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Effects of replacing corn grain by reconstituted or un-reconstituted sorghum grain on carcass characteristics of Japanese quails (*Coturnix coturnix japonica*)

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Abstract

The study was performed to evaluate the effects of replacing untreated or reconstituted sorghum grain (*Sorghum bicolor* L.) in place of corn grain on carcass characteristics of Japanese quail (*Coturnix coturnix japonica*). Sorghum grains reconstituted by adding water to whole grain to raise the moisture level to about 30%, followed by anaerobic storage in sealed plastic buckets for 21 days at room temperature. Subsequently, the grains were sun-dried, and then ground for use in diets of Japanese quails. A total of 700 one-day old unsexed quail chicks were fed same diet for 20 day in cage system. After 20 days the quails were sexed based on their breast feather color and 300 male chicks reared for 21 day experimental period. The statistical arrangement of the study was done as completely randomized design (CRD) with 5 treatment and 4 replicates contain 15 birds in each treatments. Experimental treatments were as: A) diet contains corn grain and without sorghum grain (control group); B) replacing 50% reconstituted sorghum grain in place of corn grain; C) replacing 50% untreated sorghum grain in place of corn grain; D) replacing 100% reconstituted sorghum grain in place of corn grain and E) replacing 100% untreated sorghum grain in place of corn grain. At 42 days of age, 8 birds from each treatment (2 birds per replicate) were killed by cervical dislocation for carcass measurements and organ weights. Results showed that there is no significant difference between treatments and reconstitution could not improve the carcass yield and carcass components as well as edible internal organs of Japanese quails. Finally, it can be concluded that replacing 50% or even 100% sorghum grain in place of corn grain have not adverse effect on carcass characteristics of Japanese quails.

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Introduction

Sorghum (*Sorghum bicolor* L.) as the fifth major cereal crop is grown over an area of 44 million hectares yielding about 69 million tonnes of grain under rain-fed farming systems in tropical and sub-tropical regions of the world (Kumar *et al.,* 2007). As increased the importance of sorghum worldwide, its importance also have been increased in Iran. Corn grain price as well as importing problems in Iran makes the farmers to replace it by other cereal grains such as wheat, barley and sorghum.

Nowadays, inclusion of alternative grains in place of maize in the animal diets is a strategic approach to overcome above mentioned problems. Among available cereal grains, nutritive value of sorghum grain is near to corn. Several workers suggested that sorghum have similar nutritional characteristics to corn grain (Tyagi *et al.,* 2003; Faquinello *et al.,* 2004; Travis *et al.,* 2006; Kwari *et al.* 2011) and it can be completely used instead of maize in the diets of broilers without adverse effects on performance (Issa *et al.,* 2007; Medugu *et al.,* 2010).

However, an important factor that must be considered when using sorghum grains in animal nutrition is the presence of tannins, which limit large-scale use. If, on the one hand, the high tannin contents in the seed reduce the damages caused by birds to the culture due to the astringent flavor, on the other, the seeds become also less palatable and nutritive, since tannin interferes with the metabolism of carbohydrates and proteins (Rostagno et al., 1973, Faquinello, 2004). The level of tannin in sorghum grains varies from 1.3 to 3.6% in high tannin and from 0.1 to 0.7% in low tannin sorghum grains (Faquinello *et al.,*2004). Butler *et al.* (1984) suggested that under optimal conditions, sorghum tannin is capable of binding and precipitating at least 12 times its own weight of protein.

It can be considered two different strategies to overcome this problem (i.e. high tannin content). The first strategy is using animals resistant to higher levels of tannins such as ruminants and some birds, and the second way is reduction and/or elimination of tannins from sorghum grain. Considering first strategy, it seems that Japanese quail (*Coturnix coturnix japonica*) can tolerate more amounts of tannins than broiler chickens. Japanese quails are grown for egg and meat production worldwide. Recently, quail rearing is increasingly becoming more widespread since it is possible to achieve yields in much more limited spaces, without substantial investments and within shorter periods of time and since quails is much more resistant to environmental factors (Nagarajan *et al.,* 1991, Maheri-Sis *et al.* 2009). Faquinello *et al.* (2004) concluded that high tannin sorghum may replace corn grain at up to 80% in diets of Japanese quails without any adverse effect on feed intake. Second strategy is including physical, chemical and enzymatic methods to overcome anti-nutritional factors in sorghum grain (Duodu *et al.,* 2003; Kumar *et al.* 2005; Selle *et al.,* 2010; Shawrang *et al.* 2011). Reconstitution is an energy-efficient process for this purpose. In this process, moisture content of grains reach to about 30% and then stored in anaerobic conditions for about three weeks (Pflugfelder and Rooney 1986; Madacsi *et al* 1988; Kumar *et al.* 2005; Kumar *et al.* 2007). Several studies showed that reconstitution can lowered or eliminate tannins in high-tannin sorghum grain and improve nutrient availability for broiler chickens (Mitaru *et al.* 1983; Mitaru *et al.* 1985; Madacsi *et al.*1988; Kumar *et al.* 2005; Kumar *et al.* 2007).

