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Digestibility of sun dried cassava chips in dogs

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Abstract

We have earlier shown that sun dried, ground, non-heated cassava chips are highly digestible in growing pigs. In this study, we tested the possibility that sun dried cassava meal would also be well digested by dogs. Twelve adult dogs were subjected to a 3×3 Latin square design with three experimental diets and three periods (three weeks each). The control diet was a homogenized, commercial, extruded diet that was pelleted at environmental temperature. The two test diets were made in the same manner, but after grinding, the commercial diet was blended with either 10 or 30% of sundried, non-heated cassava meal. The diets were well accepted by the dogs. The inclusion of cassava in the diet did not affect the amount and water content of faeces, but it significantly elevated the faecal score in a dose-dependent fashion. The faecal score for the 30% cassava diet was equivalent to diarrhoea. It was suggested that the feeding high amounts of non-heated cassava lowers water binding of faecal matter. The apparent digestibility of the non-structural carbohydrates (nitrogen-free extract) in non-heated cassava, as calculated by the difference method, was found to be 79.8% for the 10% cassava level and 84.0% for the 30% level. It was concluded that high intake levels of sun dried, non-heated cassava are unsuitable for dogs.

Keywords: Cassava; dog; digestibility; faeces consistency

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Introduction

There is an increasing use of cassava (tapioca) as ingredient for the production of dry, high-temperature-extruded dog foods (Aldrich, 2011). As a functional ingredient, cassava is commonly incorporated as starch source into hypoallergenic diets. The current owners' interest in grain-free dog foods has further stimulated the use of cassava as starch source alternative to grains (Aldrich, 2011).

Gröner and Pfeffer (1997) fed dogs an extruded basal diet as such or as blend with 40% cassava and determined the apparent digestibility of non-structural carbohydrates (nitrogen-free extract, NFE) in cassava by the difference method. The digestibility of non-structural carbohydrates in cassava, in essence representing the starch component, was found to be 98%. The inclusion of cassava in the diet induced the production of more shaped and harder faeces (Gröner and Pfeffer, 1997). Carciofi et al. (2008) used an extruded diet containing 42.5% cassava flour as major starch source and reported an apparent starch digestibility of 99%. The faeces characteristics were described as hard, formed and dry.

In the two studies (Gröner and Pfeffer, 1997; Carciofi et al., 2008), the diets containing cassava had been extruded, and thus the cassava was exposed to high temperature, prior to feeding to the dogs. It would appear that the production process rendered the starch component available for digestion, resulting in a digestibility as high as 99%. Gelatinization and disintegration of starch granules, as effected by thermal

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processing, increases starch susceptibility for amylolytic degradation and thus enhances starch digestion in dogs.

Sun dried cassava chips are highly digestible in growing pigs fed non-heated diets in meal form: for a diet containing 58% cassava chips and 40% soybean meal, the apparent digestibility of the nitrogen-free extract was found to be 96.5% (Vasupen et al., 2008). As dogs and pigs share similar characteristics of starch digestion at the level of the small intestine, it could be suggested that sun dried cassava meal may also be highly digestible in dogs. If this would indeed be the case, sun dried cassava could be used in dog foods produced at relatively low temperatures.

The questions to be addressed in the experiment with dogs were as follows. i) Is the starch in sun dried, ground, non-heated cassava chips indeed highly digestible? To answer this question, the digestibility of homogenized cassava chips was determined by the difference method at two inclusion levels (10 and 30%) in a dry food. ii) Does cassava meal inclusion have any effects on the digestibility of macronutrients in the whole diet? iii) Does cassava meal affect feed intake, body weight and faeces quality?

Materials and Methods

Dogs and housing

Twelve Golden Retrievers, aged 29 months, were used. There were 8 intact males and 4 spayed females. The dogs were housed as a group in a confinement (10 × 10 m) located under a roof, but otherwise with open air. Within the confinement there were 12 cages (1.0 x 0.5 × 0.6 m) with plastic grated floor. The animals could move freely within the confinement, including the open cages. However, during feeding and faeces collection intervals, the dogs were locked up in their own cage.

Experimental design

The dogs were subjected to a 3×3 Latin square design with three experimental diets and three periods of three weeks each. Per diet order there were 4 dogs. Table 1 shows the ingredient and analysed composition of the three experimental diets. The control diet was a commercial diet (Bok Dök, Nutrix Company Ltd, Muang, Chachoengsao, Thailand) of one production batch. The extruded diet was homogenized, water was added and the mixture was put through a pelleting machine at environmental temperature. The pellets were sun dried. The test diets were made in the same manner, but after grinding either 10 or 30% of sun dried, homogenized cassava chips were added. The analysed composition of the cassava chips was as follows: moisture, 13.7%; crude protein, 2.6%; crude fat, 2.4%; ash, 1.9% and crude fibre, 4.0%. The calculated amount of non-structural carbohydrates was 75.4%.

