Animal Feed Science and Technology 151 (2009) 251–260

Contents lists available at ScienceDirect

Animal Feed Science and Technology

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

Comparison of micronized whole soybeans to common protein sources in dry dog and cat diets

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ARTICLE INFO

Article history:
Received 14 December 2007
Received in revised form 6 November 2008
Accepted 24 December 2008

Keywords:
Animal diets
Digestibility
Plant proteins
Poultry products
Soybean proteins

ABSTRACT

The current investigation compared coefficients of total tract apparent digestibility (CTTAD), postprandial blood urea response and faecal characteristics for three isonutrient foods formulated with micronized whole soybeans (μSB), soybean meal (SBM) or poultry by-product meal (PPM) in dog diets and digestibility, palatability and faecal characteristics for two isonutrient foods employing either μSB or maize gluten meal (CGM) in cats diets. These protein sources represented 0.40 and 0.60 of total dietary protein in cat and dogs diets, respectively. In dogs CTTAD showed that μSB resulted in greater dry matter and fat digestibility than the PPM diet ($P<0.05$), and greater fat digestibility than the SBM ($P<0.05$) diet. Digestibility of fat was higher in the μSB diet fed to cats than in CGM diet ($P<0.05$). Faecal quality and production for both species was similar among all diets, with the exception of faecal dry matter that was greater ($P<0.05$) in dogs fed the PPM diet. Greater palatability, demonstrated as increased consumption ($P<0.01$), was verified for the μSB diet fed to cats. Mean incremental serum urea concentration and its incremental area under the curve were not different

Abbreviations: AAFCO, Association of American Feed Control Officials; ANOVA, analysis of variance; AOAC, Association of Official Analytical Chemistry; AUC, area under the curve; BW, body weight; CGM, corn gluten meal; CP, crude protein; DM, dry matter; GE, gross energy; ME, metabolizable energy; μSB, micronized whole soybeans; NRC, National Research Council; OM, organic matter; PPM, poultry by-products meal; SAS, Statistical Analysis System; SBM, soybean meal; SD, standard deviation; SEM, pooled standard error of the mean; SNK, Student Newman Keuls.

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0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2009.01.002

among treatments fed to dogs. It was concluded that micronized whole soybeans in combination with other protein sources containing complementary amino acids are a source of highly available, quality-consistent protein raw materials for both dog and cat diets.

1. Introduction

Although both dogs and cats belong to the mammalian order Carnivora, dogs are widely believed to be omnivorous in dietary habits and digestive capabilities while cats are strictly carnivorous—their specific amino acid, essential fatty acid and vitamin requirements are better provided by animal tissue (Morris, 2001). Commercial dry pet diets often contain cereals due to their dependable supply and low price (Yamka et al., 2005). However, relatively little published data are available regarding the digestibilities of plant-based protein sources by companion animals.

Soybeans are an excellent source of protein, fibre, oil (containing linoleic acid) and energy (Moore et al., 1980). Specifically, micronized soybeans – a product derived from full-fat dehulled soybeans – have an interesting composition due to high oil (250 g/kg) and protein (410 g/kg) content, which could be utilized in specific pet diet formulations. However, inconsistencies were found in studies investigating the digestibility of soy products. It is believed that this is the result of the antinutritional factors present in soy, of which oligosaccharides and phytate are the most concern for dogs (Zuo et al., 1996; Clapper et al., 2001; Yamka et al., 2005).

Even though animal co-products are the generally preferred protein sources for pet food manufacturing companies, their component composition and bioavailability can be very variable because processing conditions and inclusion of less desirable components. In fact, variations in component content are much greater in animal protein meals than plant-based proteins (Lowe, 1989). Consequently, digestibility data of diets based on animal co-products present greater ranges of values (Johnson et al., 1998; Yamka et al., 2003). In this regard, plant proteins can be a high quality source of protein for dog (Clapper et al., 2001) and cat (Funaba et al., 2005) diets when combined with additional protein sources containing complementary amino acids.

The current investigation compared coefficients of total tract apparent digestibility (CTTAD), postprandial blood urea changes and faecal characteristics for three isonutrient diets fed to dogs employing either micronized whole soybeans, soybean meal or poultry co-product meal and CTTAD, palatability and faecal characteristics for two isonutrient diets fed to cats employing either micronized whole soybeans or maize gluten meal as sources of protein.

