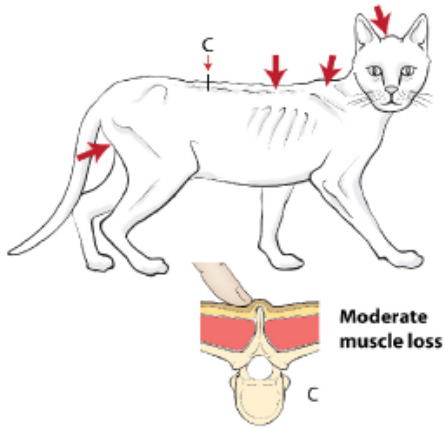
Normal muscle mass



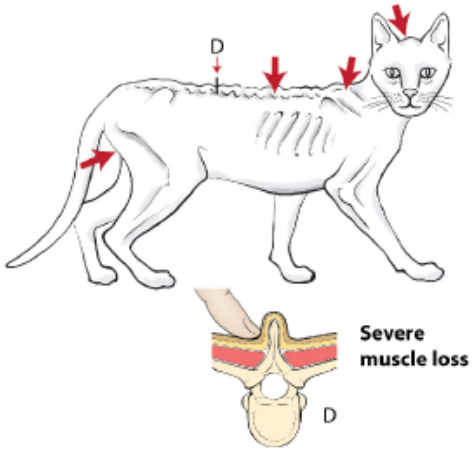
Mild muscle loss



Moderate muscle loss



Severe muscle loss



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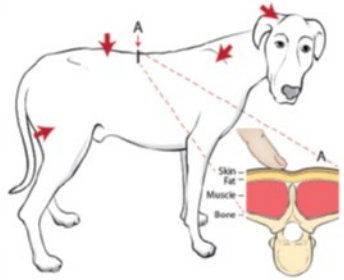
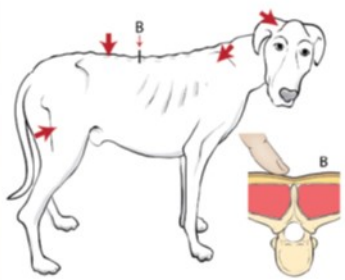
Muscle Condition Score

Muscle condition score is assessed by visualization and palpation of the spine, scapulae, skull, and wings of the ilia. Muscle loss is typically first noted in the epaxial muscles on each side of the spine; muscle loss at other sites can be more variable. Muscle condition score is graded as normal, mild loss, moderate loss, or severe loss. Note that animals can have significant muscle loss if they are overweight (body condition score > 5). Conversely, animals can have a low body condition score (< 4) but have minimal muscle loss. Therefore, assessing both body condition score and muscle condition score on every animal at every visit is important. Palpation is especially important when muscle loss is mild and in animals that are overweight. An example of each score is shown below.

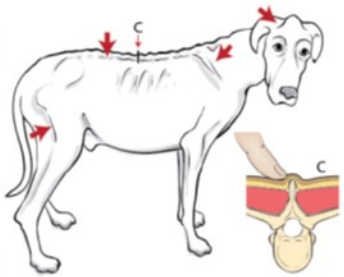
Normal muscle mass



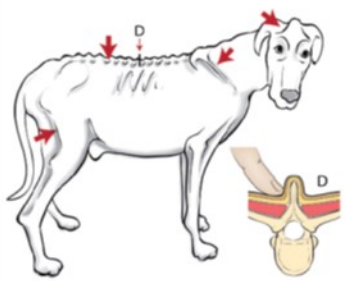
Mild muscle loss



Moderate muscle loss



Severe muscle loss



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Key nutrients: protein in cats

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- low carbohydrate/high protein diet might help management?
  - Cat: carnivore, gluconeogenic species
  - 1 study with only 5 healthy cats (Mori et al 2009) suggested that protein may be a more potent insulin secretion stimulator than glucose in this species
  - One study (Mimura et al 2013), however, supports a larger effect of starch and fiber (c protein) on blood glucose and insulin

Key nutrients: fiber

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Proposed mechanism of action

- **Insoluble fiber**

- Decrease transit time
- Impede substrate access to enzyme / decrease absorption of dietary carbohydrat

- **Soluble fiber**

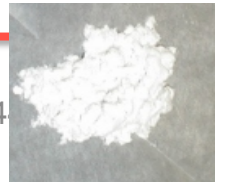
- Delay gastric emptying
- Form gel in aqueous solutions → « bind » glucose

→ Slower glucose absorption / lower insulin need









Key nutrients: fiber

- Positive effect of soluble and insoluble fiber on disease control (Nelson et al. 1991, Nelson et al 1998, Graham et al 2002) – E intake/ Weight loss!
- Positive effect of insoluble and soluble fiber (Kimmel et al 2000). High adverse effects of soluble fiber
- No effect of fiber use on glycemic control (Fleeman et al 2009) – other nutrient intake differences

Key nutrients: fiber

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- Nelson et al 2000
  - 16 cats with spontaneous non insulin dependent diabetes mellitus, high fiber diet (cellulose, 12% DM) lower pre and post prandial glycemia vs low fiber diet.
  - Careful interpretation: high fiber diet was also slightly lower in carbohydrates than the control diet

Key nutrients: fiber

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- Different fiber types and sources at different dosages: interpretation? Dose recommendation?
- High number of confusing effects:
  - Weight loss
  - Different macronutrient composition that can affect insulin secretion
- High individual variation for positive & negative effects
- Dogs 15-20% DM (sol or insol), Cats 12% Dm (insol) potentially helpful in reducing post pandrial BG

Key nutrients: digestible carbohydrates: TYPE

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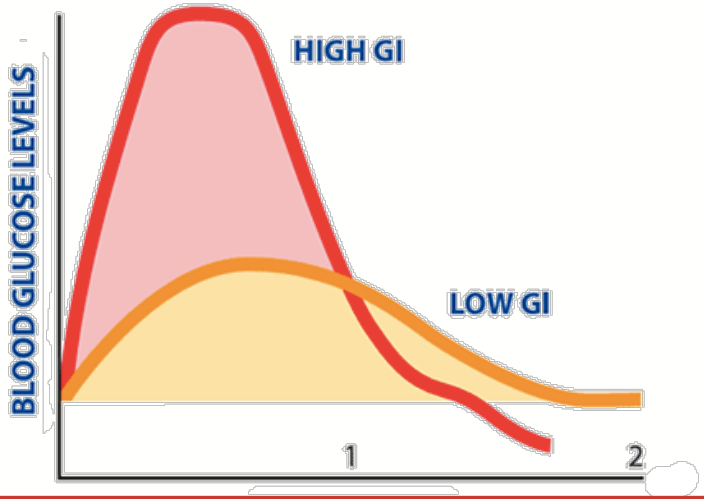
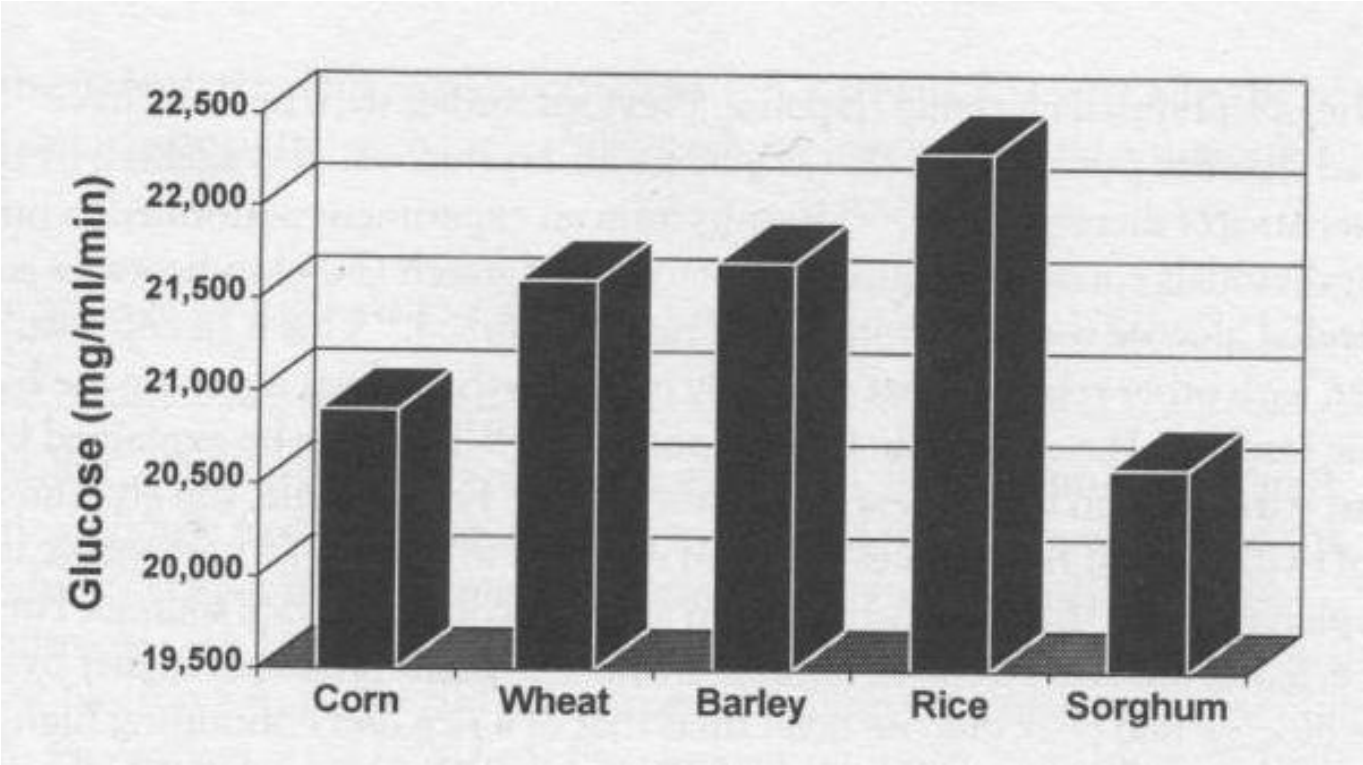
- Soluble carbohydrates (starch) are potent stimulators of insulin secretion in healthy individuals (cats?)
- Classical recommendation from humans: use starch that results in lower post pandrial glucose curve (low glycemic index)