Mitaru *et al.* (1983) obtained that reconstitution of high but not low tannin sorghums improved protein digestibility (6-16%) and dietary metabolizable energy (0.1- 0.3 kcal/g) for broiler chickens. Mitaru *et al.* (1985) also indicated that amino acid digestibility of reconstituted high tannin sorghums increased from 73.5 to 90.9% in broiler chicks. Similarly, Kumar *et al.* (2005, 2007) concluded that reconstitution of high tannin red sorghum resulted in about 30% reduction in its tannin concentration and consequently improve nutrient availability with no adverse effects on broiler performance.

The aim of the current study was to evaluate effect of different levels of untreated and reconstituted sorghum grain (*Sorghum bicolor* L. Moench) on carcass characteristics of Japanese quail (*Coturnix coturnix japonica*).

Materials and Methods

Samples preparation

Sorghum grains were provided from the farms of the Miyaneh region in East Azerbaijan, Iran. Half of grains reconstituted by adding water to whole grain to raise the moisture level to about 30% (DM 70%), followed by anaerobic storage in sealed plastic buckets for 21 days at room temperature (25°C). Subsequently, the grains were sun-dried, until the moisture content reached 10%, and then ground for use in diets of Japanese quails (method outlined by Kumar *et al.* 2007).

Experimental treatments

A total of 700 one-day old unsexed quail chicks were obtained from commercial hatchery and fed same diet for 20 day in cage system. After 20 days the quails were sexed based on their breast feather color and 300 male chicks reared for 21 day experimental period. The statistical arrange of the study was done as completely randomized design (CRD) with 5 treatment and 4 replicates contain 15 birds in each treatments. Diets (Table 1) were formulated according to the nutritional requirements of NRC (1994). Experimental treatments were as: A) diet contains corn grain and without sorghum grain (control group); B) replacing 50% reconstituted sorghum grain in place of corn grain; C) replacing 50% untreated sorghum grain in place of corn grain; D) replacing 100% reconstituted sorghum grain in place of corn grain and E) replacing 100% untreated sorghum grain in place of corn grain.

Carcass traits

At 42 days of age, 8 birds from each treatment (2 birds per replicate; weights near the mean of each replicate) were fasted for 6-8 h, weighed and then killed by cervical dislocation for carcass measurements and organ weights. Dressing percentage was as the proportion of the dressed weight to the weight of the bird before slaughter multiplied by 100. The weight of carcass parts (breast and thighs) and edible internal organs (gizzard, heart and liver) were also expressed as percentages of the live weight.

Statistical analysis

Data were subjected to one-way analysis of variance (ANOVA) in a completely randomized design and treatment means were tested for statistical significance by Duncan's multiple range tests using software of SAS (2001).

Results and discussion

Slaughter weight

The slaughter weight of Japanese quails fed different levels of raw or reconstituted sorghum grains in place of corn grain are presented in Table 2. There are no significant differences between experimental treatments (208.80-225.16 g). However, Kwari *et al.* (2011) and Ragab *et al.,* (2002) reported that birds fed corn grain in diet have higher slaughter weight than that of fed sorghum grain. They are also found that sorghum variety can be a determinative factor on carcass traits of broiler and quail chicks. Ragab *et al.,* (2002) and Aghajanzadeh-Golshani *et al.* (2009) also stated that gender of birds may be another important factor on carcass traits. Based on their findings slaughter weight of female Japanese quails were higher than that of males. Although, Manwar and Mandal (2008) found that the reconstitution of the grains caused significant reduction in anti-nutritional factors of the grains, which was accompanied by significant improvement in nutrient availability, obvious effect of this phenomenon have not seen in this experiment. However, reconstitution is a less expensive method of feed processing and can easily be adopted under field conditions if it is needed.

Table 1. Feed ingredients and nutrient contents of experimental diets of Japanese quails at growing period (21-42 d)

	Treatments				
	A	B	C	D	E
Ingredients	0% S	50% RS	50% URS	100% RS	100% URS
Corn grain	50	25	25	0	0
Sorghum grain	0	25	25	50	50
Wheat grain	6.80	8.04	8.04	8.01	8.01
Soybean meal	32.61	31.07	31.07	31.15	31.15
Gluten meal	7	7.62	7.62	7.70	7.70
Oyster shell	1.6	1.35	1.35	1.35	1.35
DCP	0.82	0.81	0.81	0.78	0.78
Lys. Sup.	0.25	0.18	0.18	0.19	0.19
Met. Sup.	0.1	0.11	0.11	0	0
Coccidiostat	0.07	0.07	0.07	0.07	0.07
Vit. Premixes	0.25	0.25	0.25	0.25	0.25
Min. Premixes	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Nutrients (calculated)					
ME (Kcal/Kg)	2900	2900	2900	2875.49	2875.49
CP %	23.74	23.50	23.50	23.50	23.50
CF %	3.68	3.64	3.64	3.67	3.67
Ca %	0.90	0.80	0.80	0.80	0.80
Av. P %	0.30	0.30	0.30	0.30	0.30
Met. %	0.50	0.50	0.50	0.40	0.40
Lys. %	1.30	1.20	1.20	1.20	1.20
Cys. %	0.39	0.39	0.39	0.39	0.39
Met.+ Cys. %	0.89	0.89	0.89	0.79	0.79
Threonine %	0.87	0.86	0.86	0.86	0.86
Na %	0.12	0.12	0.12	0.11	0.11
K %	0.86	0.85	0.85	0.86	0.86
Cl %	0.19	0.21	0.21	0.22	0.22

