



Short Communication

Nutritional Evaluation of Two Sorghum Varieties in Broiler Fortified with Phytase

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ABSTRACT

Poultry industry is largely based on cereals for energy component in poultry ration. However, certain anti-nutritional factors hamper the bioavailability of nutrients and need to be addressed to avoid compromised birds' performance. The present study assessed the impact of phytase on enhancing the nutrient retention and phosphorus utilization in two different sorghum cultivars fed to broiler. In an open sided house, a total of 160, 14-days-old broilers were allotted to four dietary bioassay treatments and fed mash red and white sorghum grain with or without phytase enzyme (500 FTU/kg) for 12 days (including 4 days adaptation period). Standard lab protocols were adapted to measure proximate analysis, minerals and phytate content in grain and fecal samples. Sorghum cultivars were different in nutrient profile with red higher in protein content (11.41%). It was observed that phytase inclusion in grain increased the availability of all nutrients except crude lipids. Total tract nitrogen retention was increased by 3% in red sorghum compared to white. Minerals absorption was increased but differently in different cultivars with higher degradation of phytate in both red and white sorghum. Apparent metabolizable energy was significantly enhanced both in red and white sorghum by 5.9 and 4.5%, respectively. From these findings, it can be deduced that phytase is effective in improving the utilization of nutrients of sorghum by broilers at day-21 and also reduces the losses of nutrients into the litter.

Article Information

Received 12 August 2018

Revised 20 September 2018

Accepted 25 October 2018

Available online 22 March 2019

Authors' Contributions

RA performed the experimental work. NC analyzed the data. RUK, NC and AT wrote the article.

Key words

Broilers, Phytase enzyme, Nutrients digestibility, Minerals retention, Sorghum.

Animal nutritionists are striving hard to cope with the challenge to provide quality products to the end consumers (Khan *et al.*, 2012a, b). Grains are the principle sources of energy and protein in poultry ration (Abd El-Hack *et al.*, 2018). Due to the increased pressure on wheat and maize worldwide, serious alternatives sources of energy and protein is required (Abd El-Hack *et al.*, 2018). Poultry requires a large percentage of cereal grains in the ration to provide adequate amount of protein and energy. Keeping in view the nutritional value, price and availability, sorghum grain is the next replacement to maize in poultry diet (Subramanian and Metta, 2000). Sorghum mainly contains carbohydrates of which starch and dietary fiber are the major components. Amount of protein in sorghum ranges from 6 to 10 % (McDonough and Rooney, 2000). Sorghum grains contain high amount of iron (Fe), magnesium (Mg), potassium (K), calcium (Ca) and phosphorous (P).

Sorghum utilization in poultry feed is discouraged because of multiple antinutritional factors mainly phytate. However, certain enzymes may be used to neutralize the effect of phytate. Phytase is the only enzyme that can hydrolyze phytate (Abd El-Hack *et al.*, 2018). The digestibility of necessary amino acids, crude protein and nitrogen is enhanced by phytase (Sharlie, 2005). It has been revealed from several studies that adding phytase enzyme to poultry ration has enhanced P digestibility and its excretion in environment has been minimized (Lott *et al.*, 2009). Phosphorus is an important mineral, required for the proper development of egg shell (Frost and Roland, 1991). Several studies have shown that addition of phytase enzyme has enhanced P utilization thereby positively affecting egg production and egg shell quality (Liu *et al.*, 2014). The objective of this paper was to find the effect of phytase on two different varieties of sorghum affecting the digestibility indices of broiler.

Materials and methods

Two sorghum varieties (red and white) were obtained from the market and grounded to mesh form. The *E. coli*

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0030-9923/2019/0003-0001 \$ 9.00/0
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derived Phytase enzyme (500 FTU/kg) was procured from supplier in Pakistan and mixed well in the grains. The feed was made isocaloric and isonitrogenous to meet or exceed the energy and protein levels as recommended by the NRC (1994) as shown in [Supplementary Tables I and II](#).

A total of 160 broiler birds were divided into two groups according to the sorghum varieties. Birds were further divided into 16 replicates. The trials lasted for 7 days.

During the last eight days, fresh feces were collected daily, weighed and stored in labeled plastic bags and stored at -20°C. Apparent metabolizable energy (AME) of the diet and gross energy (GE) of the diets and excreta were determined according to the method described by [Khan *et al.* \(2016\)](#). Calcium and P content of grains and feces samples were measured using acid digestion method and were detected using atomic absorption and spectrophotometer, respectively.

Nutrient digestibility coefficients were calculated by the difference between the nutrients consumed and voided by the broilers in feces.

The experiment was conducted in a 2×2×4 factorial design in a completely randomized design. Two levels of the varieties and enzyme were considered. The data was arranged in Microsoft Excel 2007. The effect of sorghum and their varieties were determined by using PROC MIXED procedure of Statistical Analysis System ([SAS, 2003](#)). P values equal or less than 0.05 was considered statistically significant.

Results and discussion

Digestibility coefficient values of DM, OM, nitrogen,

crude fat, AME, retention of ash, CF, Ca, P and phytate of the two varieties of grains affect by the addition of the enzymes are shown in [Table I](#). The results showed that addition of the enzyme significantly ($P<0.05$) increased DM, OM, ash, CF, Ca, P, Phytate and AME in both varieties.

