AMIDO E RESPOSTAS METABÓLICAS EM CÃES

Prof. Dr. Fabio Alves Teixeira

XXI CONGRESSO PET
11 E 12 DE MAIO | 2022

AMIDO

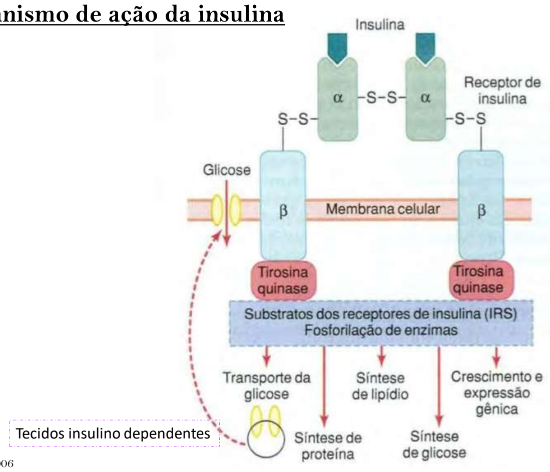
- Carboidrato complexo (polissacarídeo) não estrutural
- Glicoses
- Ligações α
- Acessível a enzimas

Pós absorção

Designação	Principais sítios de expressão e função
GLUT1	Tecidos fetais e células em cultura; em adultos, altas concentrações em células sangüíneas, barreira hematoencefálica e rim; responsável pelo transporte basal de glicose na maioria das células
GLUT2	Hepatócitos, célula β pancreática, membrana basolateral de células epiteliais de intestino delgado e túbulo renal, astrócitos de núcleos cerebrais tais como em hipotálamo paraventricular, e lateral entre outros; transportador de alta capacidade confere uma capacidade glico-sensora às células em que se expressa
GLUT3	Principal transportador em neurônios, também presente em placenta e testículos
GLUT4	Músculo esquelético e cardíaco, tecido adiposo branco e marrom; medeia o transporte de glicose estimulado pela insulina
GLUT5	Transportador de frutose; altas concentrações em intestino delgado e testículo
GLUT6	Identificado em humanos; pseudo-gen que não se expressa funcionalmente
GLUT7	Fração microssomal de células hepáticas; está associado ao complexo enzimático da glicose-6-fosfatase e medeia a liberação de glicose do retículo endoplasmático
SGLT1	Bordo em escova das células epiteliais do duodeno, jejuno e segmento S3 do túbulo proximal do néfron
SGLT2	Bordo em escova das células epiteliais do segmento S1 do túbulo proximal do néfron

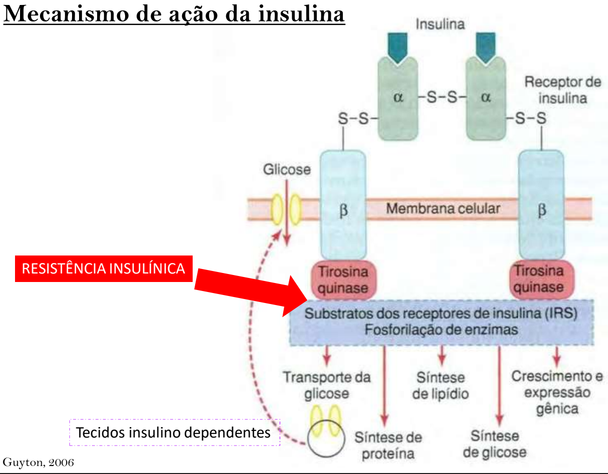
Machado, 1998

Mecanismo de ação da insulina



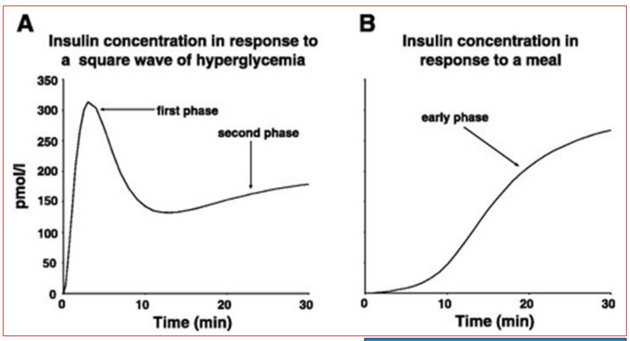
Guyton, 2006

Mecanismo de ação da insulina



Guyton, 2006

Secreção de insulina



- Velocidade de digestão
- Presença de fibra
- Secretagogos: glicose, hormônios incretínicos, aminoácidos

Caumo & Luzi, 2004

Índice Glicêmico (IG)

- Ranking de carboidratos de acordo com seu efeito na glicemia pós-prandial
- Baseado na comparação com "carboidrato" padrão

Carga Glicêmica (CG)

- Relação entre o índice glicêmico e quantidade de CHO

CG = IGmédio x Quantidade de carboidrato

- Seria um indicador da demanda de insulina ou resposta glicêmica induzida pelo total de carboidrato ingerido

Postprandial impairment of flow-mediated dilation and elevated methylglyoxal after simple but not complex carbohydrate consumption in dogs

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NUTRITION RESEARCH 32 (2012) 278–284

- 6 beagles (3 MC + 3 FC); 2,8 ± 0,75 anos; ECC = 4 ou 5/9
- Recebendo alimento manutenção [PB (mín.): 21%, G (mín.) 10% e FB (máx.) 12%]

- Cross-over
- CHO simples (glicose 20%)
- CHO complexo (arroz, milho, ervilha e cevada)
- 10 gramas CHO disponível

Table – Glycemic and insulinemic responses to carbohydrate sources

	Glucose	Rice	Barley	Corn	Peas
Glucose					
Peak (mmol/L)	8.5 ± 0.3^a	5.3 ± 0.1^b	5.4 ± 0.1^b	5.3 ± 0.1^b	5.0 ± 0.1^b
Time to peak (min)	34 ± 4^a	85 ± 9^b	91 ± 10^b	111 ± 12^b	94 ± 15^b
Area under the curve (mmol/L min)	181 ± 13^a	95 ± 7.4^b	91 ± 12^b	80 ± 15^{b,c}	50 ± 7.6^c
GI		55 ± 6^b	51 ± 7^b	47 ± 10^{a,b}	29 ± 5^a
Insulin					
Peak (pmol/L)	458 ± 60^a	75 ± 12^b	62 ± 11^b	78 ± 15^b	95 ± 14^b
Time to peak (min)	30 ± 4^a	106 ± 12^b	79 ± 9^{b,c}	99 ± 16^b	53 ± 12^{a,c}
Area under the curve (pmol/L min)	16377 ± 2310^a	3698 ± 508^b	3164 ± 497^b	3635 ± 752^b	2993 ± 491^b

Values are means ± SEMs; n = 6 in duplicate. Values in a row with superscripts without a common letter differ; P < .05, repeated-measures general linear model with LSD post hoc test.

