ผลการเสริมกลีเซอรีนดิบในอาหารต่อการย่อยได้ของพลังงานและโภชนะของไก่เบตง

Effect of crude glycerin supplementation on energy and nutrient digestibility diets fed to Betong chickens

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บทคัดย่อ: การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาถึงผลการเสริมกลีเซอรีนดิบ (CG) ในสูตรอาหารต่อค่าพลังงานและสัมประสิทธิ์การย่อยได้ ที่ปรากฏโดยการเก็บมูลทั้งหมด (excreta) โดยใช้ไก่เบตงเพศผู้จำนวน 15 ตัว มีน้ำหนักตัวเฉลี่ย 2.36 ± 0.14 กก. ไก่แต่ละตัวถูกสุ่มแยกเลี้ยงในกรงเมแทบอลิก และได้รับอาหารทดลองที่เสริมกลีเซอรีนดิบแตกต่างกัน 3 ระดับ คือ 0 5 และ 10% หลังจากระยะปรับไก่ให้ได้รับอาหารนาน 7 วัน จากนั้นจึงทำการเก็บมูลทั้งหมดติดต่อกันเป็นเวลา 3 วัน ในระหว่างการทดลองไก่ทุกตัวได้รับอาหารจำนวน 100 กรัมแห้ง และได้รับน้ำอย่างเต็มที่ ผลการศึกษา พบว่าการเสริม CG ที่ระดับสูงสุด 10% ในสูตรอาหาร ไม่มีผลทำให้ค่าพลังงานเมแทบอไลท์ที่ปรากฏ วัตถุแห้ง โปรตีน อินทรียวัตถุ และพลังงานรวมแตกต่างกัน ($P>0.05$) แต่การเสริม CG ในสูตรอาหาร 10% มีผลทำให้ไก่เบตงมีค่าสัมประสิทธิ์ของ การย่อยได้ที่ปรากฏของไขมันสูงกว่าอย่างมีนัยสำคัญทางสถิติ ($P <0.05$) จากผลการศึกษาสรุปได้ว่า CG สามารถใช้งาน ได้ถึง 5% โดยไม่มีผลต่อค่าสัมประสิทธิการย่อยได้ที่ปรากฏของอาหาร

คำสำคัญ: กลีเซอรีนดิบ, การย่อยได้, ไก่เบตง, พลังงานเมแทบอไลซ์

ABSTRACT: This study aimed to investigate the effect of crude glycerin (CG) supplementation in diets on energy values and coefficients of total tract apparent digestibility (CTTAD) of Betong chicken. Fifteen roosters of Betong chickens at 2.36 ± 0.14 kg of live weight were randomly allocated to three levels of crude glycerin (0, 5, and 10% CG) mixed with a basal diet were used in this study. Each chicken was individually kept in a metabolic cage and total collection method was applied for excreta collection. The roosters had *ad libitum* access to water and received 100 g dry matter (DM) feed allowance. The feed intake and excreta were measured and collected on a daily basis. After 7 days of adaption period, the excreta was continuously collected for 3 days. The birds fasted overnight before the first and the last day of excreta collection. Results showed that the level of CG up to 10% in diets has no effect on nitrogen-corrected apparent metabolizable energy (AMEn) and dry matter (DM), crude protein (CP), organic matter (OM), and gross energy (GE) digestibility. However, a significantly higher ($P<0.05$) ether extract CTTAD was observed at 10% CG supplementation. In conclusion, CG could be used up to 5% without affecting the diets nutrient digestibility.

Keywords: Crude glycerin, digestibility, Betong chicken, metabolizable energy

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Introduction

The Thai biodiesel production has increased from 0.91 billion liters in 2012 to 1.42 billion liters in 2017 (Preechajan and Prasertsri, 2017) and yields crude glycerin (CG) as a by-product approximately 10% of the total biodiesel (Thompson and He, 2006). CG major component, glycerol, is a potential energy source for feed. However, The CG values seem to vary between studies. This variation may be related to different sources of CG and type of animal (Papadomichelakis et al., 2015; Mandalawi et al., 2015; Madrid et al., 2013).

Many studies reported the optimum level of CG in broiler diet was about 5 to 10% (Boonwong et al., 2018; Papadomichelakis et al., 2015; Mclea et al., 2011), but a higher inclusion (>14%) had an adverse effect on growth performance and indicated energy losses (Papadomichelakis et al., 2015). However, there was limited published report about CG effect on local chicken, particularly about energy and nutrient utilization on Betong chicken, a popular native chicken in southern Thailand. Hence, the aim of this study was to evaluated energy values and coefficients of total tract apparent digestibility (CTTAD) nutrients of diets supplemented with CG on Betong chicken

Materials and Methods

Experimental design and diets

Fifteen 25-week-old male Betong chickens with average live weight 2.36 ± 0.14 kg were randomly allocated in three experimental diets, 5 birds each, with different levels of crude glycerin (0, 5 and 10%) at individual metabolic cage 50 x 43 x 60 cm^3 width, length, and height, respectively. The metabolic cages were inside an open housing system. During

Table 1 Ingredients and nutrient composition of experimental diets mixed with different levels of crude glycerin

Items	Treatments		
	CG 0%	CG 5%	CG 10%
Ingredient (%)			
Corn	64,00	60,80	57,60
CPO	5,00	4,75	4,50
Soybean meal (43% CP)	21,00	19,95	18,90
Fish meal (60% CP)	8,50	8,08	7,65
Dicalcium Phosphate	0,95	0,91	0,86
DL-Methionine	0,05	0,05	0,05
Premix Boiler	0,50	0,48	0,45
Crude glycerin	0	5	10
Total	100,00	100,00	100,00
Analyzed chemical composition (% unless stated otherwise)[1]			
DM	89,37	88,34	87,36
Ash	5,32	5,18	5,18
CP	19,2	18,67	16,39
EE	7,3	7,4	7,53
GE, kcal/kg	4392	4399	4428

[1] The analyses of diets were performed according to AOAC (2006) using three replication each treatment. DM: dry matter, CP: crude protein, EE: ether extract, GE: gross energy.

the experiment, the minimum and maximum temperatures were 26 and 32°C, respectively and received artificial lighting for 16 h.

