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Effects of Bioassay and Age on Amino Acid Digestibility and Metabolizable Energy of Soybean, Sunflower and Canola Meals

Research Article

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ABSTRACT

These experiments were conducted to determine metabolizable energy and amino acid digestibilities of soybean meal, sunflower meal and canola meal in broiler chickens by using titanium oxide as indigestible marker in intact or caecectomized cockerels. Ileal and total tract digestibility of amino acids were measured using broiler chickens, moreover, digestibility were also determined in the intact and caecectomized cockerels. The mean excreta apparent and true digestibility of amino acid in broiler and intact cockerel were 76.99, 78.07 and 84.18, 88.35 for soybean meal 92.16, 92.84 and 78.09, 85.94 for sunflower meal and 69.82, 70.22 and 86.47, 88.50% for canola meal respectively. The mean values of ileal apparent and true digestibilities (standardized ileal digestibility) of amino acid in broiler were 72.18, 73.12 for soybean meal; 47.48, 48.47 for sunflower meal and 62.05, 62.45% for canola meal respectively. The mean values of apparent and true digestibilities of amino acid obtained from caecectomized cockerel and broiler were 80.34, 84.45 for soybean meal, 74.48, 82.47 for sunflower meal and 84.74, 87.12% for canola meal respectively. The experiments shown that apparent amino acid digestibility of soybean (9 to 11%), sunflower (34 to 50%) and canola meals (19 to 27%) from broiler (excreta and ileum), were lower than those intact and caecectomized cockerel. The result of experiments indicated that apparent metabilizable energy (AME), True metabolizable energy corrected for nitrogen (AMEn), True Metabolizable Energy (TME) and Nitrogen correction of True Metabolizable Energy (TMEn) values for canola and sunflower meals at 21 and 42 d broiler were significantly higher than cockerels. However, data shown that amount of metabolizable energy obtained from canola and sunflower meals were higher than those of broiler excreta or ileal and caecectomized cockerels.

KEY WORDS broiler, caecectomized, intact cockerels, soybean, sunflower and canola meals.

INTRODUCTION

A number of factors influence the metabolizable energy and amino acid digestibility of oilseed meals. Many studies have demonstrated that the amino acid digestibility and metabolizable energy of feed ingredients may depend on the age, genotype and gender of the birds. The amino acid bioassay can be a major source of variation which is often overlooked (Ravindran and Bryden, 1999). Some researcher have examined this factor using broilers of different ages, laying hens, and roosters fed different cereals and protein meals (Wallis and Balnave, 1984a; Rostagno *et al.* 1995; Batal and Parsons, 2002a; Huang *et al.* 2005; Huang *et al.* 2006; Huang *et al.* 2007; Garcia *et al.* 2007). In general, the digestibility coefficient of amino acids increases with age and depend on feedstuff composition. Digestibility assay may be separated into two main categories: excreta and ileal methods. Excreta assay involves the collection of excreta from intact or ceaccectomized birds. Most of the published data on digestible amino acids in feed ingredients have been obtained from excreta assays with roosters (Sibbald and Wolynetz, 1986; Green *et al*. 1987; NRC, 1994; Rhone-Pulenc, 1993). Although evidence suggests that ileal digestibility values are better indicators of amino acid availability than excreta-based values (Ravindran *et al*. 1999) there is a paucity of data on the ileal digestibility values (Ravindranetal, 2005).

The caecal microflora may change the profile of amino acid during the flow of digesta through this part of the gastro intestinal tract.

Because the caeca are the main sites of post ileal microflora activity, caecectomy has been proposed as a method for reducing microbial influence on digestibility (Parsons, 1984; Johns *et al*. 1986; Parsons, 1986; Green *et al*. 1987; Green, 1988).

Variation in digestibility values will also arise from difficulties associated with the conduct of bioassay procedures and the measurement of endogenous amino acid losses (EAAL) and endogenous energy losses (EEL) (Yaghobfar and Zahedifar 2003).

Endogenous amino acid at the ileal can be divided into a basal EAAL fraction assumed to be independent of the raw material and to be occurring in any diet and a specific fraction with is considered a characteristic of the single raw material. Standardized ileal digestibility is an approach to describe amino acid digestibility for broiler (Lemme, 2004). Ravindran *et al*. (2001) showed that amino acid profile of endogenous amino acids losses (EAAL) did not differ between broiler, layer and adult rooster except for serine, glutamic acid, proline and isoleucine. Song *et al*. (2003) reported some differences in endogenous amino acid excretion using the N-free and fasting methods.

The main objective of the present study was to compare the amino acid digestibility and metabolizable energy in broiler chickens (excreta and ileal digesta) and roosters (intact and caecectomized cockerel) in soybean meal, canola meal, and sunflower meal.

MATERIALS AND METHODS

In these study according to object of experiment to compare the amino acid digestibility as apparent and standardized or ileal amino acid digestibility and intact or caecectomized birds, two bioassays were as following performed.

Experiment 1

Birds and housing

The experiments were conducted to determine metabolisable energy and amino acid digestibility of the soybean meal, sunflower meal and canola meal. In this study 200 old-day male broiler chicks (Rose 308) were used for ileum digesta and excreta assay.

All birds were placed in metabolic cage in environmentally controlled rooms, where the temperature kept 32 ˚C and according to manual of hybrid 2 ˚C.

Weekly reduced until 21 ˚C temperature. Birds were randomly assigned to each dietary treatment with 6 replicate containing 2 birds per each cage (12 birds per treatment). The birds received the experimental diets as *ad libitum* from 15 to 21 d of age and from 35 to 42 d. At beginning of experiment for accustom chickens during 4 days the diet were available for birds.

The birds were then allowed to consume the respective assay diet for a 3 d period then for 24 h withdraw feed. Following this, excreta were collected for 3 time on a tray place under each cage, transferred to frozeer (-25 ˚C). Other the killing the birds on d 42 and the contents of the ileum digesta were collected to determine amino acid digestibility and metabolizable energy content of the each meal using titanium oxide (TiO_2) as a marker. The ileum was tied off, and flushed with distilled water to complete the removal of contents. While of the small amounts of ileal digesta obtained, samples from three birds were pooled to provide enough material for amino acid and titanium dioxide (TiO_2) analyses and then samples were stored at -20 ˚C. The following equations were used for calculation of apparent metabilizable energy (AME), Apparent Metabolizable Energy corrected for nitrogen (AMEn), True Metabolizable Energy (TME) and Nitrogen correction of True Metabolizable Energy (TMEn) content oil seed meals (Yaghobfar, 2001).

$$AME\ (kcal) = [GE_{kcal/kg\ diet} - (TiO_{2\%\ diet}/TiO_{2\%\ excreta} \times GE_{kcal/kg\ excreta})]$$

$$AMEn\ (kcal) = AME - 8.73\ [N_{\%diet} - (TiO_{2\%\ diet}/TiO_{2\%\ excreta} \times N_{\%\ excreta})]$$

$$TME\ (kcal) = AME + EEL / I_{ntake}$$

$$TMEn\ (kcal) = AMEn + [EEL + (8.73 \times NR_o) / I_{ntake}]$$

Where:

GE: is gross energy.