Comparative Biochemistry and Physiology, Part A 257 (2021) 110973

Glycemic, insulinemic and methylglyoxal postprandial responses to starches alone or in whole diets in dogs versus cats: Relating the concept of glycemic index to metabolic responses and gene expression

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Table 1
Postprandial glycemic responses in fasted dogs and cats following a single feeding of a glucose control (15% w/v solution; 1 g/kg) compared to single feedings of pure starches (1 g available carbohydrate/kg bodyweight) from different sources.

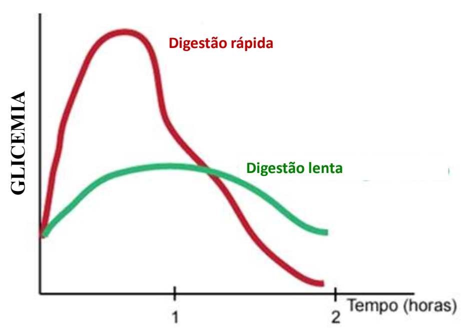
	Glucose	Tapioca	Wheat	Rice	Unmodified corn	Pea	Modified corn	Lentil	Faba bean	Potato
Dogs										
Peak (mmol/L)	6.8 ± 0.3^a	4.8 ± 0.2^{cde}	4.7 ± 0.2^{cde}	5.5 ± 0.1^b	5.2 ± 0.2^{bc}	4.7 ± 0.1^{cd}	4.4 ± 0.1^{de}	4.4 ± 0.1^{de}	4.3 ± 0.1^e	4.5 ± 0.1^{cde}
Time to Peak (min)	35 ± 2^a	51 ± 6^{bc}	47 ± 8^{abc}	36 ± 4^{ab}	49 ± 7^{abc}	53 ± 4^c	41 ± 4^{abd}	54 ± 4^c	60 ± 8c^d	49 ± 5^{cd}
AUC (mmol/L min)	111 ± 16^a	100 ± 29^{ab}	57 ± 12^b	57 ± 15^b	55 ± 22^{ab}	52 ± 16^b	49 ± 9^b	49 ± 10^b	45 ± 16^b	42 ± 24^b
Glycemic index	100	93 ± 32	56 ± 16	55 ± 16	55 ± 26	49 ± 15	48 ± 11	47 ± 10	46 ± 17	34 ± 19

Table 3
Postprandial blood glucose responses from dogs and cats following single feedings of a glucose control (15% w/v solution; 1 g/kg) and whole diets formulated with 30% inclusion of the corresponding starch (meals fed to give 1 g available carbohydrate/ kg bodyweight).

	Glucose	Modified corn-starch diet	Pea starch diet	Faba bean starch diet	Lentil starch diet
Dogs					
Peak (mmol/L)	6.8 ± 0.3^a	5.3 ± 0.1^b	4.7 ± 0.1^c	4.8 ± 0.2^c	5.0 ± 0.1^{bc}
Time to Peak (min)	35 ± 2^a	53 ± 4^b	51 ± 5^b	64 ± 6^b	58 ± 10^{ab}
AUC (mmol/L min)	111 ± 16^a	61 ± 11^b	49 ± 13^b	47 ± 9^b	36 ± 12^b
Glycemic index	100	65 ± 15	55 ± 20	48 ± 11	37 ± 11

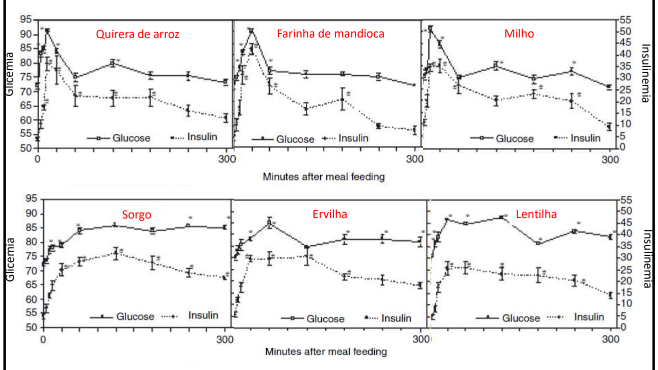
AMIDO:

– Quanto mais rápida e completa a digestão, mais rápida e "maior" será a curva glicêmica pós-prandial produzida



Fonte de amido:

6 cães saudáveis por dieta



Carciofi, 2008

AMIDO – tempo de digestão:

- Variação dos grânulos
  - Tamanho
  - Formato
  - Composição
    - Proteica
    - Complexos amido-lipídicos
    - Inibidores enzimáticos
    - Associação com polissacarídeos não amiláceos
    - Ligação com outros componentes (fósforo)

Tempo de digestão

Teórico e in vitro

(ENGLYST, 1992)

Tempo de digestão

Teórico e in vitro

(ENGLYST, 1992)

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Influence of type of starch and feeding management on glycaemic control in diabetic dogs

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Cães diabéticos – cross over

