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BLOOD BIOCHEMICAL PROFILE IN DOGS AND CATS UNDER DIFFERENT FEEDING DIETS

(Perfil bioquímico sangüíneo em cães e gatos com diferentes regimes alimentares)

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ABSTRACT – The aim of the present work was to carry out a study on the variation of the blood chemistry constituents of dogs and cats subjected to different feeding diets. Blood samples from 50 healthy dogs and 25 cats were used to study the effect of feeding diets with commercial ration, homemade or mixed (concentrate and homemade) on their blood biochemical profile. Both, dogs and cats, fed with mixed rations showed higher glucose and cholesterol blood levels, which could be suggestive of a high caloric intake and a risk of obesity. Intake of proteins in animals with homemade feed seems to be low considering concentrations of plasma albumin and/or urea in dogs and cats. Low levels of calcium were found in dogs with non-concentrated feed. Cats with homemade feed could have low intake of minerals considering the lower levels of calcium, phosphorus and magnesium observed.

Key words: clinical biochemistry, clinical nutrition, canine, feline.

RESUMO – Foram determinados os parâmetros de bioquímica sanguínea em 50 cães e 25 gatos sadios submetidos a três regimes alimentares: ração comercial, comida caseira e alimentação mista (ração e caseira). Os cães e os gatos alimentados com regime misto apresentaram níveis sanguíneos elevados de glicose e de colesterol, sugerindo um consumo de alimentos calóricos acima dos requerimentos e um maior risco de obesidade. A ingestão de proteínas na alimentação caseira parece ser restrita, considerando-se as baixas concentrações de albumina e/ou uréia sanguíneas nos cães e nos gatos. Baixos teores de cálcio foram encontrados nos cães de alimentação não concentrada. Os gatos com alimentação caseira podem estar consumindo quantidades baixas de minerais revelado pelos menores teores sanguíneos de cálcio, fósforo e magnésio.

Palavras chave: bioquímica clínica, nutrição clínica, caninos, felinos.

Introduction

Biochemical plasma profiles have been extensively used in Veterinary Medicine for clinical evaluation procedures in individuals, as well as in populations (PAYNE and PAYNE, 1987). When properly interpreted, plasma biochemical values give important information concerning clinical status, nutritional balance, deficit condition, treatment monitoring and prognostics.

Few studies in Brazil carried out studies plasma profile variations in healthy dogs and cats. AMARAL (1994) determined reference values for alanine transaminase (ALT), alkaline phosphatase (ALP), amylase, lipase, total proteins, albumin, globulins and cholesterol in dogs in the State of Rio Grande do Sul (South of Brazil).

Dogs and cats, as carnivore animals, may not have actual need of carbohydrates in their diet. Protein-based diets would fulfill energy requirements (BURGER, 1989). However, protein is an expensive source and energy sources are frequently used in inappropriate way.

Studies on metabolic profile variations must include the determination of normal reference values for a specific population. Those values have to be based on representative groups of animals in order to define confidence intervals (HANDELMAN and BLUE, 1993). However, blood metabolites may suffer important variations within the same species due to many factors, mainly, feeding regimen, age and physiological status (PAYNE and PAYNE, 1987).

The knowledge of variations on biochemical blood profiles in specific populations of dogs and cats, as a function of their feeding regimen, will contribute to better interpretation of clinical biochemistry data. The present work aimed to study those variations in dogs and cats from Southern Brazil.

Material and methods

The research was carried out at the Veterinary Hospital of the Federal University of Rio Grande do Sul in Porto Alegre (Southern Brazil). Fifty adult clinically healthy dogs 1 to 5 years-old of both sexes were used. All animals live indoor with their owners. The dogs were grouped according to their feeding regimen, as follows:

Group 1: commercial ration (n= 16). Mean composition of commercial ration for dogs was: crude protein 21% total lips 8%, fibre 4,5%, humidity 12%, mineral matter 9%.

Group 2: homemade feeding (n= 17). In this case, refers left overs of human food, basically composed by rice, potatoes, cessava, fatty meat and bone rests.

Group 3: mixed commercial ration and homemade feeding (n= 17).

It is assumed that group 1 received balanced and groups 2 and 3 received non-balanced rations.