2. Materials and methods

2.1. Animals and housing

Twelve cats were used in the digestibility trial and forty cats in palatability trial. The cats were mixed-breed, neutered, male and female, aged 3 ± 1.2 years (mean $\pm$ SD), and mean body weight of 4.0 ± 0.31 kg (mean $\pm$ SD) with body condition score between 4 and 6 (Laflamme, 1997a).

Eighteen intact male and female Beagles, aged 4 ± 0.8 (mean $\pm$ SD) years, with body condition scores between 4 and 6 (Laflamme, 1997b) and mean body weight of 11 ± 1.7 kg (mean $\pm$ SD) were used in digestibility and postprandial blood urea response tests.

The animals were kept in the Research Laboratory of Dog and Cat Nutrition and Nutritional Disease at São Paulo State University (Jaboticabal, Brazil). During the digestibility trial cats were individually housed in 0.7 m $\times$ 0.8 m $\times$ 1.0 m stainless steel metabolic cages. Dogs were individually housed in similar 1.0 m $\times$ 1.0 m $\times$ 1.0 m cages during their digestibility and postprandial blood urea response trials. Water was available *ad libitum* throughout the duration of the experiment. The Ethics Committee for Animal Well-Being at the College of Agricultural and Veterinarian Sciences, São Paulo State University approved all experimental procedures.

Table 1
Chemical composition of protein sources evaluated.

Item	Ingredient			
	PPM[a]	CGM[b]	SBM[c]	μSB[d]
Dry matter, g/kg	914.0	908.0	861.9	938.3
DM basis, g/kg				
Ash	173.8	14.0	34.8	44.6
Crude protein	655.6	727.6	479.0	412.5
Acid-hydrolyzed fat	133.9	25.4	21.9	250.5

[a] Poultry by-product meal.
[b] Maize gluten meal.
[c] Soybean meal.
[d] Micronized whole soybeans.

2.2. Foods

Three dry dog and two dry cat diets were tested. Each dog diet incorporated one of three protein ingredients (Table 1) as the main source of protein: micronized whole soybeans, poultry co-product meal, or soybean meal (Table 2). Each cat diet incorporated one of two protein ingredients (Table 1) as protein sources: micronized whole soybeans, or maize gluten meal (Table 2). The protein sources evaluated represented 0.40 of dietary crude protein in the cat diets, and 0.60 of dietary crude protein in the dog diets.

The soybean micronization process includes grain selection and cleaning, followed by thermal treatment, removal of the hulls, cooling, grinding and micronization. The grains were ground to a mean particle size of approximately 0.03 mm to improve digestibility.

Diets were formulated to be isonitrogenous and isoenergetic in accordance with the AAFCO (2004) energy and nutrient guides for cats and dogs, and balanced to meet maintenance requirements for each species before being extruded and kibbled under identical processing conditions in a single-screen extruder at the College of Agricultural and Veterinarian Sciences, Sao Paulo State University (Mab 400S, Extrucenter, Monte Alto, Brazil). The food manufacturing quality was controlled every 20 min by adjusting the density (g per litre) of each food preparation.

2.3. CTTAD assay

Digestibility was determined according to AAFCO (2004) guidelines, with 6 dogs or cats per diet being evaluated. For dogs, a 5 d test-food adaptation phase preceded 5 d of total faeces collection. For cats, a 5 d test-food adaptation phase preceded 10 d of total faeces collection. The quantity of food allotted was calculated using standard equations that determine proper energy requirements for maintenance (cat ME, MJ = $0.29 \times BW$; dog ME, kcal = $0.55 \times BW^{0.75}$), in compliance with NRC (1985, 1986). Each day food was weighed and divided into two equal portions, placed in stainless steel bowls and left out at 09:00 h and 17:00 h. Bowls were removed before the next meal and any remaining food was weighed and recorded. On the first day of faecal collection, all faeces were removed from the cages prior to 08:00 h and discarded. Faecal output was collected from this point on at each mealtime for the next 5 d for dogs or the next 10 d for cats and frozen (−15 °C) as it was collected.