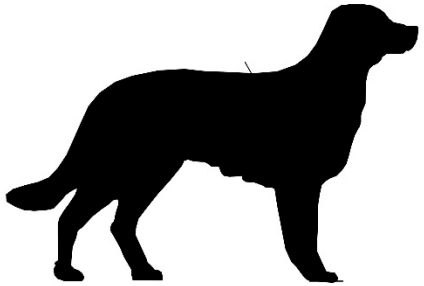


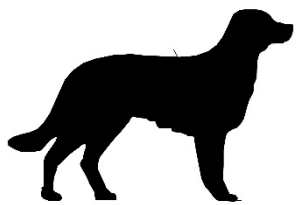
Not used for pet food:

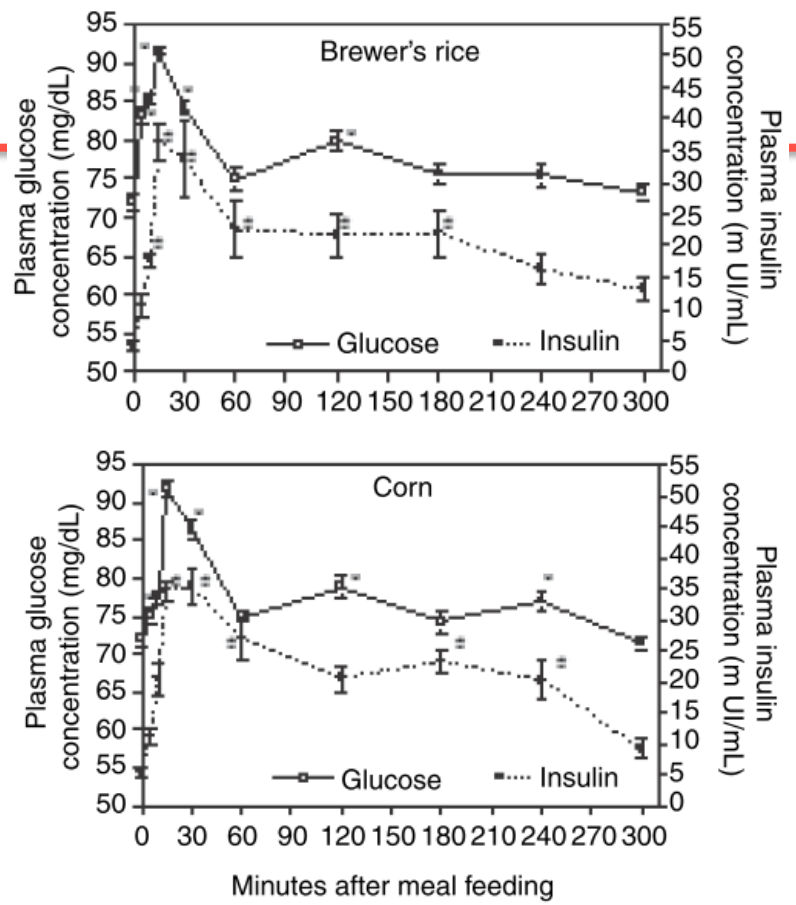
- Mixture of ingredients vs. single CHO sources
- Fat may affect gastric emptying and thus BG
- Processing may affect starch digestibility

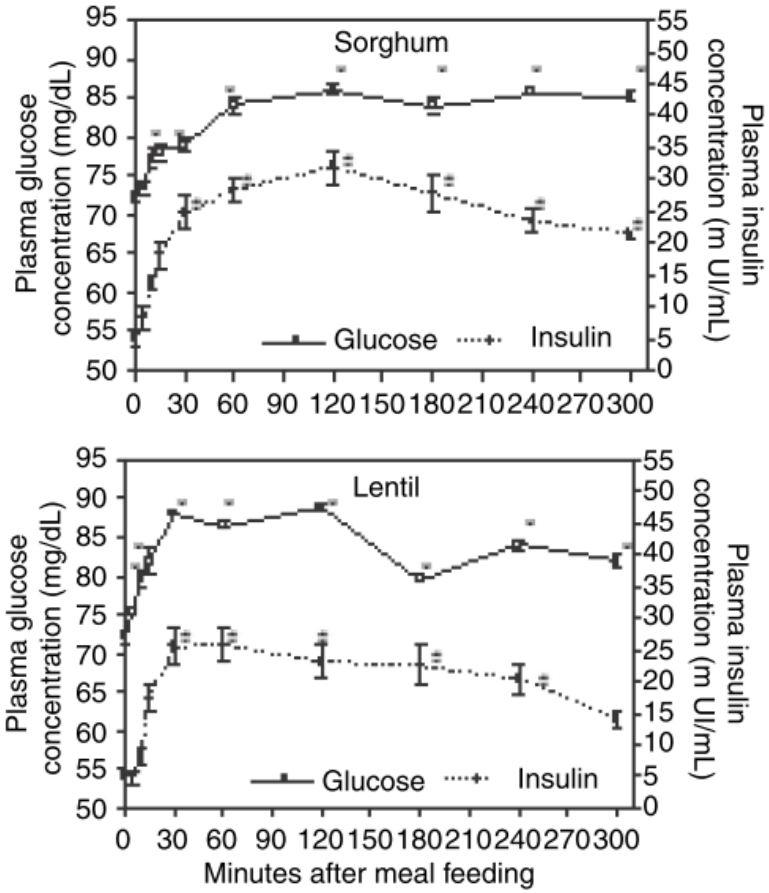
- Sunvold and Bouchard 1998.
  - Healthy dogs
  - 5 starch sources (30% dry matter) for 2 weeks











Carciofi AC et al. *J Anim Physiol Anim Nutr (Berl)* 2008;92.

Fiber?

Same amount of starch (~ 35% DM), the source of CHO affects postprandial blood glucose AUC (→ fiber effect?)

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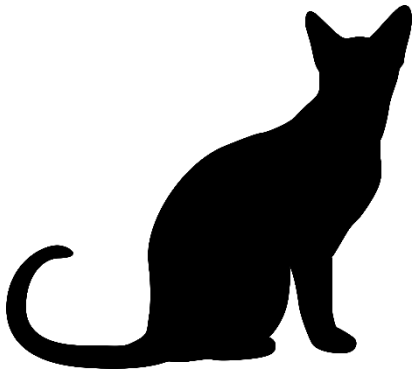