A restricted amount of each diet was fed in two equal portions per day. During feeding, the dogs were confined in their own cage for a period of 15 min. The daily amount of food provided was equivalent to 5536 kJ and 4461 kJ of metabolizable energy for the males and females respectively. The amounts of energy were equivalent to 90% of the assumed requirement for maintenance (500 kJ per kg body weight$^{0.75}$). To calculate the energy value of the experimental diets, the energy values for protein, fat and carbohydrates were taken to be 17, 37 and 16 kJ metabolizable energy per gram. The calculated energy value of the control diet was 1415 kJ/100 g. For the test diets with 10 or 30 % sun dried cassava the calculated energy densities were 1407 and 1392 kJ/100 g. The energy density of the control diet was based on the guaranteed analysis panel on the packaging: crude protein (20%); crude fat (7%); crude fibre (6%); ash (6%) and moisture (10%).

During the last 5 days of each period, the dogs were penned up in their own cage. From each dog, the faeces were collected quantitatively.

Measurements

At the beginning of each period, body weights of the dogs were determined. Throughout the experiment, the faeces quality was scored on a 1-5 scale (Waltham Faecal Grading System). Feed and faeces samples were processed for the proximate analysis of dry matter, crude fat, crude protein, crude fibre and ash as described (Vasupen et al., 2008). The amount of non-structural carbohydrates was calculated as residual fraction.

Statistical analysis

The data were evaluated for diet effects with the use of ANOVA. If there were statistically significant diet effects, the three diet groups were compared with the Tukey test. $P<0.05$ was taken as a criterion of statistical significance.

Results

Table 1 shows the analysed composition of the experimental diets. As would be expected, mixing of sun dried cassava chips with the commercial diet reduced protein and fat levels, but raised the amount of non-structural carbohydrates. Unexpectedly, blending of the commercial diet with cassava increased the content of crude fibre.

Throughout the experiment, there were no food refusals: each dog ate its ration within 15 min after administration. Within the feeding periods, there were no significant changes in body weight. Initial body weights were 28.4±0.2 (mean±SE) and 21.3±0.9 kg for males and females dogs respectively. The final body weights were 28.8±0.2 and 21.8±1.0 kg for males and females respectively.

Table 1: Ingredient and analysed composition of the experimental diets

	Control	10% cassava	30% cassava
Ingredient, g			
Commercial diet	1000	900	700
Sun dried cassava	-	100	300
Chemical analysis, % of dry matter			
Dry matter*	94.6	94.7	96.5
Crude protein	19.8	18.6	15.6
Crude fat	8.3	7.7	7.5
Crude fibre	6.1	6.3	6.5
Ash	9.2	7.4	7.8
Carbohydrates (NFE)	56.6	60.0	62.6

NFE = nitrogen-free extract; *Expressed on product basis

Table 2: Faeces production and score for dogs fed the experimental diets

	Control	10% cassava	30% cassava	SEM	P value
Faeces					
g/day	433	450	465	36.9	0.826
g dry matter/100g	29.1	29.1	28.6	1.3	0.940
Score	2.6^{a}	2.9^{b}	4.3^{c}	0.06	0.000

Means (n=12) within the same row not sharing the same superscript letter are significantly different (P<0.05)

Table 3: Apparent digestibility of nutrients in dogs fed the experimental diets

	Control	10% cassava	30% cassava	SEM	P value
Apparent digestibility (Percent of intake)					
Dry matter	69.6	71.9	68.0	3.27	0.705
Organic matter	74.1	76.1	73.0	2.80	0.728
Crude protein	74.4	76.2	70.5	3.49	0.503
Crude fat	76.6	81.1	75.1	2.75	0.280
Crude fibre	24.3	27.4	22.0	8.93	0.913
Carbohydrates (NFE)	78.3	78.4	80.0	1.66	0.726
Ash	27.4	28.9	15.6	7.18	0.369

Means (n=12) within the same row are not significantly different

The inclusion of cassava in the diet did not significantly affect the amount of fresh faeces produced daily and left the faecal dry matter content unchanged (Table 2). The addition of cassava to the diet significantly elevated the faecal score in a dose-dependent fashion. A faeces score of 2.5 is equivalent to well formed stools with a slightly moist surface. A score of 4.5 represents diarrhoea with some areas of consistency.

The apparent digestibility of dry matter, organic matter, crude protein, crude fat, crude fibre, ash and non-structural carbohydrates were not significantly affected by mixing cassava into the diet (Table 3). When compared with the control diet, group-mean digestibility of crude protein, crude fat and crude fibre were higher for the diet with 10% cassava, but lower for the diet containing 30% cassava. Such a tendency was not seen for the digestibility of non-structural carbohydrates.

The apparent digestibility of the NFE component of cassava was calculated by the difference method. The calculations were made separately for the 10 and 30% inclusion levels. The digestibility of non-structural carbohydrates was found to be 79.8% for the low level and 84.0% for the high level.