At the end of the collection period, faeces were thawed, homogenized, and pooled by animal. Prior to performing laboratory tests, faeces were dried in a forced air oven at 55 °C for 72 h (320-SE, Fanem, Sao Paulo, Brazil) and ground in a cutting mill with a 1 mm sieve. Food samples were ground in the same way. Foods and faeces were analyzed according to AOAC (1995) standards for dry matter (DM) by oven-drying the sample (934.01), ash through muffle furnace incineration (942.05), crude protein (CP) applying the Kjeldahl method (954.01), acid-hydrolyzed fat (954.02), phosphorus (964.06), and calcium (968.08). Organic matter (OM) was calculated by difference (OM = 100 − Ash). Food and faeces gross energy contents were determined using a bomb calorimeter (model 1261, Parr Instrument Company, Moline, IL, USA). All analyses were carried out in duplicate, with a coefficient of variation below 5%.

Table 2
Ingredient and chemical composition of dry foods formulated using micronized soybeans (μSB), soybean meal (SBM) and poultry by-product meal (PPM) for dogs and μSB and maize gluten meal (CGM) for cats.

Item	Dog foods			Cat foods	
	μSB	SBM	PPM	μSB	CGM
Ingredient composition (as-fed basis, g/kg)					
Micronized whole soybeans	335.0	–	–	293.0	–
Soybean meal	–	295.0	–	–	–
Poultry by-product meal	–	–	228.0	190.0	190.0
Maize gluten meal	–	–	–	–	172.0
Meat and bone meal	120.0	120.0	120.0	–	–
Brewer's rice	250.0	250.0	250.0	180.0	180.0
Maize	150.0	150.0	150.0	180.0	180.0
Maize starch	74.0	93.0	147.0	94.0	127.0
Soybean oil	18.0	63.0	47.0	15.0	80.0
Brewer's dried yeast			10.0		
Sodium chloride	5.0	5.0	1.0	5.0	5.0
Cellulose	27.0	3.0	30.0	19.0	30.0
Choline chloride			1.0.		
Mold inhibitors[a]			3.0		
Antioxidant[b]			3.0		
L-Lysine	–	–	–	–	5.0
DL-Methionine	1.0	1.0	–	2.0	1.0
Potassium chloride	–	–	7.0	–	8.0
Vitamins—trace minerals[c]	5.0				
Taurine	–	–	–	2.0	2.0
Chemical composition (DM basis, g/kg)					
Dry matter	937	941	936	946	946
Ash	68	69	100	82	76
Crude protein	231	247	228	291	300
Acid-hydrolyzed fat	131	122	108	131	138
Calcium	12	13	22	10	10
Phosphorous	9	9	14	8	8

[a] Mold Zap: Ammonium dipropionate, acetic acid, sorbic acid and benzoic acid—Alltech do Brasil Agroindustrial Ltda.
[b] Banox: BHA, BHT, propyl gallate and calcium carbonate—Alltech do Brasil Agroindustrial Ltda.
[c] Per kg of food: iron, 120 mg; copper, 15 mg; magnesium, 10 mg; zinc, 150 mg; iodine, 2 mg; selenium, 0.2 mg; vitamin A, 18,000 IU; vitamin D_3, 1000 IU; vitamin E, 100 IU; thiamin, 8 mg; riboflavin, 10 mg; pantothenic acid, 50 mg; niacin, 75 mg; vitamin B_6, 6 mg; folic acid, 0.30 mg; vitamin B_{12}, 0.1 mg.

Faecal samples were scored according to the following system: 1 = watery: liquid that can be poured; 2 = soft, unformed: stool assumes shape of container; 3 = soft, formed, moist: softer stool that retains shape; 4 = hard, formed, dry stool: remains firm and soft; 5 = hard, dry pellets: small, hard mass.

2.4. Postprandial blood urea response test

After the digestibility trials, postprandial urea response tests were conducted in dogs (six dogs per diet) according to Watson et al. (1981), with modifications in sampling time. Dogs were fed to meet maintenance requirements (ME, MJ = $0.55 \times BW^{0.75}$ kg; NRC, 1985), and adapted to their foods for 3 d before testing. During this period they were conditioned to ingest all food within 15 min; dogs that took longer than this to consume their total amount of food were not tested. Afterwards the animals were deprived of food for the 24 h period prior to their urea test. On this same day, each dog was aseptically catheterized using a peripheral intravenous catheter inserted into the cephalic vein (Angiocath 20 GA × 1.16 in., Becton, Dickinson, USA). Blood samples were taken pre-feeding (baseline sample, time 0) and 1, 2, 3, 4, 4.5, 5, 6, 7, 8, 9 and 10 h post-feeding (the times were counted from the end of the meal). Blood collection was always done at the same time, starting at 08:00 h. Each 3-mL blood sample was taken using a syringe and transferred to a glass tube and serum was separated within 15 min of collection and stored at −20 °C. All samples were assayed within 24 h of collection

