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Effects of spray-dried animal plasma on food intake and apparent nutrient digestibility by cats when added to a wet pet food recipe

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A B S T R A C T

Spray dried animal plasma (SDAP) is a preferred binder in canned pet food products due to its high protein content and excellent physicochemical properties and because it is highly preferred by cats. Eleven mixed breed adult cats were used in a crossover digestibility design study to determine apparent nutrient digestibility of canned chunks and gravy food containing either 30 g/kg SDAP or 30 g/kg wheat gluten (WG) added to the emulsion as binders for producing chunks prior to addition of gravy and subsequent sterilization and canning. Cats were fed 400 g/d of each diet for a 7 d acclimation period followed by a 5 d fecal collection period. Cats fed the SDAP diet had improved ($P < 0.05$) apparent dry matter, crude fiber, ash, phosphorus, and calcium digestibility compared to the WG diet. Results indicate that components in SDAP may retain biological functions that exert beneficial effects on the digestive system of healthy adult cats even after sterilization and canning.

1. Introduction

Spray-dried animal plasma (SDAP) is a common ingredient that is preferred in canned pet food products due to its high protein concentration and technological properties. Spray-dried animal plasma has excellent water-holding capacity, foaming and emulsifying properties (Tybor et al., 1975; Etheridge et al., 1981; Caldironi and Ockerman, 1982; Polo et al., 2005) and gel strength when heated above 80 °C (Parés et al., 1998; Polo et al., 2005, 2007). In addition, because SDAP is an animal protein, strict carnivores such as cats prefer diets formulated with SDAP to those that use wheat gluten (WG) or other vegetable proteins (Polo et al., 2005, 2007). For the purposes of pet food manufacture, blood is hygienically collected from healthy animals approved for slaughter for human consumption. The liquid plasma is obtained after centrifugation of whole blood (either from bovine or porcine origin) and further concentrated by membranes before being dehydrated using spray-drying technology. The spray-drying technique is a mild dehydration process that maintains the functional physicochemical and biological properties of the product.

Spray-dried animal plasma is commonly used as a functional protein ingredient in diets of farm animals to improve performance and health conditions (Torrallardona, 2010; Boyer et al., 2015). In addition, SDAP has been demonstrated to

Abbreviations: SDAP, spray-dried animal plasma; DM, dry matter; CF, crude fiber; CP, crude protein; GE, gross energy; TDF, total dietary fiber; WG, wheat gluten.

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Table 1
Chunk recipe of the two wet pet food products used in the study.

Ingredients (g/kg)[a]	Recipe A SDAP	Recipe B WG
Chicken carcass (50:50 fresh:frozen)	474	474
Pig liver	30.0	30.0
Poultry meal	20.2	20.2
Spray-dried plasma	30.0	0.000
Wheat gluten	0.000	30.0
Sodium chloride (NaCl)	2.40	2.40
Sodium tripolyphosphate	2.00	2.00
Dextrose	1.40	1.40
Cat vitamin premix	0.700	0.700
Cat mineral premix	0.300	0.300
Total chunk	561	561
Potassium chloride (KCl)	1.20	1.20
Sodium carbonate (Na_2CO_3)	0.700	0.700
Chicken broth (C1301)	8.00	8.00
Water	429	429
Total gravy	439	439
TOTAL	1000	1000

[a] Frozen animal by-products (chicken carcass and pork liver) from CORSA Petfood, S.L. (Barcelona, Spain). Fresh poultry carcass from Costa Angelet (Vilanova del Vallès, Barcelona, Spain). Sodium chloride (NaCl) food grade from Unión Salinera de España (Barcelona, Spain). Sodium tripolyphosphate food grade from Payon (Engis, Belgium). Dextrose from Cargill (Saint Germain en Laye, France). Poultry meal from Avifood (Tarragona, Sain). Potassium chloride from k+s Kali (Kassel, Germany). Sodium carbonate from Quimivita (Barcelona, Spain). Chicken broth from Essentia (Ankeny, US). Spray-dried plasma (AP820P) from APC-Europe (Granollers, Spain). Wheat Gluten Vital from Roquette (Lestrem, France). Chicken broth (C1301) from Essentia Protein Solutions (Ankeny, IA, USA). Vitamin and mineral premixes supplied by Affinity Petcare in Sant Cugat del Vallès (Barcelona, Spain). Vitamin premix contains: 38,400 MIU/kg vitamin A as retinyl acetate; 2560 MIU/kg vitamin D3 as cholecalciferol; 136 g/kg vitamin E as di-alpha-tocopheryl acetate; 24 g/kg vitamin B1 as thiamine mononitrate; 12.8 g/kg vitamin B2 as riboflavin 80% spray-dried; 32 MIU/kg vitamin B5 as calcium pantotenate 98%; 12.8 g/kg vitamin B6 as pyridoxine hydrochloride; 4.8 g/kg vitamin B9 as folic acid 96%; 64 mg/kg vitamin B12 as cianocovalamin on CaCO3 flour; 128 g/kg niacin as nicotinic acid; 112 mg/kg biotin as biotin 2% on CaCO3 flour; 320 mg/kg vitamin K as k3 menadione nicotinamide bisulfite and 45% calcium carbonate (carrier). Mineral premix contains: 8000 mg/kg cooper as cupric sulphate; 1310 mg/kg iodine as potassium iodine; 131 g/kg zinc as zinc sulphate; 100 mg/kg selenium as sodium selenite; 78 g/kg iron as ferrous sulphate; 36.5 g/kg manganese as manganous sulphate and sepiolite or calcium carbonate as carriers.

