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Research Article

Growth and Body Composition of Kampung Unggul Balitnak (KUB) Chicken as Affected by Diets Containing Varying Levels of Protein and Energy

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Abstract

Background and Objective: The study was conducted to evaluate three different feeding regimens on growth performance and body composition of Kampung Unggul Balitnak chickens (KUB) during the growing period. **Materials and Methods:** One hundred and eighty day old chicks were sexed and fed a commercial crumble diet containing 23% Crude Protein (CP) and 3000 kcal Metabolizable Energy (ME)/kg until 3 days of age after which they were fed according to 17% CP and 3000 kcal ME/kg as Low Protein-Low Energy (LP-LE), 19% CP and 3100 kcal ME/kg as Medium Protein-Medium energy (MP-ME) and 21% CP and 3200 kcal ME/kg as High Protein-High Energy (HP-HE). Each feeding regime was designed with three replicates and having 10 birds per replicate.

Results: Increasing CP and energy levels in the diet did not improve body weight at 53 days of age, and body weight gain during the overall experimental period (4 to 53 d of age). Feed conversion ratio (FCR) was more efficient (p = 0.0416) in higher protein and energy diets than the lower protein and energy diets. Giblets and inedible parts were not affected by dietary treatments. Sex of KUB chicks had significant effects on feed intake, FCR, drumstick, giblet and leg.

Conclusions: LP-LE diet (17% and 3000 kcal ME/kg) was sufficient for females while MP-ME diet (19% CP and 3100 kcal ME/kg) was appropriate for the males.

Keywords: Body Weight; Feed Intake; Growth Rate; Sex

Introduction

Kampung Unggul Balitnak (KUB) is an indigenous Indonesian chicken breed evolved recently at the Livestock Research Centre, Ciawi, Bogor through individual selective breeding of female lines for six generations[1.] KUB chicken is characterized by higher egg production capacity (160-180 eggs/hen/year), better resistance to disease, and lower broodiness than most local chicken [1]. As egg producers, KUB chicken is preferred to be raised in different production systems [2,3]. Regarding the feeding regimes, although scientific reports are scanty, a diet containing 16% crude protein (CP) and 2800 kcal metabolizable energy (ME)/kg is thought to be sufficient for the layer chicks of this breed during the period from 0 to 12 wk[2]. Based on a case study on semi-intensive and intensive systems applied by small holders [3], KUB chickens when fed a diet containing 12.8 to 16.8% crude protein and 2,614 to 2,750 kcal ME/kg, achieved body weights at marketing of 850-950 g (at 90 d of age), implying that feeding practices for optimal production are variable in different production systems. However, experimental studies in this respect are rare. Previous studies by Bouwkamp., *et al.* (1973) [4] and (Moran, l994) [5] in broiler chicken showed that the response of different genotypes to different nutrients may vary within a class of birds. Differences in nutrient requirements are a major cause of observed differences in portion of carcass yield [4,5] and of differences in body composition [6] of growing chickens. In addition, the variable nutrient requirements as growth proceeds are a challenge in optimizing the nutrient requirements for optimal growth performance [7] Therefore, an experimental was undertaken to determine the response of KUB growing chicks to different dietary protein and energy levels and to provide the possibility of determining the nutrient requirements relating to the different production systems in terms of the optimal growth rate.

Materials and Methods

The study was conducted at the teaching farm of Faculty of Animal Science, Mataram University, Indonesia. One hundred-and eighty-day old KUB straight-run chicks from the local breeder were feather sexed, wing-banded, weighed and allocated at random into 12 pens with 1.00 x 0.80 m in a rearing room at 31°C. Each pen was provided with one watering and feeding troughs and one bulb of 25 watt. The birds were fed a commercial crumble diet containing 23% CP and 3000 kcal ME/kg until 3 days of age after which they were fed according to the dietary treatments (see below). Vaccination against Newcastle Disease was applied on the 4^{th} day of age. Vitamins were provided in drinking water during the first week of life. Feed and fresh water were supplied *ad libitum* throughout the study.