CG was obtained from the Specialized Research and Development Center for Alternative Energy from Palm Oil and Oil Crops, Prince of Songkla University. It had 84.04% dry matter (DM), 15.08% ether extract (EE), 0.64% crude protein (CP), 6.34% Ash, 4,471 kcal/kg gross energy (GE), and 42.88% Glycerol (Sopian et al., 2018). The nutrient and composition of experimental diets are shown in Table 1.

The total collection method was adapted from Bourdillon et al. (1990) with minor modifications. The diets and cages adaptation lasted for 7 days followed by 3 days of total excreta collection. The roosters had *ad libitum* access to water and given 100 g (DM) feed allowance, which was determined based on average amounts of ad libitum feeding for each cage measured during 5 d prior to the adaptation period (Kim et al., 2013). The feed intake and the excreta were measured and collected on a daily basis. The birds fasted overnight before the first and the last day of excreta collection. The excreta of five birds within a treatment were pooled together. Subsequently, representative subsamples were dried in an oven at 65°C for 72 h, ground using mortar and pestle and kept in an airtight plastic container at 4°C for DM, CP, EE, ash (AOAC, 2006) and GE (LECO AC500) analysis.

Calculations and statistical analysis

The coefficients of total tract apparent digestibility (CTTAD) and nitrogen-corrected apparent metabolizable energy (AMEn) of nutrients were calculated as follows (De Marco et al., 2015):

CTTAD Z diet = [(total Z ingested - total Z excreted)/total Z ingested]

$$\text{AMEn diet} = \frac{(\text{GE I} - \text{GE O}) - 8.22\ \text{NF}}{\text{FI}}$$

where Z represents DM, OM, CP, EE, and GE. GE I is the intake of GE from the feed, GE O is excreta GE output, NF is nitrogen retained in the fed bird, and FI is the feed intake.

Table 2 Effect of crude glycerin supplementation on energy values and coefficients of total tract apparent digestibility (CTTAD) nutrients in diets fed to Betong chicken

Items	Treatments[1]				
	BD	CG5	CG10	SEM	P value
Energy values (kcal/kg)					
GE	4,392	4,400	4,429	8.97	0.227
AMEn	3,579	3,631	3,695	29.90	0.308
CTTAD					
Organic matter (OM)	0.768	0.776	0.794	0.008	0.462
Crude protein (CP)	0.808	0.796	0.786	0.007	0.487
Ether extract (EE)	0.902[a]	0.908[ab]	0.928[b]	0.004	0.016
Gross energy (GE)	0.814	0.824	0.832	0.006	0.531
Dry matter (DM)	0.738	0.740	0.756	0.009	0.721

[1] Means within the same row with different superscripts were significantly different (p<0.05). BD: Basal diet; CG: crude glycerin; CG5: 95% BD + 5% CG; CG10: 90% BD + 10% CG. SEM: Standard error of the mean.

Data were analyzed as a completely randomized design and any differences were analyzed with Tukey test by SPSS version 20.

Results and Discussion

The results showed that there were no differences in GE and AMEn diets containing CG (**Table 2**). These findings were in agreement with Sopian et al. (2018) who reported the energy values and DM digestibility of diet incorporate with CG up to 10% had not significantly different with the control diets. No other similar studies have been found to compare directly. However, the GE and AMEn values in the present study have the same trends with the other studies in broiler chicken (Papadomichelakis et al., 2015) and laying hen (Mandalawi et al., 2015).

In this study, CG supplementation was not affected coefficients of total tract apparent digestibility (CTTAD) of organic matter, crude protein and dry matter diets except ether extract which had higher CTTAD in 10% CG inclusion than those in 5 and 0% CG. The CTTAD values, as well as GE and AMEn, are difficult to compare with another CG studies on local chicken due to lack of information. The other study in growing-finishing pigs, Madrid et al. (2013) found that CG increased EE digestibility in line with the result in this study. Papadomichelakis et al. (2015) and Mandalawi et al. (2015) reported also that the OM, DM and CP digestibility diets for broiler and laying hen were not influenced by CG inclusion. However, Kim et al. (2013) observed that CTTAD of GE and DM had greater value than basal diet (BD) but had no effect on the CTTAD of CP, EE, and ash. The contradictory finding may be associated with the different level of inclusion and the CG composition. Moreover, the impurities in the CG also may affect its utilization. The CG in this study had a higher content of EE (15.08%) and lower glycerol content (42.88%) than the previous studies. Another possible explanation is the genetic variations between broiler and Betong chicken. Consequently, it may affect the diets nutrient digestibility.

Conclusion

Based on the present study, CG supplementation in Betong chicken at finisher stage had no effect on diet energy values and nutrient digestibility except the CTTAD of ether extract in 10% CG inclusion. Thus, CG supplementation (5% in diet) can be used for Betong chicken. Further research should be conducted to evaluate CG effects on productive performance and meat quality of Betong chicken.

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