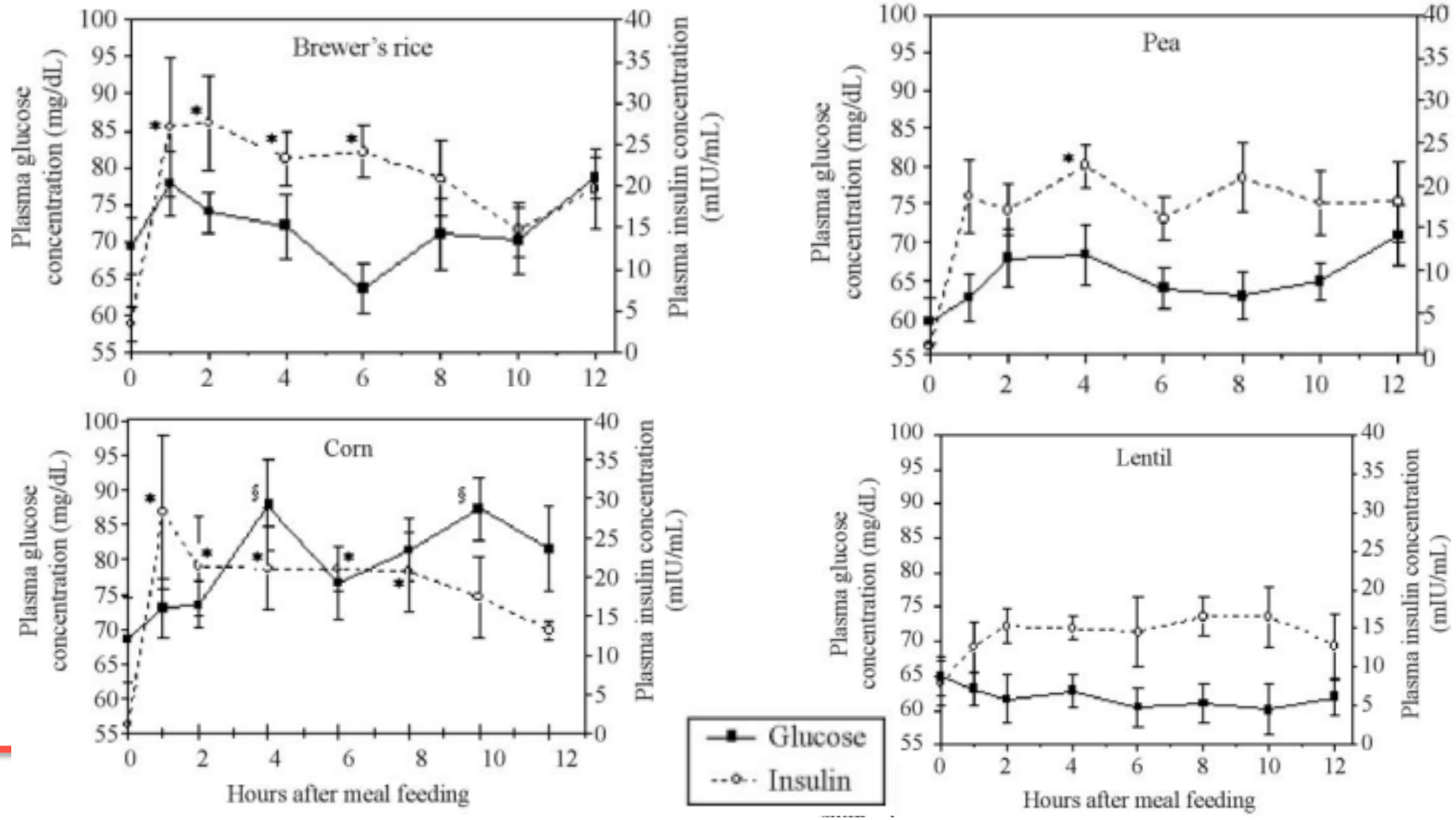

de-Oliveira LD et al. *J Anim Sci* 2008;86.

Key nutrients: digestible carbohydrates: AMOUNT

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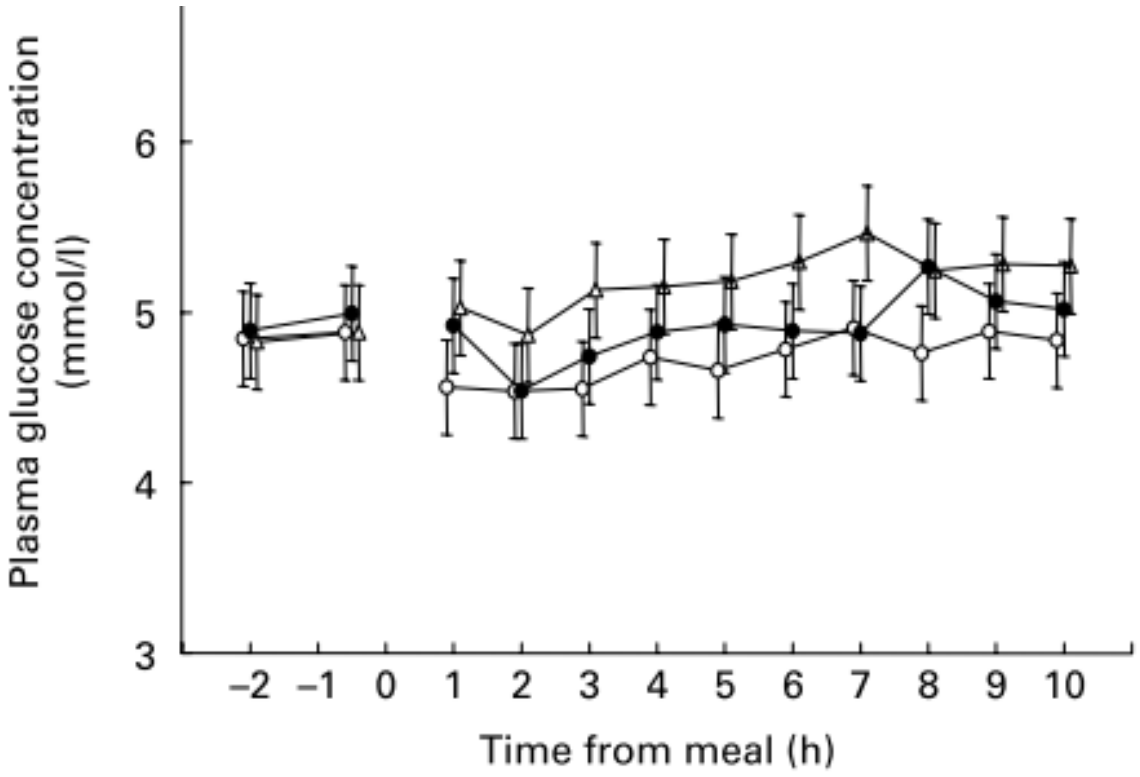
- Initially considered for cats
  - Lack fructokinase
  - Low/no glucokinase (hexokinase)
- Maybe low starch diets can help control BG



CHO
12 %
30 %
43 % ME

9 Labrador retrievers (4 M, 5 F)
Cross-over design
Measure after single meal

No clear

Hewson-Hughes AK et al. *Br J Nutr* 2011;106 Suppl 1.

A diet lower in digestible carbohydrate results in lower postprandial glucose concentrations compared with a traditional canine diabetes diet and an adult maintenance diet in healthy dogs

K.F. Elliott [a,*], J.S. Rand [a], L.M. Fleeman [a,b], J.M. Morton [a,c], A.L. Litster [a,d], V.C. Biourge [e], P.J. Markwell [f]

12 **healthy** neutered dogs, cross over study, 3 weeks per period

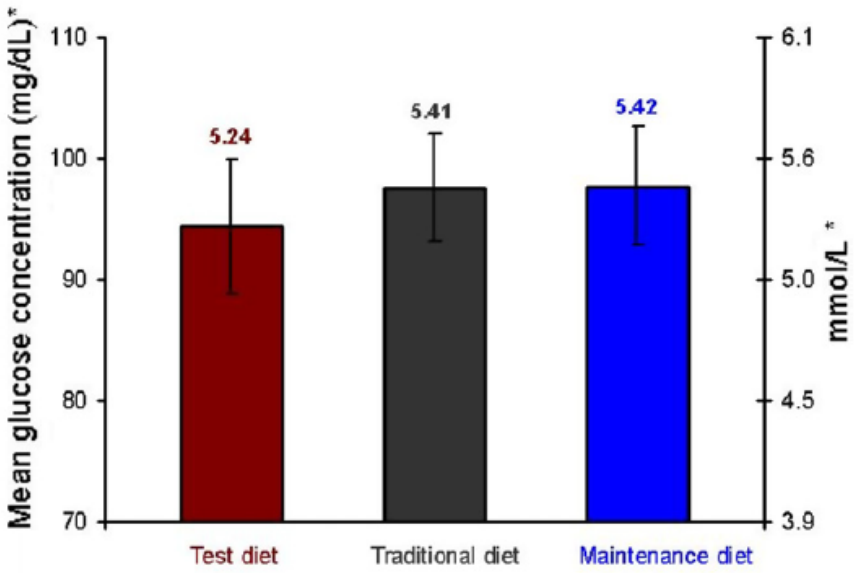


Fig. 3. Mean plasma glucose concentrations for 12 h (mean ± standard deviation) following consumption of three diets in a cross-over study in 12 healthy dogs. Mean glucose concentration for the test diet was significantly lower than for each other diet ($p \leqslant 0.02$). *Y axes represent the reference range.

