

Comparative digestibility of amino acids of cereals in caeectomized cockerels and japanese quails

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A total of 24 intact and 24 caeectomized cockerels (30 weeks of age) and 60 adult Japanese quails (15 weeks of age) were used to determine the apparent digestibilities of amino acids in low tannin sorghum, maize, finger millet and pearl millet. The ingredients except finger millet were fed to cockerels as per Farrell's "Rapid ME" method. While, all the test ingredients were fed to quails as per Farrell's technique. Finger millet (50 g) was fed to cockerels by crop intubation method. The apparent digestibility of methionine in sorghum was significantly higher in caeectomized cockerels ($P < 0.05$) than their intact counterparts. The digestibilities of majority of the amino acids in finger millet (except threonine) determined with caeectomized cockerels were significantly higher ($P < 0.01$) than those determined with intact cockerels. Similarly the apparent digestibilities of methionine, lysine and histidine in pearl millet were markedly higher ($P < 0.01$) in caeectomized cockerels. The digestibilities of amino acids in sorghum determined with intact quails were similar to intact cockerels, with the exception of histidine, which was significantly lower ($P < 0.01$) in quails. In finger millet, the digestibilities of methionine and leucine were significantly higher, while the digestibilities of histidine and cystine were significantly ($P < 0.05$) lower in quails as compared to those of intact cockerels. The digestibilities of amino acids of pearl millet in quails were comparable to intact cockerels, except that of histidine, which was significantly lower ($P < 0.01$) in intact quails. Almost all the amino acids in maize, except histidine, had significantly higher ($P < 0.01$) digestibility values in quails as compared to intact cockerels. Histidine digestibility of all the four cereals in intact Japanese quails were significantly lower ($P < 0.01$) than that of intact cockerels. The present observations revealed that the amino acid digestibility values of cereals determined with caeectomized cockerels may be highly suitable to be adopted in feed formulations rather than those evaluated using intact cockerels. Further, the amino acid digestibility values determined with intact cockerels does not support its application in formulating practical quail feed. The apparent amino acid digestibility values estimated using intact quails appear to be suitable for quail feed formulation.

Key words: cockerels; caeectomized; quails; amino acid digestibility; millet

Introduction

Most of the published data on digestible amino acids in feed ingredients have been obtained from excreta assays with adult cockerels (Sibbald, 1986; Green *et al.*, 1987; Parsons, 1991; Rhone-Poulenc, 1993). The amino acid digestibility values generated from roosters are widely used in practical diet formulations for broilers and layers. But for quails reports on digestible amino acid values are limited.

The objective of the study was thus to determine the apparent digestibility of amino acids of common cereals in normal and caecectomised roosters, and Japanese quails.

Materials and Methods

Cereals and their processing: Maize, low tannin sorghum, pearl millet and finger millet grains were procured from commercial feed manufacturing units. Maize and sorghum were ground through 4 mm screen. Pearl millets and finger millets were fed as such to quails. While for chicken (cockerels), finger millets were ground through 1 mm sieve before force feeding.

Experimental birds: Forty-eight adult cockerels (white leghorn), having similar body weight were selected from a flock of same hatch (25 wk of age). Half the number of birds was caecectomized following the surgical procedure as described by Green *et al.* (1987) with slight modifications. They were allocated for trial 30 d after surgery. The cockerels were housed in individual wire-mesh cages. The birds were maintained on a commercial grower mash containing 180 g crude protein and 2600 kcal (10.88 MJ) ME/kg diet. These birds were trained for 14 d to eat their daily feed allowance in 1 h. Initially, the quails were trained to eat their daily feed allowance at different time intervals, viz., 1, 2, 3, 4 and 5 h for 14 d period. It was observed that the feed consumption at 3 h, 4 h and 5 h duration was similar. Hence, 3 h restricted feeding regimen was adopted for quails in the present study. Adult Japanese quails, about 60 numbers were selected from the same hatch (15 wks of age) and confined to individual wire mesh cages.