Following the same criteria, there were used 25 cats. In this case, the number of animals per group was 7, 8 and 10, for groups 1, 2 and 3, respectively. Mean composition of commercial ration for cats was: crude protein 31%, total lipds 8%, fibre 4,5%, humidity 10%, mineral matter 8,2%, taurine 0,1%. Homemade feed for cats had similar composition to that of dogs, mentioned above.

Blood samples of fasted animals were obtained from cephalic vein (medium and big dogs) or jugular vein (small dogs and all cats), using *vacutainer* heparinized tube (Becton Dickinson, Rutherford, NJ, USA). Blood aliquots of dogs were separated to determine packed cell volume (PCV) and hemoglobin, as described by KANTEK and PACHALY (1994), at the same day of sampling. Other blood aliquots were centrifuged (10 minutes, 2.500 rpm) after sampling to obtain plasma, and kept under freezing (-20ºC) until chemical analysis. Cat samples were only analyzed for chemical constituents.

Biochemical blood determination was by spectrophotometric methods as follows: glucose by glucose oxidase method[1], cholesterol by cholesterol esterase/cholesterol oxidase method[1], total protein by biuret method[2], albumin by bromocresol green method[2], urea by colorimetric diacetilmonoxime method[2], creatinine by picrate method, alanine transaminase (ALT) by refractometry[3], alkaline phosphatase by (ALP) Roy modified method[2], calcium by cresolftalein method[1], phosphorus by molibdate method[2] and magnesium by Mann and e Yoe method[2].

Values were statistically analyzed by variance analysis and mean comparison tests (Duncan) to observe differences among groups, using Stata Program (Cary, NC, USA).

Results and Discussion

Blood profile in dogs - Mean and standard deviation values of blood profile in dogs are shown in TABLE 1. The blood values obtained in this work are well compared with those of the literature reference (KANEKO *et al.*, 1997). However, some differences were found among the studied groups. Dogs with mixed feed have mean values of glucose (115,7 mg/dl) and cholesterol (167,8 mg/dl) higher than dogs feeding commercial ration or homemade feed. This finding has a physiological importance when considering those metabolites as energy balance indicators. Blood glucose level may have a small but consistent increase in dogs fed on a starch and soluble sugar basis (MEYER *et al.,* 1995). Similarly, blood cholesterol increase in dogs fed with diets rich in animal fat (BUSH, 1991). Increased glycemia and colesterolemia may indicate overfeeding with energy-rich meals, which could contribute to develop obesity, the most important cause of malnutrition observed in small

[1]Katal/Biobrás (Belo Horizonte, Brazil); [2]Bioclin/Quibasa (Belo Horizonte, Brazil);[3]Reflotron (Boehringer-Mannheim, Meylan, France); [4]Merck S.A. (Rio de Janeiro, Brazil); [5]Wiener Lab. (Rosario, Argentina).

animal clinics (MARKWELL, 1989).

In southern Brazil it is a common habit to feed dogs with human surplus food, frequently starch-derived and fatty bovine and swine meat. MASON (1970) observed that obesity is more common in dogs having homemade feed than in dogs fed with commercial ration.

Albumin level was lower in homemade fed dogs, compared with the other two groups. Those animals had a mean albumin (22,9 g/l) bellow the minimum reference value (26 g/l) related by KANEKO *et al.* (1997). Low plasma albumin in clinically healthy dogs may indicate long-term protein deficiency intake, as a consequence of a diminished synthesis of hepatic albumin (BUSH, 1991).

TABLE 1 – MEAN AND STANDARD DEVIATION VALUES OF BIOCHEMICAL BLOOD PROFILE IN DOGS FED WITH DIFFERENT REGIMES IN PORTO ALEGRE, BRAZIL (2000). (n=50).