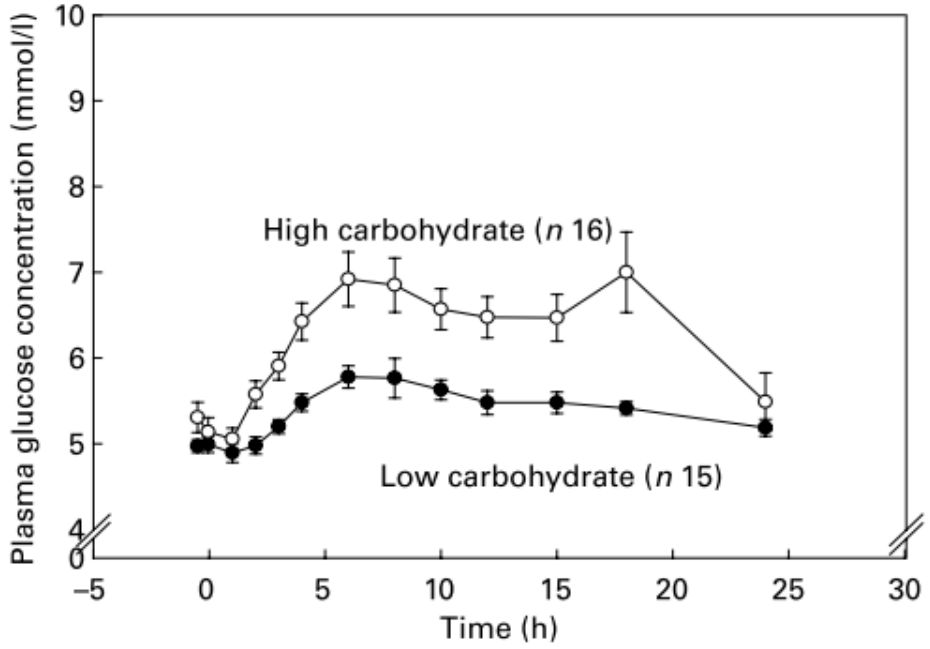
Table 1
Energy distribution expressed as percentage of metabolizable energy (%ME) and total energy content for the three test diets.

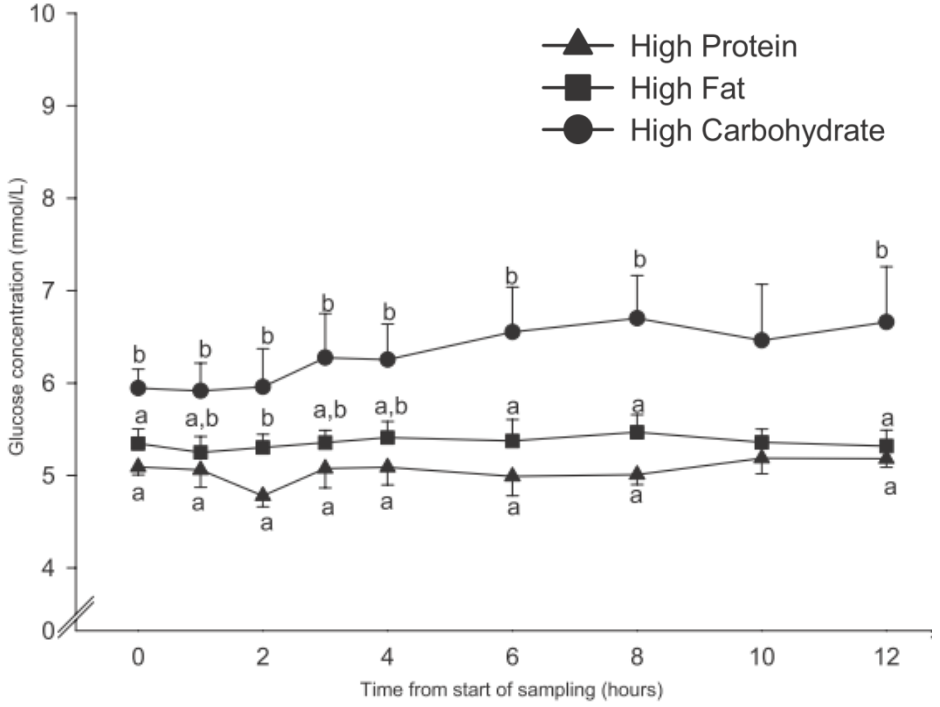
	Test diet	Traditional diet	Maintenance diet
Carbohydrate %ME[a]	25	55	45
Fat %ME[a]	32	23	31
Protein %ME[a]	43	22	24
Fibre g/100 kcal	3	10	2
Total ME kcal/100 g	351	288	378

[a] The composition of the three diets was determined using modified Atwater gures (National Research Council (U.S) Ad Hoc Committee on Dog and Cat Nutrion, 2006).

Test diet lower peak PP BG and mean BG concentration

- In healthy cats, dietary starch level DOES affect postprandial blood glucose concentrations.





Coradini M et al. *Br J Nutr* 2011;106 Suppl 1.

Farrow HA et al. *J Vet Intern Med* 2013;27

- Lower starch diets result in lower PP BG concentrations in cats
- BUT
  - Glucose, insulin WNL
  - Does not affect fasted BG (similar to other species)
  - One single meal over 24h – relevant?

Dietary carbohydrate & DM in cats

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What is considered a "low" carbohydrate diet?

Typically subjective or arbitrary concentrations

- AAHA Diabetes Management Guidelines (Rucinsky, 2010)

> Carbohydrate levels can be loosely classified as ultralow (<5% ME), low (5% to 25% ME), moderate (26% to 50% ME), and high (>50% ME).[22]

- ACVIM **draft** consensus statement, 2011

CHO	Very Low	Low	Moderate	High
% ME	< 10	10 to < 25	25 - 40	> 40

$$NITROGEN\ FREE\ EXTRACT\ (\%\ AS\ IS) = 100 - (CRUDE\ PROTEIN + CRUDE\ FAT + \text{CRUDE FIBER} + \text{ASHES} + \text{MOISTURE})$$

Sources of error:

1. Analysis
2. Moisture declared
3. Crude fiber vs TDF

Total dietary fiber composition of diets used for management of obesity and diabetes mellitus in cats

Tammy J. Owens, DVM; Jennifer A. Larsen, DVM, PhD; Amy K. Farcas, DVM, MS; Richard W. Nelson, DVM; Philip H. Kass, DVM, MPVM, PhD; Andrea J. Fascetti, VMD, PhD

Dietary carbohydrate & DM in cats

- 4 studies examining the effect of low CHO/high protein diets in diabetic cats:
  - Only 2 are “controlled” (product comparison, typically with higher CHO/fiber diet)
  - Different types/regimens of insulin were used
  - Many nutrient differences between diet groups; some may impact DM management (protein, fiber)

Dietary carbohydrate & DM in cats

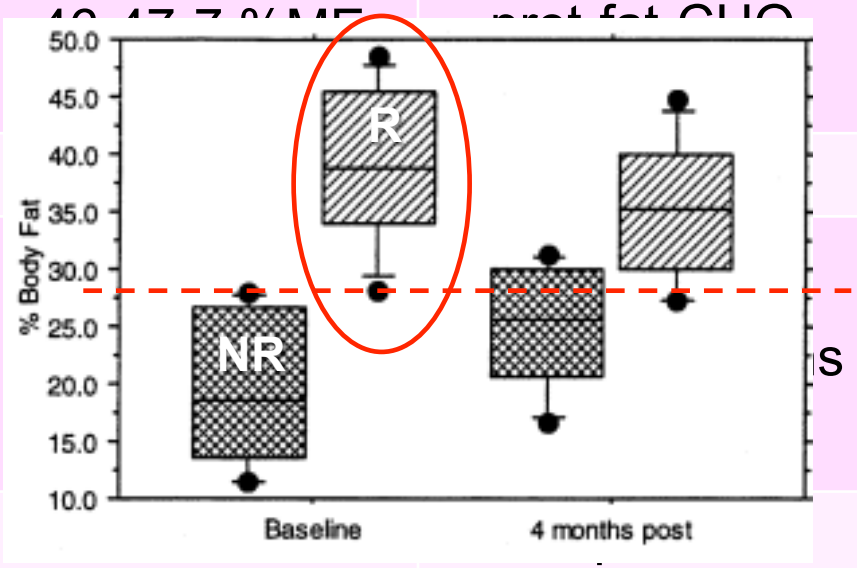
Frank, 2001	Mazzaferro, 2003	Bennett, 2006	Hall, 2009
Uncontrolled			
n=9			
Diet switch from			

Entry[*]	*Stabil End*[†]	*Treat End*[§]
444	643	811
644	595	513
ND	678	311
456	443	635
331	357	448

Frank G et al. *Vet Ther* 2001; 2: 238-246.

