Brazilian Journal of Poultry Science
Revista Brasileira de Ciência Avícola

ISSN 1516-635X Jul - Sept 2014 / v.16 / n.3 / 333-336

http://dx.doi.org/10.1590/1516-635x1603333-336

Technical Note

Complete Replacement of Corn by White or Red Sorghum in Japanese Quail Feeds

Author(s)

Freitas ER
Raquel DL
Nascimento AJN
Watanabe PH
Lopes IRV

Mail Address

Corresponding author e-mail address:
Universidade Federal do Ceará – UFC
Av. Mister Hull, 2977 – Campus do Pici
60021-970 – Fortaleza – CE - Brazil
E-mail: ednardo@ufc.br

Keywords

Yolk color, egg production, egg quality.

Submitted: August/2013
Approved: July/2014

ABSTRACT

This study aimed at evaluating the total replacement of corn by white or red sorghum and the inclusion or not of pigment in the diet on the performance and yolk color of Japanese quail eggs. In the trial, 210 Japanese quails were distributed according to a completely randomized experimental design consisting of five treatments with six replicates of seven birds each. Treatments consisted of Corn-based diet (C), white sorghum-based diet (WS), white sorghum-based diet + pigment (WSP), red sorghum-based diet (RS), and red sorghum-based diet + pigment (RSP). Feed intake, feed conversion ratio, egg production, and egg mass were no influenced by the treatments. However, paler egg yolks were produced when corn was replaced by sorghum. When red and white sorghum varieties were compared, there were no differences in yolk color or response to pigment dietary inclusion. It was concluded that the total replacement of corn by sorghum in the feed did not influence the performance of Japanese quails and that yolk color response is not affected by the inclusion of pigments in diets containing sorghum, independently of its variety.

INTRODUCTION

Problems related to corn prices and availability have driven the research on alternative feedstuffs for poultry feeding. Among alternative feedstuffs, sorghum presents adequate nutritional characteristics and it is often used to replace corn, particularly in semi-arid and tropical regions, where sorghum crops present better nutritional yield per area and its price is lower compared with corn (Ligeiro *et al*., 2009). In terms of nutritional composition, sorghum contains 5% lower metabolizable energy lower digestibility than corn, but its crude protein content is higher (NRC, 1994). Moreover, sorghum also has lower carotenoid pigment levels (xanthophyll and carotenes), which are responsible for egg yolk pigmentation.

Another aspect to be considered when including sorghum in feeds is the presence of tannins. Tannins can form carbohydrate and protein complexes, thereby reducing diet their digestibility and palatability (Rostagno *et al*., 2005). However, the development of low-tannin sorghum varieties has allowed their increasing inclusion in non-ruminant diets (Moreno *et al*., 2007), including in layer feeds (Costa *et al*., 2006; Moreno *et al*., 2007; Assuena *et al*., 2008; Ligeiro *et al*., 2009).

To date, the low level of carotenoid pigments in sorghum has been the main limitation for its inclusion in layer diets. When sorghum replaces corn, there is a proportional reduction in the intensity of yellow of the yolks, demanding the dietary inclusion of pigments (Costa *et al*., 2006; Moreno *et al*., 2007; Assuena *et al*., 2008; Ligeiro *et al*., 2009). Faquinello *et al*. (2004) evaluated the replacement of corn by graded levels of high-tannin sorghum in Japanese quail diets and concluded that up to 80% corn can be replaced by sorghum, despite the observed worse feed conversion ratio, egg production and paler egg yolks as dietary sorghum levels increased.

The increasing replacement of corn by sorghum both in human and animal feeding has driven genetic research for sorghum with reduced tannin levels and higher crop yield. New sorghum genetic varieties have been launched, and grain color is one of the features that differentiates them.

This study aimed at evaluating the total replacement of corn by white or red sorghum and the inclusion or not of pigment in the diet on the performance and yolk color of Japanese quail eggs.

MATERIALS AND METHODS

In the trial, 210 Japanese quails were distributed according to a completely randomized experimental design consisting of five treatments with six replicates of seven birds each. Birds were housed at a density of fiver birds per cage in (33-cm long x 23-cm wide x 16-cm high) metal battery cages equipped with trough feeders and nipple drinkers.

Treatments consisted of diets based on corn (C), white sorghum (WS), white sorghum + pigment (WSP), red sorghum (RS), and red sorghum + pigment (RSP).