N: is nitrogen.

TiO_2: is titanium dioxide, and 8.73 is the energy equivalent of uric acid nitrogen, that is, 8.73 kcal/kg of uric acid nitrogen. EEL is endogenous energy losses by the nitrogen free diet (D -glucose).

RN_o: is nitrogenous losses of fecal metabolic and endogenous urinary (FmEn+UmEn+UeEn).

The following method was uses for calculation of the AME value of the test ingredient (soybean meal, sunflower meal and canola meal).

ME of test ingredient (kcal/kg)= [ME test diet – (ME basal diet×% basal in test diet/100)] / % test ingredient in test diet × 100

Excreta and ileal digesta processing

The apparent ileal and exreta amino acid digestibility for each diet contained oil seed meals were calculated by the following equation using titanium TiO2 as an indigestible marker at a level of 0.3 % (Ravindran *et al*. 1999; Ravindran *et al*. 2001; Ravindran *et al*. 2005):

$$ADAA_{\text{ Diet}}\ (\%)\ \text{or}\ DC= 100 - (100\times[(TiO_{2\text{ Diet}}\times AA_{\text{ Digesta}}/TiO_{2\text{ Digesta}}\times AA_{\text{ Diet}})]$$

Where:

$ADAA_{\text{ Diet}}$: apparent amino acid digestibility of diet or digestibility coefficient.

$TiO_{2\text{ Diet}}$ and $TiO_{2\text{ Digesta}}$: are concentrations of TiO_2 in the diet and digesta samples (g/kg) respectively.

$AA_{\text{ Diet}}$ and $AA_{\text{ Digesta}}$: respective concentrations of the AA in the diet and digesta samples (g/kg) respectively.

The apparent digestibility of amino acid were transformed to standardized ileal digestibility by correcting for the basal endogenous amino acid losses using the values obtained by nitrogen free diet (D glucose) fed chickens with following formula:

Standardized Ileal digestibility of amino acid (%)= apparent amino acid digestibility (%) + [(endogenous amino acid losses, as g/100g of DM) / (amino acid content of the feedstuffs, as g/100g of DM) ×100]

True amino acid digestibility was calculated using the following equation:

True amino acid digestibility= AAAD + endogenous amino acid output in excreta × 100 / amino acid concentration in diet

The apparent ileal and excreta digestibility of amino acids in oil seed meals were determined by substitution (Woyengo *et al*. 2010), with the basal diet using the following equation:

$$D_A= D_B + (D_D–D_B) / P_A$$

Where:

D_A: digestibility of amino acid in an assay feedstuff (oil seed meal).

D_B: digestibility of amino acid in the basal diet.

D_D: digestibility of amino acid in an assay diet (oil seed meals – basal diet).

P_A: proportion (decimal percentage) of assay feedstuffs (oil seed meals) in assay diet.

Experiment 2

Birds and housing

The experiment was performed for caecectomised and intact adult cockerels to determine amino acids digestibility and metabolizable energy, contents of soybean, canola, and sunflower meals.

Thirty two (16 intact and 16 caecectomized) adult cockerels (Rhode Island Red type, RIR), (40 weeks of age; and 2.9 kg BW), were maintained in individual metal cages (0.66 m×0.66 m) with 16 h light/day and had free access to feed and water. The average temperature in the experimental house was 24±2 ˚C. Each cage was fitted with an individual feeder and a nipple drinker. A fixed aluminium tray was placed under each cage to allow droppings to be collected separately.

As well, before experiments, adult cockerels were offered diet. In the conventional addition method (CAM), the experimental period including 6 days: a 3-day pre-collection period and a 3-day collection period.

Also, before collection period, the birds withheld for 24 h to ensure that no feed residues remained in their gastrointestinal tracts.

Amount of feed intake during 3 day of experimental period were 118.79 to 214.17 g per each bird (average 164.86 g). An additional 6 birds were given no feed and starved as negative controls to provide a measure of the EEL.

The samples of dropping voided during the experiment period were collected, weighted and frozen. Before analysis, the frozen samples were removed from the freezer, taken out of the bags and placed in an oven, to be dried at 90 ˚C overnight. Samples of ground maize and excreta were assayed for gross energy using an adiabatic oxygen bomb calorimeter (Parr4 Model 1241).

Caecetomised adult cockerel

Caecectomy was performed when cockerels were 38 weeks of age. Prior to surgery, the cockerels selected to undergo the caecectomy were deprived of feed for 24h and water for 24 h.

Caecectomy procedure was done as described by (Angkanaporn *et al*. 1997; Green *et al*. 1987). After the surgery, the birds were kept in a warm (28±2 ˚C) house with *ad libitum* supply of the water and also, solid feed was withheld for 24 h.

Two weeks after the operation, the cockerels were used for experiment. Soybean, canola, sunflower meals were dried at 80 ˚C overnight. Gross energy of the meals and excreta samples were determined by adiabatic oxygen bomb calorimeter using a Parr4 Model 1241 Calorimeter. Crude protein was calculated as total nitrogen × 6.25, total nitrogen being analyzed by an automated Kjeldahl procedure according to AOAC (1990).

The collected excreta were dried, weighed, and ground to pass a 1-mm screen.

Calculations and statistical analysis

The mean value of oil seed meals was determined for each replicates. Total intake of feed energy (IE) and nitrogen (IN) and droppings energy (FE+UE) and nitrogen (FN+UN) were measured for each birds, and results of the experiments were evaluated by the following formulae (Yaghobfar and Boldaji, 2002).

