



Assessment of nutrient digestibility in four dry dog foods containing different levels of protein, fat and carbohydrate[#]

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Abstract

A study was undertaken in switch over design to find out the effects of four different treatment combinations of protein, fat and carbohydrates in dry dog foods on the apparent digestibility of nutrients. Four medium sized healthy adult nondescript dogs of about one to two years of age and around 10 to 15 kg body weight were selected and allotted to four dietary treatments- T1 (40 per cent CP, 23 per cent fat, 30 per cent carbohydrate and 3626 kcal ME), T2 (35 per cent CP, 20 per cent fat, 38 per cent carbohydrate and 3528 kcal ME), T3 (26 per cent CP, 15 per cent fat, 52 per cent carbohydrate and 3475 kcal ME) and T4 (20 per cent CP, 11 per cent fat 62 per cent carbohydrate and 3370 kcal ME). The feeding trial was conducted in switch over model of design with one week in between the periods to nullify carry over effect. Results revealed that levels of nutrients in diet had a significant influence on nutrient digestibility in the experimental animals. Among the dietary treatments, T1 with higher fat and protein levels had better dry matter digestibility while T3 diet containing 26 per cent protein, 15 per cent fat and 52 per cent carbohydrate had better crude protein and ether extract digestibility, hence can be recommended.

Keywords: Dry dog food, nutrients, levels of protein, fat and carbohydrate, digestibility

Humans have a complex and very long history of relationship with dogs and cats. This bond has its origins in domestication and has developed to take on a wide range of manifestations

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in modern society. Along with appropriate health care and adequate medical attention, nutrition is an important component of pet care. Understanding basic nutrition and the nutrients required by healthy dogs and cats is crucial for understanding practical feeding strategies (Case *et al.*, 2011). According to 20th livestock census 2019, the dog population of Kerala is 8.36 lakhs, most of which are medium sized dogs (12-20kg). Considering the popularisation of pets across income groups in Kerala, it is becoming imperative to look into the nutritional profile of pet dogs so as to ensure their health and clinical well-being. The commercial pet foods have different levels of protein, fat and carbohydrate with levels of carbohydrates on a higher side in most pet foods. Even though dogs can utilise carbohydrates, the extent of utilisation is limited. Hence this work was undertaken to assess the influence of various levels of nutrients on digestibility in dogs.

Materials and methods

This study was conducted in switch over design at the Animal Nutrition Production Shed, Department of Animal Nutrition, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala during the period from February, 2022 to June, 2022.

Preparation of dry dog food

Complete dry food for adult medium sized dogs was developed at the first stage. Different combinations of feed items were

used for formulating four different dry foods. The dietary treatments were T1 (40 per cent CP, 23 per cent fat, 30 per cent carbohydrate and 3626 kcal ME), T2 (35 per cent CP, 20 per cent fat, 38 per cent carbohydrate and 3528 kcal ME), T3 (26 per cent CP, 15 per cent fat, 52 per cent carbohydrate and 3475 kcal ME) and T4 (20 per cent CP, 11 per cent fat, 62 per cent carbohydrate and 3370 kcal ME). The fat to protein ratio was made uniform in all these combinations. The ingredient compositions of diets are provided in Table 1.

Feeding trial

Four medium sized, healthy adult dogs between one to two years of age and around 10 to 15kg body weight were selected. They were dewormed and vaccinated against rabies at the beginning of experiment. The experimental animals were housed individually in well ventilated, clean and dry kennel with facilities for feeding and watering and were maintained under uniform management conditions. The dogs were randomly allotted to one of the dietary treatments initially and fed with the corresponding diet for a period of four weeks. Thereafter the animals were switched. One week was given in between treatments to nullify the carry over effect. Subsequent food was given during rest period and the entire feeding trial period was for a period of five months. At the end of each feeding trial, a digestibility trial for 3 days was carried out, by total collection method.

Table 1. Ingredient composition of the experimental rations, per cent

Ingredient	Per cent composition			
	T1	T2	T3	T4
Wheat	2	2	13.8	16
Maize	1.7	1.4	4.5	16
Soybean	20	19.5	16.3	13
Wheat Bran	10.2	14.6	9	9
Ragi	10	15.5	25	25
Chicken	28	20	9	2.8
Meat cum bone meal	10.5	10.6	9.2	7.2
Coconut oil cake	6	6	4.6	4.6
Rendered fat	10.5	9.3	7.5	5.3
SuppleVit – M (Mineral supplement)	0.5	0.5	0.5	0.5
Becom-DS (Vitamin A,B ₂ ,D ₃)	0.4	0.4	0.4	0.4
Common salt	0.2	0.2	0.2	0.2

Statistical analysis

As the design adopted was switch over design, variation between treatments were analysed after removing the variation due to period and also variation due to animal. For this, three-way ANOVA without interaction was adopted. When the F-value corresponding to treatment was found to be significant, Duncan Multiple Range Test (DMRT) was used for finding out which treatments are homogenous.

