



Chia Seeds in Dog Feeding

Sachin Kumar et al.

***In Vitro* Evaluation of Chia Seeds (*Salvia hispanica*) in Dog Food**

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ABSTRACT

In order to assess the *in vitro* digestibility of commercially available food with GADVASU produced food that contains chia seeds at 1 and 3%, the current study was carried out. Using standard techniques, the analysis of feeds was carried out. The amount of aflatoxin in various foods was also examined. Contrary to ether extract, which was higher in Chia 1% and Chia 3% based foods, commercial food had higher levels of dry matter, crude protein, crude fibre, and total ash. Aflatoxin levels in commercial food were higher than in chia 1% and 3% based foods, although they were all within acceptable range. While Chia 1% and 3% based foods have higher digestibilities for dry matter, crude protein, and organic matter than commercial foods, Chia 1% based food has a higher digestibility for ether extract. Due to its greater dry matter, crude protein, and ether extract digestibilities, this study demonstrated that a meal containing 1% of chia seeds is more digestible than the other two. It was concluded that a diet containing 1% chia seeds can replace commercial dog food.

KEY WORDS: Aflatoxin, Chia seeds, Commercial food, Dog, *In vitro* digestibility

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INTRODUCTION

Pet dog owners usually feed their dog as per their convenience and the food items mainly include the leftovers of homemade cooked food (Tiwari et al., 2020a). which are nutritionally imbalanced with respect to protein, energy and minerals especially calcium and phosphorus. The most common deficiencies encountered are in calcium levels, micronutrients such as zinc, copper, choline, vitamin D and vitamin E levels. Such feeding practices hampers the growth of pets and their nutritional requirements are not met by such feeding practice. Currently very little information is available on the nutritional adequacy of homemade food for dogs but certain study conducted in the different zone of Punjab related to the nutritional and managerial practices adopted by dog owners, found that most of the pet owners were feeding nutritional imbalanced diet to their dogs (Singh et al., 2020a;

Singh et al., 2020b; Tiwari et al., 2020b; Singh et al., 2022) therefore it is the need of the hour to explore certain feed ingredient which can improve the nutritional value of the dog food one of such ingredient could be Chia seed. Chia (*Salvia hispanica*) seeds are rich in a variety of polyphenols and have protein, fat, carbohydrate, dietary fibre, ash, and dry matter levels ranging from 15 to 25%, 30-33%, 41%, 18%, 4% and 90-93% (Ixtaina et al., 2008). Numerous studies have demonstrated the benefits of consuming Chia, including a reduced risk of coronary heart disease, type 2 diabetes, and a number of cancers (Reyes-Caudillo et al., 2008). Chia has several times more calcium, phosphorus, and potassium than wheat, rice, oats, and corn, as well as 6 and 2.4 times more iron than spinach and liver (Beltran-Orozco and Romero, 2003). Chia oil's higher omega-3 content can aid in the treatment of dyslipidemia, or an elevated LDL, triglyceride, and

low HDL cholesterol level. Additionally, chia seeds dramatically raised glutathione concentration and catalase (CAT) & glutathione peroxidase activity of antioxidant enzymes in plasma (Marineli et al., 2015). Chia's fatty acid composition has been published in the literature and each of the studies' concentrations of omega-3 and omega-6 fatty acids were consistent with just slight differences (Ayerza, 2011). Therefore, the present study was undertaken to investigate the *in vitro* digestibility of commercially available food with GADVASU produced food that contains chia seeds at 1 and 3% level.

MATERIALS AND METHODS

Selected feed items, including meat and bone meal, rice gluten, soybean meal, and rice, were purchased from the neighborhood market. The lab of Department of Animal Nutrition GADVASU, Ludhiana, conducted the examination of the ingredients' approximate composition. The Association of American Feed Control Officials (AAFCO, 2014) specifications were followed when formulating diets for adult dogs, which contained 18% crude protein, 5% ether extract, 0.5% calcium, and 0.4% phosphorus. Dietary energy density was maintained at 3500 kcal. Metabolisable Energy/kg in accordance to Indian Council of Agricultural Research's description of the country's meteorological conditions (ICAR, 2013). As a control diet, Puppy Pedigree, a commercial food, was employed.

Estimation of aflatoxin in dog foods

The amount of aflatoxin in the dog foods were estimated by Vicam (4EX) instrument following standard procedure.