AME (kcal/kg DM)= [IE - (FE+UE)] / FI

AMEn (kcal/kg DM)= [(IE-(FE+UE)-K (IN-(FN+UN)] / FI

TME (kcal/kg DM)= AME + EEL / FI

TMEn (kcal/kg DM)= AMEn + (EEL+(RN_o×8.74) / FI

RN_o= (FmEn+UmEn+UeEn)

Where:

Appropriate, the energy voided in the droppings (FE+UE) was corrected to zero nitrogen balance (FEn+UEn) by assuming that excreta nitrogen, resulting from tissue nitrogen catabolism, has an energy of 8.74 kcal/g (energy value of 1g of urinary nitrogen of tissue origin. Apparent and true fecal digestibilities of amino acids (ADAA and TDAA, respectively) were calculated using these formulas:

ADAA (%) or digestibility coefficient= [(AA_c-AA_e) / AA_c] × 100

TDAA (%)= [(AA_c-AA_e+EAAL) / AA_c] × 100

Where:

AA_c (amino acid consumed): feedstuff intake × feedstuff amino acid quantity.

AA_e (amino acid excreted): dry excreta weight × excreta amino acid quantity.

EAAL= endogenous amino acid Losses by fasting cockerel.

Chemical analysis

The frozen samples were placed in an oven to be dried at 80 ˚C overnight. Gross energy of the meals and excreta samples was determined by adiabatic oxygen bomb calorimeter (Parr4 Model 1241). Crude protein was calculated as total nitrogen × 6.25, (automated Kjeldahl) according procedure AOAC (1990). The collected excreta were dried, weighed, and ground to pass a 1-mm screen. For amino acid analysis, the samples were hydrolyzed with 6NHCL and then quantities of amino acids determined by high-performance liquid chromatography (HPLC) according to the procedure described by Siriwan *et al*. (1993).

Statistical analysis

The experiments were carried out on the basis of a completely randomized design with 4 replicates; Statistical analysis of the data was accomplished using the GLM procedure of SAS software (SAS, 1996).

The Duncan's test was used to elucidate differences between treatments means.

RESULTS AND DISCUSSION

The Chemical compositions, amino acid concentration and effect of age and bioassay on apparent and true ileal of excreta amino acid digestibility of soybean meal, canola meal and sunflower meal evaluated are shown in Table 1 to 8. The differences between ileal and excreta values from broiler and intact cockerel varied depending on the oil meals and the amino acid considered. Among the meals, average ileal and excreta of broiler and cockerel (intact and caecectomized) amino acid digestibility values (Table 2) for each bioassay in soybean and sunflower meals were significantly different (P<0.05).

In contrast, the digestibility estimates in canola meal were influenced by bioassay, the ileal amino acid digestibility values being much lower than the corresponding excreta amino acid and intact and caecectomized digestibility values.

However for excreta amino acid digestibility in adult bird (intact and caecectomized) were not significantly different. The average excreta apparent and true digestibility of amino acid from broilers and cockerels are as followed: soybean meal 76.99, 78.07 and 84.18, 88.35, sunflower meal 92.16, 92.84 and 78.09, 85.94 and canola meal 69.82, 70.22 and 86.47, 88.50% respectively (P<0.05). The average ileum apparent and true digestibilities of amino acid in broiler for soybean meal were 72.18, 73.12, sunflower meal 47.48, 48.47 and canola meal 62.05, 62.45% respectively. The average cockerels ceccectomized apparent for soybean meal were 80.34, 84.45, sunflower meal 74.28, 82.47 and canola meal 84.74, 87.12% respectively. Proportional differences were present in means of amino acid digestibility between the broiler (excreta and ileal digestibility) and cockerels (intact and caecectomized) bioassay. The amino acid digestibility of different age in soybean meal and canola meal (Table 2) for 21 d broiler and adult cockerel was higher than 42 d broiler (P<0.05).

However, the average digestibility of amino acids content of sunflower in 42 d broiler was higher than 21 d broiler and cockerel (P<0.05). The magnitude of the difference between four bioassay values varied greatly depending upon the oil meals and the specific amino acid considered (Table 3 and 5). In contrast, the digestibility estimates in sunflower were influenced by the site of measurements, the excreta amino acid digestibility values being much higher

Table 1 Chemical composition (Means±SEM) (percent/DM) and amino acid concentration (g/100g) in the oilseed meals

Amino acid	Soybean meal	Sunflower meal	Canola meal
Dry matter	93.92	95.30	94.28
C. Protein (N × 6.25)	45.46	30.83	35.7
Crude fiber	6.91	25.25	17.15
Crude ash	6.70	7.95	8.0
Ether Extra	1.43	0.98	4.60
Gross energy	4680.92	4406.80	4571.98
NFE	33.72	30.30	28.83
Viscosity faces	3.12	2.25	2.14
Viscosity ileum	3.13	3.54	5.67
Aspartic acid	3.15	1.87	1.91
Glutamic acid	9.60	9.93	8.05
Serine	3.47	2.73	1.96
Glysin	2.25	2.60	2.21
Histidine	1.37	1.14	0.93
Arginine	2.17	1.53	1.32
Threonine	3.63	2.80	2.08
Alanine	1.25	1.22	0.64
Tyrosine	1.84	1.25	0.93
Valine	2.27	2.02	1.52
Methionine	0.92	0.97	0.86
Cystein	0.39	0.31	0.26
Isoleucine	2.02	2.13	0.91
Leucine	4.04	3.54	2.65
Phenylalanine	1.32	1.78	1.93
Lysine	3.4	2.17	1.73
SEM	0.38	0.09	0.36

Table 2 The effect of age and bioassay of birds on the amino acid digestibility contents of oilseeds meals

Oil meals	Soybean meal		Sunflower meal		Cotton meal	
			Age*			
	ADAA**	TDAA	ADAA	TDAA	ADAA	TDAA
21 d	82.09[a]	84.10[a]	79.57[b]	81.57[b]	83.31[a]	85.20[a]
42 d	77.52[b]	78.56[b]	92.16[a]	92.84[a]	71.88[b]	72.21[b]
Adult	81.51[a]	86.29[a]	78.09[b]	85.94[b]	86.94[a]	88.82[a]
Overall mean	80.37	82.98	83.27	86.78	80.69	82.08
SEM	11.00	10.45	10.94	11.08	8.78	8.80
			Bioassay***			
Excreta digest	76.99[c]	78.07[c]	92.16[a]	92.84[a]	69.82[b]	70.22[b]
Ileal digest	72.18[d]	73.12[d]	47.48[d]	48.47[d]	62.05[c]	62.45[c]
Intact digest	84.18[a]	88.35[a]	78.09[b]	85.94[b]	86.47[a]	88.50[a]
Cececectomised digest	80.34[b]	84.45[b]	74.28[c]	82.47[c]	84.74[a]	87.12[a]
Overall mean	78.42	80.99	73.00	77.37	75.77	77.07
SEM	10.98	10.60	9.27	9.15	10.38	1.41

SEM: standard error of the means; Overall mean: mean of 12 amino acids.
* 21 and 42 d age (excreta digestibility for broiler chickens), adult (intact cockerel).
** Apparent or digestibility coefficients.
*** Bioassay (apparent and true excreta, ileal digestibility and standardized ileal digestibility for broiler chickens), adult (intact and caecectomized cockerel).

than the corre sponding ileum, intact and caecectomized amino acid digestibility values (Table 4). The average for total tract and ileal digestibility of amino acids in soybean, sunflower and canola meals were 79.99, 72.18, 92.16, 48.79, 69.82 and 62.05% respectively. The corresponding values at the intact and caecectomized birds of soybean sunflower canola meals were 84.18, 80.34, 78.09, 74.28, 86.46 and 84.74% respectively. However, four bioassay as excreta, ileum, intake and caecectomized were noted for individual amino acids within soybean, sunflower and canola meals.