Dietary carbohydrate & DM in cats

Frank, 2001	Mazzaferro, 2003	Bennett, 2006	Hall, 2009
Uncontrolled	Uncontrolled		
n=9	n=24		
Diet switch from 37-38-25 to	Switched to diet 34-60-6 %ME		
Weight stable	were cats with high % body fat		



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Mazzaferro EM et al. *J Feline Med Surg* 2003; 5: 183-189.

Dietary carbohydrate & DM in cats

Frank, 2001	Mazzaferro, 2003	Bennett, 2006	Hall, 2009
Uncontrolled	Uncontrolled	Controlled	
n=9	n=24	n=63, 2 groups	
Diet switch from 37-38-25 to 46-47-7 %ME prot-fat-CHO	Switched to diet 34-60-6 %ME prot-fat-CHO + acarbose	Diet 40-34-26 or 37-51-12 %ME prot-fat-CHO	
3 months	4 months	4 months	
↓ Insulin in 8 Stopped in n=3	15/24 remissions	No difference in final fructosamine. Remission rate 40 vs 70% (↓CHO)	
Weight stable	Responders were cats with high % body fat	Most responders lost fat mass (DEXA) in both groups	

Bennett N et al. *J Feline Med Surg* 2006; 8: 73-84.

Dietary carbohydrate & DM in cats

Frank, 2001	Mazzaferro, 2003	Bennett, 2006	Hall, 2009
Uncontrolled	Uncontrolled	Controlled	Controlled
n=9	n=24	n=63, 2 groups	n=12, 2 groups
Diet switch from 37-38-25 to 46-47-7 %ME prot-fat-CHO	Switched to diet 34-60-6 %ME prot-fat-CHO + acarbose	Diet 40-34-26 or 37-51-12 %ME prot-fat-CHO	Diet 32-40-28 or 48-40-12 %ME prot-fat-CHO
3 months	4 months	4 months	2 ½ months
↓ Insulin in 8 Stopped in n=3	15/24 remissions	No difference in final fructosamine. Remission rate 40 vs 70% (↓CHO)	No difference in final fructosamine 1 remission in each group
Weight stable	Responders were cats with high % body fat	Most responders lost fat mass (DEXA) in both groups	NB: mixed feeding

Hall TD et al. *J Feline Med Surg* 2009; 11: 125-130.

Dietary carbohydrate & DM

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- **Dietary starch level**
  - Affects postprandial BG in healthy cats
    - but within normal limits
    - Does not clearly affect it in dogs
  - Can alter glycemic control in diabetic cats
    - levels <12 %ME may ↑ remission rates & glycemic control
    - solid evidence is still lacking
    - other macronutrients (protein) may play a role
    - No data on dogs with DM

Dietary carbohydrate & DM

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Summary (cont'd)

- **Current evidence suggests that:**
  - Diabetic remission/control in cats can be achieved with different dietary strategies
    - High protein, low carbohydrate diets
    - Moderate carbohydrate, high fiber diets
  - Fat mass loss is important to reduce insulin resistance and achieve remission (along with insulin therapy)
  - Clinical trial effect?

→ **Individualize your recommendations to each cat!**

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

Review

Systematic review of feline diabetic remission: Separating fact from opinion

Ruth Gostelow [a,*], Yaiza Forcada [a], Thomas Graves [b,1], David Church [a], Stijn Niessen [a,c]

The current level of evidence was found to be moderate to poor. Common sources of bias included lack of randomisation and blinding among trials, and many studies were affected by small sample size. Failure to provide criteria for the diagnosis of diabetes, or diabetic remission, and poor control of confounding factors were frequent causes of poor study design. Addressing these factors would significantly strengthen future research and ultimately allow meta-analyses to provide an excellent level of evidence. No single factor predicts remission and successful remission has been documented with a variety of insulin types and protocols. Dietary carbohydrate reduction might be beneficial, but requires further study. A lack of well-designed trials prevents reliable remission rate comparison. Factors associated with remission resemble those in human medicine and support the hypothesis that reversal of glucotoxicity is a major underlying mechanism for feline diabetic remission.

What about diet and *prevention* of feline DM?

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- Cats: carnivorous, prey low in starch
- Some authors propose dry diets, rich in starch, can be a risk factor for DM

Available online at www.sciencedirect.com
ScienceDirect
The Veterinary Journal 179 (2009) 247–253
The Veterinary Journal
www.elsevier.com/locate/tvjl

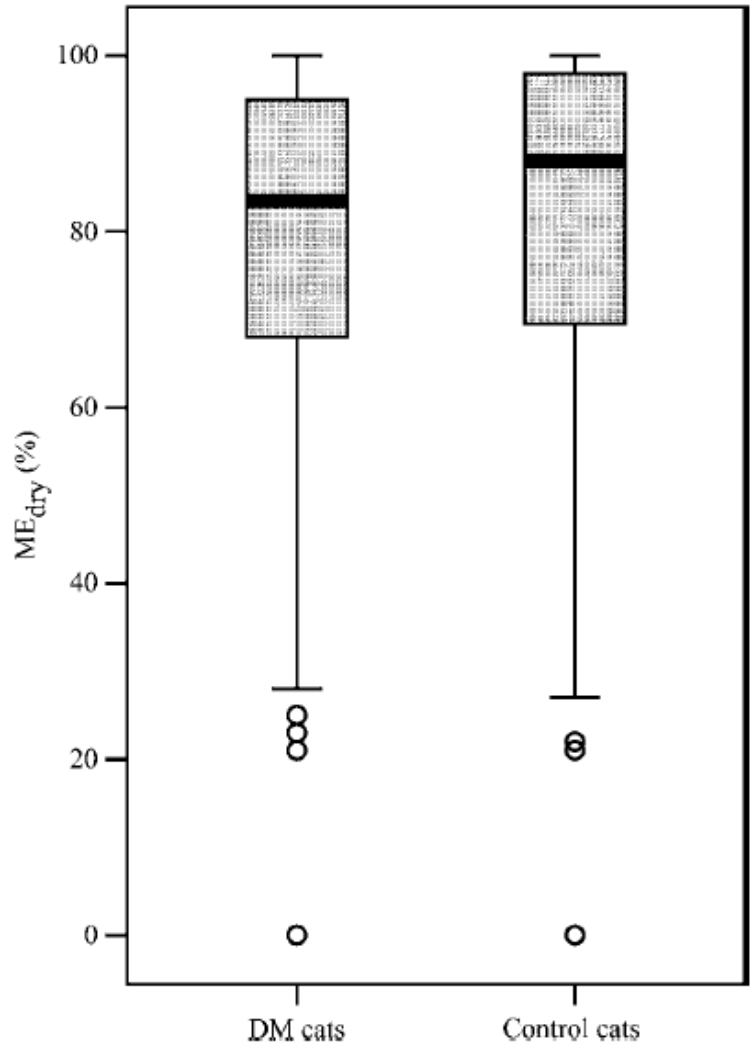
Indoor confinement and physical inactivity rather than the proportion of dry food are risk factors in the development of feline type 2 diabetes mellitus

L.I. Slingerland [a,*], V.V. Fazilova [a], E.A. Plantinga [b], H.S. Kooistra [a], A.C. Beynen [b]

- 96 cats with DM and 192 matched controls (age, sex, BW, BCS)
- Diet and activity information **at time of diagnostic**

  Dry, canned, homemade, ad lib vs restricted, snacks

  Outdoor access, activity level, play time, sleep time, time outdoors



g. 1. Box plots of the estimated metabolisable energy (%) of dry food in e diet (ME_{dry}) of 96 diabetic cats and 192 control cats.

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Male sex, glucocorticoids, physical inactivity and indoor confinement correlated to DM

No differences in %ME from dry food between cases and controls

Limitations

- Retrospective
- Owner recall
- Assumption on dry food energy density and overall energy intake

Sallander *et al. Acta Veterinaria Scandinavica* 2012, **54**:61
http://www.actavetscand.com/content/54/1/61

AVS Acta Veterinaria Scandinavica
ACTA VETERINARIA SCANDINAVICA

RESEARCH Open Acc

Prevalence and risk factors for the development of diabetes mellitus in Swedish cats

Marie Sallander[1,2*], Johanna Eliasson[1] and Åke Hedhammar[1]

20 swedish cats with DM and 20 matched controls (age, sex)

Diet information

#meals/day, products, table foods, treats, supplements **at time of diagnostic**

BCS estimated by owner

- Male
- Average age 9 y.o.
- Controls consumed higher DM % of dry food vs cases
- Cases were less active than controls

Limitations

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- Retrospective
- Sample size
- Owner recall
- % DM intake (E intake might vary)
- BCS estimated by owner

Journal of Veterinary Internal Medicine
ACVIM
Open Access

Standard Article
J Vet Intern Med 2017;31:29–35

Environmental Risk Factors for Diabetes Mellitus in Cats

M. Öhlund, A. Egenvall, T. Fall, H. Hansson-Hamlin, H. Röcklinsberg, and B.S. Holst

Insurance database, 1369 DM cats identified, age matched controls (5363)

