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

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Abstract: The experiment was conducted to determine metabolizable energy and amino acid digestibilities of the soybean, sunflower and canola meals using broiler chickens by collection digesta from the terminal ileum and excreta using titanium oxide (indigestible marker) in intact and caecectomized cockerels. The mean excreta apparent and true digestibility of amino acid in broiler and intact cockerel for soybean meal were 76.99, 78.07, 84.18 and 88.35 sunflower meal: 92.16, 92.84, 78.09 and 85.94 and canola meal 69.82, 70.22, 86.47 and 88.50%, respectively. The mean values of ileum apparent and true digestibilities (Standardized Ileal digestibility) of amino acid in broiler for soybean meal were 72.18 and 73.12; sunflower meal: 47.48 and 48.47 and canola meal: 62.05 and 62.45%, respectively. The average apparent and true digestibilities of amino acid in caecectomized cockerel and broiler in soybean meal were 80.34 and 84.45 sunflower meal 74.48 and 82.47 and canola meal 84.74 and 87.12%, respectively. Apparent digestibility of amino acid in soybean, sunflower and canola meals measured in broiler (excreta and ileum) were 9-11, 34-50 and 19-27% units lower than those measured in intact and caecectomized cockerel. The AME, AMEn, TME and TMEn values for canola and sunflower meals obtained at 21 and 42 days broiler age were significantly higher than cockerels. Intact cockerels obtained higher metabolizable energy from canola and sunflower meals than those broiler excreta or ileum and caecectomized cockerels.

INTRODUCTION

A number of factors influence the metabolizable energy and amino acid digestibility of oilseed meals. A number of studies have demonstrated that the amino acid digestibility and metabolizable energy of feed ingredients may depend upon the age, genotype and gender of the bird. Difficulties associated with amino acid bioassay can be a major source of variation which is often overlooked (Ravindran and Bryden, 1999). A number of studies have examined this factor using broilers of different ages, laying hens and roosters fed different cereals and protein meals (Wallis and Balnave, 1984a, b; Rostagno *et al*., 1995; Batal and Parsons, 2002a, b; Huang *et al*., 2005, 2006, 2007; Garcia *et al*., 2007). In general, the digestibility coefficient of amino acids increases with age and varies with feedstuff.

Digestibility assay may be separated into two main categories: excreta and ileal Excreta digestibility involves the collection of excreta from intact or ceaccectomized birds. For measurement of ileal digestibility digesta are collected from the digesta part of the ileum. Most of the published data on digestible amino acids in feed ingredients have been obtained from excreta assays with roosters (Green *et al*., 1987; Parsons, 1991; NRC., 1994; Rhone-Poulenc, 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 (Ravindran *et al*., 2005). The caecal microflora may change the profile of amino acid during 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). Endogenous amino acid at the ileal level can be divided into a basal EAAL fraction assumed to be independent of the raw material and to be occur 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. Golian reported that using the NFD methods which is relatively simply, may allow feed ingredients to be compared more accurately, thus leading to a greater consistency in feed evaluation. Ravindran and Hendriks shown that amino acid profile of endogenous amino acids losses did not differ between broiler, layer and aduld rooster except for serine, glutaminc acid, proline and isoleucine.

Song *et al*. (2003) reported that differences in endogenous amino acid excretion using the N-free and fasting methods. However, the true available amino acids were higher for the N-free methods than for the fasting methods.

The main objective of the present study was to compare estimates of amino acid digestibility and metabolizable energy determined using differences bioassay and age on the excreta and ileal digesta in broiler chickens and intact and caecectomized cockerel of soybean, canola and sunflower meal.

MATERIALS AND METHODS

To compare the amino acid digestibility obtained by the apparent and standardized chick excreta and ileal digestibility and the Conventional Additional Method (CAM) intact and cecectomized adult cockerel assays, two experiments were conducted.

