Research article

Effect of Dry Brewery Residue on the Growth of Local Chicken (*Gallus domesticus*)

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Abstract Residue from the food industry such as dry brewery residue (DBR) has the potential to replace traditional ingredients used in chicken feed, the costs of which have been increasing greatly year by year. The current study is aimed at evaluating the effect of different levels of DBR in chicken feed on chicken growth. The basic diet was supplemented with 0% (used as a control), 20%, 25%, or 30% DBR content. The broiler chickens were raised in a Completely Randomized Design (CRD) with three replicates, and each replicate contained ten six-week-old broilers. Experimental results showed that there was no significant difference in the mean weight of chickens among the four treatments from week 1 to week 5. However, in weeks 6 and 7, the second treatment which applied 25% DBR, resulted in greater weight gain than the control (0% DBR), the first treatment (20% DBR), and the third treatment (30% DBR) at $P<0.05$. Additionally, the intake of feed by chickens in the second treatment was significantly higher than for other treatments ($P<0.05$) during weeks 6 and 7. Taken together, these results suggest that basic feed supplemented with 25% DBR can promote chicken growth better than other levels of DBR, and this increased growth is likely promoted by more feed intake.

Keywords dry brewery residue (DBR), local broiler chicken, intake, growth

INTRODUCTION

Animal husbandry plays a pivotal role in contributing to the growth of the agricultural sector. According to the General Department of Animal Health and Animal Production, Cambodia achieved USD 5.1 billion in 2021 in the animal husbandry sector, an increase of six percent compared to 2020's USD 4.8 billion (Khmer Times, 2022).

In rural Cambodia, the people's livelihoods are dependent predominantly on agriculture. More than half of all rural Cambodian households keep poultry (IFAD, 2021). Still, Cambodian farmers who raise chickens face a range of problems, such as slow-growing chickens, disease, markets, and expensive feed. Feed is commonly imported from neighboring countries such as Vietnam and Thailand, costing approximately USD 200-300 million each year (The Phnom Penh Post, 26 July 2022).

Poultry production in Cambodia is still a small-scale industry compared with neighboring countries and the production can be classified into traditional/backyard, semi-intensive small or medium-scale, and intensive large-scale industrial (Birhanu et al., 2021). About 90% of poultry production is under the traditional/backyard system that has small flock sizes usually less than fifty

birds per household (Birhanu et al., 2021). Demand for poultry products has significantly increased in the past decades and this upward trend is projected to continue (ICEM, 2014; Sun, 2018). Local bird breeds are the highest in demand in the local market, especially during festivals and celebrations (IFAD, 2021).

Animal feed is one of the most important factors for determining animal growth, quality, and price in animal chain production. However, the main problem needed to be addressed is to lower the cost of animal feed through the efficient utilization of local input. The current study applied different levels of Dry Brewery Residue (DBR) discarded by the brewery industry to the chickens' basic feed diet and we found that the application of 25% DBR promoted growth better than other DBR inputs.

OBJECTIVE

The main objective of the study is to find out the optimal level of DBR supplemented with the basic diet that best promotes local chicken growth.

METHODOLOGY

Experimental Location

The experiment was conducted at the Department of Livestock Research Section, Kampong Speu Institute of Technology (Figure 1) from June 1st to July 12th, 2022.

Fig. 1 Location of the experimental site in Angkom Village, Amlaing Commune, Thpong District, Kampong Speu Province
The red point indicates the chicken farm (11°48'05.8"N 104°17'29.4" E).

Table 1 Experimental design with 4 treatments and 3 replicates

Experimental Design		Number of Chickens	Level of DBR (%)
T0 (control)	T0R1	10	0%
T0 (control)	T0R2	10	0%
T0 (control)	T0R3	10	0%
T1	T1R1	10	20%
T1	T1R2	10	20%
T1	T1R3	10	20%
T2	T2R1	10	25%
T2	T2R2	10	25%
T2	T2R3	10	25%
T3	T3R1	10	30%
T3	T3R2	10	30%
T3	T3R3	10	30%

Note: T stands for Treatment, whereas R for Replicate

Experimental Design

The experiment was designed as a Complete Randomized Design (CRD) including 4 treatments with 3 replicates with each replicate containing 10 chickens (Table 1). Each treatment (referred to as T) was added with different levels of DBR as follows: T0 (0%), T1 (20%), T2 (25%), and T3 (30%). The same amount of basic diet including rice bran 10%, broken rice 8%, dietary supplement 42%, final feed product 18%, brewers Dried Grains 20%, and corn 9% was added to each treatment.

Feeding: First, brewery residue was received from the brewery factory (Khmer Beverages) and was put in the dryer at 280°C for 45 seconds in order for it to become Dried Brewery Residue (DBR) (Kuleile et al., 2019). Different levels of DBR (as mentioned in Table 1) were supplemented with a basic diet. This feeding method is primarily based on the description by Leang, 2004 with a slight modification. The feed was provided three times a day starting at 6:00 AM for the first time, 12:00 pm for the second time, and 17:00 pm for the third time (Leang, 2004).

Data collection and statistical analysis: The amount of feed intake (FI), initial weight of chicken, and weekly chicken growth weight were recorded. All relevant data was analyzed using the Excel program. One-way ANOVA was performed to compare the quantitative data among the treatments.

RESULTS AND DISCUSSION

Chicken Growth

The current study focused on the growth of local chickens (*Gallus domesticus*), through the application of different levels of DBR. The experimental results revealed that each treatment steadily increased chicken weight growth from week 1 to week 7 (Table 2).

