

Protein digestibility and energy metabolisability of finger millet and pearl millet grains in caeectomised cockerels and Japanese quails

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Adult white leghorn cockerels (30 weeks of age), 12 caeectomized and 12 normal (intact) ones and 60 adult Japanese quails were used in the present study to determine the apparent and true protein digestibility as well as apparent and true energy metabolisability in finger millet and pearl millet grains. Pearl millet was fed to cockerels as per Farrell's "Rapid ME method" after 48 hr fasting. Finger millet was force fed (50g) to cockerels as per "Sibbald method". Both the test ingredients were offered to quails as per "Farrell's method". No significant difference was observed in AMEn and TMEn values of pearl millet. In finger millet, the AMEn values determined with caeectomised cockerels were significantly ($P < 0.01$) higher than their normal counterparts (13.29 MJ or 3177 kcal/kg vs 12.54 MJ or 2996 kcal/kg). Even though the TMEn values were numerically higher in normal cockerels, they were statistically non-significant. In comparison to normal cockerels, Japanese quails recorded significantly lower ($P < 0.01$) AMEn and TMEn values in both the cereal grains. The apparent protein digestibility of pearl millet was significantly higher ($P < 0.05$) in caeectomised cockerels than the normal ones (81.52 vs 76.01%), whereas the apparent as well as true protein digestibilities of finger millet determined with caeectomized cockerels were markedly lower ($P < 0.05$) than their counterparts. The true protein digestibility of pearl millet in Japanese quails were significantly higher ($P < 0.05$) than the normal cockerels (95.97 vs 88.82 %). In contrast, the apparent protein digestibility of finger millet in Japanese quails were markedly lower than the ($P < 0.01$) conventional cockerels (64.35 vs 73.6 %).

Key words: cockerels; caeectomized; quails; finger millet; pearl millet

Introduction

The digestibility and availability of nutrients in feed ingredients may vary depending upon physiological status of the bird. A number of studies indicated that the energy metabolisability and protein digestibility of feed ingredients were influenced by many variables including species, age, genotype and sex of bird. Farrel *et al.* (1997) observed large differences in the AME_n of a diet between laying hens and 3 wk old broilers. Fisher and Shannon (1973) reported similar differences in AME_n between chicken and turkey. Generally, the nutritive values generated with roosters are widely used in feed formulations for broilers, layers and quails. Comparative studies on energy metabolisability and protein digestibility values of cereals viz. pearl and finger millets for caeectomised roosters, normal roosters and quails are scanty. The objectives of the present study thus were to determine the apparent and

true digestibility of protein and to estimate the apparent and true metabolisable energy for finger and pearl millet in caecectomised rooster, normal rooster and Japanese quails.

Materials and Methods

Test ingredients: Finger millet and pearl millet were obtained from a commercial source. Pearl millet was coarsely ground before the initiation of the test. Finger millet was fed as such to quails, while crushed ones were precision fed to roosters.

Experimental birds: Adult, single comb white Leghorn cockerels, 24 in numbers, about 25 weeks of age, were selected from a single hatch flock. Half the numbers were caecectomised according to the procedure described by Green *et al.* (1987). The birds were confined to individual wire-mesh cages. The birds were subjected to trial after 30 days post surgical rest. Adult male Japanese quails, 60 in numbers, about 15 weeks of age, were selected from a single homogenous group, housed individually in quail metabolic cages fitted with individual feeder, waterer and excreta collecting tray.

Cockerel assay: Six each of normal and caecectomised cockerels were precision fed with 50 g of finger millet after 48 h starvation by Sibbald's crop intubation (1976) method. Pearl millet was offered *ad libitum* to six birds each in both the groups for 1 h (Farrell, 1978). Excreta voided during the following 48 h was collected at 8 h intervals, dried at 80°C for 24 h, ground and stored in airtight polythene bags at -20°C until further assay. The excreta collected from protein free diet fed birds and 96 h fasted birds represented the endogenous nitrogen and energy output.

Quail assay: Sixty birds were divided into six groups of 10 birds in each. Pearl millet and finger millet were fed to 3 groups each as per Farrell's rapid ME method (1978), with slight modifications. The birds were fed *ad libitum* for 3 h duration after 48 h starvation. The excreta voided during the following 48 h were collected at 8 h intervals. The excreta of each group (10 quails) was amassed into one sample, weighed, dried at 80°C for 24 h, ground and stored at -20°C until further assay. The excreta collected from 96 h fasted birds represented the endogenous nitrogen and energy output.

Chemical analysis: The cereal grains were fine ground and analysed for crude protein, crude fibre, crude fat and ash as per AOAC (1995) method. The gross energy value of cereal grains and excreta samples were determined by Gallenkamp PLC autobomb calorimeter. The uric acid content of excreta were analysed according to the procedure described by Marquardt (1983).

Calculations: The apparent and true metabolisable energy values were calculated as per the procedure described by Sibbald (1986). The protein digestibility using uric acid corrected nitrogen values were calculated as described by Marquardt (1983).

Results and Discussion

The proximate composition of pearl millet and finger millet are presented in Table 1. The apparent metabolisable energy value of both the millet grains were higher ($P < 0.05$) in caecectomised cockerels than their intact counterparts. No significant difference was observed for TME and TME_n values of millets. However, AME_n value of finger millet was ($P < 0.001$) higher for caecectomised cockerels as compared to normal cockerels (Table 2). The apparent protein digestibility value of pearl millet determined with caecectomised cockerels was ($P < 0.05$) higher than that determined with intact

cockerels. In contrast, the apparent as well as true protein digestibility of finger millet was higher ($P < 0.05$) in normal cockerels than their caeectomised partners (Table 3).