Experiment 1

Birds and housing: The experiments were conducted to determine metabolisable energy and amino acid digestibility content of the soybean, sunflower and canola meals by used a bioassay as collecting ileum digesta and excreta of male broiler chickens. About 200 day-old male broiler chicks (Rose 308) were placed in metabolic cage in environmentally controlled rooms where the initial temperature were 32°C and reduced weekly by 2°C (at an ambient temperature of 21°C and 24-h light), Birds were randomly assigned to each dietary treatment with 6 replicate containing 2 chicks each (12 birds per treatment). The birds received the experimental diets *ad libitum* from 15-21 days of age and from 35-42 days. After the acclimatization period, the birds were given their respective diets *ad libitum* for 4 days and were fasted for 24 h. The birds were then allowed to consume the respective diet for a 3 days period. The birds were again fasted for 24 h. Following this, excreta were collected for 3 time on a tray place under each cage, transferred to frozen (-25°C). Other the killing the birds on days 42 and the contents of the ileum digesta were collected for determine amino acid digestibility and metabolizable energy content of the meals was determined by using Titanium Oxide (TiO_2) as a marker. Birds were euthanatized 4 h later and the small intestine was immediately exposed. The ileum was tied off, using the vitelline diverticulum as the boundary between jejunum and ileum. Ileal contents were expressed by gentle manipulation and the ileum flushed with distilled water to complete the removal of contents. Because 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 stored at -20°C. Samples, after freeze were ground to pass though a 0.5 mm sieve prior to analysis.

Thus, amino acid content in digesta and excreta were determined in 3 samples per treatment. Feed, ileal digesta and excreta samples submitted to quantify amino acids.

Calculations and statistical analysis. The following equations were used for calculation of metabolizable energy content oil seed meals:

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

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

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

$$\text{TMEn (kcal)} = \text{AMEn} + [\text{EEL} + (8.73 * NR_{o})/I_{\text{ntake}}]$$

Where:

- GE = Gross energy
- N = Nitrogen
- TiO_2 = Titanium dioxide
- 8.73 = The energy equivalent of uric acid nitrogen that is 8.73 kcal kg^{-1} of uric acid nitrogen
- EEL = Endogenous Energy Losses by the nitrogen free (D glucose) diet fed chickens
- RN_o = (FmEn+UmEn+UeEn)

The substitution, method uses the equation below for calculation of the AME of the test ingredient (oil seed meals) from the AME of the basal diet and the AME of the test diet (oil seed meals) and basal diet.

ME of test ingredient (kcal) = [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 TiO_2 as an indigestible marker at a level of 0.3 %:

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

Where:

- $ADAA_{Diet}$ $TiO_{2Digesta}$ = Apparent amino acid digestibility of diet or digestibility coefficient
- TiO_{2Diet} and $AA_{Digesta}$ = Respective concentrations of TiO_2 in the diet and digesta samples (g kg^{-1})
- AA_{Diet} and = respective concentrations of the AA in the diet and digesta samples (g kg^{-1})

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 aminoacid (%) = apparent amino acid digestibility(%)+[(endogenous amino acid lossesas g/100 g of DM)/(amino acid content of the feedstuffs as g/100 g of DM)×100].

True amino acid digestibility for excreta in broiler of the assay diets was calculated using the following equation.

True amino acid excreta 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 assay as caecectomised and intact adult cockerels to determine amino acids digestibility and metabolizable energy and also quantities for Soybean (SBM), Canola (CM), Sunflower (SFM) meals. The thirty two (16 intact and 16 caecectomized) adult cockerels (Rhode Island Red type, RIR), (age, 40 weeks; mean body weight, 2.900 kg) were maintained in individual metal cages (0.66 m×0.66 m) with 16 h light/day and free access to feed and water. The average temperature in the experiment house was 24±2°C with a lighting cycle of 16:8 h (light: dark). 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 as before experiments, adult cockerels were fed on a diet containing corn (50%), wheat (13%), barley (7.4%), soybean meal (20%) and mineral-vitamin mixture (0.5%). Also before the start of experiment, the birds withheld for 24 h to ensure that no feed residues remained in their alimentary tracts. For the conventional addition method (CAM) method, the experimental period was 6 days: a 3-days pre-collection period and a 3-day collection period. Amount of feed intake during 3 day of experiment period as 118.79-214.17 g per each bird (average 164.86 g). An additional 6 birds were given no feed and served as negative controls to provide a measure of the FEm and UEe (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 by means of an adiabatic oxygen bomb calorimeter.

Caecetomised adult birds (cockerel): Caecetomised cockerels were used to overcome the problem of microbial modification of dietary protein and microbial protein synthesis in the hindgut. 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 according with it described by Angkanaporn *et al*. (1997) and 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. About 2 weeks after the operation, the cockerels were used for experiment. Samples 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) (Association of Analytical Chemists). The collected excreta were dried, weighed and ground to pass a 1-mm screen. For amino acid analysis, the samples were hydrolyzed with 6N HCL and then quantities of amino acids determined by High-Performance Liquid Chromatography (HPLC) according to the procedure described by Siriwan *et al*. (1993) and Moore (2004).