using a semi-automated analyzer (Labquest model BIO-2000, Labtest Diagnóstica S.A., Lagoa Santa, Brazil). Urea concentrations were determined by kinetic ultraviolet assay (Uréia UV Liquiform, Labtest Diagnóstica S.A., Lagoa Santa, Brazil).

2.5. Palatability

Palatability was measured for cat foods using two-pan method on three consecutive days with forty cats in individual cages (Griffin, 2003). In the morning they received two pans, each containing one of the experimental foods (μSB and CGM) which alternated sides at every meal. The amount of food offered in each pan surpassed the consumption capacity of the animal to always ensure leftovers. Before the next feeding the pans were removed, the leftovers weighed and the consumption recorded. Interpretation of results was based on the relative consumption of each food.

2.6. Calculations and statistical analysis

CTTAD values were determined for each experimental cat and dog diet. Metabolizable energy was calculated according to AAFCO (2004) standards for the method without urine collection. To determine palatability, relative consumption was calculated by the formula:

$$\text{Relative consumption} = \frac{\mu\text{SB food consumption}}{\mu\text{SB food consumption} + \text{CGM food consumption}}$$

Changes in canine plasma urea concentration were calculated for each postprandial interval. Responses were compared for average and maximum increase, average and maximum incremental increase (the difference among absolute and baseline urea concentrations), and time to peak increase. The integrated area under postprandial urea response curve and the integrated area under postprandial incremental urea curve were calculated by the trapezoidal method. The software ORIGIN (Microcal Software, Inc., Version 6.0, Northampton, MA, USA) was used for area under curve (AUC) computing.

Digestibility results for cats and dogs were analyzed in a completely randomized design using the general linear model functions of SAS (Version 8, SAS Institute Inc., Cary, NC, USA). The experimental unit was cat or dog. For the experiment with dogs the model sums of squares were separated into diet and animal effects, with three diets and six replicates per treatment making 18 animals in total. For the experiment with cats the model sums of squares were separated into diet and animal effects, with two diets and six animals per diet making 12 animals in total. Where significant ($P<0.05$) differences were detected in ANOVA's *F* test for intakes, faeces characteristics, or CTTAD, multiple comparisons of means were made using SNK test ($P<0.05$).

Repeated measures analysis of variance with two among-animal factors (diet and period) and one within-animal factor (time of sampling) was the statistical method chosen to evaluate the effects of diet and time on canine postprandial urea changes, with six animals per treatment. Pair wise means comparisons were also made through SNK test ($P<0.05$) when the ANOVA *F* test results were statistically significant. All data were found to comply with the assumptions of ANOVA models. Feline palatability comparisons were made using the paired *T*-test, also in the SAS statistical program.

3. Results

3.1. Dogs

Although diets were formulated to be isonitrogenous and isoenergetic based on analyses of ingredients there were slight differences in the dog diets for total crude protein and fat contents (Table 2). However, these differences were relatively small and should not effect experimental interpretation.

Intake, CTTAD, palatability and faecal characteristics of dogs are presented in Table 3. All animals adequately consumed their diets and there were no episodes of diarrhea or vomiting. Intakes (g/kg BW/d) were similar for all dog foods ($P>0.05$).

No differences were observed in CTTAD of OM, CP, or GE for evaluated foods. Fat digestibility was highest in μSB food ($P<0.05$). Dry matter digestibility was highest in the μSB diet, while the SBM diet

Table 3
Nutrient intake, coefficient of total tract apparent digestibility, metabolizable energy, and faecal characteristics of dogs fed dry foods formulated using micronized soybeans (μSB), soybean meal (SBM) and poultry by-product meal (PPM) and cats fed μSB and corn gluten meal (CGM).