For instance, digestibility of aspartic acid, glutamic acid, valin, lysine in soybean meal (P<0.05). Also, those of aspartic acid, glutamic acid, thyrosin, valine, methionine, leusin and lysine in canola meal (P<0.05), and therefore, all 12 individual amino acid in sunflower (P<0.05) were influences by the site of measurement.

For apparent digestibility of the 12 amino acids compared significant (P<0.05) excreta–ileum and intact and caecectomized differences were found for 7 amino acids in soybean meal, 12 amino acids in sunflower and 7 amino acids in canola meal.

Table 3 Apparent and true or standardized amino acid digestibility (%) for soybean meals determined in the broiler chickens and adult cockerel

	Apparent amino acid digestibility					True or standardized amino acid digestibility				
AA	B1	B2	B3	B4	SEM	B1	B2	B3	B4	SEM
Aspartic acid	78.93^{ab}	74.29^{b}	89.06^{a}	84.21^{ab}	11.67	80.13^{ab}	75.23^{b}	91.07^{a}	86.05^{ab}	11.81
Glutamic acid	79.35^{b}	77.87^{b}	88.43^{a}	84/82^{ab}	7.54	82.78^{ab}	81.31^{b}	90.04^{a}	87.11^{ab}	7.76
Serine	75.17^{b}	70.56^{b}	85.89^{a}	78.64^{ab}	9.28	76.30^{b}	71.28^{b}	90.03^{a}	85.67^{a}	9.05
Glysin	71.80	71.43	81.06	76.02	10.58	72.60^{b}	72.10^{b}	84.77^{a}	81.71^{ab}	10.65
Tyrosine	79.37	74.51	85.58	80.53	10.60	80.31^{ab}	75.37^{b}	88.18^{a}	83.14^{ab}	10.23
Valine	70.78^{ab}	62.41^{b}	81.73^{a}	79.33^{a}	14.71	71.59^{ab}	63.14^{b}	85.89^{a}	83.50^{a}	14.01
Methionine	78.03	66.00	73.51	76.31	17.41	78.64	66.69	78.74	79.40	15.90
Cystein	86.30	79.77	90.90	80.91	13.54	86.37	79.85	92.80	86.28	13.13
Isoleucine	64.10	64.72	83.74	81.64	20.70	64.82	65.53	84.27	84.49	20.56
Leucine	71.58^{b}	76.31^{ab}	89.03^{a}	89.29^{a}	15.26	72.83^{b}	77.56^{ab}	92.44^{a}	91.45^{a}	15.08
Phenylalanine	82.15^{a}	72.35^{ab}	70.84^{ab}	61.24^{b}	12.92	83.37^{ab}	73.55^{b}	87.72^{a}	72.06^{b}	11.90
Lysine	86.35^{a}	75.13^{b}	90.40^{a}	91.13^{a}	8.99	87.08^{a}	75.87^{b}	94.26^{a}	92.58^{a}	8.28
Overall mean	76.99	72.18	84.18	80.34	-	78.07	73.12	88.35	84.45	-
SEM	14.31	15.72	11.00	11.51	-	14.37	15.65	9.41	10.98	-

B1: excreta digestibility for broiler chickens; B2: apparent and standardized ileal digestibility for broiler chickens; B3: intact cockerel and B4: caececectomice cockerel.
SEM: standard error of the means; Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Table 4 Apparent and true or standardized amino acid digestibility (%) for sunflower meals determined in the broiler chickens and adult cockerel

	Apparent amino acid digestibility					True or standardized amino acid digestibility				
AA	B1	B2	B3	B4	SEM	B1	B2	B3	B4	SEM
Aspartic acid	97.32^{a}	39.27^{c}	77.96^{b}	82.96^{b}	8.06	97.88^{a}	40.09^{c}	84.38^{b}	87.43^{ab}	7.86
Glutamic acid	94.30^{a}	55.85^{b}	87.43^{a}	84.40^{a}	6.92	97.71^{a}	62.19^{b}	89.62^{a}	87.81^{a}	6.52
Serine	92.74^{a}	47.18^{c}	71.79^{b}	59.79^{bc}	12.96	93.19^{a}	48.68^{c}	82.35^{ab}	73.02^{b}	12.09
Glysin	85.85^{a}	56.61^{b}	65.68^{b}	58.52^{b}	13.08	86.74^{a}	57.86^{b}	74.11^{ab}	67.46^{ab}	12.00
Tyrosine	88.25^{a}	37.45^{b}	80.50^{a}	86.09^{a}	5.60	88.67^{a}	38.35^{b}	86.80^{a}	91.98^{a}	5.49
Valine	83.31^{a}	37.82^{b}	75./94^{a}	76.80^{a}	10.96	83.95^{a}	37.79^{b}	84.96^{a}	86.96^{a}	10.04
Methionine	88.61^{a}	36.90^{b}	87.11^{a}	85.05^{a}	6.35	89.05^{a}	37.70^{b}	94.56^{a}	88.22^{a}	6.03
Cystein	95.87^{a}	88.90^{a}	88.70^{a}	65.35^{b}	11.41	96.05^{a}	89.00^{ab}	93.25^{ab}	76.49^{b}	10.53
Isoleucine	98.28^{a}	61.51^{c}	69.36^{b}	64.39^{c}	2.81	98.63^{a}	61.68^{c}	70.22^{b}	71.37^{b}	3.09
Leucine	90.49^{a}	47.45^{b}	82.71^{a}	81.64^{a}	10.39	91.10^{a}	47.42^{b}	90.25^{a}	87.48^{a}	8.84
Phenylalanine	99.22^{a}	31.16^{c}	66.34^{b}	73.47^{b}	13.14	99.21^{a}	31.66^{b}	92.49^{a}	86.90^{a}	15.86
Lysine	91.74^{a}	45.38^{c}	83.59^{ab}	72.90^{b}	9.47	91.92^{a}	45.34^{c}	88.29^{ab}	81.90^{b}	5.92
Overall mean	92.16	48.79	78.09	74.28	-	92.84	48.81	85.94	82.25	-
SEM	10.11	8.43	10.34	10.19	-	9.58	8.75	10.60	8.27	-