Rooster assay: The caecectomised and intact cockerels were divided into four groups of six roosters in each. Each assay ingredient was offered to six intact and six caecectomised roosters after 48 h fasting. Corn, sorghum and pearl millet were offered to birds for 1 h (Farrell, 1978). Finger millet was precision fed (50 g) as per the crop intubation method (Sibbald, 1976). The excreta of six birds (each treatment) were pooled and analyzed for its amino acid content.

Quail assay: The quails were divided into six groups of 10 birds in each. Each ingredient was allocated to 3 groups of birds (replicates). All the four cereal grains were fed for 3 h duration following 48 h fasting. The excreta of each quail was collected for the following 48 h, at 8 h intervals, dried, weighed and ground. The excreta of each replicate (10 quails) was pooled and subjected to amino acid analysis. The amino acids in cereal grains and excreta samples were analysed from degussa AG, Hanau, Germany. Apparent digestibility of amino acids were calculated as the difference between amino acid intake and amino acid excreted, expressed as percentage of amino acid intake.

Results and Discussion

The amino acid composition of cereal grains are presented in Table.1. The apparent digestibilities of methionine, lysine, isoleucine, leucine, valine and phenylalanine in maize were higher ($P<0.05$) in caecectomized cockerels than their intact counterparts (Table 2). The apparent digestibility of methionine in sorghum was higher ($P<0.05$) in caecectomized cockerel as compared to normal cockerels. The apparent digestibilities of almost all the indispensable amino acids in finger millet (except threonine) determined with caecectomised cockerels were higher ($P<0.01$) than those determined with intact cockerels (Table 3). The digestibilities of methionine, lysine, arginine, isoleucine, leucine and histidine of pearl millet were higher ($P<0.05$) in caecectomised cockerels than their normal counterparts.

Table 1. Nitrogen and amino acid composition of cereal grains (g/100 g)

	Sorghum	Finger millet	Pearl millet	Maize
Nitrogen	9.46	8.80	10.95	11.05
Methionine	0.16	0.28	0.24	0.24
Cystine	0.15	0.19	0.22	0.23
Meth+Cys	0.30	0.48	0.45	0.48
Lysine	0.24	0.24	0.28	0.31
Threonine	0.30	0.39	0.38	0.41
Arginine	0.36	0.38	0.43	0.50
Isoleucine	0.34	0.39	0.41	0.40
Leucine	1.05	0.93	0.98	1.50
Valine	0.44	0.57	0.55	0.52
Histidine	0.19	0.23	0.25	0.31
Phenylala	0.42	0.49	0.48	0.61
Serine	0.38	0.48	0.44	0.57
Proline	0.67	0.66	0.67	0.91
Alanine	0.72	0.58	0.75	0.89
Aspa.acid	0.63	0.57	0.76	0.74
Glut.acid	1.58	1.98	1.83	2.19

Table 2. Apparent amino acid digestibility coefficients of maize and sorghum in caecectomised and normal cockerels

parameter	Maize			Sorghum		
	Caecec	Normal	Pooled SEM	Caecec	Normal	Pooled SEM
Methionine	91.92 ^a	88.20 ^b	0.69***	85.22 ^a	75.46 ^b	2.44*
Cystine	83.68	81.83	0.76	64.19	62.44	4.42
Meth+Cystine	88.19	85.84	0.64	74.80	68.00	3.33
Lysine	81.14 ^a	70.63 ^b	1.85***	67.16	52.63	4.75
Threonine	78.24	76.14	0.99	67.96	60.35	2.62
Arginine	88.72	86.48	0.61	79.52	71.18	2.90
Isoleucine	88.44 ^a	83.95 ^b	0.87**	81.61	74.68	2.56
Leucine	94.66 ^a	93.12 ^b	0.34*	89.88	86.44	1.38
Valine	87.23 ^a	83.84 ^b	0.78*	79.66	74.50	2.67
Histidine	87.91	86.54	0.56	74.64	68.09	3.34
Phenylalanine	92.02 ^a	90.21 ^b	0.45*	84.62	79.96	2.07
Serine	86.16	85.46	0.60	70.74	68.76	3.62
Proline	90.53 ^a	88.23 ^b	0.55*	81.59	79.46	2.31
Alanine	90.79 ^a	88.14 ^b	0.58*	84.95	81.05	1.99
Aspa.acid	84.33 ^a	80.68 ^b	0.90*	74.92	68.76	3.28
Glut.acid	93.30 ^a	91.53 ^b	0.41*	87.22	83.48	1.71

The values are means of six cockerels.

