Production Performance of Broiler Chickens Fed Glucogenic and Lipogenic Diets to Overcome Environment Temperature

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Abstract

Two types of diet, glucogenic and lipogenic, were equally tested to 24 broiler chicken in completely randomized design for four weeks to evaluate their effects on body weight, feed intake, feed conversion ratio (FCR), carcass, and whole carcass weight. Diets were designed to contain 1.05% and 7.0% of palm oil, as glucogenic and lipogenic ones, respectively. Both diets were formulated as isoprotein (22%) and isocaloric (3050 kcal/kg) to overcome the environment temperature of 25.8-30.4^{0}C, around the poultry housing at campus. The birds were weighed at the beginning, weekly, and at the end of the diet application. The difference of these body weights were calculated as body weight gain (BWG). Feed intakes were accumulated weekly to the end. The FCR was calculated as the ratio of feed intake to body weight gain. Carcass and whole carcass were then compared to their body weight gain for each diet. Results showed that even though there were no significant differences ($p>0.05$), however, BWG in glucogenic diet chicken were 2.3% higher than that of in lipogenic diet birds. While, the feed intake in lipogenic diet chicken were significantly higher ($p<0.05$) than that of in glucogenic diet birds. Accordingly, the FCR was also significantly higher ($p<0.05$) in lipogenic diet of broiler chicken. None of carcass variables was significantly different, however, the glucogenic diet birds were 10.6% heavier than that of the lipogenic diet birds. Having higher in BWG, carcass weights, and carcass ratios, yet, lower in Feed intake and FCR, it can be concluded that glucogenic diet fed to broiler chickens was more efficient in overcoming the environment temperature, therefore the production performance was better than that of lipogenic diet.

Key words: glucogenic, lipogenic, production performance, broiler chicken

Introduction

Glucogenic and lipogenic diets refer to the level of fat source being included in the diet, the higher fat content, it is as lipogenic diet. This, even was clearly differenciated from one another by the inclusion of 0 and 2.5% of fat from palm oil in Glucogenic and lipogenic diets, respectively (vanKnegsel et, 2007). Feeding both diets or even a combination or mixed diet would come up with certain consequences relating to the stage of the physiological condition of the animal. Glucogenic source for birds is usually derived from amino acid, containing high protein diet, as well as it was out of D-glucose. While, lipogenic source could be from glucose and triglycerol. Therefore, glucose, amino acid, and glycerol are the keys for lipid metabolim in non ruminants (Larson, 1985).

Heat stress environment may lead to production and physiological impairment. Designing proper diet is a key to maintain these performances. High density diets made of different source or different level of certain ingredient, such as palm oil may be expected to keep production performance. Therefore, it was crucial to evaluate the effects of the glucogenic and lipogenic diets on the performance of broiler chicken under the environment temperature, 28-31 ^{o}C.

Materials and Method

Animals and Diets

Twenty four broiler chicken were allocated into two different diets in completely randomized design. As the purpose of this small study was to evaluate between glucogenic and lipogenic therefore there was no control diet. There were three replications and four birds for each replication. Birds being used were at one week day old at the beginning of the treatment for four weeks.

All ingredients for both diets were the same, with the exception of the level of each feedstuff. These diets were composed with the same level of crude protein (CP), that was 22% (isoprotein) and the same level of metabolizable energy (ME), that was 3050 kcal/kg (isocaloric). The fat content derived from palm oil were 1.05 and 7.0% for glucogenic and lipogenic diets, respectively. Environment temperatures were recorded at am, noon, and pm using thermometer.