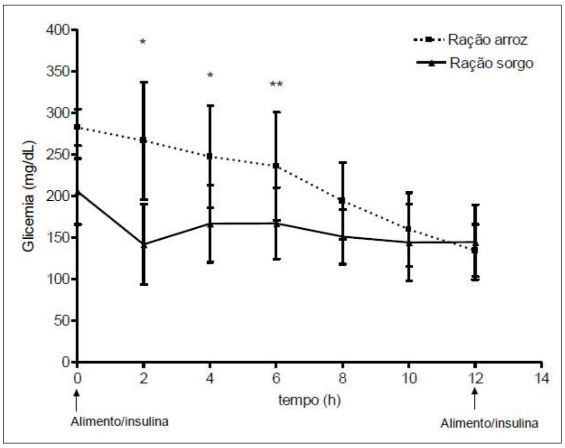
Item (%)	Ração arroz[4]	Ração sorgo[5]
Umidade	5,38 ± 1,2	5,5 ± 2,1
Proteína bruta[1]	25,12 ± 0,8	24,2 ± 0,1
Extrato etéreo ácido[1]	10,35 ± 0,7	10,8 ± 1,2
Matéria mineral[1]	8,11 ± 0,4	8,3 ± 1,1
Fibra dietética total[1]	17,08 ± 1,1	16,3 ± 3,3
Amido[1]	39,47 ± 0,3	41,3 ± 1,8
Índice de gelatinização do amido[1]	89,29 ± 4,0	92,4 ± 0,4
Amilose[1]	16,27 ± 0,3	14,7 ± 0,8

Teshima, 2021

Cães diabéticos – cross over

Parâmetro	Ração arroz	Ração sorgo	P[1]
Glicemia de jejum (mg/dL)	282,6 ± 22,1	205,6 ± 39,7	0,21
Glicemia média (mg/dL)	215,3 ± 25,0	160,2 ± 19,5	0,04
Glicemia mínima (mg/dL)	126,4 ± 32,0	90,9 ± 21,7	0,03
Glicemia máxima (mg/dL)	297,0 ± 57,3	244,0 ± 45,4	0,08
Glicemia máxima – glicemia mínima (mg/dL)	170,6 ± 32,0	153,0 ± 30,9	0,41
AACG (mg/dl.h)	2990,3 ± 528	2180,0 ± 385	0,06

Teshima, 2021



Teshima, 2021

Lente Carbohydrate: A Newer Approach to the Dietary Management of Diabetes

DAVID J. A. JENKINS

The dietary fiber hypothesis has stimulated interest in the possibility that the glycemic response to carbohydrate foods may be reduced by modifying gastrointestinal events to produce sustained-release or "lente" carbohydrate. Associated with this interest, a new branch of pharmacology has been developed involving the use of purified fiber preparations and enzyme inhibitors. These measures, together with the selection of diets containing foods that naturally release their carbohydrate products of digestion slowly, may contribute a useful facet to diabetic management in the future. DIABETES CARE 5: 634–641, NOVEMBER–DECEMBER 1982.

Jenkins, 1982

Processamento do Amido (amido resistente)

48 cães saudáveis

1 formulação

8 mudanças no preparo

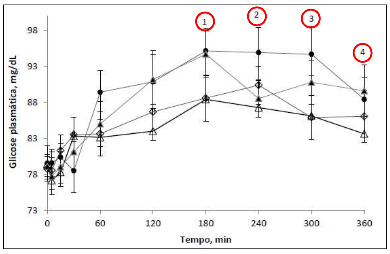
6 cães por preparo

Peneira do moinho (mm)	0,5		0,8		1,4		2,0	
Área de saída na matriz (mm^2)	63,6	23,7	63,6	23,7	63,6	23,7	63,6	23,7
Temperatura (ºC)	< 115	> 135	< 115	> 135	< 115	> 135	< 115	> 135
Gelatinização do amido (%)	83,5	89,4	75,9	85,4	72,3	77,6	65,0	74,4

Roberti-Filho, 2013

Processamento do Amido (amido resistente)

1 - 0,5 mm > 2,0 mm (P = 0,06)
2 - 0,5 mm > 1,4 mm e 2,0 mm (P < 0,05)
3 - 0,5mm > 0,8mm e 2,0mm (P < 0,07)
4 - 0,5mm e 1,4mm > 2,0mm (P < 0,05)

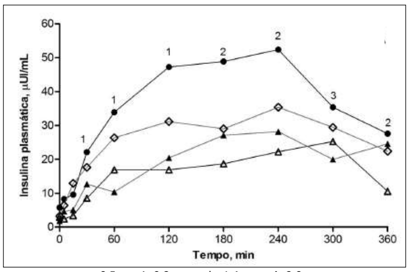


-●- 0,5-m; -Δ- 0,8-mm; -▲- 1,4-mm; -◊- 2,0-mm

Roberti-Filho, 2013

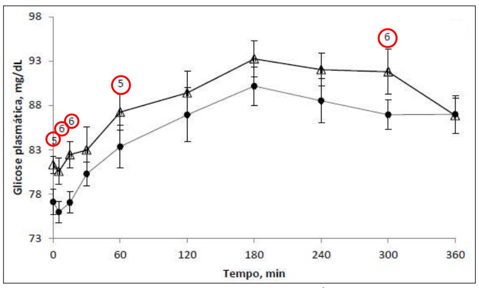
Processamento do Amido (amido resistente)

1 - 0,5 mm > 0,8 mm e 1,4 mm (P < 0,05)
2 - 0,5 mm > 0,8 mm (P < 0,05)
3 - 0,5mm > 1,4mm (P < 0,05)



-●- 0,5-m; -Δ- 0,8-mm; -▲- 1,4-mm; -◊- 2,0-mm

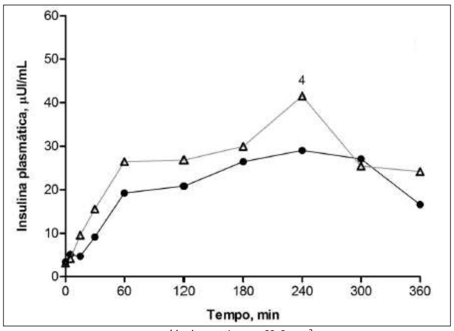
Roberti-Filho, 2013



5 – p <0,09
6 – p <0,05

-●- saída da matriz com 63,6 mm^2
-Δ- saída da matriz com 23,7 mm^2 de área aberta