The energy metabolisability values (apparent and true) of both the millet grains were significantly lower in Japanese quails than normal cockerels (Table 4). The true protein digestibility of pearl millet was higher ($P < 0.05$) in Japanese quails as against intact cockerels. In contrast, the apparent protein digestibility of finger millet in Japanese quails were ($P < 0.05$) lower than the conventional cockerels.

The marked difference in apparent metabolisable values of both the cereal grains was attributed to higher endogenous energy losses in normal cockerels (26.3 kcal vs 15.5 kcal / 48 h) as compared to caeectomised cockerels following 96 h fasting. When the apparent metabolisability values were corrected for true metabolisability, the TME values for both the cereal grains were numerically higher in normal cockerels even though they were not statistically significant. The digestibility of protein in finger millet was significantly higher in normal cockerels. The higher apparent protein digestibility of pearl millet in caeectomised cockerels is due to the higher endogenous nitrogen loss observed in normal cockerels. The protein digestibility value of finger millet indicated that the caecal microbes of intact cockerels played a significant role in nitrogen utilization.

The species factor had a profound influence on energy metabolisability and protein digestibility for finger millet and pearl millet. Cilliers *et al.* (1999) also observed that the TME_n values of different feedstuffs were higher for ostriches as compared to cockerels. In contrary, Mandal *et al.* (2005) did not find any significant difference in AME_n values of sunflower and rapeseed meal in intact chicken, guinea fowls and quails, but the values tended to be higher in quails. Overall, the present study revealed that the ME values and protein digestibility values determined for pearl and finger millet grains using cockerels may not be suitable for application in practical quail diet formulation.

Table 1. Proximate composition of feed ingredients

parameters	Pearl millet	Finger millet
Dry matter (%)	8.66	8.79
Crude protein (%)	10.95	9.46
Gross energy (kcal/g)	3.92	3.88
Crude fat (%)	4.79	1.63
Crude fibre (%)	2.92	2.17
Total ash (%)	3.45	4.98

Table 2. Apparent and true metabolisable energy of pearl millet and finger millet in caeectomized and normal cockerels

Pearl millet				
parameters	caeectomized	normal	Pooled SEM	significance
AME	3465 ^a	3206 ^b	60.03	*
AMEn	3419	3306	33.97	NS
TME	3735	3813	29.32	NS
TME _n	3725	3837	32.88	NS
Finger millet				
AME	3186 ^a	2971 ^b	41.32	***
AMEn	3177 ^a	2996 ^b	34.92	***
TME	3532	3560	21.16	NS
TME _n	3522	3584	20.40	NS

The values are means of six cockerels.

^{a,b} Means in a row bearing different superscripts are significantly different ($P < 0.05$).

* $P \leq 0.05$; *** $P \leq 0.001$

Table 3. Apparent and true protein digestibility of pearl millet and finger millet in caecectomized and normal cockerels

Pearl millet				
parameters	caecectomized	normal	Pooled SEM	significance
App N dig	81.52 ± 1.68 ^a	76.01 ± 1.49 ^b	1.40	*
True N dig	89.15 ± 0.92	88.82 ± 1.74	0.93	NS
Finger millet				
App N dig	69.97 ± 0.52 ^b	73.60 ± 0.89 ^a	0.74	*
True N dig	81.22 ± 0.52 ^b	91.06 ± 0.89 ^a	1.62	***

The values are means of six cockerels.

^{a,b} Means in a row bearing different superscripts are significantly different (P < 0.05).

* P ≤ 0.05; *** P ≤ 0.001

Table 4. Apparent and true metabolisable energy of pearl millet and finger millet in normal cockerels and Japanese quails

Pearl millet				
parameters	Cockerels¹	J.Quails²	Pooled SEM	significance
AME	3206 ^a	2779 ^b	89.10	**
AMEn	3306 ^a	2941 ^b	72.84	***
TME	3813 ^a	3119 ^b	129.90	***
TME _n	3837 ^a	3281 ^b	105.83	***
Finger millet				
AME	2971 ^a	2379 ^b	111.49	**
AMEn	2996 ^a	2586 ^b	79.07	**
TME	3560 ^a	2922 ^b	118.17	***
TME _n	3584 ^a	3129 ^b	85.07	***

¹The values are means of six cockerels.

²The values are means of three replicates (10 quails per replicate)

^{a,b} Means in a row bearing different superscripts are significantly different (P < 0.01).

** P ≤ 0.01; *** P ≤ 0.001

Table 5. Apparent and true protein digestibility of pearl millet and finger millet in normal cockerels and Japanese quails

Pearl millet				
parameters	Cockerels¹	J.Quails²	Pooled SEM	significance
App N dig	76.01 ± 1.49	81.64 ± 0.80	1.39	NS
True N dig	88.82 ± 1.74 ^b	95.97 ± 1.31 ^a	1.73	*
Finger millet				
App N dig	73.60 ± 0.89 ^a	64.35 ± 1.09 ^b	1.81	**
True N dig	91.06 ± 0.89	90.90 ± 1.64	0.75	NS

¹The values are means of six cockerels.

²The values are means of three replicates (10 quails per replicate)

^{a,b} Means in a row bearing different superscripts are significantly different (P < 0.05).

* P ≤ 0.05 ; ** P ≤ 0.01

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