Parameters	Unit	Feeding regimen		
		Commercial	Homemade	Mixed
N		16	17	17
Glucose	mg/dl	97.7 ± 22.96	102.8 ± 9.19	115.7 ± 43.2
Cholesterol	mg/dl	150.9 ± 41.4	146.8 ± 56.8	167.8 ± 49.6
Total protein	g/l	64.7 ± 7.69	69.6 ± 8.63	67.4 ± 4.77
Albumin	g/l	27.3 ± 8.95	22.9 ± 5.63	25.7 ± 3.67
Globulins	g/l	37.7^{b} ± 11.81	46.7^{a} ± 8.75	41.7^{a} ± 6.16
A/G relation	-	0.88^{a}	0.53^{b}	0.64^{b}
Urea	mg/dl	36.14 ± 10.2	31.74 ± 16.14	29.22 ± 9.4
Creatinine	mg/dl	1.54 ± 0.67	1.7 ± 0.68	1.28 ± 0.48
ALP	U/l	28.6^{b} ± 13.26	51.6^{a} ± 45.7	57.55^{a} ± 34.1
ALT	U/l	51.85 ± 14.09	52.37 ± 40.22	38.91 ± 9.6
Calcium	mg/dl	12.6^{a} ± 3.63	9.1^{b} ± 2.0	8.3^{b} ± 2.21
Phosphorus	mg/dl	3.4 ± 1.16	3.0 ± 1.17	3.2 ± 0.96
Magnesium	mg/dl	2.5 ± 0.93	3.4 ± 1.4	3.5 ± 2.33
Hemoglobin	g/dl	17.6^{a} ± 2.83	14.79^{b} ± 3.65	14.73^{b} ± 3.6
PCV	%	46.31^{a} ± 5.16	41.2^{b} ± 7.23	43.21^{b} ± 6.3

ALP= alkaline phosphatase; ALT= alanine transaminase; PCV= packed cell volume.
Different letters have significant differences ($p < 0.05$).

There was no difference in ALT activity among the three groups. This enzyme is an indicator of liver function in dogs (KANEKO *et al.,* 1997). However, higher activity of ALP was found in dogs fed homemade and mixed regimens, compared with dogs feeding commercial ration. Increased ALP activity in healthy animals was observed in cases of prolonged fasting periods, when might occur light liver lipidosis (BUSH, 1991).

There were observed significant differences in blood calcium among groups. Value of group 3 (mixed feed) was bellow (8,3 mg/dl) minimum reference interval (9 mg/dl), and had no statistical difference from group 2 (homemade feed), while group 1 (commercial ration) had the highest value of calcium (12,6 mg/dl). A tendency to low blood calcium values can be observed in low calcium diets or in cases of low albuminemia, since that mineral circulates bound to plasma albumin (WILLARD *et al.,* 1993). Some aliments as meat, grains or fruits are calcium deficient, but a low calcium diet would not be responsible for a hypocalcemia, unless for long period feedings (BUSH, 1991).

PCV and hemoglobin were within the reference intervals in all groups. However, values were significantly higher ($p < 0.05$) in dogs with commercial ration.

Blood profile in cats - Values of mean and standard deviation of blood metabolite profile are shown in TABLE 2 for the three groups of cats fed with different regimens.

Blood glucose and urea values were higher in this work compared with other reference values in the literature (KANEKO *et al.,* 1997). Glucose increase could be due to stress

situations, which is very frequent in cats in blood sampling (PAYNE and PAYNE, 1987). Urea values may increase in cats feeding protein-rich diets (BUSH, 1991).

Comparing the three groups of cats, there was a similar tendency to that observed in dogs, that is, glucose and cholesterol levels were higher ($p< 0.05$) in animals feeding mixed diet, compared with other regimens. Also, the interpretation results similar to that of dogs: mixed diets may content exceeding calories that should predispose to obesity.

TABLE 2 – MEAN AND STANDARD DEVIATION VALUES OF BIOCHEMICAL BLOOD PROFILE IN CATS FED WITH DIFFERENT REGIMES IN PORTO ALEGRE, BRAZIL (2000). (n=25).