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

* $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

Table 3. Apparent amino acid digestibility coefficients of finger and pearl millet in caecectomised and normal cockerels

parameter	Finger millet			Pearl millet		
	Caecec	Normal	Pooled SEM	Caecec	Normal	Pooled SEM
Methionine	88.18 ^a	78.87 ^b	1.56*	90.22 ^a	84.16 ^b	1.31*
Cystine	71.37 ^a	60.45 ^b	2.06**	79.21	73.74	1.90
Meth+Cys	81.37 ^a	71.42 ^b	1.75***	84.99	79.21	1.57
Lysine	65.23 ^a	41.69 ^b	4.01***	75.35 ^a	59.13 ^b	3.43**

Threonine	68.81	63.99	1.37	71.27	69.76	2.17
Arginine	75.77 ^a	59.98 ^b	2.70***	84.20 ^a	74.36 ^b	2.12*
Isoleucine	81.59 ^a	68.93 ^b	2.11***	86.39 ^a	79.54 ^b	1.62*
Leucine	86.64 ^a	78.33 ^b	1.43***	90.08 ^a	85.91 ^b	1.08*
Valine	81.92 ^a	72.15 ^b	1.72***	85.19	79.70	1.52
Histidine	74.79 ^a	60.38 ^b	2.51***	82.04 ^a	58.96 ^b	4.13***
Phenylalanine	85.04 ^a	75.43 ^b	1.65***	87.58	83.03	1.27
Serine	77.24 ^a	69.70 ^b	1.48**	78.53	75.02	1.77
Proline	80.52 ^a	71.44 ^b	1.64***	84.47	80.67	1.39
Alanine	76.14 ^a	68.93 ^b	1.46**	86.83	81.64	1.39
Aspa.acid	69.75 ^a	56.30 ^b	2.45***	81.60	75.53	1.81
Glut.acid	87.11 ^a	79.72 ^b	1.29***	90.28	86.57	1.01

The values are means of six cockerels.

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

* $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

Majority of the amino acids in maize, except histidine, had higher ($P < 0.05$) digestibility in quails as compared to normal cockerels (Table 4). The apparent digestibilities of amino acids (except histidine) in sorghum and pearl millet were similar in quails as well in intact cockerels (Table 4 and 5). Almost all the amino acids in finger millet except histidine, had significantly higher ($P < 0.05$) digestibility values in quails as compared to intact cockerels (Table 5).

Table 4. Apparent amino acid digestibility coefficients of maize and sorghum in cockerels and Japanese quails.

parameters	maize			sorghum		
	Cockere ls ¹	Quails ²	Pooled SEM	Cockerels ¹	Quails ²	Pooled SEM
Methionine	88.20 ^b	91.65 ^a	0.69***	75.46	77.04	1.22
Cystine	81.83 ^b	84.22 ^a	0.72*	62.44	56.73	2.06
Meth+Cys	85.84 ^b	88.31 ^a	0.62*	68.00	66.00	1.60
Lysine	70.63 ^b	83.76 ^a	2.39***	52.63	60.46	2.65
Threonine	76.14 ^b	82.95 ^a	1.38***	60.35	59.82	1.93
Arginine	86.48 ^b	89.24 ^a	0.64**	71.18	70.70	1.41
Isoleucine	83.95 ^b	88.48 ^a	0.92**	74.68	73.21	1.26
Leucine	93.12 ^b	94.82 ^a	0.36**	86.44	84.57	0.73
Valine	83.84 ^b	87.80 ^a	0.84**	74.50	72.53	1.29
Histidine	86.54 ^a	67.53 ^b	3.21***	68.09 ^a	38.55 ^b	5.17***
Phenylalanine	90.21 ^b	92.53 ^a	0.50**	79.96	78.28	1.02
Serine	85.46 ^b	87.73 ^a	0.61*	68.76	65.09	1.64
Proline	88.23 ^b	91.45 ^a	0.66**	79.46	80.02	1.01
Alanine	88.14 ^b	91.23 ^a	0.64**	81.05	79.59	0.95
Aspa.acid	80.68 ^b	85.70 ^a	1.05**	68.76	66.88	1.55
Glut.acid	91.53 ^b	93.19 ^a	0.39**	83.48	80.73	0.93

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 ($P < 0.05$).

