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Proximate analysis of pelleted sorghum-based feeds as substitute for corn

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ABSTRACT

The study aimed to evaluate the proximate analysis of pelleted sorghum-based feeds as a substitute for corn and it was conducted at Cagayan State University-Piat Campus. The specific objectives were to formulate a sorghum-based feed ration and evaluate the proximate analysis of the formulated pelleted feeds. In this research, a Completely Randomized Design with three (3) replications was adopted. Results revealed that the uppermost crude protein and fiber content was found in Treatment 3 (50% corn + 50% sorghum), while Treatment 2 (75% corn + 25% sorghum) displayed the highest percentage of crude fat. While Treatment 4 (25% corn + 75% sorghum) also established high levels of calcium and phosphorus content. Analysis of variance reveals no significant differences in crude protein, crude fiber, and phosphorus content among the five treatments tested, except for crude fat and calcium, which exhibited highly significant differences. It was observed that the variation in the fat content in treatments T2 and T3 may influence the efficiency of calcium absorption. Since sorghum has a higher fat content and is possibly more effective in promoting calcium absorption, its presence at higher proportions leads to improved levels of both crude fat and calcium. It is recommended that integrating sorghum into the animal diet can increase nutritional aspects, particularly fiber and calcium, which is beneficial depending on the dietary requirements of the target animals.

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INTRODUCTION

Sorghum-based feeds are an essential component of livestock and poultry nutrition. This beneficial and drought-tolerant grain crop has been a staple in many agricultural systems worldwide. Its nutritional value and versatility make it a must-have in animal feed formulations. Around 48% of world sorghum grain production is fed to livestock (Dowling *et al.*, 2002). This use is prevalent in developed countries, where up to 97% of it is consumed. According to Dowling *et al.* (2002), sorghum production in developing country is mostly commonly produced for human consumption.

The essence of sorghum-based feeds lies in their significant contribution to meeting the energy and protein supplies of animals. Carbohydrates are excellent source of energy for livestock and poultry where sorghum is not exceptional. The sorghum contains protein, but it varies from different varieties. Combining energy and protein makes sorghum an ideal feed ingredient for maintaining healthy growth, reproduction, and overall animal performance.

The sorghum-based feeds are cost-effective compared to other grains like corn or wheat, making them an attractive option for farmers looking to optimize their feed costs while maintaining nutritional quality. Additionally, sorghum's drought tolerance makes it a reliable option in regions where water scarcity is a concern, as it requires less water to grow likened to other feed crops. Ranjhan (2001), recommended that chemical composition provides the potential value of feed, however, the quantity of carbohydrate, fat, and protein does help in measuring the usefulness of feed.

Moreover, sorghum farming can contribute to sustainable agriculture due to its adaptability to less fertile soils and low-impact farming practices. Choosing sorghum as a feed ingredient will promote resource efficiency and it can reduce the environmental footprint related to livestock production. In promoting the widespread cultivation and utilization of sorghum, farmers can expand and increase their income which will create opportunities in the community. Since sorghum can thrive in different climates and regions offers flexibility and resilience in terms of food security.

To enhance animal performance, contribute to sustainable agriculture and support the local producers of sorghum into livestock and poultry must be incorporated. Sorghum's energy and protein content, cost-effectiveness, environmental advantages, and potential socioeconomic benefits make it a compelling feed ingredient that no farmer should overlook. Choosing sorghum-based feeds is a wise decision that will pay off in the long run.

Generally, the study aimed to evalaute the proximate analysis of pelleted sorghum-based feeds as substitute for corn. Specifically, it aimed to:

1. Formulate sorghum-based feeds ration; and
2. Evaluate the proximate analysis of formulated sorghum-based pelleted feeds as substitute for corn.

MATERIALS AND METHODS

The ingredients used in the study were the following: yellow corn, rice bran, sorghum, fish meal, soybean oil meal, coco oil, limestone, DL-methionine, Di-calphos, vitamin premix, L-lysine mineral premix, and salt. The five (5) treatment formulations were calculated based on the nutrient composition of each ingredient. All the ingredients were weighed individually based on the amounts calculated in the formulation and they were mixed manually in the concrete smooth flooring using a shovel. The composition and calculated nutrient analysis of the different diets are reflected in Table 1 & 2.

Table 1. Nutritive composition of corn and sorghum

Parameter	Sorghum	Corn
Crude protein (%)	9.86	8.33
Crude fiber (%)	3.54	1.6
Crude fat (%)	2.22	2.27
Moisture	11.85	11.99
Ash	1.63	1.42
Calcium	0.44	0.31
Phosphorous	0.25	0.21
Aflatoxin (ppb)	NDA	NDA

Note: NDA – No Detection of Aflatoxin.

Table 2. Formulation of treatments on corn and sorghum-based feeds

Ingredient	T1	T2	T3	T4	T5
Corn	56.00	42.00	28.00	14.00	-
Sorghum	-	14.00	28.00	42.00	56.00
Rice bran	11.35	11.35	11.35	11.35	11.35
Soybean	24.00	24.00	24.00	24.00	24.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Coco oil	2.00	2.00	2.00	2.00	2.00
Limestone	1.40	1.40	1.40	1.40	1.40
Di-Calphos	1.30	1.30	1.30	1.30	1.30
DL-Methionine	0.15	0.15	0.15	0.15	0.15
Salt	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Mineral premix	0.25	0.25	0.25	0.25	0.25
Total %	100.00	100.00	100.00	100.00	100.00

T1-Basal Diet (corn based), T2-75% Corn + 25% Sorghum, T3-50% Corn + 50% Sorghum, T4-25% Corn + 75% Sorghum, and T5-100% Sorghum.