The study was conducted in a factorial arrangement (3 x 2) in which a total of 180 birds (4 days of age) were assigned to three dietary treatments, replicated three times with 10 birds per replication per sex. The dietary treatments consisted of three different crude protein diets viz., Low Protein Low Energy (LP-LE) containing 17% CP and 3000 kcal ME/kg, Medium Protein Medium energy (MP-ME) containing 19% CP and 3100 kcal ME/kg or and High Protein High Energy (HP-HE) containing 21% CP and 3200 kcal ME/kg (Table 1). All feedstuffs were purchased from the local supplier and fed in mash form with commercial premixes added. Birds were weighed individually using an electric balance at the commencement and culmination of the study. The proximate compositions of nutrients in the feed were determined using methods of AOAC (1995) [8].

Ingredient (%)	**Dietary treatment**		
	LP-LE	**MP-ME**	**HP-HE**
Yellow corn	50	50	50
Soybean meal	15	19	26
Rice bran	26	20	13
Fish meal	8	10	10
Vitamins and trace mineral +	1	1	1
Total	100	100	100
Calculated nutrient composition			
Metabolizable Energy (kcal/kg)	3000	3100	3200
Crude Protein (%)	17	19	21
Crude Fiber (%)	7	6.5	5.0
Lysine (%)	0.91	0.99	0.99
Methionine (%)	0.57	0.62	0.67
Calcium (%)	1.60	1.54	1.51
Phosphor (available) (%)	0.70	0.68	0.63

Table 1: Ingredient and calculated nutrient composition (%) of experimental diets.

+Premix supplied the vitamins and the trace minerals (per kg of diet) as follows: vitamin A, 6,000 IU; vitamin D3, 1.000 IU; vitamin E, 4.0 IU; vitamin K3, 1 mg; vitamin B1, 1 mg; vitamin B2, 2.5 mg; vitamin B6, 0.25 mg; vitamin B12, 6 µg; vitamin C, 12.5 mg; Niacin, 20 mg; Cholin Chloride, 5 mg; Iodine, 0.1 mg; Cobalt, 0.1 mg; Copper, 2 mg; Santoquin (antioxidant) 5 mg ; Zinc Bacitracin, 10.5 mg.

Body weight (BW), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were determined every 7 days and calculated on a per-pen basis. At the end of the experiment (53 days of age), 16 birds (8 males and 8 females) of average body weight were selected from each treatment. The birds were then slaughtered manually using a sharp knife and bled, after which they were scalded in warm water (for approximately 2 min in 60°C), then plucked and eviscerated. Carcasses and cut parts of the carcass such as breast yield (both the Pectoralis major and minor), wings, thighs and drumsticks were excised, weighed and calculated on an individual basis. Similar to this, giblets (liver, gizzard, and heart) and the inedible parts consisted of blood, feather, head and neck and feet [9] were weighed. Prior to this exercise, the birds were fasted for approximately 12 hrs. Mortality was recorded daily and feed consumption data were adjusted where deaths occurred during the study. Breast yield or other parts of the eviscerated carcass, giblets or inedible were calculated and expressed as percentage of body weight.

The data on growth performance of the birds were subjected to analysis of variance (ANOVA) for CRD following the General Linear Model using SAS (version 8.07). For proximate composition of the body, the data were analyzed using CRD by considering dietary treatments and sexes as independent factors. The differences between the means of groups were identified by Tukey's Test with the significant levels of $p < 0.05$.

Results and Discussion

Growth performance

Starter diets containing Low (17%), Medium (19%) and High (21%) crude protein with ME of 3000; 3100, and 3200 kcal/kg significantly ($p < 0.001$) influenced feed intake by the birds (Table 2). Although KUB chickens fed on an LP-LE diet consumed more feed than that fed on an HP-HE diet, daily growth rate was not affected ($p = 0.4226$) by the feeding regimens as feed conversion was more efficient ($p = 0.0416$) in higher protein and energy diets than for the lower protein and energy diets (Table 2). Increasing dietary protein from 17 to 21% CP and dietary energy from 3000 to 3200 kcal/kg resulted in reduced feed intake by 0.9% and 4.8% respectively, increased live weight by 1.8% and 6.1% and improved feed conversion by 2.7% and 10.3% respectively, when the birds were fed on low to medium or to high protein diets. The results of the present study are consistent with previous reports which indicated that increased protein and energy contents in the diet improved growth performance [10,11].