Calculations and statistical analysis: The mean value of oil seed meals were determined for each replicated. 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 from the experiment were evaluated by the following formulae (Yaghobfar and Boldaji, 2002):

$$\text{AME (Kcal kg}^{-1}\text{ DM)} = [\text{IE-(FE + UE)}]/\text{FI}$$

$$\text{AMEn (Kcal kg}^{-1}\text{ DM)} = [(\text{IE-(FE+UE)-K (IN-(FN + UN)}]/\text{FI}$$

$$\text{TME (Kcal kg}^{-1}\text{ DM)} = \text{AME + EEL/FI}$$

$$\text{TMEn (Kcal kg}^{-1}\text{ DM)} = \text{AMEn+(EEL + (RNo}\times 8.74))/\text{FI}$$

$$\text{RNo} = (\text{FmEn + UmEn + UeEn})$$

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:

$$\text{ADAA (\%) or digestibility cofficient} = \left[\frac{(\text{Aa}_c\text{-AA}_e)}{\text{AA}_c}\right]\times 100$$

$$\text{TDAA(\%)} = \left[\frac{(\text{AA}_c\text{-AA}_e\text{+EAAL})}{\text{Aa}_c}\right]\times 100$$

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

HPLC: The frozen samples were removed from the freezer and placed in an oven to be 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 AOAC 1990 (Association of Analytical Chemists). 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) and Moore (2004).

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 Institute, 1990) based on completely randomized design with 4 replications. The Duncan's test was used to elucidate differences between treatments means with 0.05 level considered significant.

RESULTS

The chemical compositions, amino acid concentration and effect of age and bioassay on apparent and true ileal and excreta amino acid digestibility of oilseed meals (soybean meal, canola meal and sunflower meal) evaluated are shown in Table 1-8. The differences between ileal and excreta values from broiler and cockerel (intact and caecectomized) varied depending on the oil meals and the amino acid considered. Among oil meals, average ileal and excreta of broiler and cockerel (intact and caecectomized) amino aciddigestibility values

Table 1: Chemical composition (Means±SEM) (Percent/DM) and amino acid concentration (g/100 g) 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	35.70
Crude fiber	6.91	25.25	17.15
Crude ash	6.70	7.95	8.00
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

	Age*					
	Soybean meal		Sunflower meal		Cotton meal	
Oil meals	ADAA**	TDAA	ADAA	TDAA	ADAA	TDAA
21 days	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 days 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)

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	-

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), B4 (caececectomice cockerel) SEM (Standard error of the means)$^{a-b}$ Means within row with different superscript are significantly different ($p<0.05$) Overall mean (Mean of 12 amino acids)

(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 higher than the corresponding excreta amino acid digestibility values. But for excreta amino acid digestibility in adult bird (intact and Caecectomized) were not significantly different ($p>0.05$).

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}	4.300
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}	6.120
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}	7.810
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}	8.890
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), B4 (caecectectomice cockerel) SEM (Standard error of the means)$^{a-b}$ Means within row with different superscript are significantly different ($p<0.05$) Overall mean (Mean of 12 amino acids)

Table 6: Apparent and true digestibility of amino acid in soybean meals for broilers at 21 and 42 days 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	-

Table 7: Apparent and true digestibility of amino acid in sunflower meals for broilers at 21 and 42 days 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}	9.740
Glutamic acid	86.99	94.30	87.43	8.090	91.78	97.71	89.62	6.480
Serine	83.52^{ab}	92.74^{a}	71.79^{b}	8.950	83.88	93.19	82.35	7.530
Glysin	83.27	85.85	65.68	13.31	87.14	86.74	74.11	12.16
Tyrosine	85.76	88.25	80.50	8.730	87.41	88.67	86.80	8.470
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}	99.22^{a}	66.33^{b}	14.54	100.01	99.21	92.49	17.64
Lysine	79.96	91.74	83.59	9.180	81.46	91.92	88.29	8.870
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	-

The average excreta apparent and true digestibility of amino acid from broilers and cockerels are as followed: soybean meal 76.99 and 78.07, 84.18 and 88.35, sunflower meal 92.16, 92.84, 78.09 and 85.94 and canola meal 69.82 and 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 and 73.12, sunflower meal 47.48 and 48.47