Pelletizing procedures and nutrient analysis

After mixing thoroughly, the corn and sorghum in specified ratios, ensuring an even distribution of ingredients. The ration is fed into a pellet mill, where it is subjected to high pressure and temperature through the die and rollers, forming pellets of uniform size. After pelleting, the pellets were placed in a dry cool place to stabilize them and reduce moisture content, which helps prevent spoilage. Finally, the cooled pellets are sieved to remove any fines, packaged for storage, and prepared for submission for nutrient analysis. The feed samples were submitted to the Department of Agriculture Region 2 through the Cagayan Valley Integrated Agricultural Laboratory at Tuguegarao City to determine the nutritional content, i.e. crude protein, fiber, fat, calcium, and phosphorous.

Statistical analysis

The data gathered was analyzed using the Statistical Tool for Agricultural Research (STAR) in Completely Randomized Design (CRD) with three (3) replications.

RESULTS AND DISCUSSION

Table 3 presents a comparative analysis of five different treatments based on varying proportions of corn and sorghum, focusing on their nutritional components: The highest crude protein content was observed in Treatment 3 (50% corn + 50% sorghum) at 18.67%, while Treatment 2 (75% corn + 25% sorghum) has the lowest at 17.86%. The results indicate that the protein content is relatively consistent across treatments, with no significant differences noted among the treatments tested.

In terms of crude fiber content, results show that Treatment 3 (50% corn + 50% sorghum) obtained the highest with 4.56%, while the lowest was recorded in Treatment 2 (75% corn + 25% sorghum) with 3.8%. No significant differences were determined among the treatments tested.

On the other hand, a significant result was observed in the crude fat content in Treatment 2 (75% corn + 25% sorghum) having the highest percentage of 4.28% while 3.32% in Treatment 3 (50% corn + 50% sorghum) serve as the lowest. Increasing the proportion of high-fat grains like sorghum can lead to higher crude fat levels in the feed, particularly when replacing lower-fat ingredients like corn (Zhao *et al.*, 2014). The increase in crude fat from T1 (100% corn) to T2 and T3 may be attributed to the higher fat content of sorghum. Many cereals which include corn and sorghum, show differences in terms of lipid content that will lead to the variations of crude fat levels.

The study conducted by Haug and Lantzsch (1983), reported that corn contains more easily digestible starch, which is known for a relatively moderate fat content. However, sorghum has a slightly higher lipid profile, which can affect the crude fat measurements when included in a feed formulation.

Table 3. Proximate analysis and mineral composition of sorghum-based feeds using the different treatment combinations

Treatments	Crude protein (%)	Crude fiber (%)	Crude fat (%)	Calcium	Phosphorous
T_1 – 100% Corn	18.21	4.14	3.98	1.58	1.82
T_2 – 75% Corn + 25% Sorghum	17.86	3.8	4.28	2.01	2.12
T_3 – 50% Corn + 50% Sorghum	18.67	4.56	3.32	2.71	2.12
T_4 – 25% Corn + 75% Sorghum	18.48	4.39	3.53	3.69	2.26
T_5 - 100% Sorghum	18.57	4.51	3.54	3.21	2.26
CV (%)	2.82	3.97	1.49	2.28	3.74
	ns	ns	**	**	ns

Note: ns = no significant difference, ** = highly significant difference.

There is a significant increase in calcium content as the sorghum proportion increases whereas Treatment 4 (25% Corn + 75% Sorghum) displays the highest calcium level at 3.69%. This result is due to the significant increase in calcium levels from T1 (100% corn) to T4 (25% corn + 75% sorghum) and T5 (100% sorghum). The significant differences in calcium content observed in treatments like T2, T3, and T4 support with study conducted by Xu *et al.* (2016), which discovered that replacing corn with sorghum can result in an evident increase in calcium availability in animal feed. According to Ravindran *et al.* (2006), an increase in calcium concentration is more efficient when sorghum is utilized for animal feeds which is possibly caused by its lower phytate content, which enhances mineral bioavailability. Corn has lower levels of calcium associated with other ingredients like legumes and certain grasses (Kuhn *et al.*, 2002). Sorghum absorption of calcium from the soil will likely increase also the calcium content during feed formulation (Chiofalo *et al.,* 2009).

Calcium and crude fat may be induced by bioavailability and absorption one must understand their relationship with each other. A high level of dietary fat may influence calcium absorption by changing intestinal function and potentially reducing calcium Rao *et al.* (2003). The significant differences in crude fat and calcium levels in T2 and T3 are due to the calcium absorption efficiency.

Furthermore, results show that the highest phosphorous content was obtained from Treatment 4 while the lowest was from Treatment 1 with a corresponding mean percentage of 2.26% and 1.82% respectively. Statistical analysis shows no significant differences among the treatment means.

CONCLUSION

Based on the above findings, results show that the highest crude protein and fiber content was discovered in Treatment 3 (50% corn + 50% sorghum), while Treatment 2 (75% corn + 25% sorghum) revealed the highest crude fat percentage. Under Treatment 4 (25% corn + 75% sorghum) also proved higher levels of calcium and phosphorus content. No significant differences were observed in the protein, fiber, and phosphorus among the five treatments tested, except for crude fat and calcium, which exhibited highly significant differences. Sorghum, with its higher fat content and potential to enhance calcium absorption, contributes to increased levels of both crude fat and calcium when utilized in larger proportions. This indicates that incorporating sorghum into the diet can improve specific nutritional elements, particularly fiber and calcium, which may be advantageous depending on the dietary needs of the target animals.

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