Sorghum have great importance for its less cost and one of the best substitute of maize. According to production, sorghum is fifth most important crop ([Mwithigaa and Sifuana, 2006](#)). [Hickks *et al.* \(2002\)](#) observed that the chemical profile of sorghum is consisted of 12.5% crude protein and about 37% of fat. The fat and protein contents are in line and comparable to the results of the current study. In poultry, skeletal strength is important for growth and performance and mainly depends upon on phosphorous content in the nutrition. [Ravindran *et al.* \(1995\)](#) found that in cereal grains 50 to 85% of the P is bound to molecules known as phytic acid or phytate. Using exogenous phytase has considerably increased the availability of Ca and P ([Selle and Ravindran, 2007](#)), which is comparable to the present investigation that enzyme supplementation improved calcium retention by 4.0% in both varieties of sorghum. In addition, P digestibility improved by 4.7% in red sorghum and 1.6% in white sorghum. Consuming phytase in feed increased the availability of P resulting in decrease P excretion to the environment ([Um *et al.*, 2000](#)).

It has been reported that using high concentration of phytase resulting in increased growth performance of birds ([Abd El-Hack *et al.*, 2018](#)). It is pertinent to mention that in the presence of phytase, nutrients were more available to birds resulting in improved profile of digestibility of broiler. Several studies have shown that adding phytase

Table I.- Apparent total tract digestibility co-efficient of dry matter retention, organic matter, nitrogen, fat, ash, crude fiber, calcium phosphorus phytate and apparent metabolizable energy of red and white sorghum in broilers at day 21.

Digestibility co-efficient	Sorghum				Pooled SEM		Probability of greater F-values in ANOVA		
	Red		White		Red	White	Sorghum type	Phytase	Sorghum type × phytase
	E +	E -	E +	E -					
Dry matter	0.811 ^a	0.783 ^b	0.791 ^a	0.776 ^b	0.04	0.02	0.04	0.03	0.08
Organic matter	0.831 ^a	0.813 ^b	0.841 ^a	0.823 ^b	0.03	0.01	0.05	0.02	0.07
Nitrogen	0.611 ^a	0.593 ^b	0.591 ^b	0.586 ^b	0.04	0.02	0.08	0.04	0.09
Fat	0.711	0.703	0.711	0.706	0.50	0.04	0.12	0.09	0.10
Ash	0.611 ^a	0.583 ^b	0.591 ^a	0.576 ^b	0.03	0.01	0.04	0.01	0.08
Crude fiber	0.641 ^a	0.623 ^b	0.631 ^a	0.619 ^b	0.04	0.2	0.06	0.03	0.08
Calcium	0.607 ^a	0.583 ^b	0.611 ^a	0.587 ^b	0.05	0.04	0.07	0.03	0.09
Phosphorus	0.568 ^a	0.542 ^b	0.558 ^a	0.549 ^b	0.07	0.06	0.08	0.02	0.09
Phytate	0.341 ^a	0.192 ^b	0.338 ^a	0.198 ^b	0.04	0.02	0.09	0.01	0.09
AME	14.2 ^a	13.4 ^b	13.7 ^a	13.1 ^b	0.03	0.05	0.08	0.02	0.09

to poultry ration increased the utilization of nutrients including energy and amino acids (Ravindran *et al.*, 1999; Selle *et al.*, 2000; Selle and Ravindran, 2007), which justify the present study. It has been reported that nitrogen retention has been improved by supplementation of phytase enzyme in broiler (Farrell *et al.*, 1993). The improved digestibility in the current study in response to phytase is well in line with the findings of some of the previous studies (Mondal *et al.*, 2007).

Conclusion

From this study, it can be concluded that phytase is an effective enzyme in improving the digestibility of sorghum in broilers. Sorghum varieties responded differently to phytase enzymes.

Supplementary material

There is supplementary material associated with this article. Access the material online at: <http://dx.doi.org/10.17582/journal.pjz/2019.51.3.sc2>

Statement of conflict of interest

Authors have no conflict of interest.

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Supplementary Material

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Supplementary Table I.- Composition of basal diets.

Ingredient	Amount (g/kg)*
Sorghum (Red/White)	938
Canola oil	20
Dicalcium Phosphate	17
Limestone	13
Choline chloride	3
Salt	2
Premix**	7
Total	1000

* g/kg air dry basis. **Each kg of premix contained: *trans*-retinol, 0.66mg; cholecalciferol, 0.018mg; dI- α -tocopherol acetate, 4mg; menadione, 0.4mg; thiamine, 0.3mg; riboflavin, 1.6mg; calcium pantothenate, 3mg; niacin, 6mg; pyridoxine, 1mg; folic acid, 0.4mg; cyanocobalamin, 3 μ g; biotin, 0.02mg; manganese, 15mg; zinc, 10mg; iron, 4mg; copper, 1mg; iodine, 0.2mg; cobalt, 0.06mg; selenium, 0.02mg; molybdenum, 0.32mg; choline chloride, 60mg; ethoxyquin, 25mg.

Supplementary Table II.- Nutrient composition (% Dry matter basis) of two varieties of sorghum used in the trial.

Nutrient	Sorghum	
	Red	White
Dry matter	92.05	91.85
Organic matter	95.67	96.87
Protein	11.41	9.93
Starch	74	76
Crude fat	3.1	2.9
Crude fiber	2.1	2.3
Total phosphorous	0.39	0.33
Calcium	0.04	0.03
Phytate	0.84	0.79
Crude ash	2.92	2.09
Gross energy (Kcal/kg)	3992	3792
Gross energy (MJ/kg)	16.70	15.86