Data Collection and Statistical Analysis

Collecting data were conducted weekly for feed intakes and body weights. Body weight gain (BWG) was calculated by the difference at the week- four and week-one. Feed intakes (FI) were accumulated by weeks all the way to the end. Feed conversion ratio (FCR) was calculated as ratio of feed consumed to body weight. Carcass and whole carcass (abdominal organs included) weights were as-

Table 1. Diet composition for broiler chicken

Composition	Glucogenic	Lipogenic
Corn Gluten meal, %	4.96	13.16
Corn grain, %	60	44.17
Soy bean meal, %	25	24.73
Fishmeal , %	7.91	10
Palm Oil, %	1.05	7.0
Calcium Carbonate, %	1.08	0.94
Nutrients:		
Dry Matter, %	85.12	78.49
EE, %	3.48	3.61
CP, %	22	22
ME, Kcal/kg	3,050	3,050
Ca, %	0.69	0.68
P, %	0.47	0.45

sessed at the end of the experiment. Carcass ratios were calculated by comparing toward body weight.

Data of body weight gain, feed intake, FCR, carcass weights were presented as the means with standard deviation and were analyzed using a Paired t- test (Myers, 1986).

Results and Discussion

Nutrient intakes

Looking at the diet composition and nutrient content (Table 1), it is known that both diets have relatively the same ether extract contents, 3.48% and 3.61%, respectively were for glucogenic (1.5% palm oil) and lipogenic (7.0% palm oil) diets. These ether extract levels were lower than that of in ration containing lower corn gluten meal (3%) and about the same amount of soybean meal (24.50%), was 5.92% (Sugiharto *et al*., 2010).

The data revealed that there were slight differences, even though not significant ($p>0.05$) in nutrient intakes between both diets in broiler chicken (Table 2). As in dry matter intake of glucogenic diet bird was a 10.29 g higher (0.6%), its crude protein and metabolizable energy were quantitatively higher as well, even though they contained the isoprotein and isoenergy. However, the ether extract intake of the lipogenic diet bird was slightly higher (3.1%) for as much as 1.82 g. This intake suggested that the lipogenic diet comprising 7% fat in the concentrate resulted in

Table 2. Nutrient intakes of glucogenic and lipogenic diets in broiler chicken

Nutrient Intakes	Glucogenic	Lipogenic
Dry Matter, g	1,690.41±37.63	1,680.12±58.17
Ether Extract, g	58.83±1.31	60.65±2.1
Crude Protein, g	371.89±8.28	369.63±12.80
Metabolizable Energy, kcal	5,155±114.76	5,124. 37±177.42

such amount of ether extract content that was high enough to make a small difference in its intake compared to that of in glucogenic diet birds.

Production performance and Environment Temperature

The results (Table 3) showed that body weight gain in glucogenic diet broiler was a little bit heavier for 29.6 g or 2.28% than that of the lipogenic diet. However, the feed intake was greater significantly ($p<0.05$) for as much as 157.63 g, equaled to 7.94% in lipogenic diet chicken. However, in terms of bulkiness, the dry matter intake in glucogenic diet was quantitatively higher (10 g) in Table 2. On the other hand, glucogenic diet was significantly more efficient ($p<0.05$) in converting into body weight gain. This number (1.54) is about in the same range as in the FCR of fasted and unfasted birds, were 1.49-1.54, respectively (Sugiharto *et al*., 2010). This FCR is also close to the FCR of chicken kept in different density, were about 1.55-1.66 (Sunarti *et al*., 2010). This suggested that the energy availability in glucogenic diet is about at the right level as it is in both fasted and unfasted birds to cover the energy requirement in fulfilling these birds' body weights. It seemed that the lower level of palm oil content in glucogenic diet was more efficient for the broiler kept during this environment temperature (25.8-30.4 ^{o}C; average of 27.9 ^{o}C). While, in 34 ^{o}C, broiler fed 8% palm oil or 8% soybean oil had FCR of 1.89-2.19 (Zulkifli *et al*, 2007).

Table 3. Body weight gain, feed intake, and FCR of broiler chicken fed glucogenic and lipogenic diets

Variable	Glucogenic	Lipogenic
Pre-treatment body weight, g	195.03±7.0	174.50±15.39
Post-treatment body weight, g	1488.89±20.44	1438.75±96.34
Body weight gain, g	1293.85±27.4	1264.25±111.72
Feed Intake, g	1985.92±43.49^{a}	2140.55±10.96^{b}
FCR	1.54±0.0^{a}	1.73±0.11^{b}

Note: Significant differences ($p<0.05$) between treatments.