After response rate and clean-up: 396 DM and 1670 controls

Type of diet, feeding regime, eating behaviour, BCS: **year preceeding diagnostic**

If 75% (?) only one diet considered

If 50% (?) two diets considered

- Risk factors (uni
  - Male
  - Burmese and Nor
  - Steroids
  - Dry food
  - Vaccination
  - Greedy appetite
  - Overweight
  - Indoor

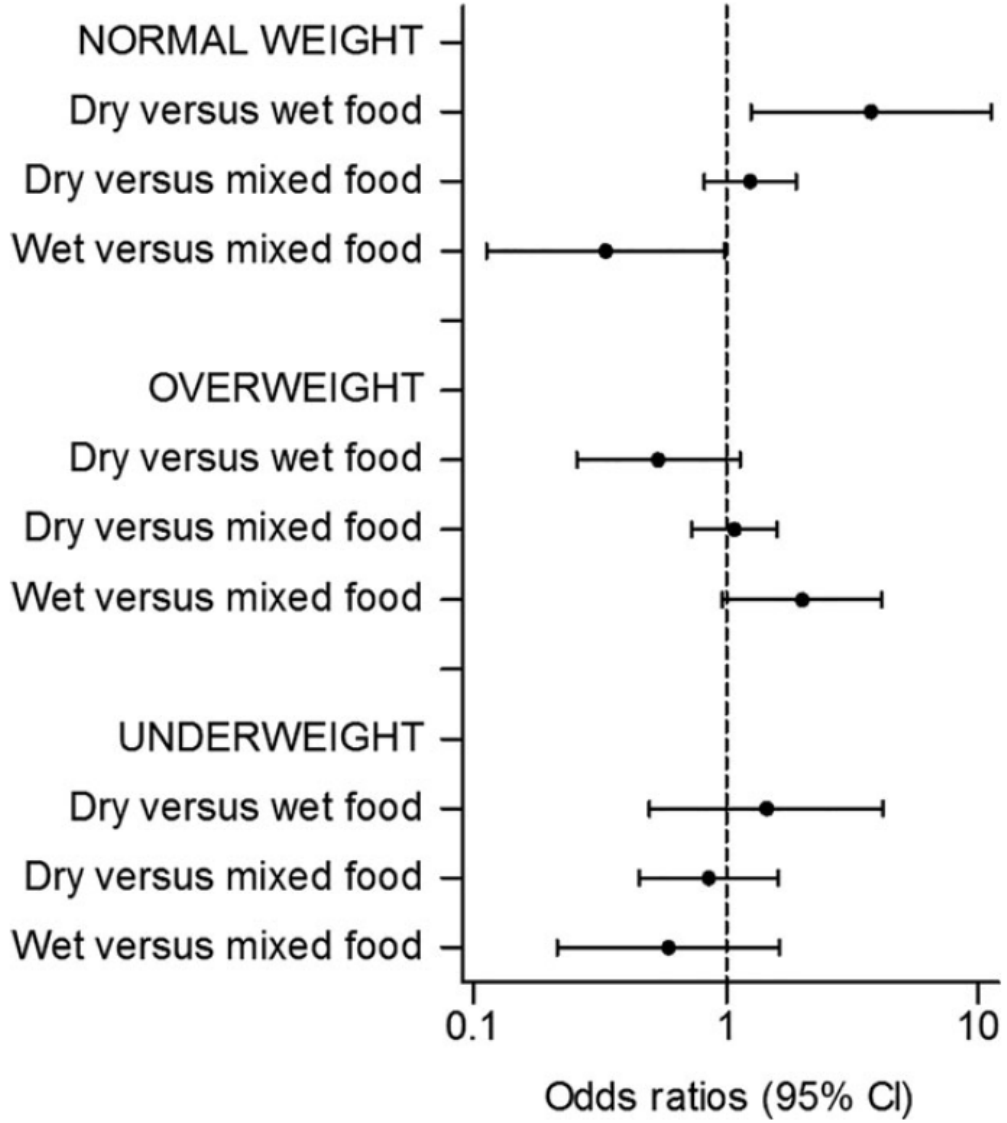


Fig 2. Odds ratios for diabetes mellitus (cases n = 396, controls n = 1,670) from the multiple logistic regression analysis for the interaction between diet and body condition. Comparisons within each body condition group. Error bars represent 95% confidence intervals (CI).

nutrition

ate analysis

ed, vaccination,
eating behaviour still
t

ght cats higher risk vs
CS for all kind of

risk in normal BCS
g dry vs canned
ts no difference
tdoor, as opposed to
cats

Limitations

- Retrospective
- Owner recall
- How was % dry food determ
- **Self assessed BCS**

Courcier et al 2010

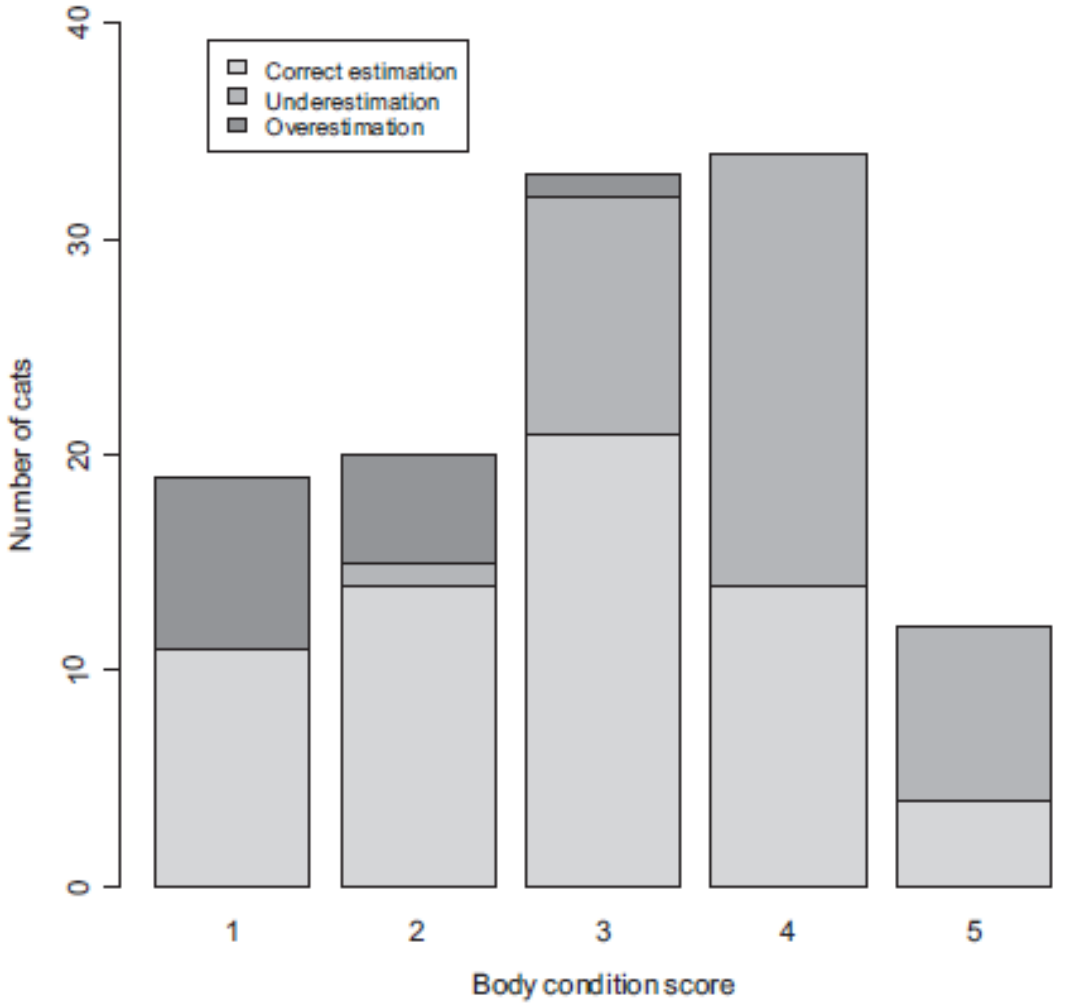


Fig 1. Interviewer assessment of cat body condition score on a five point scale where animals with a BCS of 1 were classed as underweight, 2 as slightly underweight, 3 as ideal, 4 as overweight and those with a BCS of 5 as obese. Bars are divided in owner misperception types (underestimation, overestimation and correct estimation).