Discussion

From the outset, it is important to stress that in this study sun dried, non-heated, ground cassava chips were fed to the dogs in the form of a non-heated blend with a commercial diet. According to the list of ingredients on the packaging, the extruded, commercial diet contained corn and cassava as starch sources. The diets containing 10 or 30% non-heated cassava meal were well accepted by the dogs. Cassava in the diet raised the group-mean amount of fresh faeces in a dose-dependent fashion, but the increase did not reach statistical significance. Apparent digestibility of dry matter was not significantly affected by incorporation of cassava into the diet. Faecal moisture content was not influenced by the ingestion of cassava. However, faeces scores were significantly increased by cassava in the ration. The average faeces score of 4.3, as seen for the diet containing 30% cassava, would be unacceptable in practice. A score of 4.5 represents diarrhoea with some areas of consistency. Thus, it would appear that high levels of sun dried, non-heated cassava cannot be applied in non-heated dog rations.

The effect of cassava feeding on faeces characteristics cannot be interpreted easily. In this study, the diet containing 30% non-heated cassava caused diarrhoea, but did not raise the water content of faeces. In essence, mixing non-heated cassava into the diet was done at expense of heated corn and heated cassava. It seems that sun dried, non-heated cassava does not promote osmotic diarrhoea with raised faecal water content, but decreases water binding of faecal matter.

Kamalu (1991) used wet, cooked, isonitrogenous diets consisting of lean pork, bone meal, minerals, vitamins and either 77.9% rice or 70.0% cassava on a dry matter basis. The cassava diet significantly raised the water content of faeces in young growing dogs. Extruded diets with cassava levels as high as 40% have been shown to produce hard faeces in dogs (Gröner and Pfeffer, 1997; Carciofi et al., 2008). Mixing cassava, rice or corn into a basal extruded diet was found to lower faecal water content (Gröner and Pfeffer, 1997). However, Carciofa et al. (2008) reported that cassava versus either corn or brewer's rice in an extruded diet raised the fraction of water in faeces. Thus, the results from the different studies cannot be reconciled.

Table 3 illustrates an interesting trend with regard to the group mean digestibility of dry matter, organic matter, crude protein, crude fat and crude fibre. When compared to the commercial diet, the digestibility was higher for the 10% cassava diet, but lower for the 30% cassava diet. It appears that the high intake level of non-heated cassava

interferes with digestion, whereas the low level has a promoting activity. A high level (42%) of cassava, instead of corn (53%), in an extruded diet raised the apparent digestibility of dry matter, organic matter and crude fat, but did not influence the digestibility of crude protein (Carciofi et al., 2008). Possibly, a high dietary level of non-heated cassava has different effects on macronutrient digestibility than heated cassava.

The apparent digestibility of non-structural carbohydrates in cassava was found to be on average 81.9%. Gröner and Pfeffer (1997) also used the difference method, but mixed 60% of basal ingredients with 40% cassava and then extruded the mixture. The non-structural carbohydrates in cassava had an apparent digestibility of 98% in dogs. Carciofi et al. (2008) used an extruded diet containing 42.5% cassava flour, providing essentially all non-structural carbohydrates. Apparent starch digestibility in dogs was reported to be 99.4%. When comparing the outcome of the earlier studies (Gröner and Pfeffer, 1997; Carciofi et al., 2008) and that of the present trial, it is clear that heat-treatment of cassava increases digestibility of the carbohydrate component in dogs.

In the final analysis, it may be stated that sun dried, non-heated cassava chips are unfit for inclusion in non-heated dog rations. Such rations include frozen raw foods and certain home-made formulations. Probably, sun dried, non-heated cassava also is unsuitable as ingredient for dog production by methods such as cold pressing, air drying and freeze drying. The digestibility of sun dried, non-heated cassava, as illustrated by the digestibility of the non-structural carbohydrates, was found to be relatively low. Furthermore, high dietary inclusion levels of non-heated cassava will produce diarrhoea in dogs.

References

Aldrich, G. 2011. Tapioca: a novel starch source for petfood. *Petfood Industry*, April: 44-47.

Carciofi, A.C., Takakura, F.S., De-Oliveira, L.D., Teshima, E., Jeremias, J.T., Brunetto, M.A. and Prada, F. 2008. Effect of six carbohydrate sources on dog diet digestibility and post-prandial glucose and insulin response. *Journal of Animal Physiology and Animal Nutrition*, 92: 326-336.

Gröner, T. and Pfeffer, E. 1997. Digestibility of organic matter and digestible energy in single ingredients of extruded dog feeds and their effects on faecal dry matter concentration and consistency. *Journal of Animal Physiology and Animal Nutrition*, 77: 214-220.

Kamalu, B.P. 1991. Digestibility of a nutritionally-balanced cassava (Manhitot esculenta Crantz) diet and its effect on growth in young male dogs. *British Journal of Nutrition*, 66: 199-208.

Vasupen, K., Yuangklang, C., Wongsuthavas, S., Srenanul, P., Mitchaothai, J. and Beynen, A.C. 2008. Macronutrient digestibility in Kadon pigs fed diets with isonitrogenous amounts of various carbohydrate sources. *Tropical Animal Health and Production*, 40: 249-253.