improve nutrient digestibility by pigs (Torrallardona, 2010), poultry (Campbell et al., 2003), fish (Gisbert et al., 2015) and dogs (Quigley et al., 2004).

The inclusion of SDAP in dry dog food kibble either before or after extrusion improved dry matter (DM), crude fiber (CF) and total dietary fiber (TDF) digestibility, and decreased fecal DM excretion (Quigley et al., 2004). The extrusion process used in the manufacturing of dry food kibbles and the sterilization process used in the manufacturing of canned food involves high temperature and pressure that may denature major proteins present in SDAP (APC Inc., unpublished data). However, improved digestibility observed in dry kibbles when SDAP was added before extrusion suggested that changes in digestibility were independent of the functional proteins or that certain bioactive components in SDAP survive extrusion.

Therefore, the main purpose of the study was to determine the effect of SDAP when included in a canned pet food recipe on intake and apparent digestibility of major dietary components in adult cats.

2. Materials and methods

2.1. Ethic statement

The facility of Kennel “De Morgenstond” (Dussen, The Netherlands) was used for the digestibility study. The facility was maintained according to the Dutch regulations (Animals Act, 2011) and the cats were housed in compliance with the Directive 2010/63/EU of the European parliament and of the council of 22 September, 2010 on the protection of animals used for scientific purposes. A consent permission was obtained from the owner of the cats. The animal experimental procedure was in accordance with the Association of American Feed Control Officials guidelines (AAFCO, 2001). The zootechnical procedures used in this experiment (i.e. weighing) were carried out by experienced and authorized personnel and did not cause animal suffering. Technicians at the kennel were unaware of the composition of diets.

2.2. Diets

Two experimental recipes of chunks in gravy were produced in the pilot plant of APC-Europe, S.A. (Granollers, Spain) according to the recipes indicated in Table 1. Each diet provided complete and balanced nutrition for the maintenance of adult cats (AAFCO, 2001; FEDIAF, 2013).

Frozen animal by-products (previously were ground through a 3 mm screen) were mixed with the different additives (salt, sodium polyphosphate, dextrose, mineral premix, vitamin premix) in a pilot plant meat bowl-chopper (Cato S.A., Spain) at maximum speed (2600 rpm). After mixing, poultry meal and then SDAP or WG (used as control binder) was also added to the meat bowl-chopper. The blending process was finished when the raw emulsion reached 11–14 °C. A special designed device was adapted to the piping of a stuffing machine (Cato S.A., Spain) to produce 0.5 cm thick and 1.5 cm wide ropes on stainless steel trays. The ropes were cooked in a wet steam oven (Doleschal, Austria) at 90 °C for 10 min. After cooking, the ropes were left cooling in the refrigerator (4 °C) for 20 min before manual cutting with a knife into small 0.5–1.0 cm^2 chunks. Cans of 400 g capacity were filled with 224.6 g of chunks and 175.4 g of gravy. The ratio of chunks:gravy was exactly 56.15:43.85 respectively (Table 1). All cans were sealed and sterilized at 121 °C for 1 h in a laboratory autoclave (Matachana, Spain) and were left to cool at room temperature for at least two weeks before analysis. One can per production batch of each SDAP or WG recipe (4 cans per recipe) was opened and its contents (chunks and gravy) was homogenized with a domestic electric beater (Groupe SEB Ibérica, Barcelona, Spain) to perform analysis for DM, protein, ash, crude fat, CF, calcium and phosphorus.