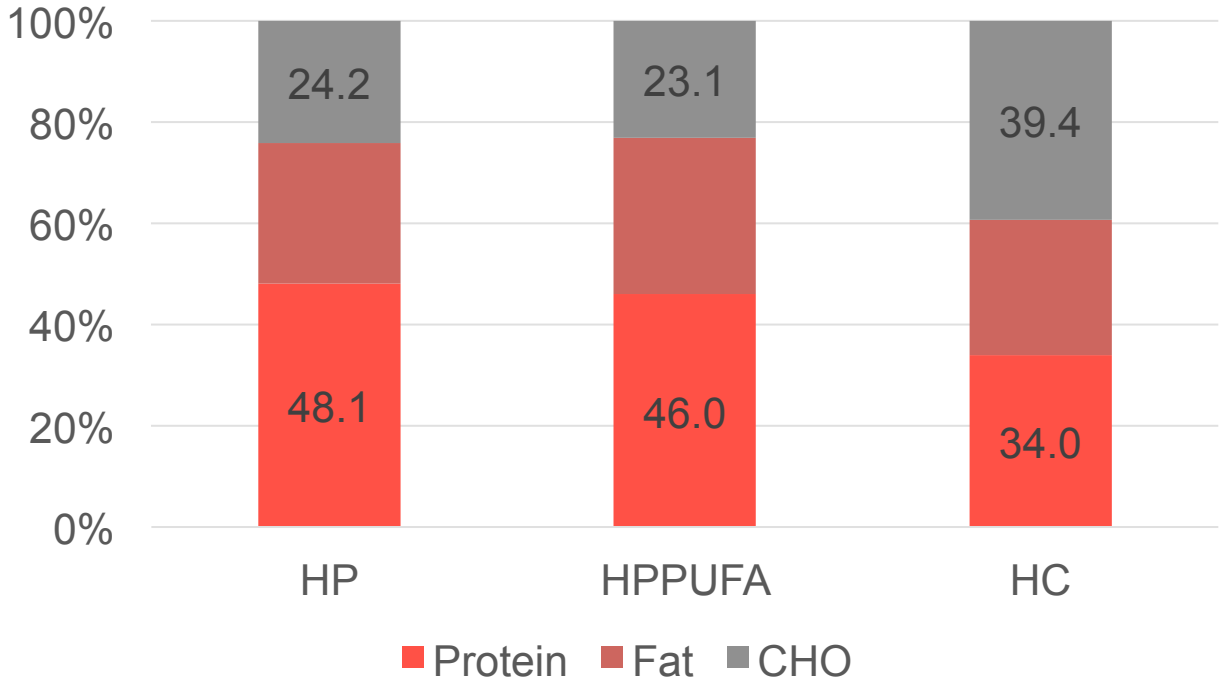
Am J Physiol Regul Integr Comp Physiol 301: R1798–R1807, 2011.
First published September 21, 2011; doi:10.1152/ajpregu.00342.2011.

Prospective data

Effect of macronutrients, age, and obesity on 6- and 24-h postprandial glucose metabolism in cats

Margarethe Hoenig,[1,2] Erin T. Jordan,[1] John Glushka,[3] Saskia Kley,[1] Avinash Patil,[4] Mark Waldron,[4,5] James H. Prestegard,[3] Duncan C. Ferguson,[6] Shaoxiong Wu,[7] and Darin E. Olson[8]

No effect of diet on assessed parameters (Endogenous glucose production, BG, insulin, leptin, T4, adiponectin) in lean or obese cats, young or old



Prospective data

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- High fat, and not high carb diets, associated with obesity development in cats (Backus et al. 2007)

British Journal of Nutrition (2007), **98**, 641–650
doi: 10.1017/S0007114507750869
© The Authors 2007

Gonadectomy and high dietary fat but not high dietary carbohydrate induce gains in body weight and fat of domestic cats

Robert C. Backus[1]*, Nick J. Cave[2] and Duane H. Keisler[3]

- Obesity, rather than diet, associated with insulin resistance development with age (Backus et al 2010)

Age and body weight effects on glucose and insulin tolerance in colony cats maintained since weaning on high dietary carbohydrate

R. C. Backus[1], N. J. Cave[2], V. K. Ganjam[3], J. B. M. Turner[4] and V. C. Biourge[5]

Critical Reviews in Food Science and Nutrition, 52:172–182 (2012)
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DOI: 10.1080/10408398.2010.499763

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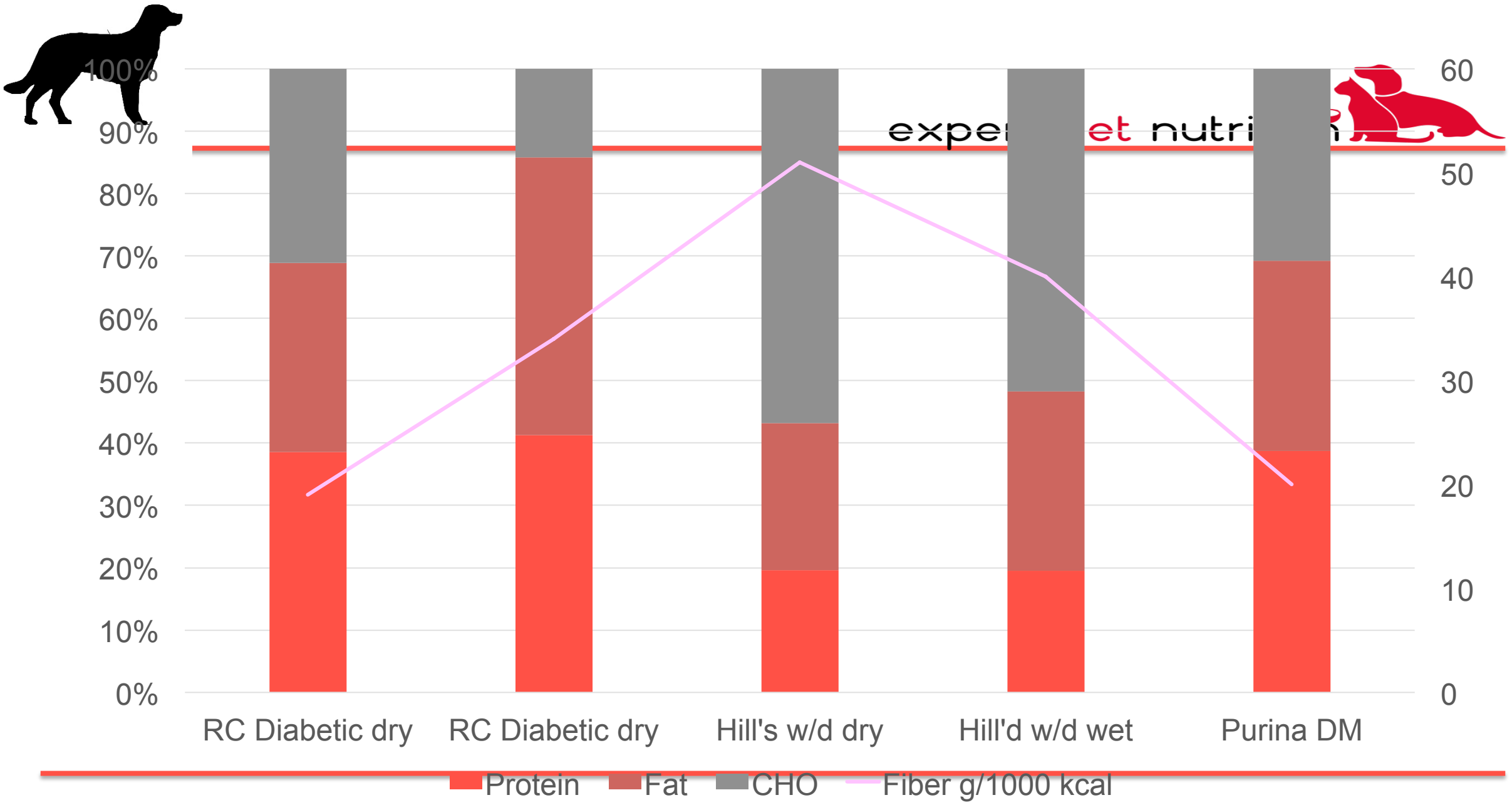
Nutritional Modulation of Insulin Resistance in the True Carnivorous Cat: A Review

