

Research Application Summary

Effect of germination and Sodium hydroxide treatment on protein digestibility of sorghum

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Abstract

Protein digestibility is an effective means of determining growth and development in animals, however few studies have been undertaken on Protein digestibility of sorghum which is one of the main cereals used in Poultry feeding. This study was undertaken to access the Protein digestibility of some sorghum cultivars grown in Sudan. In this study three groups of sorghum cultivars of comparatively low -Tabat and Safra, medium-Umbenin and Wad Akar and high-Yarawasha and HSP 5907 tannin content were subjected to two treatments. Replicates of the three sorghum cultivars groups with varying tannin content with Faterita-sorghum of low tannin content acting as control were germinated. The sorghum groups were later treated with sodium hydroxide (NaOH). Diets containing low, medium and high tannin sorghum grains were subjected to protein digestibility assay performed through the traditional method of total excreta collection. Results showed that sorghum treated with sodium hydroxide produced better performance ($p < 0.05$) with reduction in tannin content compared to the germinated category, except Fatarita-sorghum where germination produced similar results to those treated with sodium hydroxide. The results suggest that treatment with sodium hydroxide (NaOH) has potential to improve protein digestibility ($p < 0.05$) at all tannin levels. Conversely, treatment through germination failed to induce any improvement on protein digestibility ($p > 0.05$). Therefore, tannin levels are not good indicators for assessing tannin effects in broiler diets.

Keywords: Broilers, digestibility, sorghum grains, Sudan, tannin level

Résumé

La digestibilité des protéines est un moyen efficace de déterminer la croissance et le développement chez les animaux, cependant peu d'études ont été entreprises sur la digestibilité des protéines du sorgho qui est l'une des principales céréales utilisées dans l'alimentation des volailles. Cette étude a été menée pour évaluer la digestibilité des protéines de certains cultivars de sorgho cultivés au Soudan. Dans cette étude, trois groupes de cultivars de sorgho de Tabat et Safra comparativement faible, d'Umbenine et de Wad Akar moyenne et de tanin en HSP 5907 élevé ont été soumis à deux traitements. Des répétitions de trois groupes de cultivars de sorgho avec une teneur en tanin variable avec sorgho-Faterita de faible teneur en tanin agissant comme témoin ont germé. Les groupes

de sorgho ont ensuite été traités avec de l'hydroxyde de sodium (NaOH). Les régimes contenant des grains de sorgho de tanin faible, moyen et élevé ont été soumis à un test de digestibilité des protéines effectué selon la méthode traditionnelle de collecte totale des excréments. Les résultats ont montré que le sorgho traité avec de l'hydroxyde de sodium a produit une meilleure performance ($p < 0,05$) avec une réduction de la teneur en tanin par rapport à la catégorie germinée, à l'exception du sorgho-Fatarita où la germination a produit des résultats similaires à ceux traités avec de l'hydroxyde de sodium. Les résultats suggèrent que le traitement au NaOH a le potentiel d'améliorer la digestibilité des protéines ($p < 0,05$) à tous les niveaux de tanins. Inversement, le traitement par germination n'a pas permis d'améliorer la digestibilité des protéines ($p > 0,05$). Par conséquent, les niveaux de tanins ne sont pas de bons indicateurs pour évaluer les effets des tanins dans les régimes alimentaires des poulets.

Mots-clés: digestibilité, grains de sorgho, Soudan, niveau de tanin

Introduction

Nutritional quality and digestibility of plant protein is affected by presence of anti-nutritional factors which may limit the use of plants as source of proteins. The nutritional value of diets reduces when tannins present in it cause a decrease in the use of the protein and a reduction in the activity of digestive enzymes (Haslam, 1981). As a result, nitrogen retention and use of the amino acids are reduced due to the reduction in protein digestibility (Mitaru *et al.*, 1984; Mustafa and El-Zubeir, 1993; Elkin *et al.*, 1995). Gous *et al.* (1982) reported that high tannin sorghum reduced nutrient digestibility and nitrogen retention. However, Garcia *et al.* (2004) found no significant differences in the digestibility of crude protein obtained with the high tannin sorghum based diet and that with low tannin sorghum based diet. The carbohydrates are also affected by tannins, possibly due to formation of complex compounds which are difficult to digest (Trevino, 1992; Mahmoud and Smithard, 1993). Jimenez *et al.* (1985) reported that the protein digestibility increased as the germination period advanced and obtained better values when autoclaved. Preet and Punia (2000) and Trugo *et al.* (2000) observed a progressive increase in protein digestibility as the germination advanced.

Improving the nutritional quality of cereals has been attempted using different approaches including soaking (Vyayakumari *et al.*, 2007), heat treatment (Osman *et al.*, 2002), fermentation (Osman, 2004), irradiation (Siddurafu *et al.*, 2002) and germination (Chan and Cheung, 1997). However, there is still controversy as to whether detoxification results in better digestibility of protein or not. Efforts have been made by nutritionists to improve the nutritive value of sorghum by extraction of tannins before feeding (Banda-Nyanda and Vohra (1990), fat addition (Douglas *et al.*, 1990) and dry treating of sorghum with sodium hydroxide and/or ammonia solution. Based on these considerations, this study evaluated the effect of some treatments on protein digestibility of sorghum based diets with different tannin level on broilers growth.