Roberti-Filho, 2013



-●- saída da matriz com 63,6 mm^2
-Δ- saída da matriz com 23,7 mm^2 de área aberta

Roberti-Filho, 2013

British Journal of Nutrition, page 1 of 10
doi:10.1017/S000711451800171X

Effects of pea with barley and less-processed maize on glycaemic control in diabetic dogs

Fabio A. Teixeira[1], Daniela P. Machado[2], Juliana T. Jeremias[2], Mariana R. Queiroz[1], Cristiana F. F. Pontieri[2] and Marcio A. Brunetto[1]*

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Alimentos	Principais fontes de amido	Diferenças
Basal	Quirera de arroz, farinha de ervilha e cevada	Extrato etéreo (9% MS)
Ervilha	Farinha de ervilha e cevada	Isonutrientes (MS) -15% EE - 35% PB - 19% FDT - 20% Amido
Milho menos processado	Milho grão	

British Journal of Nutrition, page 1 of 10
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Effects of pea with barley and less-processed maize on glycaemic control in diabetic dogs
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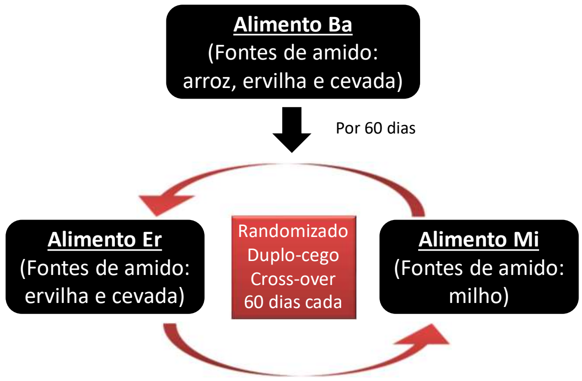
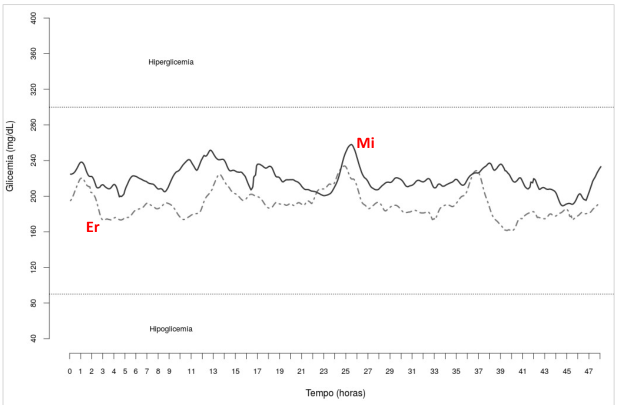
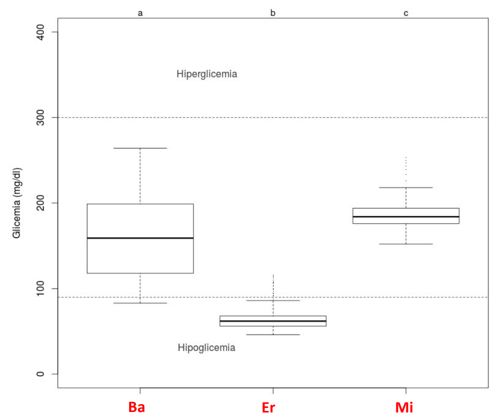
Parâmetros	Ervilha	Milho menos processado
Crivo das peneiras do moinho (mm)	1,2	2,0
Diâmetro geométrico médio (µm)	189	216
Área de vazão da saída da matriz (mm^2/ton/h)	256	380
Temperatura da extrusora (º C)	130	
Temperatura da secagem (º C)	110	

Triagem: 368 cães diabéticos;
Inclusão: 15 cães diabéticos (histórico de hiperlipidemia)



Parâmetros glicêmicos	Ervilha	Milho	*P*
Glicemia de jejum (mg/dL)	198 ± 90,9	224,7 ± 91,8	0,3
Glicemia média (mg/dL)	191,1 ± 85,4	219,3 ± 52,0	0,09
Glicemia mínima (mg/dL)	93,7 ± 54,6	103,7 ± 55,2	0,55
Glicemia máxima (mg/dL)	288,4 ± 104,0	339,2 ± 50,9	0,01
Dif. máxima e mínima (mg/dL)	194,7 ± 81,9	235,5 ± 74,8	0,03
Tempo médio hipoglicemia (%)	24,0	4,2	<0,01
Tempo médio hiperglicemia (%)	10,9	12,9	<0,01
AACG	550299,1	631441,8	0,09
$AACIG_{d1}$	-2002,1	-4847,0	0,42
$AUCIG_{d2}$	-43056,7	6401,7	0,06
Frutosamina (umol/L)	347,5 ± 82,3	351,5 ± 67,6	0,83





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BMC Veterinary Research

RESEARCH ARTICLE Open Access

Starch sources influence lipidaemia of diabetic dogs

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Abstract

Background: Hyperlipidaemia is considered a cause of other diseases that are clinically important and potentially life threatening. Combination of pea and barley as exclusive starch sources is known to interfere with glycemic control in diabetic dogs, but their effect on lipid profile of hiperlipidaemic dogs is yet to be evaluated. Twelve adult diabetic dogs were fed three dry extruded diets with different starch sources and different fat levels: peas and barley (PB), maize (Mi), and peas, barley and rice (Ba) with 15.7, 15.6 and 9.0% of their dry matter as fat, respectively. Plasmatic cholesterol and triglycerides concentration curves over 10 h were obtained after 60 days on each diet and with the same NPH insulin dose. ANOVA test or Friedman test were used to compare the dietary effects on triglycerides and cholesterol variables among the diets.

Results: Dogs presented lower mean ($p = 0.05$), fasting ($p = 0.03$), and time 8-h postprandial ($p = 0.05$) triglyceridemia after PB diet period than Ba diet period and time 4-h postprandial ($p = 0.02$) lower after PB than Mi diet. Cholesterolemia mean, minimum, maximum, area under the cholesterol curve and times points: 2, 4, 6, 8 and 10-h postprandial, had lower values after PB ingestion in comparison to Mi, without difference to Ba diet.