Table 8: Apparent and true digestibility of amino acid in canola meals for broilers at 21 and 42 days 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]	4.710	84.67[a]	73.69[b]	89.98[a]	4.70
Glutamic acid	84.96[ab]	76.24[b]	91.71[a]	6.800	88.00[ab]	77.87[b]	92.82[a]	6.62
Serine	81.35	92.98	85.77	7.990	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]	9.080	87.07[ab]	70.38[b]	92.38[a]	9.05
Cystein	86.79	81.94	85.37	6.960	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)[a-b] Means within row with different superscript are significantly different ($p<0.05$)Overall mean (Mean of 13 amino acids)

and canola meal 62.05 and 62.45%, respectively. The average cockerels ceccectomized apparent and true digestibilities of amino acids in broiler for soybean meal were 80.34, 84.45, sunflower meal 74.48 and 82.47 and canola meal 84.74 and 87.12%, respectively. Proportional differences were present in means of amino acid digestibility between the broiler excreta and ileal with cockerels intact and caecectomized.

The excreta digestibility of amino acid in soybean and canton meals for broiler and cockerel was higher than that for ileum and caecectomized broiler and cockerel respectively. The amino acid digestibility of different age in soybean meal and canola meal (Table 2) for 21 days broiler and adult cockerel was higher than 42 days broiler ($p<0.05$). However, the average digestibility of amino acids content of sunflower in 42 days broiler was higher than 21 days 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 than the corresponding ileum, intact and caecectomized amino acid digestibility values. The average excreta and ileum 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. 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%, 34-50% 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 (10-11% units, 19-44% units, 14-26% units) glutamic acid (9-7% units, 7-28% units, 16-25% units) valine (11-17% units, 8- 39% units, 42-40% units) lysine (4-16% units, 9-31% units, 19-42% 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 days 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 days but the digestibility was significantly higher for adult cockerel ($p<0.05$). The digestibility of amino acids was higher at 21 and 42 days than those for adult cockerel ($p<0.05$). The amino acids digestibility in soybean and canola meals for 21 days broiler was higher than 42 days broiler and adult cockerel. However similar trends were not observed for the digestibility of individual amino acid. Aspartic acid, glutamic acid, serine, leucine and 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. The digestibility of amino acid in sunflower for broiler was significantly ($p<0.05$) higher 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 days was lower than those in cockerel and 21 days of broiler ($p<0.05$). The apparent and true digestibility of amino acids in canola meals at 21 and 42 days of broiler chickens age and adult cockerels shown in Table 8.

The digestibilities of amino acids were similarly higher at 21 days broiler and adult birds than those at 42 days 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 days in broiler and cockerels. However, the digestibility of amino acid were significantly higher ($p<0.05$) at 21 and 42 days of age of broiler chicken compared to adult cockerel.

The amino acid digestibility in sunflower meals reduced with age from 42 days 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 days of broiler age were significantly lower than those at the 21 days 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 days broiler age was significantly higher than those adult cockerels ($p<0.05$). When comparing among 21 and 42 days 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 days broiler age (Table 9). The effects of bioassay on the days 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

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

Age* (days)	AME	AMEn	TME	TMEn
Soybean meal				
21	11.549 [a]	11.442 [a]	11.655[a]	10.278[a]
42	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	10.549[a]	10.447[a]	10.655[a]	10.527[a]
42	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	10.867 [a]	10.779[a]	10.972[a]	10.870[a]
42	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]

[a-b]Means within column with different superscript are significantly different ($p<0.05$)*21 and 42 days age (excreta digestibility for broiler chickens), adult (intact cockerel)

Table 10: Effect of excreta broiler, intact and cecectomy cockerel bioassays on metabolizable energy content of soybean, canola and sunflower (kJ kg^{-1} 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]	8.383c
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]	6.749c	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 Caecectomice	8.634[b]	8.522[b]	8.738[b]	8.605 [b]

[a-b]Means within column with different superscript are significantly different ($p<0.05$)