Results and discussion

The data on chemical composition of feed (T1, T2, T3 and T4) and faecal sample of dogs fed with the four experimental diets are presented in Tables 2 and 3.

The mean average daily dry matter intake (DMI) of the experimental animals maintained on T1, T2, T3 and T4 during digestibility trial were 151.23 ± 4.64 , 158.52 ± 3.73 , 164.06 ± 3.48 and 173.02 ± 5.22 g, respectively. The mean daily faecal output of the experimental animals maintained on T1, T2, T3 and T4 during digestibility trial were $119.37 \pm$

5.62 , 137.85 ± 7.92 , 171.55 ± 8.02 and 188.06 ± 5.09 g, respectively. The faecal output per kg body weight for dogs fed T1, T2, T3 and T4 were 10.17, 11.97, 14.78 and 16.15g, respectively. The faecal volume and faecal volume per kg body weight showed significant difference ($p < 0.01$) between all the four treatment groups with values of animals fed, with T4 value being significantly higher than those of animals in other treatment groups. In accordance with the results of the current study, Sabchuk *et al.* (2012) reported that mature Beagles confined in metabolic cages and kennels and fed diets containing 92 percent DM and 23 percent CF, respectively, had faecal production of 14.6 and 19.8 g per kg body weight. Similar to the observations made in the present study Abinaya *et al.* (2020) in their study with adult medium sized non-descript dogs also reported faecal output of 11.86, 16.37 and 19.39g per kg body weight in dogs fed isonitrogenous diets.

The apparent digestibility coefficient of nutrients in the four experimental diets calculated from digestibility trial in dogs belonging to the four dietary treatments is presented in Table 5.

Table 2. Chemical composition of experimental diets, per cent (on dry matter basis)

Parameters ¹	T1	T2	T3	T4
Dry matter	91.04 ± 0.08	92.15 ± 0.22	93.03 ± 0.18	93.12 ± 0.12
Crude protein	39.92 ± 0.10	35.00 ± 0.02	26.02 ± 0.23	20.16 ± 0.41
Crude fibre	3.65 ± 0.37	4.26 ± 0.26	3.96 ± 0.58	4.02 ± 0.46
Ether extract	23.03 ± 0.65	20.09 ± 0.83	15.18 ± 0.14	11.16 ± 0.32
Total ash	9.89 ± 0.51	9.23 ± 0.38	8.12 ± 0.02	7.63 ± 0.49
Nitrogen free extract	23.49 ± 0.03	31.41 ± 0.10	46.70 ± 0.06	57.02 ± 0.27
Acid insoluble ash	1.45 ± 0.01	1.50 ± 0.18	1.67 ± 0.01	1.70 ± 0.06
Calcium	1.26 ± 0.03	1.14 ± 0.12	1.36 ± 0.04	1.32 ± 0.10
Phosphorous	0.92 ± 0.01	0.75 ± 0.15	1.02 ± 0.02	0.96 ± 0.06

Table 3. Chemical composition of faeces, per cent (on dry matter basis)

Parameters	T1	T2	T3	T4
Dry matter	33.02 ± 0.16	32.12 ± 0.53	33.24 ± 0.79	34.56 ± 0.64
Crude protein	33.08 ± 0.58	29.97 ± 0.63	15.24 ± 0.49	12.85 ± 0.57
Crude fibre	9.16 ± 0.27	9.89 ± 0.21	8.19 ± 0.25	7.81 ± 0.39
Ether extract	4.47 ± 0.22	3.83 ± 0.25	1.71 ± 0.03	1.94 ± 0.12
Total ash	22.41 ± 0.49	20.16 ± 0.53	15.80 ± 0.27	13.20 ± 0.24
Acid insoluble ash	7.45 ± 0.43	6.53 ± 0.87	5.68 ± 0.21	5.22 ± 0.33
Nitrogen free extract	30.86 ± 0.99	36.13 ± 0.71	59.03 ± 0.43	64.18 ± 0.99
Calcium	2.89 ± 0.05	2.41 ± 0.05	2.41 ± 0.05	2.31 ± 0.03
Phosphorus	2.27 ± 0.05	1.65 ± 0.04	1.86 ± 0.03	1.68 ± 0.03

Assessment of nutrient digestibility in four dry dog foods containing different levels of protein, fat and carbohydrate.