Conclusion: Inclusion of pea and barley, as exclusive starch sources, in therapeutic diets for diabetic dogs can minimize plasmatic triglycerides and cholesterol concentration at fasting and at different postprandial time, compared to the maize diet or diet with lesser fat content.

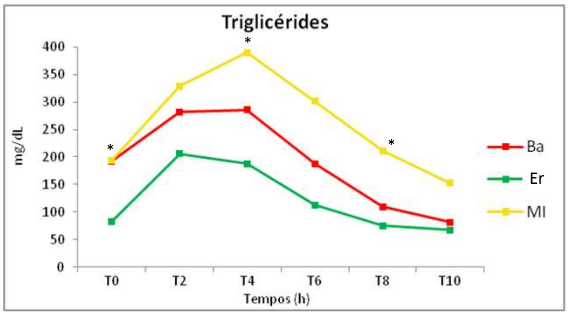
Keywords: Cholesterol, Triglycerides, Nutrition, Endocrinopathy

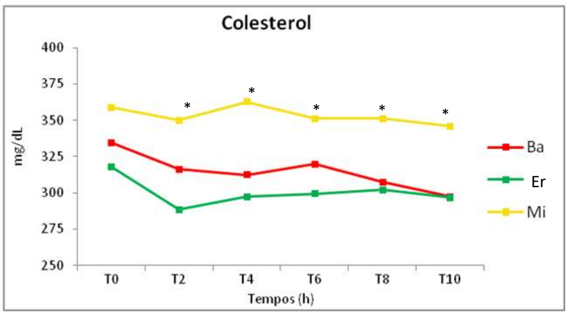
Table 2 Mean and standard deviation of plasmatic triglycerides and cholesterol concentration of 12 diabetic dogs after 2 months feeding of basal (Ba), pea with barley (PB) and maize (Mi) diets

Variables (mg/dL)	Triglycerides							Cholesterol						
	Ba	sd	PB	Sd	Mi	sd	*P*	Ba	sd	PB	sd	Mi	sd	*P*
T0	192.4†	238.8	83.8‡	43.9	194.8†‡	283.3	0.03**	334.6	113.3	318.1	96.7	358.8	119.6	0.11*
T2	282.1	262.8	205.9	144.4	328.4	340.2	0.44**	316.4†,‡	100.1	288.7†	85.2	350.2‡	113.9	0.02*
T4	285.9†‡	254.7	188.3†	175.9	389.5‡	392.9	0.02**	312.5†	106.0	297.2†	101.4	362.7‡	127.1	0.01*
T6	187.6	167.5	113.4	125.3	301.2	381.4	0.10**	319.9†‡	106.3	299.5†	102.5	351.2‡	112.3	0.02*
T8	109.9†	76.7	75.8‡	46.6	211.6†‡	306.6	0.05**	307.6†‡	123.8	302.1†	91.6	351.0‡	117.1	0.03*
T10	81.5	51.0	67.5	30.2	152.7	195.5	0.37**	297.6†	113.9	296.7†	93.0	345.9‡	115.3	0.02*
Mean	189.9†	161.9	120.6‡	79.1	263.0†‡	309.9	0.05**	314.8†‡	108.6	303.0†	96.3	353.3‡	116.6	0.02*
Minimum	76.4	51.7	63.7	30.7	141.9	198.8	0.34**	282.7†	104.4	284.5†	85.2	334.2‡	108.5	<0.01*
Maximum	316.8	260.4	221.7	180.5	397.8	386.3	0.10*	341.4†‡	116.5	323.9†	102.7	376.2‡	122.6	0.02*
Δ	240.5	244.3	158.0	175.9	255.9	224.5	0.18*	58.7	37.6	39.4	22.9	42.0	24.2	0.18*
AUC	2004.7	1692.0	1349.8	919.5	2809.0	3256.1	0.09**	3145.2†	1081.6	2856.0†	819.9	3534.8‡	1166.9	0.01*
AUIC	81.1	925.4	509.7	582.6	861.2	1078.5	0.12*	−201.2	238.3	− 183.0	141.9	−52.8	175.7	0.20*

sd Standard deviation, *AUC* Area under the curve, *AUIC* Area under the increment curve; Δ, difference between maximum and minimum values
†,‡ Different superscript symbols means statistically difference in line between diets ($p \leq 0.05$)
**P* value obtained by ANOVA test (post-hoc Tukey test)
***P* value obtained by Friedman (post-hoc multiple comparisons test)

Ervilha menor que milho e igual basal
Ervilha menor que basal e igual milho





23rd Congress of the ESVCN - Torino 18-20 Sep. 2019

Dietary carbohydrate source and process impact serum leptin concentration of diabetic dogs

Teixeira F A[1], Bonder B S A[1], Queiroz M R1, Jeremias J T[2], Pontieri C F F[2], Brunetto M A[1]
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[2]Grandfood Industria e Comercio LTDA (Premier Pet), Dourado, Brazil. e-mail: mabrunetto@usp.br

Table 4 - Serum incretins, hormones and cytokines of diabetic dogs after 60 days consuming two iso-nutrient diets.

Variables (pg/mL)	Ervilha	Milho	p-value
IL-10	22.7 (40.26)	22.7 (39.92)	*0.71
IL-6	559.4 (998.16)	469.7 (887.99)	*0.85
TNF-α	181.3 (322.19)	135.6 (216.47)	*0.67
Amylin	1.93 (1.99)	1.82 (1.64)	*0.88
GLP-1	0.51 (0.96)	2.43 (7.62)	*0.59
Leptin	9741.9 (7984.5)^{a}	8063.0 (7393.4)^{b}	*0.01
PYY	231.5 (114.9)	227.2 (109.6)	**0.81
Glucagon	61.3 (61.6)	64.8 (77.1)	*0.68

IL = interleukin; TNF-α = tumor necrosis factor-α; GLP-1 = Glucagon-like peptide-1; peptide YY; PB = pea and barley diet; CO = corn diet. ^{a,b}Different superscript letters mean statistical difference in line (p<0.05);*p-value obtained by Wilcoxon test; **p-value obtained by paired T test.