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

	Fasting					
Amino acid	Intact	Caececectomice	N. free diet	Mean	SEM	Significant
Partic acid	11.26	13.35	12.58	12.39	3.55	0.7100
Glutamic acid	38.18	36.98	38.21	37.79	10.89	0.9800
Serine	31.83 [a]	41.77[a]	18.66[b]	30.75	7.36	0.0050
Glysin	21.28 [a]	19.46[ab]	12.87[b]	17.87	4.55	0.0600
Alanine	7.57	5.88	6.82	6.76	1.97	0.5000
Proline	15.79	16.83	12.28	14.97	3.92	0.2800
Tyrosine	9.19	19.15	11.59	9.98	3.10	0.4700
Valine	15.76	15.32	14.98	15.35	4.35	0.9600
Methionine	5.91	4.27	6.19	5.45	1.69	0.2700
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	0.0010
Leucine	21.98	14.69	17.32	17.99	5.19	0.1900
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	0.1000

[a-b]Means within column with different superscript are significantly different ($p<0.05$)

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

	tact	Caececectomice	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

intact cockerels were no differences for MEn, TME and TMEn values of soybean meals. 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 caececectomice) and N-free diet (D (+) glucose) methods (mg kg^{-1} DM intake) are shown in Table 11. 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 cystine and isoleucine 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 12).

DISCUSSION

In the present study, data had shown that digestibility of amino acids content of soybean and canola meals from intact and caectomized cockerels were higher than those excreta and ileal digestibility of broiler chickens, the reason of this result may be development of physiology and amino acid metabolism by hindgut microflora in adult birds (Parsons *et al*., 1982).

As well as, the digestibility or coefficient digestibility of amino acid content of sunflower for broiler excreta assay was higher than those other bioassay as intact, caectomized and ileal (standard ileal D), receptively (Kadim *et al*., 2002; Siriwan *et al*., 1993). It may be amounts of cell wall carbohydrates that are poorly digestibility in the small intestine. 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*., 1993).

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 *et al*. (1983) and Johns *et al*. (1986). In these studies clearly demonstrated that amino acids metabolism by hindgut microflora in intact birds and influence amino acid digestibility and due to overestimated or excess values (Parsons *et al*., 1982).

Differences observed between intact and caecectomized birds noted for the apparent amino acids digestibility of the 12 amino acid studied in soybean, canola and sunflower meals except cystein and isoleucine in sunflower meals. These differences become insignificant when apparent digestibility were amended to true or standard digestibilities except for glysin which had significantly higher digestibility in intact birds (87.72) compared to caecectomized birds (72.06) in canola meal and lysine which had higher apparent digestibility in intact than in caecectomized birds. Differences in true digestibility of lysine between intact and caecectomized birds were substantial for three oilseed meals, higher in intact birds compared to caecetomized birds. The general effects of caecectomized observed in the present experiments are consistent with result described for caecectomized birds by various authors (Parsons, 1985; Johns *et al*., 1986).

This way, intact birds compared to excreta and caecectozied had more 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). In influences on ME values contents of canola and sunflower meals in contrast to soybean meal. But excreta bioassay of broiler chicks had shown higher ME than those ileal, intact and caecectomized birds. Metabolizable energy values obtained of caecectomized birds lower than other bioassays. 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 (1984) and TenDoeschate *et al*. (1993). Digestibility of amino acid in soybean and canola meals was higher at 21 days than 42 days of age. Furthermore, trypsin and chymotrypsin activities in the pancreas have been shown to reach a maximum at day 11 post-hatching and reduce at 23 days (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 (Zelenka and Liska, 1980; Garcia *et al*., (2007) have reported lowered digestibility of crude protein and amino acids with advancing age, others (Wallis and Balnave, 1984; TenDoeschate *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. 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).

The differences in apparent amino acid digestibility between intact and caecectomized birds were in endogenous losses (Mirhadi *et al*., 2009; Kessler, 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 ($p<0.05$) 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. Also, Ravindran shown that endogenous flows of amino acid obtained in broiler and rooster were similar except serine and isoleucine in rooster were higher than broiler. But, contrast with Prasons *et al*. (1983) and Muztar and Slinger (1986). Thus, quantities endogenous amino acid excretion by intact and caecectomized adult cockerel were not significant difference. Reporters however, with respect to amino acid excretion from birds fed a protein-free diet vs. fasted control birds are conflictive. 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*., 2003). Thus, in correction using endogenous amino acids determined a different age would clearly result in less accurate true digestibility estimates (Ravinidran *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 caecectomized cockerels for soybean, canola and sunflower meals. It also showed that AMEn, TME and TMEn values of soybean 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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