In-vitro study

In-vitro approach established by Biagi et al. (2016) was used & modified. After two rounds of digestion, the undigested samples were collected and centrifuged; instead, they were filtered using nylon bags and rinsed with cold water. The residue recovered from each bottle following the *in-vitro* digestion was weighed, and the digestibility was calculated using the formula below to estimate the dry matter digestibility of the food samples:

$$\text{Dry matter digestibility} = (100 - ([\text{residue weight} - 100]/\text{sample weight}))$$

Crude protein, ether extract, and ash were measured in the undigested portion using the Association of Official Agricultural Chemists' standard procedures (AOAC, 2005). The following equation was used to determine the digestibility of nutrients:

$$100 - \{[\text{nutrient\% in residue} \times (100 - \text{diet digestibility})] / \text{nutrient \% in diet}\}$$

Statistical analysis

The data generated was statistically analyzed using SPSS (2012) version 21 computer package. For comparison of groups, one way ANOVA procedure Turkey's B test was used (Snedecor and Cochran, 1994). Significance difference among the groups was established at $P < 0.05$.

RESULTS AND DISCUSSION

The chemical composition of the various foodstuffs used in dog food preparation is presented in Table 1.

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Table 1. Percentage chemical composition of the feed ingredients selected for dog food formulation

Ingredient	Dry matter	Crude protein	Ether extract	Crude fibre	ME (kcal/kg)	Calcium	Total Phosphorous
Rice	89.4	7.87	0.78	0.78	3630	0.04	0.06
Bengal gram	89.4	24.5	4.95	4.40	3120	0.08	0.13
Soybean meal	87.2	42.0	1.50	9.10	2876	0.32	0.28
Skim milk powder	95.8	34.0	0.28	0.22	3590	1.3	-
Rice gluten	89.4	47.2	3.90	5.02	3150	0.62	0.78
De-oiled rice polish	88.7	15.7	1.50	23.75	2100	0.07	1.33
Meat cum bone meal	90.0	44.6	5.90	5.99	2500	13.86	6.78
Chia seeds	92.4	17.9	35.5	33.7	4297	0.60	0.47
Dicalcium phosphate	-	-	-	-	-	23.0	18.0
Oil	-	-	98	-	8500	-	-

When rice was analysed, it was found to have 7.87% CP, 0.78% EE, and 0.78% CF. The highest ME value was 3630 kcal/kg as per Kumar (2014). There was 8.75% of CP, 2.1% of EE, 15.17% of CF, 0.12% of Ca, & 1.38% of P in wheat bran. Bengal gram's CP, EE, CF, Ca, P, and ME were observed to be 24.5, 4.95, 4.4, 0.08, 0.13%, and 3120 kcal/kg, respectively. With the exception of ether extract and crude fibre, Dhaliwal et al. (2015) reported composition that was nearly identical. High protein (42%) and ME value of 2876 kcal/kg were found in soybean meal. It contained a significant amount of crude fibre, 9.1%. Chia seeds had protein, ether extract, carbohydrate, dietary fibre, ash, and dry matter contents ranging from 15-25%, 30-33%, 41%, 18-30%, 4-5%, and 90-93%, with a wide range of polyphenols (Ixtaina et al., 2008). Skim milk powder had 37% CP, 0.285 EE%, 13.86 Ca, 6.78% P, and ME value of 3590 kcal/kg according to Gopalan et al. (2004). The variety of rice gluten meal chosen for use in dog food formulation also had the highest protein content (55.12%), a moderate level of EE (3.9%), crude fibre content of 5.02%, 0.62% Ca, and 0.78% P, as well as a high ME content

of 3159 kcal/kg which correspond with findings of Metwally and Farahat (2015). Deoiled rice bran (DORB) was found to have the greatest crude fiber level among items in a basic diet, at 23.75%, and ME 2100 kcal/kg. It contained 15.75% CP and 1.5% EE, which is very similar to the conclusions made by Bhanja and Verma (2001). Therefore, its ME value of 2100 kcal/Kg was determined appropriately. Meat cum bone meal (MBM) was comparable with conventional composition of MBM as mentioned by Agricultural & Processed Food Products Export Development Authority (APEDA, 2000) in the red meat manual. It had 44.6% CP, a ME value of 2500, and a high amount of Ca and P content, at 13.86 and 6.78%, respectively. Lime stone powder was employed as a source of Ca because it contains 35% Ca, while dicalcium phosphate (DCP) was employed as rich source of P because it contains 18% P as well as 23% Ca. As an energy source, refined vegetable oil is used. It had a ME value of 8500 kcal/kg, which fulfill specific requirements of dog food. It was revealed from the chemical analysis of commercial, chia seed 1% and chia seed 2% based dog food that the nutrients requirements specified

by AAFCO (2014) and ICAR (2013) for puppy food was fulfilled. (Table 2). Finally, 91.2% DM, 25.38 75% CP, 7.35% EE, and 5.49% CF were present in commercial food. All the diets satisfied the basic needs of adult dogs. However, the commercial food's proximate composition was higher than those of other foods namely, Chia 1% and Chia 3%. Dogs are poisoned by mycotoxins, particularly aflatoxin B1. The amount of aflatoxin in the feeds chosen for *in vitro* tests was determined. Chia 1% feed had the lowest amount of aflatoxin of all the diets analysed (5.6ppb). The maximum aflatoxin content was found in commercial feed (8.6 ppb), whereas aflatoxin levels in Chia 3% feed were 7.3 ppb. Gazzoti et al.