ADRONIE VERBRUGGHE,[1] MYRIAM HESTA,[1] SYLVIE DAMINET,[2] and GEERT P.J. JANSSENS[1]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Purina DM
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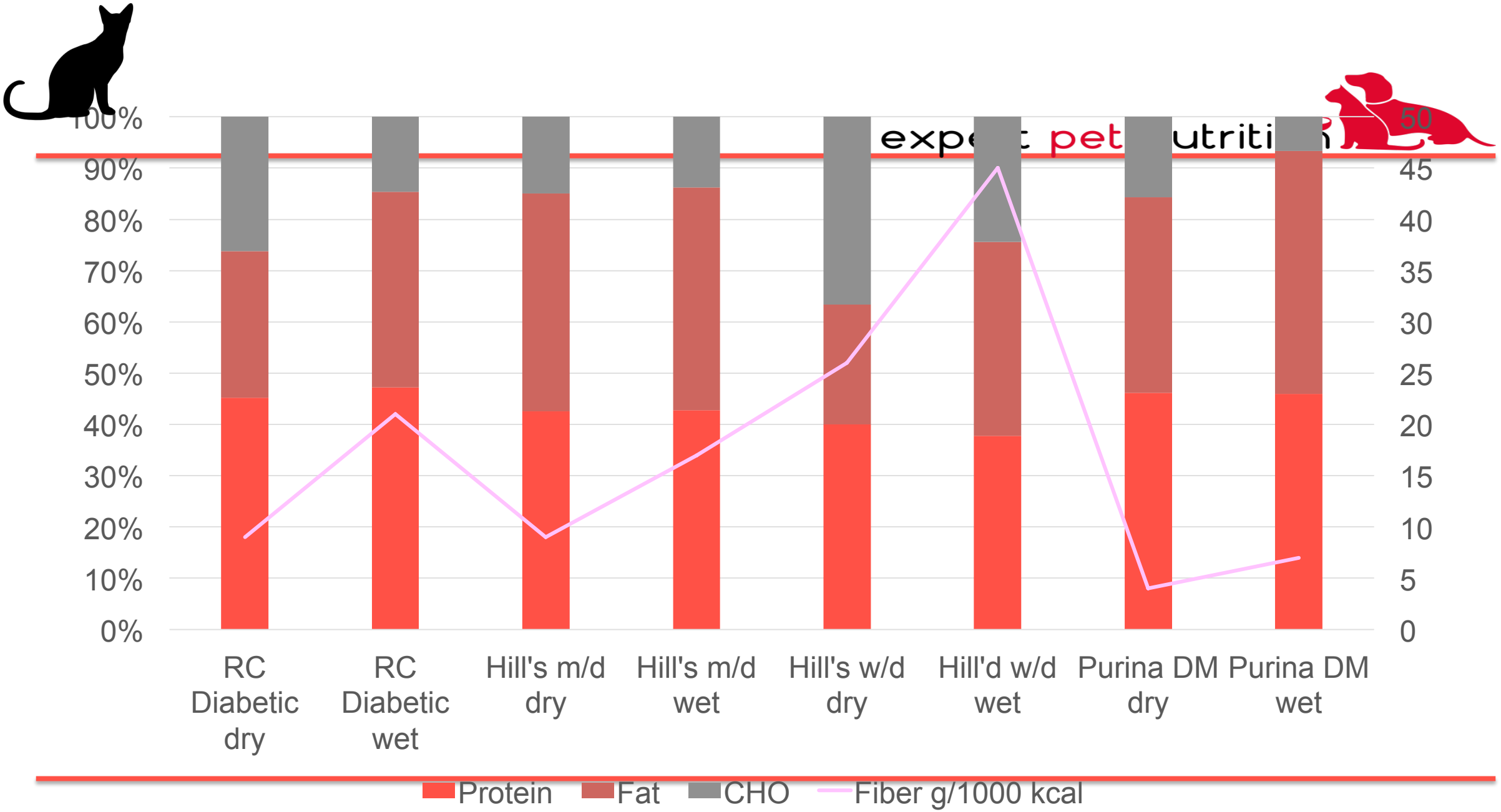
CHO
Fiber g/1000 kcal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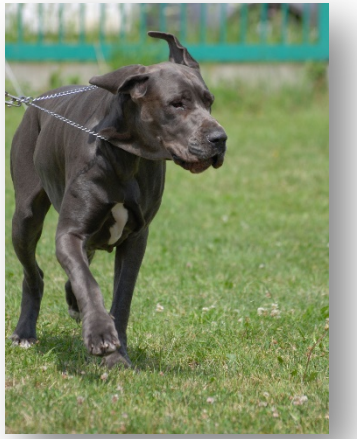
RC Diabetic dry
RC Diabetic wet
Hill's m/d dry
Hill's m/d wet
Hill's w/d dry
Hill'd w/d wet
Purina DM dry
Purina DM wet
Protein
Fat
CHO
Fiber g/1000 kcal

Diabetes mellitus: feeding management in DOGS

expert pet nutrition

- **CONSISTENCY: same diet, same amount, same time of day, in conjunction with insulin**
- DIET CHOICE:



  - No need to change diet when diagnosed with DM. A good quality maintenance diet can be adequate as long as it is consistent and palatable
  - When is a diet change recommended?

1) Dog has a comorbidity that responds to diet: pancreatitis, obesity, etc.
2) Dog is difficult to control: try a diet either high fiber or lower in carbohydrates to see if insulin dose can be reduced or its effect maximized

High fiber diets are CONTRAINDICATED in dogs with low body condition score

Diabetes mellitus: feed management in DOGS

expert pet nutrition

- Treats are not recommended (unless they are given at the same time of the main meals)
- Amount to feed: Maintenance energy requirements , adjust every 2-4 weeks for stable body weight and body condition

$$MER\ (kcal/d\ ) = 95\ to\ 130\ x\ Kg\ body\ weight^{0,75}$$

Diabetes mellitus: feeding management in CATS

expert pet nutrition

- CONSIDER not changing diet at diagnostic (except concomitant disease that requires it)
  - Usual diet until stabilitzation
- Once stabilized, consider change, depending on
  - Body weight, body condition score, muscle condition score
  - Control of DM (clinical signs, fructosamine)
  - Patient preferences
  - Client circumstances

Diabetes mellitus: feeding management in CATS

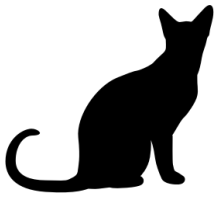
expert pet nutrition

- Consider using a
  - Low carb/high protein diet
    - contraindicated in obese prone (except for canned)
  - High fiber diet: contraindicated in thin animals
  - Weight loss diet in body condition score above 5/9
- If body condition score ok and control DM adequate, assess if diet change is necessary

Diabetes mellitus: feeding management in CATS

expert pet nutrition

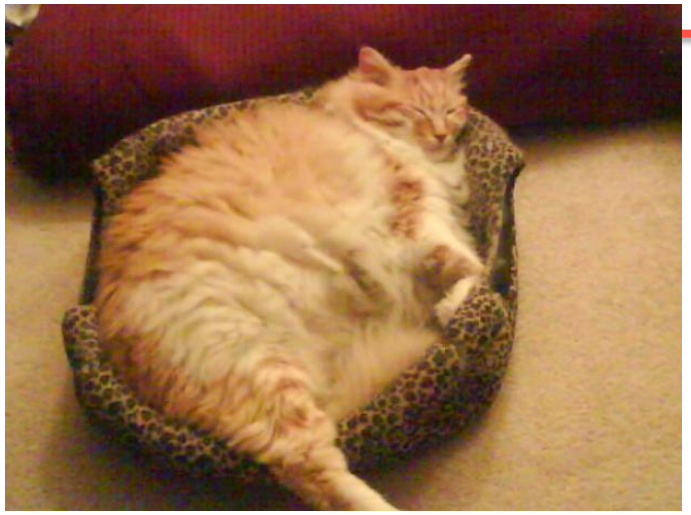
- Feed maintenance energy requirements: adjust q 2 weeks



$$MER\ (kcal/d) = 100 \times Kg\ body\ weight^{0,67}$$ **lean**

$$MER\ (kcal/d) = 130 \times Kg\ body\ weight^{0,4}$$ **overweight**

- Treats <10% calories, avoid semi moist treats
- If overweight:



1st: stabilize. Once DM controlled → Energy restriction until ideal body condition score

Frequent reevaluation of insulin dose

Decrease insulin resistance

Dose changes with body weight

At the end:

1) reduction insulin dise
2) Reversion
3) Consider diet change (canned: less energy dense)

Feeding method

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- Adapt it to type and dose of insulin (1 vs 2 times a day)
  - **Key: consistency: same diet, same amount, same time of day**
    - Same applies to treats
- If concurrent diseases (amenable to nutritional management), consider that DM can be treated with insulin (meds) when having to decide when deciding on a diet!

Key points

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- Dietary management for patients with DM consists in providing a complete and balanced diet in sufficient amounts to promote ideal BCS
- Nutritional evaluation important for feeding plan choice
- Some strategies can help control glycemia and help manage this disease, such as high fiber or low starch diets, but we need more evidence to support both approaches in dogs and cats (most studies are product testing)
  - High fiber and low carb are relative/non agreed upon terms
  - Both have contraindications

Key points

- Co-morbidities will affect diet choice
- Obesity should always be addressed if possible
- Consistency (same diet, same amount, same time of day) and coordination with insulin is key
- Diet change not always necessary

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Acknowledgments:

Marta Hervera
Yann Queau (slides on carbs & cats)

Thank you

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