Item	Dog foods			SEM[a]	Cat foods		SEM
	μSB	SBM	PPM		μSB	CGM	
Intake, g/day	192[a]	169[b]	189[a]	1.9	44	41	1.1
Intake, g/kg BW/d[b]							
Dry matter	18	16	18	1.0	11	10	0.6
Organic matter	17	15	16	1.1	10	9	0.7
Crude protein	4.5	4.2	4.4	0.32	3.3	3.1	0.22
Acid-hydrolyzed fat	2.5	2.1	2.2	0.13	1.5	1.4	0.11
Coefficients of total tract apparent digestibility							
Dry matter	0.86[a]	0.84[ab]	0.83[b]	0.005	0.82	0.81	0.013
Organic matter	0.89	0.88	0.88	0.005	0.85	0.85	0.011
Crude protein	0.87	0.86	0.85	0.006	0.84	0.84	0.013
Acid-hydrolyzed fat	0.94[a]	0.92[b]	0.92[b]	0.003	0.90[A]	0.86[B]	0.009
Gross energy	0.89	0.89	0.89	0.004	0.86	0.85	0.013
Metabolizable energy (MJ/kg)	15.9[a]	14.2[b]	15.9[a]	0.41	15.9	16.3	0.41
Faecal characteristics							
Faecal DM, g/kg	309[b]	318[b]	454[a]	80.1	311	309	80.1
Score	3.3	3.3	3.5	0.12	3.5	3.3	0.1
g faeces (dry)/g DM consumed	0.14[b]	0.16[ab]	0.17[a]	0.001	0.18	0.19	0.001
g faeces (wet)/g DM consumed	0.40[ab]	0.48[a]	0.36[b]	0.001	0.55	0.48	0.010
Palatability	–	–	–				
Relative consumption[c]					0.7[A]	0.3[B]	0.10
Food intake (g/day)					37[A]	18[B]	3.2

Within a row, mean for dogs without a common superscript (a and b) differ (P<0.05). Within a row, mean for cats without a common superscript (A and B) differ (P<0.05).

[a] SEM = pooled standard error of the mean, $n = 6$ animals per food.

[b] Mean weight of animals differ among foods.

[c] Relative consumption = (μSB food consumption)/(μSB food consumption + CGM food consumption).

had the lowest ME value (P<0.05). Canine faecal scores were similar among diets, but faecal dry matter and faecal production (g dry faeces/g DM consumed) were greatest in dogs fed the PPM diet (P<0.05). Dogs fed the SBM-based diet produced more wet faeces (g wet faeces/g DM consumed) than dogs fed PPM food (P<0.05).

Postprandial blood urea responses for dogs are presented in Table 4. Mean incremental urea and urea peak concentrations did not differ among diets; however, time to urea peak was delayed in dogs fed the μSB diet (P<0.05). The incremental blood urea response curve is illustrated in Fig. 1. Incremental urea concentrations were significantly higher than basal values at 2 h post-feeding for μSB and PPM diets

Table 4
Postprandial blood urea response of dogs fed dry foods formulated using micronized whole soybeans (μSB), soybean meal (SBM) and poultry by-product meal (PPM).

Postprandial response test	Dog foods			
	μSB	SBM	PPM	SEM[a]
Urea, mg/dL				
Mean incremental concentration	12	12	13	0.5
Mean incremental peak concentration	20	23	21	1.2
Time to peak (h)	7[a]	5[b]	5[b]	0.3
Area under incremental curve (mg/dL/h)	126	127	131	9.3

Within a row, mean without a common superscript (a and b) differ (P<0.05).

[a] SEM = pooled standard error of the mean, $n = 6$ animals per food.