The following sorghum varieties were used: BRS 308 (grain sorghum, no tannin, red grains) and BRS 309 (grain sorghum, no tannin, white grains). The chemical analysis, performed according to the methodology described by Silva & Queiroz (2002), showed the red and white sorghum varieties used in the present experiment contained 88.84 and 88.30% dry matter, 4,071 and 3,946 kcal gross energy/kg, 9.19 and 9.14% crude protein, and 8.21 and 7.72% ether extract on ‘as-fed’ basis, respectively.

The experimental diets (Table 1) were formulated to supply the nutritional requirements recommended by the NRC (1994) for quails in lay and considering the feedstuff composition proposed by Rostagno *et al*. (2005), but adjusting sorghum protein and amino acid levels to the average protein content of the sorghum varieties used in the experiment.

Due to their similar composition, red sorghum was isometrically replaced by white sorghum, according to treatment. In the diets with pigment inclusion, the inert material was replaced by the pigment product Sunred-50®, containing more than 5 g xanthophyll/kg.

Table 1 – Composition of the experimental diets containing corn or sorghum (on ‘as-fed’ basis).

Ingredients (%)	Experimental diets	
	Corn	Sorghum
Corn	58.024	0.000
Soybean meal 45%	32.713	32.789
Sorghum	0.000	56.022
Soybean oil	1.611	3.492
Limestone	5.320	5.333
Dicalcium phosphate	1.457	1.436
DL-Methionine	0.221	0.235
Vitamin premix[1]	0.200	0.200
Mineral premix[2]	0.100	0.100
Salt	0.353	0.367
Inert filler[3]	0.000	0.025
Total	100.00	100.00
Calculated values		
Metabolizable energy (kcal/kg)	2,850	2,850
Crude protein (%)	20.00	20.00
Calcium (%)	2.50	2.50
Available phosphorus (%)	0.40	0.40
Sodium (%)	0.20	0.20
Total lysine (%)	1.05	1.05
Total methionine (%)	0.53	0.53
Total methionine+cystine (%)	0.81	0.81
Total threonine (%)	0.76	0.76
Total tryptophan (%)	0.25	0.25

[1]Vitamin supplementation: Vitamin A - 3,500,000 IU; Vitamin B1 - 1000 mg; Vitamin B2 - 1,500 mg; Vitamin B12 - 4,000 mg; Vitamin D3 - 750,000 IU; Vitamin E -2,000 mg; Vitamin K - 1000 mg; Choline chloride – 250 mg; Niacin -7,500 mg; Selenium - 150 mg; Calcium pantothenate – 2,500 mg; Antioxidant - 25 g; excipient qsp - 1,000 g.

[2]Trace mineral supplementation: Mn - 65,000 mg; Zn - 50,000 mg; Fe - 50,000 mg; Cu - 12,000 mg; I - 1,000 mg, excipient qsp - 1,000 g.

[3] Washed sand.

A 64-days experimental period, divided in four 21-d periods, was applied. During the entire experimental period, birds were supplied feed and water *ad libitum*, and a lighting program of 16h of light (natural+artificial) per day was applied.

The following parameters were evaluated: egg production (%/bird/day), feed intake (g/bird/day), feed conversion ratio per egg mass (g/g), egg mass (g/bird/day), and yolk color (Roche colorimetric fan). Data were submitted to the analysis of variance using SAS (2000) statistical package, and means were compared by the SNK test at 5% probability level.

RESULTS AND DISCUSSION

There was no effect of the treatments ($p>0.05$) on feed intake, egg production, egg mass, or feed conversion ratio, indicating that there was no influence of the substitution of corn by sorghum or pigment inclusion in the diets containing sorghum on performance (Table 2).

Table 2 – Performance and yolk color of Japanese quails fed diets based on corn or sorghum.

Treatments[1]	Parameters[2]				
	Feed intake (g/bird/d)	Egg production (%/bird/d)	Egg mass (g/bird/d)	FCR per egg mass (g/g)	Egg yolk color
C	28.08	91.46	10.3	2.71	5.08[a]
WS	26.60	85.28	9.66	2.75	1.53[c]
WSP	28.18	91.54	10.64	2.67	4.13[b]
RS	26.68	89.16	10.33	2.55	2.11[c]
RSP	26.83	89.95	10.35	2.62	4.44[b]
Mean	27.27	89.49	10.26	2.66	3.46
CV (%)	4.78	5.37	7.97	5.84	13.08

[1]C = corn-based diet, WS = white sorghum-based diet, WSP = white sorghum-based diet + pigment, RS = red sorghum-based diet, RSP = red sorghum-based diet + pigment.

