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Evaluation of Apparent Metabolizable Energy of Five Oil Sources in Broiler Chickens

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Abstract: Digestibility trial was conducted to evaluate the apparent metabolizable energy (AME) of crude palm oil (CPO), soybean oil (SO), crude palm fruit oil (CPFO), RBD palm olein (RBDPO) and RBD palm olein + lecithin were evaluated. A total of 100, 1-day old broiler chicks were purchased from local hatchery. On day 21, birds with similar body weight were picked randomly and distributed to experimental units with three birds per unit (cage) and five replicates per unit were randomly distributed. The birds fed for eight days with five test diets containing different oil sources (CPO, SO, CPFO, RBDPO and RBDPO+L), that were developed by replacing 60g/kg of the basal diet and corn-soy basal diet. The findings showed that there were no significant different (P>0.05) among the treatment in apparent metabolizable energy for the different oils.

Keywords: Apparent metabolizable energy; broiler chicken; digestibility; palm fruit oil.

تقييم الطاقة الأيضية الظاهرة لخمسة مصادر زيتية في الدجاج اللاحم

المستخلص: تم إجراء تجربة الهضم لتقييم الطاقة الأيضية الواضحة (AME) لزيـ ت النخيـ ل الخام (CPO)، وزيت فول الصويا (SO)، وزيت ثمار النخيل الخام (CPFO)، وتم تقييم أولين النخيل RBD (RBDPO) وأولين النخيل RBD + الليسيثين. تم شراء عدد 100 فـ رخ لاحـ م عمر يوم واحد من المفرخ المحلي. في اليوم 21، تم اختيار الطيور ذات الوزن المماثل عشوائيا ووزعت على الوحدات التجريبية بواقع ثلاثة طيور لكل وحدة (قفص) وخمسة مكـ ررات لكـ ل وحدة تم توزيعها عشوائيا. تم تغذية الطيور لمدة ثمانية أيام بخمسة أنظمة غذائية اختبارية تحتوي على مصادر زيتية مختلفة (CPO، وSO، وCPFO، وRBDPO، وRBDPO+L)، والتي تـ م تطويرها عن طريق استبدال 60 جم/كجم من النظام الغذائي الأساسي والنظام الغذائي الأساسـ ي للذرة وفول الصويا. أظهرت النتائج عدم وجود اختلاف معنوي (P>0.05) بين المعاملات فـ ي الطاقة الأيضية الواضحة للزيوت المختلفة.

الكلمات المفتاحية: طاقة واضحة قابلة للاستقلاب؛ الدجاج اللاحم؛ الهضم. زيت ثمار النخيل.

INTRODUCTION

Vegetable oils and animal fats are used in poultry diets to enhance energy concentration and to boost productivity (Lopez-Bote et al., 1997). Because of their high apparent metabolizable energy (AME), the (AME) content in oils is thrice higher than the other source of energy which is used in poultry diet (Mateos & Sell, 1981). Feeding cost account about 65% of total production cost, dietary oils maybe can help industry to produce meat at a reasonably price by improve the growth performance and meat yield (Corzo et al., 2005).

The supplement of oil in checks diet, in addition of being the main source of energy, also enhance the absorption of fat-soluble vitamin, decrease the pulverulence, elevate the palatability of the diet and increase the adequacy of the consumed energy. Moreover, it reduces the passage rate of the food that is under digestion in the gastrointestinal tract, that permits a well absorption of all nutrients present in the diet (Ayed et al., 2015; Baião & Lara, 2005). Soybean oil and palm fruit oil are commonly used in feed factory.

While former findings have shown the influence of complementing different kinds of oils on growth performance, apparent metabolizable energy (AME) and metabolism of fats in broiler chicken, the information are still not reliable. Because of that, Tancharoenrat et al. (2013) observed that the birds consuming tallow has a significantly higher percentage of apparent metabolizable energy compared with birds consumed soybean oil, palm fruit oil and poultry fat. Abdulla et al. (2016) found that there were no significant difference in apparent metabolizable energy between birds consuming palm fruit oil, linseed oil and soybean oil despite they are different in their fatty acid profile. In addition, most available data on the AME of different source of oil which used in broiler diets are very old (25 to 50 years ago) and most of the studies were conducted using slow growing strains of broiler chickens, not only have broiler strains changed the oils source also changed in their (composition and quality) Thus, the current study was aimed at assessing the AME in different source of oils: Crude Palm oil (CPO), Soybean oil (SO), RBD Palm olein (RBD PO), Crud Palm Fruit oil (CPF) and RBD Palm olein + 2% lecithin when fed to broiler chicks.