For the digestibility trial, a total of 306 cans were produced in different daily production batches according to the capacity of production of the pilot plant used; therefore, 153 cans of each SDAP or WG recipe were produced in four different batches.

Cans were labelled as A (SDAP) or B (WG) without any more identification and sent to the animal facility where the trial was done (Kennel "De Morgenstond", The Netherlands). The digestibility trial started on March 9th and finished on April 1st, 2015.

2.3. Animals and feeding protocol

Eleven healthy adult mixed breed cats (six females and five males) with an average age of 143.9 ± 10.5 months and 4.08 ± 0.20 kg body weight were used in a crossover digestibility study design. Each period of the experiment included a 7-day adaptation phase and a 5-day fecal collection phase. Cats were fed 400 g/d of diet always at the same time and the food remaining in the bowl was removed and weighed to calculate food intake. Cats were subjected to a natural light environment during the study and the temperature was maintained at 18 ± 2 °C. Cats had continuous access to fresh and clean water.

During the first 7 days of acclimation, all animals receiving the same diet were housed together as a group in playgrounds except during the daily feeding time at 0800 h and 1600 h. From days 8–12, cats were placed in individual cages to collect and to evaluate the production of feces.

All cats were weighed on days 0, 7 and 12 of each experimental period. Daily food consumption was noted per animal during the complete trial.

2.4. Samples

Total feces were collected daily during the 5 day collection period, weighed and frozen at −20 °C. Fecal score was evaluated by trained people using the following scale: 0 = no feces visible in the cage at observation time; 1 = liquid diarrhea; 1.5 = diarrhea; 2 = wet, shapeless feces; 2.5 = wet, slightly shaped feces; 3 = wet, distinctly shaped feces; 3.5 = sticky, well-shaped feces; 4 = well shaped feces; 4.5 = hard feces; 5 = hard, very dry feces likely to crumble easily. At the end of each period, all the feces produced by each animal were mixed and freeze-dried (Liolabor 30, Coolvacuum Technologies SL, Pallejà, Spain). After freeze-drying, feces were ground, sieved (discarding hair, straw and foreign materials) and stored at 4 °C until analysis.

2.5. Analysis

Fecal samples and experimental cans (chunks mixed homogeneously with gravy) were analyzed externally for dry matter (AOAC method 925.45), crude protein (AOAC method 990.03), ash (AOAC method 942.05), crude fat (AOAC method 954.02), crude fiber (AOAC method 962.09), calcium (AOAC method 968.08) and phosphorus (AOAC method 965.17) (AOAC, 2001). Total tract apparent digestibility of dietary components was determined from these data. Crude fiber (CF) was used as an indicator of fiber digestion; however, use of CF as an index of fiber digestion ignores the loss of soluble polysaccharides, of some insoluble polysaccharides and of lignin (Fahey et al., 1990a, 1990b). This makes other indices of dietary fiber, such as total dietary fiber (TDF), preferable to CF but unfortunately, TDF was not measured in this study. Gross energy (GE) was estimated by applying the NCR equation (NRC, 2006).

2.6. Statistical analysis

Results are expressed as mean of eleven cats. Statistical analysis of the data were performed with the aid of Statgraphics Centurion WX, version 15.2.14 (Manugistics, Inc., USA). The effect of diet and day of study and their interactions, on food consumption and on the production and consistency of feces was done by One-Way ANOVA using LSD as an all pairwise multiple comparison procedure. Differences were considered significant when $P < 0.05$. When comparisons were made between two groups Student *t*-test was used and differences were considered significant when $P < 0.05$.

Table 2
Nutrient composition of chunk and gravy recipes[a].

	Diet A SDAP	Diet B WG	SEM	P-value[b]
Dry matter (g/kg)	268	274	2.22	0.176
Protein (g/kg)	123	135	3.23	0.012
Ash (g/kg)	40.3	35.9	1.27	0.054
Calcium (g/kg)	9.40	9.93	1.89	0.148
Phosphorus (g/kg)	6.00	5.90	1.13	0.677
Crude fat (g/kg)	99.3	80.5	4.47	0.003
Crude fiber (g/kg)	1.90	1.71	0.285	0.749

[a] Values are expressed as the average of four different samples in SDAP diet and four different samples in WG diet. Samples were obtained by homogenization of chunks with gravy contained in one can.
[b] Probability of a significant treatment effect by Student *t*-test.

