Efficiency of metabolisable energy utilisation by commercial broilers and indigenous chickens in Malaysia
(Kecekapan dalam penggunaan tenaga metabolisme oleh ayam pedaging komersil dan ayam kampung di Malaysia)

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Key words: efficiency, commercial broiler, indigenous chicken

Abstract
Growth rates and efficiencies of metabolisable energy (ME) utilisation by brown commercial broilers and indigenous chickens were estimated in a feeding trial in MARDI Research Station, Serdang, Malaysia. Daily growth rate measured from 2 to 7 weeks of age for the commercial broilers (30.0 g) was three times higher ($p < 0.01$) than that of the indigenous chickens (10.5 g). Daily ad libitum intake measured when the animals were 6 to 7 weeks of age was 91.6 g and 41.2 g for the commercial broilers and the indigenous chickens, respectively. Feed conversion ratio calculated from the above values was 3.1 g/g gain for the commercial broilers and 3.9 g/g gain for the indigenous chickens. Efficiency ($k$ value) of ME use for net energy retention for the commercial broilers (0.81) was 1.5 times ($p < 0.05$) that of the indigenous chickens (0.56). The results indicate that the commercial broilers grew faster and were energetically more efficient than the indigenous chickens, presumably due to higher rate of fat deposition and lower energy maintenance requirement for the former.

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Introduction

Poultry production in Malaysia has developed rapidly in the last 2–3 decades from the low input-low output backyard system to a highly commercialised one. Feed conversion ratio of the modern strains of broiler managed using modern technologies is highly efficient (Seet et al. 1992). These efficient production systems have enabled Malaysia to produce broiler meat at an internationally competitive price. However, the indigenous chicken meat continues to be favoured by some local consumers who believe that the slow growing indigenous chicken meat tastes better and is more nutritious. This niche market demand has enabled the indigenous chicken to fetch a premium price and thus its production persists.

This study compared the growth and efficiency of dietary energy utilisation by commercial broilers and indigenous chickens under similar management conditions. In addition, it provided estimates of the efficiency of metabolisable energy (ME) use for net energy retention for the two strains of chicken kept under the humid tropical conditions in Malaysia.

Materials and methods

Animal management and body weight measurement

Seventeen 2-week-old commercial brown broilers and 21 indigenous chickens of similar age were used for this study. The commercial broilers were kept individually in wire mesh cage measuring 31 cm wide, 46 cm long and 31 cm high, while the indigenous chickens, being about one-third of the body weight (BW) of the commercial broilers, were kept in groups of 3 birds/cage.

During the 5-week feeding trial, a broiler diet (Table 1) with a calculated ME of 12.5 kJ/g and crude protein content of 19% was offered ad libitum to the chickens. The amount of daily feed offered was based on the previous day’s intake and this was divided into two equal portions; the first was offered at 0900 h and the balance at 1600 h.

Table 1. Feed composition of the experimental diet

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (g/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>64.70</td>
</tr>
<tr>
<td>Rice bran</td>
<td>2.10</td>
</tr>
<tr>
<td>Soybean</td>
<td>26.50</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.60</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.00</td>
</tr>
<tr>
<td>Palm oil</td>
<td>0.60</td>
</tr>
<tr>
<td>Fish meal</td>
<td>3.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.30</td>
</tr>
<tr>
<td>DL-methionine</td>
<td>0.15</td>
</tr>
<tr>
<td>Trimix</td>
<td>0.10</td>
</tr>
<tr>
<td>TM-100</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Clean drinking water was always available via drinking nipples connected to the main water supply. Artificial lighting was provided 24 h a day throughout the feeding trial. The lights were left on continuously so the chickens’ activities would be similar throughout the 24 h period, and the heat production estimates made over 12 h could be extrapolated to a daily basis.

Body weight of the individual commercial broiler and of groups of three birds in each cage for the indigenous chickens was recorded weekly. Weekly BWs were later averaged for strain and the average weekly BWs in grams were regressed against time in days (as independent variables) using rectilinear regression for the two strains of chicken. The slope of the regression (coefficient b) was taken as the average daily gain for the respective strain of chickens.