B1: excreta digestibility for broiler chickens; B2: apparent and standardized ileal digestibility for broiler chickens; B3: intact cockerel and B4: caececectomice cockerel.
SEM: standard error of the means; Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Table 5 Apparent and true or standardized amino acid digestibility (%) for canola meals determined in the broiler chickens and adult cockerel

	Apparent amino acid digestibility					True amino acid digestibility				
AA	B1	B2	B3	B4	SEM	B1	B2	B3	B4	SEM
Aspartic acid	73.38^{b}	60.96^{c}	88.18^{a}	87.0^{6a}	4.29	73.69^{b}	61.28^{c}	89.98^{a}	88.84^{a}	4.30
Glutamic acid	76.24^{b}	65.85^{b}	91.71^{a}	90.49^{a}	6.29	77.87^{b}	67.49^{b}	92.82^{b}	92.19^{a}	6.12
Serine	75.45	61.39	85.77	82.76	16.34	75.84	61.77	88.15	88.65	16.37
Glysin	63.17	70.68	86.12	85.63	13.53	63.57	71.08	88.09	88.27	13.54
Tyrosine	69.16^{ab}	57.28^{b}	87.53^{a}	86.78^{a}	13.99	69.38^{ab}	57.53^{b}	89.51^{a}	88.89^{a}	13.99
Valine	47.32^{b}	42.96^{b}	85.92^{a}	84.99^{a}	13.51	47.59^{b}	43.07^{b}	87.72^{a}	87.18^{a}	13.44
Methionine	70.22^{b}	62.08^{b}	90.55^{a}	92.92^{a}	7.85	70.38^{b}	62.27^{b}	92.9a	94.03^{a}	7.81
Cystein	81.94	82.24	85.37	68.84	12.23	81.98	82.29	86.58	71.76	12.06
Isoleucine	67.29	66.26	86.77	87.80	21.41	67.83	66.80	86.91	89.46	21.56
Leucine	64.45^{b}	60.24^{b}	95.22^{a}	95.39^{a}	13.12	67.70^{b}	60.49^{b}	96.64^{a}	96.48^{a}	13.10
Phenylalanine	79.68	68.54	66.12	66.24	14.91	79.92	68.84	72./99	69.73	15.30
Lysine	69.56^{b}	46.14^{c}	88.33^{a}	88.013^{a}	9.01	69.89^{b}	46.52^{c}	90.21^{a}	89.92^{a}	8.89
Overall mean	69.82	62.05	86.46	84.74	-	70.22	62.45	88.50	87.12	-
SEM	20.20	14.24	4.71	6.63	-	20.20	14.23	5.00	6.65	-

B1: excreta digestibility for broiler chickens; B2: apparent and standardized ileal digestibility for broiler chickens; B3: intact cockerel and B4: caececectomice cockerel.
SEM: standard error of the means; Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Significant difference (P<0.05) in true digestibility, excreta-ileum and intact-caecectomized were recoded for 9 amino acids in soybean, 12 amino acids in sunflower and 7 amino acids in canola meals. Apparent digestibility of amino acid in soybean, sunflower and canola meals measured in broiler bioassay (excreta and ileum) were 9 to 11%, 34 to 50% and 19 to 27% units lower than those measured at the intact and caecectomized adult cockerel bioassay (P<0.05).

The significant differences were particularly evident for aspartic acid (10 to 11% units, 19 to 44% units, 14 to 26% units) glutamic acid (9 to 7% units, 7 to 28% units, 16 to 25% units) valine (11 to 17% units, 8 to 39% units, 42 to 40% units) lysine (4 to 16% units, 9 to 31% units, 19 to 42% units) in soybean, sunflower and canola meals respectively. For apparent digestibility of the 12 amino acids compared, significant (P<0.05) excreta-ileum and intact and caecectomized cockerels differences were found for 7 amino acids in soybean meal, 12 in sunflower and 7 amino acids in canola meal. For true digestibility significant (P<0.05) excreta-ileum and intact and caecectomized cockerels differences were recorded for 9 amino acids in soybean, 12 in sunflower and 7 amino acids in canola meal.

The effect of age on the excreta digestibility amino acids in soybean meals are shown in Table 6. The digestibility of amino acid in soybean meal was higher (P<0.05) at 21 age of broiler and adult cockerel compared to those at 42 d age of broiler, except for glysin, tyrosine, valine, methionine cystein, Isoleucine, and phenylalanine amino acids. The digestibility of lysine was similar at 21 and 42 d, but the digestibility was significantly higher for rooster (P<0.05).

The digestibility of amino acids was higher at 21 and 42 d than those for rooster (P<0.05). The amino acids digestibility in soybean and canola meals for 21 days broiler was higher than 42 d broiler and adult cockerel. However similar trends were not observed for the digestibility of individual amino acid. Aspartic acid, glutamic acid, serine, leucine, lysine increased significantly (P<0.05) for adult cockerel compare to broiler (21 and 42 days). For example lysine varied approximately 11% increasing was observed between broiler and adult cockerels compare than those for adult cockerel (Table 7).

The average digestibility of amino acid in broiler was lower than adult cockerel (P<0.05) and the digestibility in broiler at 42 d was lower than those in cockerel and 21 d of broiler (P<0.05). The apparent and true digestibility of amino acids in canola meals at 21 and 42 d of broiler chickens age, and adult cockerels shown in Table 8. The digestibilities of amino acids were similarly higher at 21 d broiler and adult birds than those at 42 d of broiler. Exceptions were serine, glysin, histidine, tyrosine, cystein, isoleucine, phenylalanin, and lysine for which no age effect was observed. The digestibility of amino acids in sunflower meal was not influenced by the age of broiler (21 and 42 d) and adult cockerel (Table 7).

The digestibility of amino acids was also not influenced by age, except for aspartic acid, serine, and phenylalanine.

The digestibility of lysine was similar at the age of 21 and 42 d in broiler and cockerels. However, the digestibility of amino acid were significantly higher (P<0.05) at 21 and 42 d of age of broiler chicken compared to adult cockerel.