3. Results

3.1. Recipes

There were no significant differences in dry matter, calcium, phosphorus and fiber content between diets (Table 2). However, the diet containing SDAP had lower protein, higher fat and higher ash content compared to the diet containing WG.

3.2. Food intake

The diet had no significant effect on daily food consumption during the whole study. By multi-factorial ANOVA (diet and day) no significant effect was found for diet ($P = 0.529$) or day of trial ($P = 0.998$), and there was no effect related to the interaction of diet and day of trial ($P = 0.958$) (data not shown).

No differences in dry matter, crude protein (CP), CF, ash, calcium, phosphorus or GE were observed between diets; however, cats fed the control diet containing WG had lower ($P = 0.005$) fat ingestion compared with the cats fed the SDAP diet (Table 3).

3.3. Feces production and consistency

The daily production of feces during the collection period was not significantly affected by diet ($P = 0.572$) or day of collection ($P = 0.240$), and there was no effect related to the interaction of diet by day ($P = 0.982$) (data not shown). No differences of dry fecal excretion were observed between diets (Table 3).

The fecal consistency was not different during the collection period. No significant effect was found for either outcome considered, diet ($P = 0.515$) and day of trial ($P = 0.823$), and there was no effect related to the interaction of both ($P = 0.798$) (data not shown).

3.4. Body weight

There were no significant differences in body weight measured on days 1, 7 and 12 of the assay between diets (Table 3).

3.5. Apparent digestibility

Apparent digestibility of CF ($P < 0.001$), ash ($P = 0.001$), calcium ($P = 0.053$), phosphorus ($P = 0.022$) and DM ($P = 0.019$) was improved in the SDAP diet compared to the WG diet (Table 3). Furthermore, the diet containing SDAP had numerically higher digestibility of CP, fat, and GE.

4. Discussion

Spray-dried animal plasma and wheat gluten are protein sources that are widely used in canned pet foods as binder ingredients because of their high capacity to produce a mild gel after heat treatment, and to retain water under hot conditions (Polo et al., 2005, 2007). Therefore, use of wheat gluten in the control diet was appropriate comparing the digestibility of SDAP against a common binder used in this application.

The diets used in this study contained only three main animal by-products (chicken carcass, pig liver and poultry meal) that accounted for 93% of the chunk recipe (without the gravy) due to the fact that the intention of the study was to test the digestibility of a 3% inclusion level of SDAP versus 3% WG. In addition, because of the small scale chunk production in our facility, 4 days of production for each diet was needed, and although care was taken to homogenize the raw material for each production lot, we could not prevent recipe variation in protein, ash, and fat concentrations. The differences in protein

Table 3
Mean body weight, fecal excretion, fecal scores, intake and apparent digestibility of cat food diets containing 30 g/kg spray dried animal plasma (SDAP) or wheat gluten (WG)[a].

Item	SDAP[b]	WG[b]	*SEM*	*P*-value[c]
Body weight, kg				
d 1	3.87	4.13	0.141	0.368
d7	4.00	4.02	0.157	0.954
d 12	3.92	3.97	0.159	0.866
Feces, g/d (wet)	30.0	33.6	4.50	0.569
Feces, g/d (dry)	5.90	7.56	0.881	0.347
Fecal score[d]	3.20	3.40	0.113	0.358
Nutrient intake				
Intake (g/d)	240	235	8.78	0.794
Dry matter, g/d	63.5	64.4	2.38	0.843
CP, g/d	29.2	32.0	1.14	0.217
CF, g/d	0.455	0.400	0.016	0.119
Fat, g/d	23.5	18.9	0.835	0.005
Ash, g/d	9.55	8.45	0.342	0.106
Calcium, g/d	2.23	2.33	0.085	0.550
Phosphorus, g/d	1.42	1.39	0.052	0.752
GE, kcal/d	391	380	14.4	0.693
Apparent Digestibility, coefficient				
DM	0.926	0.890	0.008	0.019
CP	0.938	0.926	0.006	0.314
CF	0.957	0.857	0.013	<0.001
Fat	0.969	0.949	0.007	0.122
Ash	0.742	0.595	0.030	0.001
Calcium	0.621	0.510	0.035	0.053
Phosphorus	0.690	0.576	0.031	0.022
GE	0.950	0.937	0.005	0.192