Table 2. Carcass characteristics of Japanese quails fed different levels of reconstituted or un-reconstituted sorghum grain in place of corn grain (as percentage of live body weight)

Experimental Treatments	Live Body Weight (g)	Carcass yield (%)	Thighs (%)	Breast (%)	Gizzard (%)	Heart (%)	Liver (%)
Corn grain (0% S)	208.80	61.19	14.99	24.96	2.10	1.007	2.21
50% RS	225.16	61.37	14.58	26.27	2.31	1.013	2.00
50% URS	219.23	62.19	14.81	25.60	2.06	1.072	2.07
100% RS	220.60	61.79	14.92	26.72	2.30	0.932	2.35
100% URS	220.19	60.82	14.40	26.13	2.39	0.950	2.33
SEM	7.24	1.05	0.36	0.58	0.09	0.040	0.12
P value	0.601	0.906	0.757	0.267	0.063	0.275	0.228

S: sorghum grain, RS: reconstituted sorghum grain, URS: un-reconstituted sorghum grain SEM: standard error of means

Carcass yield

The carcass yield (%) of experimental treatments is presented in Table 2. Results show that Japanese quails fed different levels of raw or reconstituted sorghum grains in place of corn grain have similar carcass yield (60.82-62.19%) and reconstitution could not improve carcass yield of sorghum fed quails. The similarities observed between corn and the sorghum grain for carcass yield in the current study are in line with the reports of several previous workers (Issa *et al.* 2007; Medugu *et al.* 2010; Kwari *et al.* 2011) who observed no differences in carcass yield of broilers fed sorghum compared with corn grain. Mateo and Carandang (2006) also obtained that no significant differences were observed on the carcass weight and carcass yield in birds fed with different grains (wheat, corn and sorghum). However, Ragab *et al.,* (2002) indicated that sorghum grain variety and level but not variety x level, significantly affected percentages of carcass, dressing and whole meat. In overall conclusion, they are suggest that four sorghum grain varieties used in their research can completely substitute corn grain during the period from 7 to 42 days of age without any detrimental effect on slaughter parameters of Japanese quails. Based on their literature review these results are agree with the findings of Fayek *et al.* (1989) and Attia (1998) who found that Egyptian sorghum grain in broiler diets had insignificant effects on carcass characteristics. Ragab *et al.,* (2002) and Aghajanzadeh-Golshani *et al.* (2009) also reported that one of determinative factors on carcass traits is the sexuality of the quails. They are reported that carcass yield of male Japanese quails were higher than that of females. Faquinello et al. (2004) suggest that high tannin sorghum may replace corn grain at up to 80% in diets of Japanese quails without adverse effect.

Carcass components

Percentage of important parts of carcass (thighs and breast) was similar in experimental treatments (Table 2). Findings of Ragab *et al.,* (2002) showed that there is an insignificant difference in percentage of rear meat but not front meat of Japanese quails fed different sorghum varieties instead of yellow corn. This is in turn in agreement with results of Kumar *et al.* (2005). Kwari *et al.* (2011) also reported that values for cut-up parts of broiler chickens showed similarities between the sorghum cultivars and maize except for the Tumbuna cultivar which consistently showed lower weights than maize. The lower carcass values obtained on the cultivar was attributed to the reduced nutrient digestibility on this diet as a result of its higher tannin content.

Edible internal organs

As it is shown in Table 2, there is no significant difference between experimental treatments view point of edible internal organs (gizzard, heart and liver). Similar results have been reported by several workers (Fayek *et al.* 1989; Attia 1998; Ragab *et al.* 2002; Kwari *et al.* 2002; Kumar *et al.* 2005) who found that inclusion of sorghum grain in broiler and quail diets had no significant effects on body organs (giblets).

Conclusion

Results of the current study showed that there is no significant difference between carcass yield and components in Japanese quails fed sorghum grain in place of corn. Reconstitution also could not improve the carcass characteristics and edible internal organs of Japanese quails. Finally, it can be concluded that replacing 50% or even 100% sorghum grain (reconstituted or un-reconstituted) in place of corn grain have not adverse effect on carcass traits of Japanese quails.

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