The amino acid digestibility in sunflower meals reduced with age from 42 d broiler to adult cockerels. The digestibility of individual amino acid in adult cockerel was higher (P<0.05) than those observed in broiler for soybean and canola meals.

The broiler estimated were also lower (P<0.05) than those for cockerel except for sunflower. Digestibility of amino acid was similar between broiler and cockerel, except for glysin, praline, methionine, and phenylalanine in soybean, and histidine, cystein, and phenylalanine in canola meal; which were higher (P<0.05) in cockerel.

The effect of age on metabolizable energy content of oil seed meals (soybean, sunflower and canola meals) are shown in Table 9. The AME and AMEn values obtained for soybean were significantly different between ages (P<0.05). However, AME, AMEn, TME and TMEn values at 42 d of broiler age were significantly lower than those at the 21 d of broiler age (P<0.05). The AME and AMEn values significantly decreased with age for the soybean meals with compare broiler age to adult cockerel, but there were no significant effects of age TME and TMEn values for soybean meals.

There are significant effect of broiler age compared to adult cockerels for canola and sunflower meals metabolizable energy values (P<0.05). Thus, the ME, MEn, TME and TMEn values for canola and sunflower meals obtained at 21 and 42 d broiler age was significantly higher than those adult cockerels (P<0.05).

When comparing among 21 and 42 d broiler age, there were no different AME, AMEn, TME and TMEn values for canola and sunflower meals against adult cockerels. There were no significant differences between AME, AMEn, TME and TMEn values obtained of canola and sunflower meals determined with 21 and 42 d broiler age (Table 9). The effects of bioassay on the d metabolizable energy content of soybean, sunflower and canola meals shown in Table 10. The AMEn, TME and TMEn values of soybean obtained from excreta digestibility of broiler were significantly higher (P<0.05) than those ileum digestibility of broiler, intact and cecetomized birds but when comparing between methods as ileum digestibility and intact cockerels were no differences for MEn, TME and TMEn values of soybean meals.

Table 6 Apparent and true digestibility of amino acid in soybean meals for broilers at 21 and 42 d of age and adult cockerel

	ADAA				TDAA			
AA	21d	42d	Adult	SEM	21d	42d	Adult	SEM
Aspartic acid	85.97[ab]	78.93[b]	89.06[a]	7.99	86.54[ab]	80.13[b]	91.07[a]	8.22
Glutamic acid	87.13[ab]	79.35[b]	88.43[a]	7.58	90.68[a]	82.78[a]	90.04[a]	8.25
Serine	84.23[a]	75.17[b]	85.89[a]	8.60	84.61[ab]	76.30[b]	90.03[a]	8/55
Glysin	80.25	71.80	79.37	9.08	82.94[a]	72.60[b]	83.31[a]	9.07
Proline	86.66[a]	83.79[a]	48.84[b]	8.48	89.96[a]	84.48[a]	63.18[b]	7.59
Tyrosine	83.70	79.37	86.14	9.67	85.96	80.31	88.67	9.45
Valine	81.35	70.78	81.21	15.22	84.07	71.59	85.45	14.52
Methionine	82.79	78.03	77.67	16.39	83.03	78.64	82.72	14.83
Cystein	82.02	86.30	86.31	14.92	81.71	86.37	88.52	14.88
Isoleucine	74.81	64.10	84.77	21.22	77.12	64.82	85.11	21.26
Leucine	83.25[ab]	71.58[b]	89.42[a]	14.74	86.89[ab]	72.83[b]	92.09[a]	14.55
Phenylalanine	75.07	82.15	70.08	17.39	77.91	83.37	87.75	16.14
Lysine	82.24[b]	86.35[ab]	92.45[a]	9.2	84.06	87.08	93.83	9.33
Overall mean	82.27	77.51	82.05	-	84.27	78.56	86.70	-
SEM	13.99	13.96	11.84	-	14.02	14.00	10.03	-

SEM: standard error of the means; Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Table 7 Apparent and true digestibility of amino acid in sunflower meals for broilers at 21 and 42 d of age and adult cockerel

	ADAA				TDAA			
AA	21d	42d	Adult	SEM	21d	42d	Adult	SEM
Aspartic acid	80.70[b]	97.32[a]	77.96[b]	10.07	80.94[b]	97.88[a]	84.38[ab]	9.74
Glutamic acid	86.99	94.30	87.43	8.09	91.78	97.71	89.62	6.48
Serine	83.52[ab]	92.74[a]	71.79[b]	8.95	83.88	93.19	82.35	7.53
Glysin	83.27	85.85	65.68	13.31	87.14	86.74	74.11	12.16
Tyrosine	85.76	88.25	80.50	8.73	87.41	88.67	86.80	8.47
Valine	70.84	83.31	75.94	15.05	73.89	83.95	84.97	14.06
Methionine	71.56	88.61	87.12	18.98	70.69	89.06	94.57	18.55
Cystein	81.21	95.87	88.70	15.34	80.08	96.06	93.25	15.42
Isoleucine	62.67	98.29	69.36	23.84	64.56	98.63	70.22	23.28
Leucine	73.00	90.49	82.71	13.70	77.00	91.10	90.25	12.01
Phenylalanine	95.37[a]	99.22a	66.33[b]	14.54	100.01	99.21	92.49	17.64
Lysine	79.96	91.74	83.59	9.18	81.46	91.92	88.29	8.87
Overall mean	79.57	92.16	78.09	-	81.57	92.84	85.94	-
SEM	19.60	10.11	10.33	-	19.05	9.58	10.60	-

SEM: standard error of the means; Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Table 8 Apparent and true digestibility of amino acid in canola meals for broilers at 21 and 42 d of age and adult cockerel

	ADAA				TDAA			
AA	21d	42d	Adult	SEM	21d	42d	Adult	SEM
Aspartic acid	84.58[a]	73.38[b]	88.18[a]	4.71	84.67[a]	73.69[b]	89.98[a]	4.70
Glutamic acid	84.96[ab]	76.24[b]	91.71[a]	6.80	88.00[ab]	77.87b	92.82[a]	6.62
Serine	81.35	92.98	85.77	7.99	81.47	88.15	93.28	7.94
Glysin	77.95	65.96	86.12	11.91	81.28	66.35	88.09	11.92
Histidine	96.00	75.68	92.66	20.41	96.14	75.87	92.66	20.32
Tyrosine	80.94	69.16	87.53	13.64	83.06	69.38	89.51	13.65
Valine	74.57[ab]	47.32b	85.92[a]	16.05	77.74[ab]	47.59[b]	87.72[a]	15.97
Methionine	87.19[ab]	70.23[b]	90.55[a]	9.08	87.07[ab]	70.38[b]	92.38[a]	9.05
Cystein	86.79	81.94	85.37	6.96	86.75	81.98	86.58	6.98
Isoleucine	76.84	67.29	86.77	14.81	80.00	67.83	86.91	14.98
Leucine	79.71[ab]	64.45[b]	95.22[a]	12.36	83.17[ab]	64.70[b]	96.64[a]	12.38
Phenylalanine	88.24	79.67	66.13	12.13	92.32	79.98	72.99	12.50
Lysine	83.91	69.56	88.33	10.48	85.98	69.89	90.21	10.37
Overall mean	83.31	71.83	86.94	-	85.20	72.21	88.82	-
SEM	4.33	19.93	4.63	-	4.23	19.90	4.90	-