Item	Initial body weight	Feed intake	Final Body weight	Weight gain	Daily gain	FCR
	g	g	g	g	g/d	g/g
Dietary Protein						
LP-LE	52.7	1,338[a]	457.2	404.4	8.1	3.394[a]
MP-ME	49.7	1,326[a]	465.9	416.3	8.4	3.301[ab]
HP-HE	50.3	1,274[b]	480.6	430.1	8.8	3.043[b]
PSEM	1.25	7.10	13.9	13.5	0.3	0.104
Sex						
Male	51.3	1,325[a]	473	421.2	8.6	3.305[b]
Female	50.5	1,299[b]	462	412.6	8.4	3.327[a]
PSEM	0.8	5.6	9.5	9.2	0.2	0.095
	Probability					
Dietary regimen	0.7505	0.0302	0.3430	0.3696	0.4226	0.0416
Sex	0.9134	0.0411	0.2884	0.5325	0.5827	0.0231
Interaction	0.6182	0.4232	0.7482	0.8751	0.8751	0.6651

Table 2: Performance of KUB chicken fed on different protein and energy levels from day 4 to 53 d of age.

[a-b]Means followed by different superscripts within a row are significantly different; LP-LE = Low Protein- Low Energy:17%CP + ME 3000 kcal/kg; MP-ME=Medium Protein - Medium Energy:19%CP + ME 3100 kcal/kg; HP-HE= High Protein-High Energy: 21%CP+ ME 3200 kcal/kg; PSEM= Pooled Standard of Error Means.

The influence, however, of genotype on nutritional requirements and responses is widely considered when formulating a ration. The present study found varying protein diets did not affect the growth rate of indigenous KUB chicken. Mahfuhz., *et al.* (2011) [10] noticed indigenous chickens were more capable of using low protein diet (16% CP) compared to higher protein diets (18 and 20% CP). Results of the present study corroborate these facts and since KUB chicken have been selected to improve egg production [12].

Results of the present study (Table 2) also agrees with several previous authors that males grew faster and were more efficient in converting feed, than females [13,14]. However, high protein and energy diets improved growth performance in both sexes. The present study showed the males were more responsive to MP-ME (19% CP and 3100 ME kcal/kg) diet but the females showed no responses differing levels of dietary protein and energy (Figure 1), implying that LP-LE diet is sufficient for female indigenous KUB chicks. As was reported previously by Ten Doeschate., *et al.* (1993) [15] there was a notable effect of sex on digestibility. Female broilers showed a slightly higher metabolisity, N digestibility and amino acid digestibility than their male counterparts. Le Bihan-Duval., *et al.* (l998) [16] found high genetic correlations between sexes for the different traits and very low heritabilities for sexual morphism for the various traits, suggesting that most of the genes involved in the genetic control of the traits were the same in the two sexes.

Figure 1: Gain (g/d) in male and female KUB chickens on the three dietary regimens measured every seven days from 4 to 53 days of age.

Body composition effects

Effects of feeding different levels of protein and energy from 4 to 53 days did not change the carcass yield of KUB chicks. The body composition except drumstick was not affected by sex differences. There was no interactions involving feeding regimen, or sex for body composition (Table 3). Similar findings were reported by Nguyen and Bunchasak (2005) [17] for Betong chickens and Alabi., *et al.* (2013) [18] for Venda chickens, implying genetic variability in body composition [13].

Both males and females showed similar values of dressing, breast meat, tight, drumstick and wing except drumstick slaughtered at 53 d of age (Table 3). Similar results were reported by Horniakova and Abas (2009) [19]. In contrast, Musa., *et al.* (2006) [20] found significant differences between two sexes. Females had greater breast meat than males in broilers at 42 days of age. Such differences therefore depend on slaughter age, genotype and the chicken sex.

All parts of giblets were not affected by dietary protein and energy levels as well as their interaction effects (Table 4), which is in agreement with the findings of Miah., *et al.* (2014) [11] and Gheisari., *et al.* (2015) [21]. Gizzard of males was greater than females (p < 0.0440) might be associated with the higher growth rate in male chicks which was not related to the genetic background [22]. The present study also found that varying protein and energy diets did not affect the inedible parts (Table 4).