Materials and methods

Digestibility assay was carried out using the traditional method of total excreta collection; 12 birds of four weeks old were placed on individual cages and were fed on diets containing low (Fatarita), medium (Mugud and Umbenin) and high tannin (Yarawasha). Tannin sorghum diets that were treated, untreated and germinated were used. The digestibility coefficients for the Dry matter, Crude Protein, Crude Fiber, Ether Extract and Nitrogen Free Extract were determined following the approach of AOAC (1994). Analysis of variance (ANOVA) was used to detect differences between treatments. Least significant difference (LSD) test was used to assess significance of difference between means (Gomaz and Gomaz, 1984).

Results

The effect of treatments of sorghum varieties with different tannin levels on digestibility coefficient for protein are shown in Table 1. Birds fed on Fatarita (low tannin) treated with NaOH produced the highest percentage digestibility coefficient in comparison to those fed on untreated Fatarita. Birds fed on Umbenin (medium tannin) treated with NaOH produced medium digestibility followed by birds fed on untreated Umbenin while those fed on germinated Umbenin produced the lowest digestibility. Mugud (medium tannin) sorghum had similar digestibility coefficient trend to Umbenin. The same levels of digestibility coefficients were observed with Yarawasha (high tannin) sorghum.

The effect of treatment of sorghum varieties on digestibility coefficient of protein on broilers is shown in Table 2. Interaction effect on treatment and varieties on digestibility showed a linear decrease according to tannin levels. Fatarita (low tannin) treated with NaOH had the highest digestibility coefficient followed by the medium tannin sorghum (Mugud and Umbenin) while Yaawasha had the least digestibility coefficients. For untreated treatments, Umbenin, Fatarita and Mugud had similar digestibility coefficients followed by Yarawasha sorghum diet. Under the germination category, Umbenin produced high digestibility coefficients compared to Mugud, Yarawasha and Fatarita. These results indicate that there was a linear decrease in digestibility coefficients according to tannin levels.

Table1: Effect of sodium hydroxide treatments of sorghum varieties with different tannin level on digestibility coefficient of protein

Sorghum type	Untreated	Treated (NaOH)	Germination
Feterita	75.3 ^b	79.3 ^a	71.0 ^c
Umbenin	75.3 ^b	77.3 ^a	72.9 ^c
Mugud	74.6 ^b	77.3 ^a	72.0 ^c
Yarawasha	73.0 ^b	76.6 ^a	71.8 ^c

Values are means of two replicates.

Means followed by different letters in the same row differed significantly ($p < 0.05$).

Table 2: Interactive effect of sodium hydroxide treatment of sorghum varieties with different tannin levels on digestibility coefficient of protein on broilers

Sorghum varieties * treatments	Mean coefficient of digestibility
Fatarita treated	79.30 ^a
Umbenin treated	77.52 ^b
Mugud treated	77.26 ^b
Yarawasha treated	76.62 ^c
Umbenin Untreated	75.33 ^d
Fatarita Untreated	75.26 ^d
Mugud Untreated	74.57 ^d
Yarawasha Untreated	72.88 ^e
Umbenin germinated	72.80 ^e
Mugud germinated	71.92 ^f
Yarawasha germinated	71.79 ^{gf}
Feterita germinated	71.03 ^g
Standard error±	0.27

Values are means of two replicates.

Treated were those subjected to sodium hydroxide

Means followed by different letters in the same column differ significantly ($p < 0.05$).

Discussion

In this study the three treatments showed differences in their mean values of digestibility coefficient with the highest values shown in sorghum treated with sodium hydroxide followed by untreated and germinated sorghum. The improvement in protein digestibility due to NaOH treatment in low tannin sorghum (Fatarita) is attributed to reduced tannin content in the diet leading to better digestibility and better broiler performance. This is in line with the findings of Savelkoul *et al.* (1992) that sprouting or controlled germination of cereals increases protein and carbohydrate digestibility, enhances some of their vitamin contents, reduces the anti nutritional factors and improves their overall nutritional quality. Similarly Malleshi and Klopfenstein (1996) stated that as sprouting proceeds, the ratio of essential to non essential amino acids changes, providing more of essential amino acids.

The low protein digestibility for germinated sorghum with low tannin levels was not consistent with the finding of Romo-parada *et al.* (1985) who observed that fermentation and germination process improved the nutritive value of the grains because they lead to increase in lysine, methionine and tryptophan content of the seed and significantly increase in invitro protein digestibility of the sorghum grain. However, Bhlise (1998) also stated that in the case where high tannin sorghum is soaked for 10 hours and germination is left for a period of three days, a significant increase in *in-vitro* protein digestibility often arises.

Conclusion

Treatment with Sodium hydroxide was found to be effective in reducing tannin effects, but the two treatment soaking and germination failed to make improvement on medium tannins. Sorghum treatment with NaOH could be incorporated in broiler feed formulations.

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