[2]Means followed by different letters in the same column are statistically different by the SNK test ($p<0.05$).

Experimental quails fed diets in which corn was completely replaced by sorghum presented paler yolks, independently of sorghum color. When sorghum varieties were compared, the obtained yolk colors were not significantly different, also when they were supplemented with the pigment product.

The similarity of the performance results obtained with the two sorghum varieties may be attributed to their similar nutritional values, as they present similar chemical composition and both contain low tannin levels. In addition, yolk color intensity was not affected by color differences between sorghum varieties or the inclusion of the natural pigment in the diets containing sorghum. Although the pigment inclusion at 0.025% in the sorghum diets increased the yellow intensity of the yolk, this level was not sufficient to achieve the same pigmentation as that obtained with corn.

The results of the present study are consistent with the findings with laying chickens (Costa *et al*., 2006; Moreno *et al*., 2007; Assuena *et al*., 2008; Ligeiro *et al*., 2009), indicating that sorghum may completely replace corn in the feed with no detrimental effects on performance. However, yolk pigmentation is impaired. This effect is stronger when high sorghum levels are added to the diet, but it may be corrected by the inclusion of pigmenting additives in the feed. Evaluating the replacement of corn by high-tannin sorghum in Japanese quail diets, Faquinello *et al*. (2004) indicated a maximum replacement level of 80%, and also recommended the inclusion of pigments to improve yolk color.

The response obtained in the present study with the inclusion of pigment in sorghum-based diets fed to Japanese quails is in agreement with the results of Moura *et al*. (2011), who did not verify any influence of the dietary addition of calendula extract or paprika or their association of the live performance or egg quality of Japanese quails, except for yolk color. However, in the aforementioned studies, sorghum grain color was no reported and no reports on the use of white sorghum in poultry diets were found. In this context, considering that both sorghum varieties produce low-tannin grains and their chemical composition is very similar, it is possible to infer that their inclusion does not change dietary chemical composition.

The total replacement of corn by sorghum in the feed does not influence the performance of Japanese quails. Sorghum grain color does not affect yolk color response, independently of the inclusion of pigments.

REFERENCES

Assuena V, Filardi RS, Junqueira OM, *et al.* Substituição do milho pelo sorgo em rações para poedeiras comerciais formuladas com diferentes critérios de atendimento das exigências em aminoácidos. Ciência Animal Brasileira 2008;9:93-99.

Costa FGP, Gomes CAV, Silva JHV, *et al.* Efeitos da inclusão do extrato oleoso de urucum em rações de poedeiras com substituição total ou parcial do milho pelo sorgo de baixo tanino. Acta Scientiarum Animal Science 2006;28(4):409-414.

Faquinello P, Murakam AE, Cella PS, *et al.* Hight tannin sorghum in diets of Japanese Quail (*Coturnix coturnix japonica*). Brasilian Journal of Poultry Science 2004;6:81-84.

Ligeiro EC, Junqueira OM, Filardi RS, *et al.* Avaliação da matriz nutricional da enzima fitase em rações contendo sorgo para poedeiras comerciais. Revista Brasileira de Zootecnia 2009,38(10):1948-1955.

Moreno JO, Espindola GB, Santos MSV, *et al.* Desempenho e qualidade dos ovos de poedeiras comerciais, alimentadas com dietas contendo sorgo e páprica em substituição ao milho. Acta Scientiarum. Animal Sciences 2007;29:159-163.

Moura AMA, Takata FN, Nascimento GR, *et al.* Pigmentantes naturais em rações à base de sorgo para codornas japonesas em postura. Revista Brasileira de Zootecnia 2011;40 (11):2443-2449.

National Research Council. Nutrient requirements of poultry. Washington: NAS; 1994. 176p.

Rostagno HS, Albino LFT, Donzele JL, *et al.* Tabelas brasileiras para aves e suínos: composição de alimentos e exigências nutricionais. 2.ed. Viçosa: Universidade Federal de Viçosa; 2005. 186p.

Silva DJ, Queiroz AC. Análise de alimentos: métodos químicos e biológicos. 3.ed. Viçosa: Editora UFV; 2002. 165p.