MATERIALS AND METHODS

Birds, husbandry and experimental procedure

A total of 100 one-day old Cobb500 broiler chicks were purchased from a commercial hatchary. The starter diet (22% crude protien) were offerd from one day old until day 21. The birds were raised in open-sided house under the tropical conditions at the Research station in Universiti Putra malaysia. The birds were given feed and water ad-libitum. All birds were vaccinated with ND-IB live vaccine (May Vac, Kuala Lumpur, Malaysia) against infectious bronchitis and Newcastle Disease on day 4, IBD vaccine (May Vac, Kuala Lumpur, Malaysia) against infectious bursal disease on day 7 and ND -IB live vaccine against infectious bronchitis and Newcastle diseases on day 21 through eye drops. On day 21 birds with similar body weight were picked randomly and distributed to experimental units; 3 birds per unit (cage) and five replicates per treatment were distributed randomly to a basal diet and each of the five test diets: Crude palm oil CPO ; Soybean oil SO; Crude palm fruit oil CPFO; RBD palm olein; RBD Palm olein + lecithin 2% (E8000-S2). The composition of Fatty Acid (% of Total Identified Fatty Acid) is shown in Table 1. For the measurement of AME test the classic total extra method was used. The birds were fed in mash form for a periode of eight days, with first four days as an adaptation period. During the last four days, feed intake (FI) of each unit were recorded, and the chicks' feces were collect on daily basis, collected and weighted within a cage. The collected feces was mixed thoroughly sub-sumple and freeze-dried (Model 0610, Cuddon Engineering, Blenheim, New Zealand). Dried excreta sample were crushed to pass through a 0.5 mm sieve and stored in airtight plastic containers at – 4˚ C for further analyses. Dry matter (DM) and gross energy (GE) of the diet and excreta samples were analyzed at the laboratories of Universiti Putra Malaysia.

Apparent metabolizable energy assay

The AME of CPO, CPFO, RBD PO and RBD PO+2%L and SO were determined based on the method of Horwitz. W and Latimer (2000). Official Methods of Analysis of AOAC International, Gaithersburg MA, USA. Association of Official Analytical Chemist. (Nalle et al., 2011). In this method, corn-soybean basal diet was formulated (Table 2) and the test diets, each containing different oil samples, were developed by replacing (w/w) 60 g/kg of the basal diet with different oil. The DM was determined using standard procedures (Horwitz. W & Latimer, 2000).

Before oven drying, the samples were weighted and placed in an oven dryer for 24 hours at a temperature of 105˚ C and after half an hour cooling in a desiccator the weights were recorded again. An adiabatic bomb calorimeter (Gallenkamp Autobomb, Uk) standardised with benzoic acid was used to detemine the GE.

The AME for both the basal and test diet (different oils) was caculated based on Ravindran et al. (2014) using the following formula:
AME of diet (kcal/kg) = [(FI × GE diet) – (Excreta output × GE excreta)] ÷ FI
AME of the oil (kcal/kg) = [(AME of test diet) – (AME of basal diet × 0.95)] ÷ 0.06.

Table:(1). The composition of fatty Acid (% of total identified fatty acid) of different oils.

Fatty Acid	Crude Palm Oil	Soybean oil	Crude Palm Fruit oil	RBD Palm olein	RBD Palm olein + lecithin
C6					
C8			0.3		
C10	0.2		0.7		
C12	0.2		3.8	0.1	0.2
C14	1		2.1	0.9	1
C15	0.1		0.1		0.1
C16	45.7	10.84	39.7	40.3	42
C16:1			0.2	0.2	0.2
C17	0.2		0.2	0.1	0.2
C18	4.2	3.84	4	3.9	4.2
C18:1	37.2	23.18	38	40.6	40.1
C18:2	10.2	53.92	10.6	12.8	11.3
C20	0.3	0.38	0.4	0.4	0.4
Total Fat	99.3	92.2	99.8	99.3	99.5

Table:(2). Composition of the basal diets (as fed basis) used in the AME digestibility assays.

Ingredients (%)	AME Assay[1]
corn	64.51
Soybean meal	31.27
MDCP 21%	1.35
Calcium carbonate	1.55
Salt	0.30
L-Lysine	0.30
DL-Methionine	0.20
Anti-Oxidant	0.02
Vitamin mix	0.10
Mineral mix	0.15
Choline chloride	0.10
Toxin binder	0.15
Total, kg	100
Calculated analysis	
ME Kcal/Kg	2966.00
Protein (%)	19.00

[1]Test diets were prepared by replacing 60g/kg of the basal diet with Crude palm fruit oil, Soybean oil, Crude palm fruit oil, RBD palm olein, RBD Palm olein + lecithin 2% (E8000-S2).

Statistical analysis

Data were analyzed by one-way Analysis of variance (ANOVA) using the general linear Model (GLM) procedure of the statistical Analysis System (SAS, 9.4). The Alpha level used for assessment of significance for all the analyses was set at 0.05.

RESULTS

The apparent metabolizable energy of different source of oil in broiler chicken is summarized in Table 3. The result showed that there was no significant difference (P>0.05) in AME between CPO (8111 Kcal/kg), SO (8365 Kcal/kg), CPFO (8232 Kcal/kg), RBD PO (8179 Kcal/kg) and RBD PO+2%L (8020 Kcal/kg). There was no significant different (p>0.05) in AME among the treatments.

Table:(3). AME of different sources of oil in broiler chicken.