Effect of hypothyroidism on insulin sensitivity and glucose tolerance in dogs

Natalie Hofer-Inteeworn, Dr med vet, MS; David L. Panciera, DVM, MS; William E. Monroe, DVM, MS; Korinn E. Saker, DVM, PhD; Rebecca Hegstad Davies, PhD; Kent R. Refsal, DVM, PhD; Joseph W. Kemnitz, PhD

AJVR, Vol 73, No. 4, April 2012

Research in Veterinary Science 1984, 36, 177–182

Decreased insulin sensitivity and glucose tolerance in spontaneous canine hyperadrenocorticism

M. E. PETERSON, *The Animal Medical Center, New York, New York 10021*, N. ALTSZULER, *The New York University School of Medicine, New York, New York 10016*, C. E. NICHOLS, *College of Veterinary Medicine, University of Wisconsin, Madison, Wisconsin 55715, USA*

Journal of Animal Physiology and Animal Nutrition

DOI: 10.1111/jpn.12275

ORIGINAL ARTICLE

Effect of an extruded pea or rice diet on postprandial insulin and cardiovascular responses in dogs

J. L. Adolphe[1], M. D. Drew[2], T. I. Silver[3], J. Fouhse[4], H. Childs[1] and L. P. Weber[1]

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Effect of an extruded pea or rice diet on postprandial insulin and cardiovascular responses in dogs

J. L. Adolphe[1], M. D. Drew[2], T. I. Silver[3], J. Fouhse[4], H. Childs[1] and L. P. Weber[1]

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- Beagles, 3,1 ± 0,2 anos

- Duas fases

- Objetivo 1: índice glicêmico rações extrusada a base de ervilha X arroz (isonutrientes)

- Objetivo 2: efeitos metabólicos destes alimentos a longo prazo em obesos

Table 1 Ingredient composition and proximate analysis of yellow field pea and white rice diets

Ingredient	Pea diet (g/kg)	Rice diet (g/kg)
Chicken meal	206	346
Pea starch	314	–
White rice	–	288
Yellow field peas	150	–
Chicken fat	136	120
Solka Floc®	–	100
Fish meal	66	50
Gelatin	57	–
Dicalcium phosphate	18	47
Salmon oil	10	10
Vitamin/mineral premix*	10	10
Celite®	10	10
Potassium chloride	7	7
Sodium chloride	5	5
Calcium carbonate	6	2
Choline chloride	4	4
DL-methionine	1	1

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<u>ESTUDO 02:</u>
- 9 cães (4 MC + 5 FC)
- ECC = 4 ou 5/9
- Período de engorda: 12 semanas recebendo Dog Chow ad libitum
  - PB (mín.): 21%, G (mín.) 10% e FB (máx.) 12%

- Cross-over, duplo cego de 12 semanas cada ração teste (ad libitum)
- Washout de 8 semanas com Dog Chow

	ECC (/9)	Peso (kg)
Pré	4,9 ± 0,1	9,8 ± 0,6
Início	6,4 ± 0,2	12,1 ± 0,1

Effect of an extruded pea or rice diet on postprandial insulin and cardiovascular responses in dogs

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- Tomografia (gordura corporal)

- Cardio

- Pressão arterial

Sem diferença

Effect of an extruded pea or rice diet on postprandial insulin and cardiovascular responses in dogs

J. L. Adolphe[1], M. D. Drew[2], T. I. Silver[3], J. Fouhse[4], H. Childs[1] and L. P. Weber[1]

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Table 3 Serum glucose and insulin response to 10 g oral glucose tolerance test in obese dogs before and after receiving yellow field pea or white rice diet for 12 weeks (study 2)

	Pea diet* Baseline	Rice diet† Baseline	Pea diet* 12 weeks	Rice diet† 12 weeks	p-Value‡
Serum glucose					
Fasting glucose (mmol/l)	5.4 ± 0.2	5.4 ± 0.1	5.6 ± 0.2	5.6 ± 0.4	0.9
Peak glucose (mmol/l)	9.7 ± 0.6	9.9 ± 0.5	8.9 ± 0.2	9.4 ± 0.6	0.4
AUC (mmol/l·min)	236 ± 30	239 ± 23	202 ± 21	224 ± 36	0.5
Serum insulin					
Fasting insulin (pmol/l)	18.7 ± 6.6	14.5 ± 2.9	16.0 ± 4.6	9.8 ± 4.9	0.2
Peak insulin (pmol/l)	288 ± 57	362 ± 86	185 ± 57	351 ± 51	0.05
AUC (pmol/l·min)	13 151 ± 2830	15 633 ± 4171	8546 ± 3270	16 384 ± 3120	0.05
Body condition score§	6.5 ± 0.3	6.7 ± 0.3	6.3 ± 0.3	6.6 ± 0.3	0.6

Values are mean ± SEM. AUC, area under the curve.
*n = 8.
†n = 9.
‡Pea diet versus rice diet at 12 weeks (univariate GLM with baseline as covariate).
§9-point scale with score of 4–5 as ideal body weight.