SEM: standard error of the means and Overall mean: mean of 12 amino acids.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Cecectomy birds had no influence on amount of metabolizable energy values contents of soybean meals. The results of experiment showed that the excreta and ileum digestibility of broiler did not have any significant effect on metabolizable energy values of canola and sunflower meals.

However, intact cockerel experienced higher metabolizable energy from canola and sunflower meals than those broiler excreta and ileum digestibility and cecectomy cockerels (P<0.05). Therefore correction to zero nitrogen and endogenous energy losses (EEL) did not have any effects on values amount of metabolizable energy content of oilseed meals. Endogenous amino acid excretion values (mg/birds per 48 h) for the fasting (intact and caecececectomice) and N-free diet (D (+) glucose) methods (mg/kg DM intake) are presented in Table 2. Mean values were differences in individual amino acid were significant. Endogenous amino acid values for serine, glysin, cystine, isoleucine and phenylalanine were different (P<0.05) between the N-free and fasting methods. The means for the fasting treatment were greater than for the N-free diet treatment for each amino acid except isoleucine. But, endogenous amino acids excretion as cystinee and iisoleucine in caececectomiced birds were significantly higher than Intact by fasting methods. However, amount of EEL and EAAL obtained of intact and caececectomice bird were not significant differences compare to N-free diet, but their result different with each other. Means values of EEL in intact and caececectomice birds were lower than N-free diet, but EAAL are higher than N-free diet (Table 2).

In the present study, data of experiments had shown that digestibility of amino acids content of soybean and canola meals obtained of intact and caectomized cockerels method were higher than those excreta and ileal digestibility of broiler chickens assay.

These differences may be development of physiology and amino acid metabolism by hindgut microflora in adult birds (Parsons *et al*. 1982). As well as, the digestibility coefficient of amino acid content sunflower meals received of broiler excreta assay was higher than those intact, caectomized and ileal (standard ileal digestibility) receptively (Kadim *et al*. 2002; Siriwan *et al*. 1993). When, fermentable cell wall carbohydrate are limiting the undigested nitrogenous substances will be dominated by the microbes to ammonia and amines resulting in net disappearance of amino acids. Other way, microflora appeared to have only a minor influence on amino acid recovery in the faces (Ten Doeschate *et al*. 1999).

The amino acid digestibility values of soybean, canola and sunflower meals determined by caececetomized birds were lower than the corresponding determined with intact birds.

Our findings are consistent with those of Parson (1984), Johns *et al*. (1986) and N. Emamzadeh and Yaghobfar (2009).

In these studies clearly data of intact birds assay demonstrated that amino acids metabolism by hindgut microflora and due to overestimated amino acid digestibility values (Parsons *et al*. 1982).

Differences observed between intact and caecectomized birds noted for digestibility of the 12 amino acid studied in soybean, canola and sunflower meals except cystein and isoleucine in sunflower meals. Apparent digestibility of lysine in intact birds had higher than caecectomized birds (Parsons, 1985; Johns *et al*. 1986). The result of present study shown that with comparing between four bioassays and age of birds for AME, AMEn, TME and TMEn values contents of three oilseed meals were significantly different (Ragland *et al*. 1999).

The excreta bioassay of broiler chicks had shown higher ME than those ileal, intact and caecectomized birds. The differences in ME values associated with age, genetics, sex and environment temperatures and species that may be attributable to variation in the FEm + UEe losses relative to the excreta energy losses of feed origins (Sibbald and Wolynetz, 1985; Yaghobfar, 2001; Yaghobfar and Zahedifar, 2003).

A comparison of age effects on amino acid digestibility of soybean, canola and sunflower meals is of practical importance. For this reason, combined analysis of data for the 3 oilseed meals at three ages was carried out.

The results indicated that, in general, the digestibility increased with advancing age of birds. This finding is in agreement with the reports of Wallis and Balnave (1984b) and Ten Doeschate *et al*. (1993). Digestibility of amino acid in soybean and canola meals was higher at 21 d than 42 d of age (Nitsan and Alumot, 1963).

The high intestinal uptake of nutrients in young chicken may be associated closely to their rapid growth rate as well as a larger intestinal surface area per unit weight (Wakita *et al*. 1970; Uni *et al*. 1995), thus, young broiler are unable to digest α-galactoside, but digestibility has been shown to increase with age (Carre *et al*. 1995). On the other hand, digestibility of most amino acids in sunflower was higher at 42 than at adult cockerels. It is difficult to propose a biological explanation for this unexpected finding (Huang *et al*. 2005). While some researchers (Hakansson and Eriksson, 1974; Zelenka and Liska, 1980; Garcia, 2007) have reported lowered digestibility of crude protein and amino acids with advancing age, others (Wallis and Balnave, 1984a; Ten Doeschate *et al*. 1993) have found that the digestibility of amino acids increased with age. It would appear that differences in the methodology used might, in part, explain the discrepancy.