Parameters	oil sources					SEM±
	CPO	SO	CPFO	RBD	RBD+L	
AME (kcal/kg)	8111.3	8365.5	8231.7	8179.4	8020.1	86.766

CPO: 6% Crude palm fruit oil in diet, SO: 6% soybean oil in diet, CPFO: 6% Crude palm fruit oil, RBD: 6% Refine, Bleached and Deodorized palm olein oil, RBD+L: 6% Refine, Bleached and Deodorized palm olein oil + 2 % lecithen in diet.

DISCUSSION

The AME values in oils is influenced by its chemical structure (Freeman, 1984; Krogdahl, 1985). Number and position of double bonds of fatty acids, presence and absence of ester bonds (triglycerides or free fatty acids), carbon chain length, the amount and type of triglycerides, the composition of free fatty acid, glycerol backbone SFA and USFA arrangement, sex, age and the intestinal flora of birds (Baião & Lara, 2005). In this study the AME in CPO, CPFO, RBD PO and RBD PO+2%L was similar to SO, however CPO, CPFO, RBD PO and RBD PO+2%L had a higher ratio of USFA to SFA compared to SO. The AME similarity of the CPO, CPFO, RBD PO and RBD PO+2%L and SO could be due to the stearic acid (C18:0) low concentration in the oils. Lipase activity will be stop due to stearic acid presence (van Kuiken & Behnke, 1994).

Therefore, stearic acid similar concentration in oils may have similar effects on lipase activity, and the result is similar AME. This report is agreeing with the reports of Tancharoenrat et al. (2013), who reported that the AME of PO was similar to that of SO. However, this result is in conflicts with findings of Kavouridou et al. (2008), who reported that there was no significant difference in AME between birds fed a diet supplemented with LO and SO but LO had significantly higher AME compared with birds fed diet supplemented with PO.

CONCLUSION

The present research show that the AME of CPO, CPFO, RBD PO and RBD PO+2%L and SO in broiler chickens was similar even with differences in the fatty acid profile of the oils.

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REFERENCES

Abdulla, N., Loh, T., Akit, H., Sazili, A., & Foo, H. (2016). Effects of dietary oil sources and calcium: phosphorus levels on growth performance, gut morphology and apparent digestibility of broiler chickens. *South African Journal of Animal Science*, 46(1), 42-53.

Ayed, H. B., Attia, H., & Ennouri, M. (2015). Effect of oil supplemented diet on growth performance and meat quality of broiler chickens. *Advanced Techniques in Biology & Medicine*, 1-5.

Baião, N. C., & Lara, L. (2005). Oil and fat in broiler nutrition. *Brazilian Journal of Poultry Science*, 7(3), 129-141.

Corzo, A., Fritts, C., Kidd, M., & Kerr, B. (2005). Response of broiler chicks to essential and non-essential amino acid supplementation of low crude protein diets. *Animal feed science and technology*, 118(3-4), 319-327.

Freeman, C. (1984). Digestion, absorption and transport of fats--non-ruminants. *Proceedings-Easter School in Agricultural Science*, University of Nottingham.

Horwitz. W, & Latimer, G. (2000). Official Methods of Analysis of AOAC International, Gaithersburg MA, USA. Association of Official Analytical Chemist.

Kavouridou, K., Barroeta, A. C., Villaverde, C., Manzanilla, E., & Baucells, M. (2008). Fatty acid, protein and energy gain of broilers fed different dietary vegetable oils. *Spanish Journal of Agricultural Research*, 6(2), 210-218.

Krogdahl, Å. (1985). Digestion and absorption of lipids in poultry. *The Journal of nutrition*, 115(5), 675-685.

Lopez-Bote, C. J., Rey, A. I., Sanz, M., Gray, J. I., & Buckley, D. J. (1997). Dietary vegetable oils and α-tocopherol reduce lipid oxidation in rabbit muscle. *The Journal of nutrition*, 127(6), 1176-1182.

Mateos, G. G., & Sell, J. L. (1981). Influence of fat and carbohydrate source on rate of food passage of semipurified diets for laying hens. *Poultry Science*, 60(9), 2114-2119.

Nalle, C., Ravindran, V., & Ravindran, G. (2011). Nutritional value of peas (Pisum sativum L.) for broilers: apparent metabolisable energy, apparent ileal amino acid digestibility and production performance. *Animal Production Science*, 51(2), 150-155.

Ravindran, V., Abdollahi, M., & Bootwalla, S. (2014). Nutrient analysis, apparent metabolisable energy and ileal amino acid digestibility of full fat soybean for broilers. *Animal feed science and technology*, 197, 233-240.

Tancharoenrat, P., Ravindran, V., Zaefarian, F., & Ravindran, G. (2013). Influence of age on the apparent metabolisable energy and total tract apparent fat digestibility of different fat sources for broiler chickens. *Animal feed science and technology*, 186(3-4), 186-192.

van Kuiken, B. A., & Behnke, W. D. (1994). The activation of porcine pancreatic lipase by cis-unsaturated fatty acids. Biochimica et Biophysica Acta (BBA)-Lipids and Lipid Metabolism, 1214(2), 148-160.