Item	**Dressing**	**Breast yield**	**Tight**	**Drumstick**	**Wing**
	%	**(%)**	**(%)**	**(%)**	**%**
Dietary treatment					
LP-LE	56.6	14.0	9.2	9.1	8.7
MP-ME	55.9	13.7	9.3	8.9	9.1
HP-HE	57.1	13.9	9.2	9.1	9.1
PSEM	0.6	0.4	0.2	0.1	0.1
Sex					
Male	56.9	13.5	9.3	9.3a	9.0
Female	56.3	14.2	9.1	8.8b	8.9
PSEM	0.4	0.3	0.1	0.1	0.1
	Probability				
Dietary regimen	0.3339	0.4890	0.7845	0.6486	0.1636
Sex	0.3652	0.1154	0.3685	0.0162	0.4112
Interaction	0.5182	0.3232	0.1519	0.4346	0.0780

Table 3: Body composition of KUB chicken as given the Low, Medium or High dietary protein and energy regimens and affected by sex at 53 d of age.

[a-b]Means followed by different superscripts within a row are significantly different LP-LE = Low Protein- Low Energy:17%CP + ME 3000 kcal/kg; MP-ME=Medium Protein-Medium Energy:19%CP + ME 3100 kcal/kg ; HP-HE= High Protein-High Energy: 21%CP + ME 3200 kcal/kg; PSEM= Pooled Standard Error of Means.

However, legs were affected by sex. Sex differences in the growth of different genotypes were shown to be due to differences in embryonic growth pattern [23]. In young chicks, growth rate is very rapid and breast and leg muscles grow at a faster rate than other parts of the body during this growth period [24]. In addition,

Item	Giblets			Inedibles			
	Gizzard	Liver	Heart	Blood	Feather	Head and Neck	Leg
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Dietary regimen							
LP-LE	4.6	2.2	0.5	9.8	5.0	9.9	5.5
MP-ME	4.9	2.1	0.4	9.7	5.2	9.8	5.4
HP-HE	4.6	2.2	0.5	9.9	5.0	9.4	5.5
PSEM	0.2	0.1	0.02	0.4	0.4	0.2	0.2
Sex							
Male	4.9[a]	2.2	0.5	9.8	4.7	9.8	5.8 [a]
Female	4.5[b]	2.2	0.4	9.8	5.5	9.6	5.3 [b]
PSEM	0.1	0.1	0.02	0.3	0.3	0.1	0.1
Probability							
Dietary regimen	0.1354	0.4506	0.1554	0.7952	0.6672	0.1521	0.8397
Sex	0.0440	0.9608	0.0627	0.9795	0.0754	0.4899	<.0001
Interaction	0.3473	0.4102	0.0929	0.1638	0.4948	0.9536	0.5290

Table 4: Giblets and inedible parts of KUB chicken as given the Low, Medium or High dietary protein and energy regimens and affected by sex at 53 d of age.

[a-b]Means followed by different superscripts within a row are significantly different; LP-LE = Low Protein- Low Energy:17%CP+ ME 3000 kcal/kg; MP-ME= Medium Protein –Medium Energy: 19%CP+ ME 3100 kcal/kg; HP-HE= High Protein-High Energy: 21%CP+ ME 3200 kcal/kg; PSEM= Pooled Standard Error of Means.

more meat growth in the leg was from hatching to 18 wk of age whilst in breast meat increased for the first four weeks only in laying-type cockerels [9].

Conclusions

High protein and energy diets tended to improve the production performance and body composition of indigenous KUB chicks at 53 days of age. Lower protein and energy may probably be sufficient for slow growing KUB chicken. Diets of 17% CP and ME 3000 kcal/kg for females and 19% CP and 3100 kcal/kg diet for males are appropriate protein and energy diets for the indigenous KUB chicks during the growing period.

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Significant Statements

The study examines the varying levels of energy and protein in KUB chickens as an indigenous Indonesian chicken breed which was reared mostly by the small-scale farms. The study also helps the farmers to feed the birds in an appropriate nutrient requirement in the light of their genetic potential. Thus, reducing the feed cost is achieved and improving the income of the farmers is met.

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