[a] n = 11 adult cats per treatment.
[b] Values are expressed as the average of 11 values in each group.
[c] Probability of a significant treatment effect by Student *t*-test.
[d] Feces were scored daily on a scale of the following: 0 = no feces visible in the cage at observation time; 1 = liquid diarrhea; 1.5 = diarrhea; 2 = wet, shapeless feces; 2.5 = wet, slightly shaped feces; 3 = wet, distinctly shaped feces; 3.5 = sticky, well-shaped feces; 4 = well shaped feces; 4.5 = hard feces; 5 = hard, very dry feces likely to crumble easily.

and ash composition of the recipes may be explained by the lower protein and high ash content of SDAP (696 and 147 g/kg, respectively) versus that of WG (767 and 8 g/kg, respectively). The differences in fat content between recipes are related to small differences in fat in the poultry carcass used in the different production batches. This is a common situation in wet pet food industry due to the lack of homogeneity of the raw materials of animal origin (Polo et al., 2007). Nevertheless, the amount of nutrients ingested by cats between the two treatments was similar and only fat ingestion was different. Cats fed WG diet had lower fat ingestion compared to cats fed SDAP diet due to the lower fat content of the WG diet.

Results of this study indicated no differences in body weight, as this was expected due to the ingestion of similar energy intake between treatments. No differences was also observed for wet or dry feces production. Dogs fed dry kibbles containing SDAP included at 1–3% of the diet had no differences in body weight after 15 days; however, there was a consistent reduction in fecal DM output by an average of 15% across 3 trials (Quigley et al., 2004). We did not observe reduced fecal DM output reported for dogs (Quigley et al., 2004) in our study with cats, although dry feces output was numerically lower for cats fed the SDAP diet.

Fecal score was not different between treatments. This is in agreement with results from the study conducted with dogs (Quigley et al., 2004). However, for other animal species, inclusion of SDAP is well correlated with improved fecal score and reduced diarrhea (Van Dijk et al., 2001; Quigley et al., 2002; Torrallardona, 2010), probably because animals included in these studies were subjected to a more challenging pathogen environment and the use of dietary SDAP had a greater beneficial effect under these conditions (Coffey and Cromwell, 1995; Bregendahl et al., 2005). Dietary SDAP may improve the health of challenged animals by different mechanisms, including the antimicrobial protection of immunoglobulins and glycoproteins present in SDAP that may prevent growth and bacterial colonization in the small intestine, support the intestinal immune system, and prevent mucosal damage by pathogenic bacteria (Moretó and Pérez-Bosque, 2009). In addition, SDAP has been reported to reduce the overall activation of the immune system and have a systemic anti-inflammatory effect (Moretó and Pérez-Bosque, 2009; Maijó et al., 2012).

Digestibility results were in the upper range of values reported in the literature for cats fed canned pet food (Nott et al., 1994; Kerr et al., 2013, 2014). This may be due to the relatively simple diet composition and the high quality animal by-products used in our study. In fact, our values are similar to values obtained when cats were fed raw meat products (Kerr et al., 2012). We also observed higher digestibility for all nutrients measured compared with dogs fed a dry kibble containing SDAP from 1 to 3% (Quigley et al., 2004), probably because we are comparing two different species and two different processing methods (extrusion vs retorting).

In our study, we observed higher digestibility of the SDAP diet for DM, CF, ash, calcium, and phosphorus. Higher numerical digestibility values were observed for CP, crude fat, and GE for the SDAP diet. Due to the presence of IgG in SDAP, which is partially resistant to digestion, the digestibility of crude protein in diet containing SDAP was expected to be slightly lower (Roos et al., 1995; Quigley et al., 2004). Bosi et al. (2001) reported lower ileal CP digestibility in early-weaned pigs fed SDAP compared with hydrolyzed casein. Conversely, Pendergraft et al. (1993) reported that SDAP was more digestible than WG in diets fed to young pigs. Similarly, Rojas and Stein (2012) demonstrated that SDAP had higher CP and amino acid digestibility values than common animal proteins used in pig diets (fishmeal, casein, chicken meal, etc.), however, as indicated above, in our study no difference on CP was observed between treatments.

Our results indicating higher digestibility of CF in the diet containing SDAP is in agreement with the results obtained for dogs (Quigley et al., 2004). Because SDAP is not a significant source of fiber, we were not expecting differences in fiber digestion, however, the higher digestibility of crude fiber in SDAP diets may be related with improved intestinal microbiota that efficiently use the fiber provided in the diet. Torrallardona et al. (2003) indicated higher counts of lactobacillus in the ileum and cecum of piglets fed a diet containing 7% SDAP.