Table 9 Effect of bird's age on the metabolizable energy content of soybean, canola and sunflower (kJl/kg DM)

Age*	AME	AMEn	TME	TMEn
Soybean meal				
21 d	11.549[a]	11.442[a]	11.655[a]	10.278[a]
42 d	10.133[c]	10.085[c]	10.239[b]	10.167[b]
Adult	10.766[b]	10.768[b]	11.564[a]	11.566[a]
Canola meal				
21 d	10.549[a]	10.447[a]	10.655[a]	10.527[a]
42 d	10488[a]	10.394[a]	10.593[a]	10.476[a]
Adult	8.918[b]	8.919[b]	9.436[b]	9.437[b]
Sunflower meal				
21 d	10.867[a]	10.779[a]	10.972[a]	10.870[a]
42 d	10.420[a]	10.361[a]	10.526[a]	10.439[a]
Adult	6.097[b]	6.099[b]	6.749[b]	6.751[b]

AME: apparent metabilizable energy; AMEn: nitrogen correction of apparent metabolizable energy; TME: true metabolizable energy and TMEn: nitrogen correction of true metabolizable energy.
* 21 and 42 d age (excreta digestibility for broiler chickens), adult (intact cockerel).
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

Table 10 Effect of excreta broiler, intact and cecectomy cockerel bioassays on metabolizable energy content of soybean, canola and sunflower (kJ/kg DM)

Bioassays	AME	AMEn	TME	TMEn
Soybean meal				
Broiler excreta	10.766[a]	10.768[a]	11.564[a]	11.566[a]
Broiler ileum	9.644[c]	9.647[b]	10.495[b]	10.497[b]
Cockeral intact	10.133[b]	10.085[b]	10.239[b]	10.167[b]
Cockerel ceccectomice	8.402[d]	8.301[c]	8.508[c]	8.383[c]
Canola meal				
Broiler excreta	8.917[b]	8.920[b]	9.435[b]	9.437[b]
Broiler ileum	8.675[b]	8.677[b]	9.174[b]	9.176[b]
Cockeral intact	10.487[a]	10.394[a]	10.593[a]	10.476[a]
Cockerel ceccectomice	9.005[b]	8.900[b]	9.111[b]	8.982[b]
Sunflower meal				
Broiler excreta	6.097[c]	6.099[c]	6.749[c]	6.751[c]
Broiler ileum	5.725[c]	5.728[c]	6.396[c]	6.398[c]
Cockeral intact	10.420[a]	10.361[a]	10.526[a]	10.439[a]
Cockerel caececectomice	8.634[b]	8.522[b]	8.738[b]	8.605[b]

AME: apparent metabilizable energy; AMEn: nitrogen correction of apparent metabolizable energy; TME: true metabolizable energy and TMEn: nitrogen correction of true metabolizable energy.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

Table 11 Endogenous amino acids excretion by cockerel fasting (unfed) and broiler fed nitrogen free diet (mg/birds per 48 h)

Amino acid	Fasting intact	Caececectomice	N. free diet	Mean	SEM	Significant
Aspartic acid	11.26	13.35	12.58	12.39	3.55	0.71
Glutamic acid	38.18	36.98	38.21	37.79	10.89	0.98
Serine	31.83 [a]	41.77 [a]	18.66 [b]	30.75	7.36	0.005
Glysin	21.28 [a]	19.46 [ab]	12.87 [b]	17.87	4.55	0.06
Alanine	7.57	5.88	6.82	6.76	1.97	0.50
Proline	15.79	16.83	12.28	14.97	3.92	0.28
Tyrosine	9.19	19.15	11.59	9.98	3.10	0.47
Valine	15.76	15.32	14.98	15.35	4.35	0.96
Methionine	5.91	4.27	6.19	5.45	1.69	0.27
Cystine	2.57 [b]	4.43 [a]	0.44 [c]	2.48	0.57	0.0001
Isoleucine	1.22 [b]	10.27 [a]	11.43 [a]	7.64	2.86	0.001
Leucine	21.98	14.69	17.32	17.99	5.19	0.19
Phenylalanine	45.84 [a]	39.65 [a]	7.22 [b]	30.91	7.43	0.0001
Lysine	17.36	10.74	18.97	15.69	5.10	0.10

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 12 Mean values for endogenous energy loss (EEL) and nitrogenous loss (NL) by cockerel fasted, and broiler chicks fed an N-free diet

	Intact	Caecectomice	N. free diet	Mean	SEM	Significant
EEL (kcal/48 h)	21.44[b]	21.81[b]	77.42[a]	40.22	15.96	0.0001
EAAL	17.55[a]	17.34[a]	13.54[b]	16.14	5.17	0.0001
NL (g)	1.14	1.19	1.68	1.33	0.56	0.13

SEM: standard error of the means.
a, b: the means within the same column with at least one common letter, do not have significant difference (P>0.05).

It is being increasingly recognized that the determination of amino acid digestibility in poultry should be based on the analysis of ileal digesta, because of the modifying and variable effects of caecal microflora (Ravindran *et al*. 1999). Endogenous losses causes differences in apparent amino acid digestibility between intact and caecectomized birds (Nouri-Emmamzadeh and Yaghobfar, 2009; Kessler *et al*. 1981).

Differences in the endogenous amino acids output between intact and caecectomized birds have been no constant it may depend on age of birds and environment temperature of experiment, because Gereen *et al*. (1987) shown not to be statistically different.

The data indicated that endogenous amino acid excretion using the N-free method was much lower than that in the fasted birds (intact and caecectomized), except isoleucine that was higher in N-free nitrogen. This result contrast with Song *et al*. (2003) that reported endogenous amino acid excretion using the N-free methods was much higher than that in the fasted birds (Ravindran, 2005). But, Prasons *et al*. 1983 and Muztar and Slinger (1980) reported that quantities endogenous amino acid excretion by intact and caecectomized adult cockerel was not significant difference. However, with respect to amino acid excretion from birds fed a protein-free diet vs. fasted control birds are conflictive (Crissey and Thomas 1983; Enyster, 1984).

Small intestinal and pancreatic secretions contribute the greatest to total endogenous secretions, and the principal components of these endogenous secretions are mucoproteins and digestive enzymes, which are rich in phenylalanine, glycine, Isoleucine, cystine, serine, (Chung and Baker, 1992) and this may entail an error of estimation than gave different results in the determination of true digestibility amino acid in poultry (Ravindran *et al*. 1999; Song *et al*. 2004).

Thus, in correction using endogenous amino acids determined a different age would clearly result in less accurate true digestibility estimates (Ravinidram *et al*. 2001). Result of experiment, shown that mean value of EEL for the N-free treatment was greater (P<0.05) than for the fasting treatment.

CONCLUSION

The study confirmed significant differences between ileal and excreta digestibilies and also, for intact and caecec tomized cockerels for soybean, canola and sunflower meals. It also showed that AMEn, TME and TMEn values of soy bean obtained from excreta digestibility of broiler were significantly higher than ileum digestibility in broiler, intact and caecectomized digestibility in cockerels. Therefore, intact cockerels experienced higher metabolizable energy from canola and sunflower meals than those excreta and ileum digestibility or caecectomized cockerels. The data show that endogenous amino acid excretion obtained of the N-free method was lower than the fasted birds as intact and caecectomized, but, amount of endogenous energy losses (EEL) was greater.

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