British Journal of Nutrition (2011), 106, S194–S197
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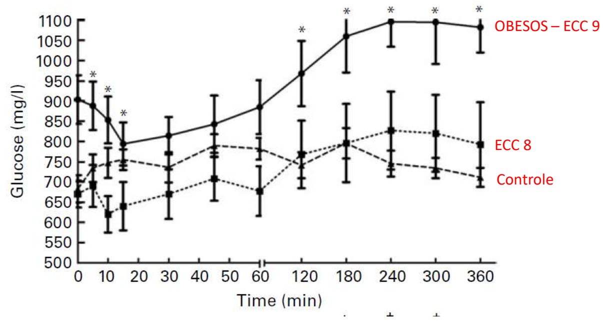
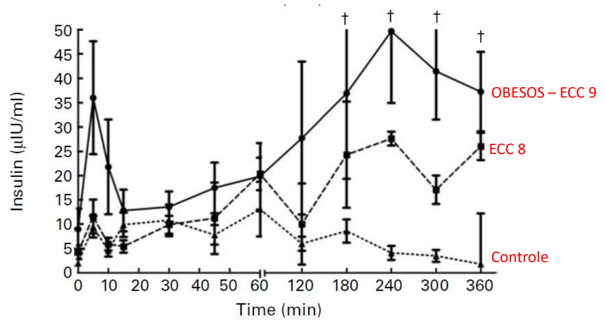
doi:10.1017/S0007114511000870

The intravenous glucose tolerance and postprandial glucose tests may present different responses in the evaluation of obese dogs

Márcio Antonio Brunetto[1], Fabiano César Sá[1], Sandra Prudente Nogueira[1], Márcia de Oliveira Sampaio Gomes[1], Amanda Gullo Pinarel[1], Juliana Toloi Jeremias[1], Francisco José Albuquerque de Paula[2] and Aulus Cavalieri Carciofi[1*]



Diferença entre Obesos X ECC 8 e controle.



Diferença entre Obesos e controle.
ECC 8 – valores intermediários?

Brunetto, 2011

Journal of Animal and Veterinary Advances 11 (7): 971-974, 2012
ISSN: 1680-5593
© Medwell Journals, 2012

Comparison of the Plasma Insulin and Adiponectin Concentrations as Metabolic Markers in Clinically Healthy Dogs with Ageing

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Table 1: Comparison of metabolic markets in clinically healthy dogs of different ages and genders

Age (year)	Gender (n)	Glucose (mg dL^{-1})	Triglyceride (mg dL^{-1})	Total cholesterol (mg dL^{-1})	Protein (g dL^{-1})	FFA (mEg L^{-1})	Insulin (ng mL^{-1})	Adiponectin (µg mL^{-1})	LDH (U L^{-1})	AST (U L^{-1})	ALT (U L^{-1})
Infant	F 50	96±2	52±3	171±6	5.9±0.1	0.26±0.03	1.1±0.2	24±3	97±15	29±2	40±3
(0-2)	M 60	95±2	51±4	153±6	5.9±0.1	0.29±0.04	1.2±0.1	34±4	89±9	30±1	47±3
Young	F 58	90±2	56±4	174±6	5.9±0.1	0.28±0.03	1.2±0.2	27±3	136±23	29±1	40±2
(3-5)	M 68	90±2	48±3	151±5	6.0±0.1	0.24±0.03	1.7±0.2	38±6	120±17	28±1	45±3
Middle	F 88	90±2	60±3	164±5	5.9±0.1	0.30±0.03	1.9±0.2*	24±4	108±11	27±1	38±3
(6-10)	M 87	90±2	52±3	164±5	6.1±0.1	0.38±0.06	1.8±0.2*	32±4	102±10	26±1	45±2
Old	F 31	87±2	54±3	169±7	6.0±0.2	0.25±0.04	2.4±0.3*	12±2	112±17	26±1	56±7
(11>)	M 39	91±2	58±5	180±7*	6.3±0.1	0.25±0.03	2.2±0.3*	25±4	109±15	28±2	58±8
Dog total	F 227	91±1	57±2	169±3	5.9±0.1	0.28±0.02	1.6±0.1	23±2	113±8	28±1	41±2
	M 254	91±1	52±2	161±3	6.1±0.1	0.30±0.02	1.7±0.1	33±2	104±7	28±1	47±2

Values are presented means±SE; F = Female; M = Male; *Indicates the significant difference when compared against the same gender in the infant group (Hold-Sidak one-way analysis of variance; p<0.05)

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https://doi.org/10.1080/1745039X.2019.1652516

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The effects of age and dietary resistant starch on digestibility, fermentation end products in faeces and postprandial glucose and insulin responses of dogs

Érico de Mello Ribeiro, Mayara Corrêa Peixoto, Thaila Cristina Putarov, Mariana Monti, Peterson Dante Gavasso Pacheco, Bruna Agy Loureiro, Gener Tadeu Pereira and Aulus Cavalieri Carciofi
Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista (UNESP), Jaboticabal, Brazil

Table 2. Chemical composition and processing quality parameters of a dog food formulation processed to obtain different levels of starch gelatinisation and resistant starch content.

	Diets	
	Low RS*	High RS†
Chemical composition [g/kg, DM-basis]		
Ash	86.1	83.0
Crude protein	279.4	279.4
Acid-hydrolysed ether extract	170.2	180.7
Crude fibre	20.0	22.1
Starch	446.4	437.0
Starch gelatinisation [%]	99.9	62.6
Resistant starch [g/kg, DM-basis]	2.2	15.3
Kibble bulk density [g/l]	300	505
Raw material mean geometric diameter [µm]	224 ± 15	312 ± 17

*Low RS, low resistant starch, raw material finely ground and extruded with high application of specific mechanical energy to obtain elevated starch gelatinisation and low resistant starch amount; †High RS, high resistant starch, raw material coarsely ground and extruded with low application of specific mechanical energy to obtain low starch gelatinisation and elevated resistant starch amount.