* $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

Table 5. Apparent amino acid digestibility coefficients of finger and pearl millet in cockerels and Japanese quails.

parameters	Cockerels ¹	Quails ²	Pooled SEM	Cockerels ¹	Quails ²	Pooled SEM
Methionine	78.87 ^a	73.26 ^b	1.23**	84.16	85.09	1.05
Cystine	60.45 ^a	43.47 ^b	3.37***	73.74	68.69	1.92
Meth+Cys	71.42 ^a	62.20 ^b	1.92**	79.21	77.30	1.40
Lysine	41.69	36.33	2.07	59.13	68.69	3.12

Threonine	63.99 ^a	52.07 ^b	2.47**	69.76	66.80	2.05
Arginine	59.98 ^a	49.35 ^b	2.33**	74.36	74.46	1.68
Isoleucine	68.93 ^a	61.90 ^b	1.62*	79.54	79.00	1.35
Leucine	78.33 ^a	71.46 ^b	1.44**	85.91	83.98	0.98
Valine	72.15 ^a	64.90 ^b	1.60**	79.70	77.82	1.37
Histidine	60.38 ^a	-33.71 ^b	17.32	58.96 ^a	23.16 ^b	6.56***
Phenylalanine	75.43 ^a	67.93 ^b	1.58**	83.03	81.37	1.15
Serine	69.70 ^a	55.23 ^b	2.83***	75.02	70.30	1.82
Proline	71.44 ^a	63.26 ^b	1.76**	80.67	78.78	1.31
Alanine	68.93 ^a	61.49 ^b	1.68*	81.64	81.50	1.21
Aspa.acid	56.30 ^a	42.34 ^b	2.92**	75.53	73.83	1.63
Glut.acid	79.72 ^a	73.35 ^b	1.34**	86.57	84.06	0.98

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 ($P < 0.05$).

* $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

Several reports on the amino acid digestibility of poultry feed ingredients have been documented (Raharjo and Farrell, 1984; Green *et al.*, 1987; Green and Kiener, 1989; Ravindran *et al.*, 1999), but variations exist due to differences in methodology followed, class of birds (broilers, roosters or layers), site of measurement (Ileal or excreta) and correction for endogenous losses (true or apparent). Till date, the amino acid digestibility as affected by poultry species and different cereals has not been examined. Hence, the present study was carried out to investigate the applicability of digestibility values of one species of birds in formulating feeds for other poultry species. The apparent amino acid digestibility values observed for the maize grains were higher than the values reported by Green *et al.* (1987). This difference might be due to the relationship that exists between intake and digestibility of an amino acid. Payne *et al.* (1971) and Sibbald (1979) documented that greater was the intake of an amino acid, the higher was its digestibility. In the present study, the intake of cereal grain was much higher as compared to 50 g of test diet as followed earlier (Green *et al.*, 1987). The amino acid digestibility values for maize, pearl millet and finger millet grains in caecectomised birds were higher than their normal counterparts. This difference may be attributed to synthesis of microbial protein in caecum of intact birds due to retention of indigestible organic matter that is reaching there. The species difference had a marked effect on apparent amino acid digestibility. Almost all the essential amino acids in maize and finger millet, except histidine, had higher digestibility values in quails. Sorghum and pearl millet demonstrated similar digestibilities in cockerels and quails (except histidine). Among all the four cereal grains, histidine digestibility was markedly lower in quails as compared to intact cockerels. The reason for this observation is unclear. In conclusion, the present study reveals that the practice of using amino acid digestibility values generated with cockerels for quails may not be appropriate for all cereal grains.

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