Energy balance trial

Energy balance trials were conducted during the fourth to the fifth week of the feeding trial. During the 2-week period, all the chickens continued to be fed ad libitum and the daily intake per cage was determined from the difference between the feed offered on each day and the feed residual the next morning at 0900 h. Chickens from five cages for each strain were randomly selected and used in estimates of energy expenditure. Measurements were made of their oxygen
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consumption continuously for 12 h per measurement in an open circuit respiration chamber. The birds were fed at one of five levels of intake randomly allocated to them (500, 800, 1 100, 1 400 kJ/BW^{0.75}/day and ad libitum). Since there was only one chamber, the measurements of oxygen consumption were staggered over 2 weeks.

On the day of measurement, the first portion of the feed was offered at 0900 h in the respiration chamber at the start of the oxygen measurement and the balance after the chicken was returned to the feeding cage at the end of the measurement at 2100 h. Before the actual oxygen consumption measurements, each selected chicken was given four training sessions during which it was placed in the respiration chamber to familiarise with the surroundings.

During the 12-h test, oxygen consumption was measured at 2-min intervals using the respiration chamber (44 cm long, 44 cm wide and 55 cm high) described by Liang and Roch (1994). Whole system calibration using nitrogen injection and recovery procedure (Yamamoto et al. 1995) obtained an average of 93.6% recovery rate for the above system. Heat production of the tested chickens was estimated at 2-min intervals using the procedure of Yamamoto et al. (1985). Cumulative heat production (HP) measured over 12 h was multiplied by 2 to give the daily heat production.

Energy retention (ER) was calculated by using the model: ME intake – HP = ER. The estimated ER were regressed against ME intakes for each strain using rectilinear regression. The regression slopes (coefficient $b$) represent the efficiencies of ME use for net energy retention.

Statistical analysis
The average daily gain and the efficiencies of ME use for net ER were compared for strain differences using the procedure of homogeneity of regression coefficients (Gomez and Gomez 1983).

Results and discussion

Body weight gains and feed conversion ratio
The average daily gain of the commercial broilers (30.0 g) estimated from the 5-week feeding period was three times higher ($p < 0.01$) than that of the indigenous chickens (10.5 g) (Figure 1). Average daily ad libitum intake per bird measured when the chickens were 6–7 weeks old for the broiler (91.6 g) was twice ($p < 0.01$) of the indigenous chickens (41.2 g). However, when intake was adjusted to similar body weight, average daily intake for the commercial broiler was lower ($p < 0.05$) than that for the indigenous chickens (85 vs. 112 g/kg BW). Based on these values, feed conversion ratio (FCR) for the two strains was found to be 3.1 and 3.9 g/g gain for the commercial broiler and the indigenous chicken, respectively. These values suggest that indigenous chickens are poorer feed converters than modern commercial broilers.

Coloured broilers similar to those used in this study were reported to be less efficient in feed conversion than the white commercial strains (Seet et al. 1992). However, the FCR value obtained in this study was lower than the values reported in

\[
\text{Commercial broilers: } y = -167.35 + 30.04x \\
\text{Indigenous broilers: } y = -86.73 + 10.48x
\]

Figure 1. Average body weight of commercial broilers and indigenous chickens at various ages
the above study, presumably due to differences in diet and experimental procedures. One commercial broiler discharging wet faeces at the fourth week of the experiment was removed. No clinical signs of disease or mortality were recorded in the rest of the experimental chickens.

**Efficiency of ME use**

The efficiencies ($k$ values) of ME use for net ER estimated for the broilers and the indigenous chickens were 0.81 and 0.56, respectively. The $k$ values obtained in this study suggest that the broilers were nearly 1.5 times ($p < 0.05$) more efficient in converting ME to net ER than the indigenous chickens (Figure 2). The commercial broilers which were selected for high growth rate, are expected to have a higher rate of fat deposition (Jorgensen 1988) than the unselected indigenous chickens. The higher rate of fat deposition explains for the higher efficiency ($k$ value) of ME use for net ER, since deposition of fat is energetically more efficient than protein deposition.

In addition, daily maintenance requirement for the commercial broiler (652 kJ/BW$^{0.75}$) was about 15% lower than the indigenous chicken (746 kJ/BW$^{0.75}$) (Figure 2). The lower maintenance requirement for the former means that a lower proportion of the ME intake is used for maintenance leaving a higher proportion for tissue deposition than the indigenous chickens.

**Conclusion**

Results of this study indicated that, because of the slower growth rate and lower efficiency in using dietary energy for gain, the indigenous chickens will take longer to attain marketable weight than commercial broilers. The longer production time would increase the cost of production and, therefore, production of indigenous chickens can only be viable if there is a price advantage over the commercial broilers.

**References**


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