Metabolite	Unit	Feeding regimen		
		Commercial	Homemade	Mixed
N		7	8	10
Glucose	mg/dl	$113,8^{b} \pm 30$	$129,2^{b} \pm 46,8$	$146,7^{a} \pm 51,6$
Cholesterol	mg/dl	$103,9^{b} \pm 30,1$	$96,7^{b} \pm 23,1$	$115,3^{a} \pm 39,0$
Total protein	g/l	$68,3^{b} \pm 10,2$	$71,8^{a} \pm 5,0$	$68,7^{b} \pm 9,1$
Albumin	g/l	$28,2 \pm 4,4$	$26,4 \pm 2,9$	$28,7 \pm 3,8$
Globulins	g/l	$40,1 \pm 7,8$	$45,0 \pm 6,3$	$39,9 \pm 8,9$
A/G relation		$0,7^{b} \pm 0,1$	$0,6^{b} \pm 0,1$	$0,8^{a} \pm 0,2$
Urea	mg/dl	$48,2 \pm 7,0$	$36,5 \pm 10,2$	$45,3 \pm 12,4$
Creatinine	mg/dl	$1,1 \pm 0,2$	$1,2 \pm 0,2$	$1,3 \pm 0,3$
ALP	U/l	$38,3^{a} \pm 18,3$	$27,3^{b} \pm 7,6$	$32,1^{b} \pm 11,7$
ALT	U/l	$14,0 \pm 7,4$	$16,2 \pm 10,8$	$15,5 \pm 9,6$
Calcium	mg/dl	$8,8^{b} \pm 1,2$	$8,1^{b} \pm 0,9$	$9,1^{a} \pm 0,5$
Phosphorus	mg/dl	$6,2 \pm 1,5$	$5,0 \pm 1,0$	$6,0 \pm 1,2$
Magnesium	mg/dl	$2,4 \pm 0,4$	$2,1 \pm 0,2$	$2,4 \pm 0,3$

ALP= alkaline phosphatase; ALT= alanine transaminase.
Different letters have significant differences ($p< 0.05$).

In relation to protein metabolism, the group of cats feeding homemade diet had lower values of albumin and urea than the other two groups. Normally, blood albumin reflects long-term protein intake, whereas urea reflects short-term protein intake (PAYNE and PAYNE, 1987). Again, the tendency in cats is similar to that of dogs in terms of protein metabolism, that is, homemade diets provide less protein than the other feed regimens.

Lower blood mineral concentrations (Ca, P, Mg) in homemade feeding cats suggest that those animals had a limited intake of those three elements than the other groups (TABLE 2).

Conclusions

Dogs and cats consuming mixed feed had higher blood levels of glucose and cholesterol indicating exceeding calories diets, which may lead to obesity risk.

Homemade diet provides limited protein intake in dogs and cats, considering lower blood concentrations of albumin and/or urea.

Homemade diet in cats provides low intake of calcium, phosphorus and magnesium, considering lower blood levels of those minerals in that group of animals.

References

AMARAL, A.S. **Determinação de valores de referência para alanina aminotransferase, fosfatase alcalina, amilase, lipase, proteínas totais, albumina, globulinas e colesterol, para cães da região de Santa Maria, RS**. Trabalho apresentado no Seminário de Pós-Graduação em Medicina Veterinária. Centro de Ciências Rurais. Universidade Federal de Santa Maria, 1994.

BURGER, I.H. Necesidades nutritivas del perro y el gato. In: EDNEY, A.T. **El libro Waltham de nutrición de perros y gatos**. 2. ed. Zaragoza: Acribia, 1989. p. 11-39.

BUSH, B.M. **Interpretation of laboratory results for small animal clinicians**. Oxford: Blackwell Scientific Publications, 1991. 287 p.

HANDELMAN, C.T.; BLUE, J. **Veterinary laboratory medicine:** in practice. Trenton: Veterinary Learning Systems, 1993. 84 p.

KANEKO, J.J.; HARVEY, J.W.; BRUSS, M.L. **Clinical biochemistry of domestic animals**. San Diego: Academic Press, 1997. 932 p.

KANTEK, C.E.; PACHALY, J.R. **Manual de hematologia veterinário**. São Paulo: Livraria Varela, 1994. 169 p.

MASON, E. Obesity in pet dogs. **Veterinay Record,** London, v. 86, p. 612-616, 1970.

MARKWELL, P.J. Nutrición clínica de los pequeños animales. In: EDNEY, A.T. **El libro Waltham de nutrición de perros y gatos**. 2. ed. Zaragoza: Acribia. 1989. p. 113-133.

MEYER, D.J.; COLES, E.H.; RICH, L.J. **Medicina de laboratório veterinário**: interpretação e diagnóstico. São Paulo: Editorial Roca, 1995. 308 p.

PAYNE, J.M.; PAYNE, S. **The metabolic profile test**. New York: Oxford University Press, 1987. 179 p.

WILLARD, M.D.; TVEDTEN, H.; TURNWALD, G.H. **Diagnóstico clínico-patológico práctico en los animales pequeños**. Buenos Aires: Intermédica Ed., 1993. 428 p.

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