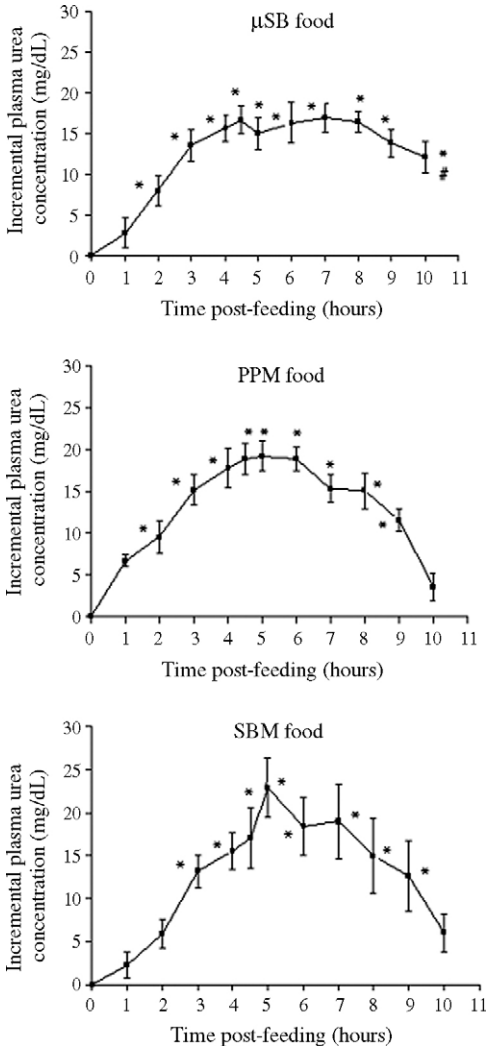

Fig. 1. Incremental plasma urea response of dogs fed dry diets formulated using micronized soybeans (μSB), soybean meal (SBM) and poultry by-product meal (PPM) (values are means ± SE of 6 animals per diet). *Values significantly greater than baseline concentration (P<0.05). #Value significantly higher than PPM food (P<0.05).

and at 3 h post-feeding for the SBM food (P<0.05). At 9 hours post-feeding no differences in incremental urea concentrations were observed among diets. By 10 h post-feeding, the serum urea concentrations of dogs fed PPM and SBM diets had returned to basal levels whereas the values encountered for the μSB diet remained significantly higher than baseline and also higher than the PPM diet (P<0.05). The area under incremental urea curve was similar among treatments (Table 4).

3.2. Cats

Both cat diets had similar compositions (Table 2). Intake, CTTAD, palatability and faecal characteristics are presented in Table 3. All animals adequately consumed their food and there were no episodes of diarrhea or vomiting. Intakes were similar for both cat diets (P>0.05).

No differences were observed in CTTAD of DM, OM, CP, and GE for evaluated diets. Similar to dogs, the fat digestibility was highest for the μSB diet ($P<0.05$). Faecal characteristics were similar among diets. Palatability indicated a preference for the diet containing micronized whole soybeans, which was consumed in 2-fold greater quantities than the maize gluten meal diet by the cats ($P<0.01$).

4. Discussion

Of the variables measured in the present study, micronized whole soybeans scored similar or superior results to poultry by-product meal and soybean meal for dogs and to maize gluten meal for cats. No other data evaluating μSB for dogs or cats could be found to compare current results.

Soybean and soy by-product uses for dogs have been evaluated by several authors (Kendall and Holme, 1982; Zuo et al., 1996; Clapper et al., 2001; Yamka et al., 2003). In contrast, similar data for cats are unavailable. The importance of evaluating soy products with cats can be justified by the fact that researchers have identified soy isoflavone content in 24 of 42 commercial cat foods available in the USA (Court and Freeman, 2002), showing that soybean and soy-derived products are often utilized for cat diets in that country. In Brazil, soybean meal is a common ingredient listed for dry cat foods.

Animal co-products may contain varying amounts of tissues, organs, fat, feet, hair, or feathers which influences their composition and availability. The process of meal rendering also influences protein quality (Murray et al., 1997). Wiernusz et al. (1995) found that processing soybeans into soy protein concentrate rather than into grits or flour increased CP digestibility. Similarly, the process of micronizing whole soybeans increased CTTAD in the present study for dogs.

Comparisons among the use of soybean meal and chicken by-product meal in diets for dogs have been made by others (Moore et al., 1980; Huber et al., 1994). Zuo et al. (1996) observed that the inclusion of different quantities of soybean meal in poultry meal-based foods resulted in increased CP digestibility and similar digestibilities of the other components tested. Clapper et al. (2001) also verified that the digestibility of a diet including soybean meal was very close to that of a poultry-meal food, including greater CP digestibility. On the other hand, in the experiment of Murray et al. (1997) crude protein digestibility tended to be lower for defatted soy flour than for several raw and rendered animal by-product proteins, demonstrating that not all soy-based products offer the same bioavailability for dogs. Thus, micronized whole soybean is an interesting ingredient due to its high digestibility, elevated fat content (250 g/kg), and due the fact that soy was de-hulled during ingredient manufacturing, resulting in a low fibre ingredient, which could be utilized in specific pet food formulations.