Table 4. Average DMI and Faecal volume of the experimental animals maintained on four experimental diets during digestibility trial, g

Variables ¹	Treatments			
	T1	T2	T3	T4
Average DMI	151.23± 4.64	158.52 ± 3.73	164.06 ± 3.48	173.02 ± 5.22
Faecal Volume	119.37± 5.62	137.85 ± 7.92	171.55 ± 8.02	188.06 ± 5.09
Faecal Volume/kg	10.17 ± 0.23	11.97 ± 0.051	14.78 ± 0.13	16.15 ± 0.43

¹ Mean of four values**Table 5.** Apparent digestibility coefficient of nutrients of the four experimental rations, per cent

¹ Variables	Treatments				p-value
	T1	T2	T3	T4	
Dry Matter	79.39 ^a ± 0.36	77.23 ^b ± 0.51	74.83 ^c ± 0.36	72.26 ^d ± 0.5	< 0.001 ^{**}
Crude Protein	82.92 ^b ± 0.36	80.48 ^c ± 0.83	85.26 ^a ± 0.44	82.34 ^b ± 0.58	0.005 ^{**}
Crude Fibre	48.34 ± 0.71	47.2 ± 0.17	47.98 ± 0.95	46.17 ± 0.69	0.160 ^{ns}
Ether Extract	95.99 ^b ± 0.25	95.66 ^{bc} ± 0.29	97.15 ^a ± 0.1	95.18 ^c ± 0.28	0.003 ^{**}
Nitrogen Free Extract	59.16 ^{ab} ± 1.92	60.59 ^a ± 0.8	60.47 ^a ± 1.85	58.71 ^b ± 1.75	0.044 [*]

¹ Mean of four values with SE, ns- Non-Significant,^{**} Significant (P<0.01) ^{*} Significant (P<0.05)

The digestibility coefficient of nutrients in the four experimental diets (T1, T2, T3 and T4) were 79.39, 77.23, 74.83 and 72.26 per cent for dry matter, 82.92, 80.48, 85.26 and 82.34 per cent for crude protein, 48.34, 47.20, 47.98 and 46.17 per cent for crude fibre, 95.99, 95.66, 97.15 and 95.18 per cent for ether extract and 59.16, 60.59, 60.47 and 58.71 per cent for nitrogen free extract, respectively. Meyer *et al.* (1999) reported digestibility coefficient of 88.90 and 87.10, 86.00 and 85.90, 93.80 and 96.40, -5.70 and 1.70, 91.10 and 66.50 per cent, respectively for organic matter, crude protein, ether extract, crude fibre, and nitrogen free extract in dogs fed dry and canned commercial diets.

The apparent digestibility coefficient for dry matter showed difference (p<0.01) between all the four treatments with digestibility in T1 being significantly higher than that in other treatment groups. Similar apparent DM digestibility coefficient of 79 per cent, 76.1 per cent, 65.8 to 72.9 per cent and 77.41 per cent were observed by Murray *et al.* (1999), Sa *et al.* (2013), Abinaya *et al.* (2020) and Kahraman and Inal (2021).

The data for crude protein digestibility was similar for T1 and T4 diets and was significantly different from T2 and T3 feeds (p<0.01) with T3 values being significantly higher

than other treatment groups. In agreement to the results of present study, Madhusudhan (2007) reported mean CP digestibility of 84 per cent in adult dogs. Hervera (2011) observed apparent CP digestibility of 71 to 91 per cent in adult dogs fed an extruded diet with CP ranging from 15.8 to 39.8 per cent (DM basis). Geiger and Weber (2022) based on their study in dogs fed with four dry dog foods containing crude protein ranging from 18 to 38 per cent observed that total tract apparent digestibility (TTAD) of proteins ranged from 69 to 84 per cent.

The calculated ether extract digestibility was similar between T1 and T2 and between T2 and T4 groups and was significantly lower from T3 group (p<0.01). According to Bazolli *et al.* (2015), mature Beagles given a diet containing 53.3 per cent maize and 4.5 per cent poultry fat had an apparent EE digestibility of 94.1 per cent. Kahraman and Inal (2021) estimated the ether extract digestibility of commercial dry dog diets with or without grains and reported values of 95.14 and 96.96 per cent, respectively.

No difference was recorded between the dietary treatments with regard to the digestibility of crude fibre. Similar to the present study, Brambillasca *et al.* (2010) reported 44.3 per cent crude fibre digestibility in dogs fed with diet containing 33 per cent crude fibre. Similarly, Kahraman and Inal (2021) observed

a crude fibre digestibility of 48 per cent in dogs fed with diets containing grain and lamb meat.

The NFE digestibility was similar between T1, T2 and T3 groups and also between T1 and T4 but digestibility in T4 was significantly lower than that in T2 and T3. Meyer *et al.* (1999) reported higher digestibility coefficient for NFE at 66.5 per cent in ten different breeds of dogs fed diets with CF ranging from 5 to 9 g/kg.

Conclusion

From the above results, we can conclude that the levels of nutrients in diet had a significant influence on nutrient digestibility in experimental animals. The dry matter digestibility was higher in high protein and fat diet whereas digestibility of crude protein and ether extract was highest for T3 diet which was having crude protein and ether extract levels less than T1 and T2 diets. The mean daily faecal output was higher for animals fed with high carbohydrate diet when compared with animals in other treatment groups. From the observations made in the study, for efficient protein and energy utilisation in adult dogs, a diet containing 26 per cent protein, 15 per cent fat and 52 per cent carbohydrate is better and can be recommended.

Conflict of interest

The authors declare that they have no conflict of interest.

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