(2015) reported the amount of deoxynivalenol, fumonisins, and ochratoxin A was greater than the allowable level, or 5g/kg, in 100%, 88% & 81% of extruded commercial dog food samples, respectively. In 88% and 75% of the samples, respectively, aflatoxins and zearalenone were detected in moderate amounts, with concentrations below the relevant limits of quantification (5g/kg for aflatoxins and 10g/kg for zearalenone). According to Food and Drug Administration (FDA, 2019), Whole dog food for any and all ages should have no more than 20 parts per billion of aflatoxin (ppb) (Table 2). The amount of aflatoxin in all prepared & commercial diets was within allowable levels.

Table 2. Nutrient Composition of Commercial diet, Chia 1% and Chia 3% dog food

Treatment	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Total Ash	Aflatoxin (ppb)
Commercial food	91.2	25.4	7.35	5.49	8.23	8.60
Chia 1%	89.1	22.3	8.45	5.23	4.88	5.60
Chia 3%	88.5	23.2	8.67	5.30	4.85	7.30

In vitro digestibility of dog food

The data pertaining to *in vitro* digestibility of dog food is presented in Table. 3.

Table 3. Percentage *in-vitro* nutrient digestibility of different dog food

Treatments	DMD	CPD	EED	OMD
Commercial food	89.3 ^a	89.7 ^a	94.4 ^b	84.1 ^a
Chia 1%	94.9 ^b	97.2 ^b	97.3 ^a	88.6 ^b
Chia 3%	94.4 ^b	97.0 ^b	92.6 ^b	90.3 ^b
SEM	1.138	1.568	0.887	1.18
P value	0.004	0.001	0.005	0.001

Figures with different superscripts in each column differ significantly (P < 0.05)

DMD-dry matter digestibility, CPD-crude protein digestibility, EED- ether extract digestibility, OMD- organic matter digestibility, SEM- standard error mean

Results revealed that the *in vitro* digestibility of dry matter, organic matter and crude protein was DM significantly (P < 0.05) higher in the diets containing 1% & 3% of chia seeds as compared to commercial diet. However, the *in vitro* digestibility of ether extract was significantly higher in the 1 % chia seed based diet as compared to 3 % chia and commercial based diet. Singh et al., (2022) reported that *in vitro* digestibility of Dry matter, organic matter

and crude protein digestibility was significantly (P < 0.05) higher in commercial puppy food and 2.5 level of infertile egg meal with shell (IEMS) as compared to other treatments. Kaur et al. (2021) evaluation that incorporation of 15 % rice gluten and 2.5% maize fibre in the dog food with different processing techniques and found that that boiling of diet reduced the *in-vitro* digestibility of ether extract. Among different processing techniques, *in-vitro*

digestibility was best in-case of extruded diets. In-vitro digestibility of CP had non significant difference among different processing techniques; however crude protein digestibility of boiled dog feed with 15% rice gluten used dog feed was comparable with extruded and raw diet. Comparative evaluation of best preformed extruded feeds with commercial diets revealed that all diets had equal nutritional digestibility of various nutrients. Similar kind of study was conducted by Kaur et al., (2021) and reported that extrusion processing improves in-vitro nutrient digestibility and the best ($P<0.01$) response was observed in diets having 5% SN containing extruded dog food. Maximum ($P<0.01$) dry matter digestibility and organic matter digestibility was observed in extruded diet; No significant difference ($P<0.01$) was observed in crude protein digestibility at 5% SN supplementation. However, with 10% and 15% SN supplementation, no significant difference ($P<0.01$) was observed in raw and boiled diets, but crude protein digestibility increased ($P<0.01$) with extrusion as compared to raw and boiled diets. Ether extract digestibility decreased ($P<0.01$) in boiled diet at all the levels of SN supplementation. Irrespective of processing techniques, level of SN supplementation had shown non-significant difference in nutrient digestibility but the extent was lesser than no supplementation. Also Biswas (2022) reported that that in vitro digestibility of the GADVASU prepared food was better than the commercial dog food.

CONCLUSION

Based on the result of the present study, it can be concluded that a dog food prepared by inclusion of 1% chia seed had better *in vitro* digestibility than the commercial dog foods and the diet containing 3 % chia seeds.

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