Other studies evaluating soybeans or soy by-products as a main source of protein in dog diets (Kendall and Holme, 1982; Yamka et al., 2003, 2005; Carciofi et al., 2006) tend to show lower values than those obtained in studies where the vegetable protein source was included with an animal source (Zuo et al., 1996; Clapper et al., 2001). Even so, the CP digestibilities evidenced by Kendall and Holme (1982) and Carciofi et al. (2006) and the DM digestibility results obtained by Yamka et al. (2005) and Carciofi et al. (2006) were similar to those observed in the present study, confirming that, with adequate processing, soy-derived protein sources are suitable protein ingredients for dog diets. However, the use of total tract apparent digestibility instead of ileal digestibility is a limitation of the present study and need to be considered in the interpretation of results. This method does not permit a clear separation between protein use by the host or by the intestinal microbial population.

Both cat diets showed high digestibilities, except for fat that presented moderate digestibility, indicating that the vegetable protein sources were well utilized by the cats. Maize gluten meal was used here to compare with μSB because it is a vegetable protein source largely used in cat diet formulation. According to Funaba et al. (2001, 2005) protein digestibility of CGM-based dry diets for adult cats is comparable to that of fish and chicken meal-based foods. In the present study the μSB food was comparable or superior to the CGM diet, suggesting that micronized whole soybeans are an adequate vegetable protein option in diets for felines, with the important advantage of being highly palatable. The greater fat digestibility of the μSB diet is interesting and may be an advantage for this ingredient, particularly in aged cats (Peachey et al., 1999). This finding requires further study, but one possible hypothesis is the presence of 5 g lecithin/kg micronized whole soybeans, which could improve fat usage for cats and also for dogs. However, the possibility that CGM decreased the fat digestibility for cats exists and should be evaluated. On the other hand, a lecithin effect is reinforced by the fact that

for dog foods soybean oil addition to SBM and PPM based diets (Table 2) did not result in the same fat digestibility than for μSB based food.

Bednar et al. (2000) and Clapper et al. (2001) observed greater faecal output in dogs fed diets containing soy-derived products compared with those fed animal protein-based foods. They justified this finding because faecal output data reflect the fibre and non-structural carbohydrate content of soy protein sources that lead to an increase in wet faecal volume. In the present study differences in wet faecal output were observed among dogs fed SBM and PPM, but not among animals fed μSB and PPM. One possible explanation is the de-hulling process of soybeans during micronization process generating an ingredient with decreased fibre content. The PPM diet resulted in greater faecal DM concentration for dogs than soybean-based diets. This could be due to the higher mineral content of PPM but carbohydrate fraction of soy may contribute to a greater water holding capacity of the faeces (Yamka et al., 2003).

The use of a urea response curve for dogs was first reported by Watson et al. (1981) who also observed urea peaks among 4 and 8 h post-feeding. According to Bergner et al. (1968), a negative correlation exists among the biological value of protein and blood urea concentrations; the latter dependent on the quality and quantity of the protein consumed. As the quantity of CP/kg BW ingested by all dogs was proportional, the similarities in postprandial urea responses suggests that there were no marked differences in protein utilization among experimental diets. However, dogs fed μSB diet presented a delayed increase and retarded decrease in postprandial blood urea concentration. For those dogs, after the 10 h observation period blood urea did not return to basal level. If the sampling time was extended for a few more hours (until urea reached baseline for dogs fed μSB), the area under incremental urea curve results could be different between diets. Another point is that urea blood response is not a very specific method and, without complimentary observations like nitrogen balance, misleading results are possible.

5. Conclusions

The current study confirms that soy protein, when associated with other protein sources that contain complementary amino acids, can provide an alternative source of highly available, quality-consistent protein for both cat and dog diets. Soybean processing technologies such as micronization may present opportunities to increase the percentage of soy protein in companion animal diets, with digestibility and faecal characteristics remaining comparable to animals consuming diets based on animal protein co-products.

Acknowledgements

The authors acknowledge the financial support of Perdigão S.A., Brazil and Mogiana Alimentos S.A (Guabi), Brazil, and the scholarship grant of FAPESP.

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