Mais AGCC fecal, menos amônia fecal e menor resposta glicêmica nos idosos que consumiram mais amido resistente

British Journal of Nutrition (2011), 106, S105–S109
© The Authors 2011
doi:10.1017/S0007114511001887

The effect of dietary starch level on postprandial glucose and insulin concentrations in cats and dogs

Adrian K. Hewson-Hughes*, Matthew S. Gilham, Sarah Upton, Alison Colyer, Richard Butterwick and Andrew T. Miller
Waltham Centre for Pet Nutrition, Waltham-on-the-Wolds, Melton Mowbray, Leicestershire LE14 4RT, UK

Table 1. Macronutrient composition of the three diets (as fed)

Nutrient (g/100 g)	Low-starch diet	Medium-starch diet	High-starch diet
Moisture	8·0	7·5	7·3
Protein	51·3	37·6	29·5
EE	18·9	15·5	11·0
CF	2·9	1·4	3·4
Ash	6·6	7·0	7·4
NFE*	12·3	31·0	41·4
Total dietary fibre	4·1	5·0	6·5
Total starch	9·5	23·0	31·7
Gelatinised starch	8·9	21·6	29·4
Starch gelatinisation (%)	93·7	93·9	92·7
Metabolisable energy (MJ/kg)†	17·7	17·3	16·0
Protein:energy ratio (%)‡	48·3	36·3	30·8
Fat:energy ratio (%)‡	40·1	33·7	25·9
Carbohydrate:energy ratio (%)‡	11·6	30·0	43·3

EE, ether extract (fat); CF, crude fibre; NFE, nitrogen-free extract.
* NFE = 100 − (M + P + EE + CF + A), where M refers to moisture, P is protein and A is ash.
† Metabolisable energy (MJ/kg diet) = 0·1672 × (P + NFE) + 0·3762 × EE.
‡ (100 × g nutrient × α)/metabolisable energy, where α = 0·1672 for P and NFE and 0·3762 for EE.

British Journal of Nutrition (2011), 106, S105–S109 doi:10.1017/S0007114511001887

The effect of dietary starch level on postprandial glucose and insulin concentrations in cats and dogs

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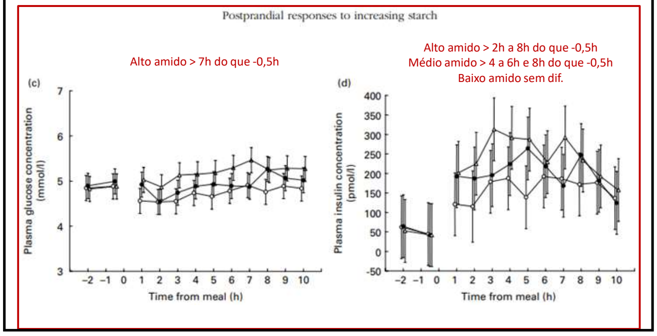

NECESSIDADE DE AMIDO:

- Amido X Glicose?

- Glicose = principal fonte de energia
  - Hemácias e neurônios

- Gliconeogenese renal e hepática: glicerol, lactato, propionato, aminoácidos (alanina, serina e glicina).

NECESSIDADE DE AMIDO:

- Gestantes e lactantes
  - Glicose para o feto
  - Lactose no leite

NECESSIDADE DE AMIDO:

- EM do CHO: 0% X 44%

  - Mesmo número de filhotes
  - Hipoglicemia
  - Cetose
  - Hipoalaninemia
  - Natimortos

(ROMSON, 1981)

Influence of a Low Carbohydrate Diet on Performance of Pregnant and Lactating Dogs[1]

DALE R. ROMSOS, HELEN J. PALMER, KATHLEEN L. MUIRURI AND MAURICE R. BENNINK
Department of Food Science and Human Nutrition, Michigan State University, East Lansing, MI 48824

SUBSTITUIÇÃO POR AMIDO:

- Baixo CHO ricas em proteínas = sem alterações (mais aminoácidos gliconeogênicos?)

(BLAZA, 1989)

Necessidade Proteica (g/kg^{0,75})	Sem amido	Com amido
Cadela gestante	12 gramas	7 gramas
Cadela lactante	30 gramas	13 a 18 gramas

(KIENZLE, 1989)

SUBSTITUIÇÃO POR AMIDO:

- Baixo CHO ricas em proteínas = sem alterações (mais aminoácidos gliconeogênicos?)

(BLAZA, 1989)

Necessidade Proteica (g/kg^{0,75})	Sem amido	Com amido
Cadela gestante	12 gramas	7 gramas
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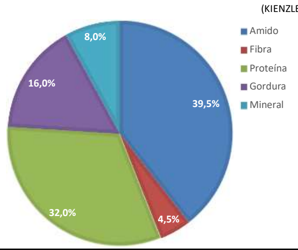
(KIENZLE, 1989)



The genomic signature of dog domestication reveals adaptation to a starch-rich diet

Erik Axelsson, Abhirami Ratnakumar, Maja-Louise Arendt, Khurram Maqbool, Matthew T. Webster, Michele Perloski, Olof Liberg, Jon M. Arnemo, Åke Hedhammar & Kerstin Lindblad-Toh

Nature **495**, 360–364 (21 March 2013) | Download Citation

Liu et al. BMC Veterinary Research (2021) 17:112
https://doi.org/10.1186/s12917-021-02815-y
BMC Veterinary Research
RESEARCH ARTICLE Open Access

Differences in the gut microbiomes of dogs and wolves: roles of antibiotics and starch

Yuting Liu[1], Bo Liu[2†], Chengwu Liu[3†], Yumiao Hu[4†], Chang Liu[5†], Xiaoping Li[1], Xibao Li[1], Xiaoshuang Zhang[1], David M. Irwin[6], Zhiqiang Wu[2], Zeliang Chen[1], Qi Jin[2] and Shuyi Zhang[1*]

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http://dx.doi.org/10.1098/rsos.160449

Amy2B copy number variation reveals starch diet adaptations in ancient European dogs

Morgane Ollivier[1,2], Anne Tresset[3], Fabiola Bastian[1,2], Laetitia Lagoutte[4], Erik Axelsson[5], Maja-Louise Arendt[5], Adrian Bălăşescu[6], Marjan Marshour[3], Mikhail V. Sablin[7], Laure Salanova[8], Jean-Denis Vigne[3], Christophe Hitte[4] and Catherine Hänni[1,2]

AMIDO E RESPOSTAS METABÓLICAS EM CÃES

- Varia com a fonte
  - Digestão rápida x digestão lenta
- Escolha dependente do objetivo

Controle glicêmico, lipídico e do excesso de peso (endocrinopatas, obesidade, idosos)

X

Alta demanda energética (ganho de peso – câncer, cardiopata, nefropata...)

- Cães são diferentes de lobos
- Sem necessidade por amido, mas inclusão útil
  - Processo
  - Macronutriente energético

OBRIGADO!

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