The higher digestibility of phosphorus as a result of the inclusion of SDAP is in agreement with the high digestibility of phosphorus observed in pigs fed diets containing SDAP (Almeida and Stein, 2011). Similarly, we observed a higher digestibility of calcium and total ash. These results indicated that minerals present in SDAP are very digestible and soluble and, consequently, highly available for the animals. Nevertheless, the contribution of phosphorus and calcium from the inclusion of SDAP at 30 g/kg is minimal and therefore the better digestibility observed by the addition of SDAP in the wet pet food recipes can be explained by the improved gastrointestinal health associated with the supplementation with this ingredient (Quigley et al., 2004; Pérez-Bosque et al., 2006; Peace et al., 2011). This can be an important observation for diets designed for all ages, but especially for adult pets.

Our results indicated that functional components present in SDAP survived canning conditions and improved digestibility of the diet. This observation is in agreement with the data published by Quigley et al. (2004) who observed that SDAP added in dry kibbles before extrusion improved digestibility of select nutrients. In addition, Campbell et al. (2006) demonstrated that poultry diets containing 1% SDAP and subjected to pellet conditioning temperatures ranging from 85 to 95 °C and expander temperatures of 149 °C did not impair the positive growth effects of SDP in pelleted or expanded broiler feed. Similarly, Gao et al. (2011) fed 10% SDAP or 10% autoclaved SDAP (auSDAP) in diets of neonatal pigs and observed that both SDAP and auSDAP improved the growth performance of neonatal pigs, although the SDAP diet had a greater effect on growth rate. According to the authors, the benefits of SDAP probably resulted from the promotion of intestinal development, accompanied by increased antioxidant capacity and decreased production of inflammatory factors in the intestinal mucosa. Conversely, Steidinger et al. (2000) demonstrated that feeding diets containing 5% SDAP and pelleted at conditioning temperatures above 77 °C decreased weanling pig growth performance. However, due to the presence of reducing sugars from lactose and starch commonly using in weaned pig diets, the reduced growth performance results observed for pelleted pig diets conditioned at greater than 77 °C was likely the result of Maillard reaction product formation that reduced the amino acid digestibility of the diet. Our results with SDAP in recipe emulsions that were subsequently cooked at 90 °C for 10 min and sterilized at 121 °C for 1 h, suggest that the improved digestibility of select nutrients was independent of the functionality of proteins, or that functional components in SDAP survive sterilization, or that some bioactive components are produced after digestion of the plasma proteins.

Plasma is a complex mixture of many physiological components including immunoglobulins, glycoproteins, growth factors, bioactive peptides, cytokines and others (Coffey and Cromwell, 2001; Moretó and Pérez-Bosque, 2009). All these components provide anti-bacterial (Nollet et al., 1999; Niewold, 2007) and anti-inflammatory effects (Pérez-Bosque et al., 2004; Pettigrew et al., 2006; Peace et al., 2011), improve intestinal barrier function (Pérez-Bosque et al., 2006; Peace et al., 2011;), and have other beneficial effects such as increase disease resistance, modulation of the immune system. It appears to dampen inflammation in healthy animals, and that effect may be important in increasing both feed intake and growth rate. In contrast, plasma appears to enhance the immune response to a challenge. (Pettigrew et al., 2006).

Overall, these data suggest that SDAP may influence gastrointestinal system function, and thereby enhance digestion. Addition of SDAP to canned cat food improved digestibility of nutrients. Improved digestibility is consistent with better digestive function observed in other animals when SDAP was included in the diet and may indicate that other components present in SDAP are resistant to high pressure and thermal processing conditions and are responsible for some of the effects observed with the supplementation of SDAP in animal diets.

5. Conclusions

SDAP in canned chunk and gravy food for cats improved apparent digestibility of dry matter, crude fiber, ash, calcium, and phosphorus. These results are similar to those reported for dry kibbles containing SDAP in digestibility studies with dogs (Quigley et al., 2004). In addition to the well-known superior physicochemical properties of SDAP as a binder, functional components in SDAP apparently retain at least some of its biological activity through high pressure and thermal processing conditions to enhance digestibility in both canned and dry extruded recipes.

Conflict of interest

The authors have read the journal's policy and the authors of this manuscript have the following competing interests: CR, NS, JR and JP are employed by APC Europe, S.A., Granollers, Spain. This does not alter our adherence to all the Animal Feed Science and Technology policies on sharing data and materials. APC Europe, S.A. manufacture and sells spray dried plasma.

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