Inspite of having been the isoenergy diets, with the higher ether extract (EE) content (3.61%) in lipogenic diet, making its energy availability might be a bit slower to be converted into body weight. Therefore, this might be the cause that the birds with this diet consumed more feed, consequently, with the lower body weight, made the FCR is higher in lipogenic diet. These data were in coherent relationship when considering the higher body weight gain, lower feed intake, therefore smaller feed conversion ratio was found in glucogenic diet birds.

Carcass weights and ratios

Carcass weight of birds fed glucogenic diet was slightly different by 111.8 g or 11.87% higher quantitatively, than that of lipogenic diet birds (Table 4). Whole carcass was also quantitatively higher by 127 g or 11.86% in glucogenic diet birds. In fact, both weights of carcass belonged to the birds with glucogenic diets were heavier than that of in lipogenic diet. In addition, the ratios of body weight gain to carcass or whole carcass were higher (0.82 and 0.93) in this glucogenic diet birds, compared to carcass ratio in lipogenic diet broiler. The glucogenic carcass were higher than that of in broiler chicken (around 0.66) with Ca-PFA as reported by Dewi *et al*. (2011).

This suggested that the higher the readiable starch such as in corn grain (60%) in glucogenic diet, the easier it would be metabolized and converted into body weight and carcass in broiler chicken with lower feed intake in the average environment temperature of 27.9 ^{o}C. However, these carcass weights were lower than that of broiler chicken (1242.39–1425.44 g) kept in the average environment temperature of 28.39 ^{o}C as reported by Sunarti *et al*. (2010).

Table 4. Carcass weight of broiler chicken fed glucogenic and lipogenic diets

Variables	Glucogenic	Lipogenic
Carcass, g	1,054±155.40	942.2±140.10
Whole carcass, g	1,198.3±145.43	1,071.3±124.80
Carcass:BWG	0.82±0.03	0.75±0.10
Whole carcass:BWG	0.93±0.11	0.85±0.09

Conclusion

Regarding to feed intake, body weight, feed conversion ratio, carcass weight, and carcass ratio to body weight, it is obvious that the glucogenic diet containing 1.5% palm oil and 60% corn grain is efficient and could be applied for broiler chicken under environment temperature.

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References

Dewi, G.A.M.K., P.A. Astawa, and I.K. Sumadi. 2011. Effect of Calcium-palm fatty acid (Ca-PFA) on growth performance and profile of body fatty acid of broiler. J. Indonesian Trop. Anim. Agric. Vol. 36. No.1. P: 55- 60.

Larson, B.L.. 1985. Lactation. The Iowa State University Press. Ames.

Myers, R. 1986. Classical and modern regression with application. PWS Publishers. 20 Park Plaza. Boston, MA 02116.

Sugiharto, P. Henckel, and C. Lauridsen. 2010. Compensatory growth and fat parameters on broiler fasted in early life. J. Indonesian Trop. Anim. Agric. Vol. 35. No.4. P: 262- 267.

Sunarti, D., Haryono, and Soedarsono. The Effect of density and floor types on perfoermance, physiological state and immune response of broilers. J. Indonesian Trop. Anim. Agric. Vol. 35. No.4. P: 275- 281.

Van Knegsel, A.T.M., H. van Brand, J. Dijkstra, W.M. van Straalen, J. Jorrtsma, S. Tamminga, and B. Kemp. 2007. Effect of Glucogenic vs Lipogenic Diets on Energy Balance, Blood Metabolites, and Reproduction in Primiparous and Multiparous Dairy Cows in Early Lactation. J. Dairy Sci. Vol. 90 No .7: 3397-3409.

Zulkifli, I., Nwe Nwe Htin, A. R. Alimon, T. C. Loh and M. Hair-Bejo. 2007. Dietary Selection of Fat by Heat-stressed Broiler Chickens. Asian-Aust. J. Anim. Sci. Vol. 20 No. 2: 245 – 251.