There was no significant difference in weight growth of chickens during weeks 1, 2, 3, 4, and 5 among the 4 treatments ($P>0.05$). However, the average chicken weight of treatment 2 (T2) using 25% DBR increased significantly as compared to the other treatment levels tested in weeks 6 and 7 ($P<0.05$) (Table 2). Nevertheless, the application of 30% DBR (T3) to the basic diet showed significantly decreased chicken weight as compared with chicken feed with 25% DBR (Table 2). Hence, these results indicate that the optimal level of DBR for chicken growth is 25%, and an increased amount of DBR beyond that value led to the reduction of chicken growth weight. This result is consistent with the previous study in poultry that found that the application of 10-20% of DBR resulted in better growth of young birds and up to 30% in older poultry (Fasuyi et al., 2018). Parpinelli et al. (2018) reported that a 10% inclusion rate of DBR in broiler chickens during the finishing phase maintained a high production performance. In broilers between 12 and 33 days old, the inclusion rate ranged between 10% and 20% of DBR, supporting acceptable growth and feed utilization and seeming to favor the development of a well-functioning gizzard (Denstadli et al., 2010). According to the National Research Council (NRC 1994), standard brewers' ingredients contain 25.3% protein, 6.3% fat, 92% dry matter, and approximately 2080 kcal/kg of metabolizable energy.

Table 2 Chicken weight growth during 7 weeks of feeding (g/chicken)

Weeks after feeding	T0 (DBR=0%)	T1 (DBR=20%)	T2 (DBR=25%)	T3 (DBR=30%)	P-value
1	702.58 ± 92.4	700.64 ± 47.4	672.25 ± 24.8	695.48 ± 97.8	0.833
2	855.80 ± 61.0	860.00 ± 77.5	841.29 ± 48.3	829.33 ± 43.5	0.918
3	991.61 ± 32.8	1024.51 ± 97.9	1027.74 ± 61.1	998.00 ± 78.8	0.883
4	1156.12 ± 97.5	1159.05 ± 43.2	1171.61 ± 73.9	1141.83 ± 28.6	0.970
5	1302.25 ± 34.9	1326.00 ± 96.2	1389.66 ± 89.3	1317.35 ± 93.3	0.597
6	1478.06 ± 21.1	1441.33 ± 25.2	*1560.66 ± 25.4	1496.89 ± 45.8	0.041
7	1532.74 ± 23.1	1554.00 ± 35.1	**1680.66 ± 22.9	1518.10 ± 45.1	0.001

Notes: Values shown are each average of 30 chickens (±SD) with 3 replicates.
** and ** indicate significance at the 5% and 1% level, respectively, compared with other treatments at the same period of feeding, as judged by One-way ANOVA analysis. T is referred to as Treatment.*

Feed Intake Index (FI)

The feed intake index (FI) is crucial for chicken weight growth and ensuring economic benefit in poultry production. To understand whether the chicken gains weight as related to FI, we observe the average amount of chicken of different DBR treatments for 7 weeks. Table 3 shows that in the first week, the FI showed no significant difference among the 4 treatments. In the second week, control (T0), without the supplement of DBR, produced higher FI ($P<0.05$). However, there was no significant difference at week 3 ($P>0.05$) among the 4 treatments. At week 4, the highest FI was observed in treatment 2 ($P<0.05$). From weeks 5, 6, and 7 treatment 2 (T2) (DBR=25%) produced significantly higher weights than other treatments ($P<0.05$). These results suggest that younger chickens showed no clear feed intake among different levels of DBR. However, it is probable that when a basic diet is supplemented with 25% DBR, the chickens consume more feed, a trend that is consistent with the increased weight of chickens among the group (Table 2).

Table 3 Feed intake index of chicken of different DBR treatments (% of the total amount of diets)

Weeks after feeding	T0 (DBR=0%)	T1 (DBR=20%)	T2 (DBR=25%)	T3 (DBR=30%)	P-value
1	56.49 ± 7.80	53.61 ± 9.84	43.73 ± 16.0	52.28 ± 8.60	0.250
2	**76.73 ± 5.57	52.77 ± 8.22	59.60 ± 11.3	58.20 ± 7.72	0.001
3	53.68 ± 2.66	60.39 ±12.2	64.65 ± 9.96	65.27 ± 9.84	0.235
4	67.81 ± 2.31	81.78 ± 4.17	85.48 ± 4.87	**88.08 ± 1.37	0.001
5	78.04 ± 1.47	81.92 ± 5.29	*85.20 ± 3.71	82.20 ± 4.24	0.011
6	84.39 ± 3.57	84.04 ± 5.60	*88.87 ± 4.36	80.96 ± 8.12	0.044
7	85.12 ± 5.82	83.15 ± 6.20	**90.13 ± 6.54	78.85 ± 7.78	0.001

Notes: Values shown are each average of 30 chickens (±SD) with 3 replicates.
** and ** indicate significance at the 5% and 1% level, respectively, compared with other treatments at the same period of feeding, as judged by One-way ANOVA analysis. T is referred to as Treatment.*

Feed Conversion Ratio (FCR)

Feed conversion ratio (FCR) is the amount of feed eaten relative to the weight of one chicken. It plays an important part in determining feed efficiency and production cost. To see whether the chicken growth is relevant to FCR, we observe the feed conversion ratio of the 13-week-old chicken. As shown in Table 4, the ratio of FCR seems slightly decreased when the basic diet supplemented with T1 (DBR=20%), T2 (DBR=25%), and T3(DBR=30%) compared with control T0 (without DBR supplement) but there is no significantly different among 4 treatments tested. These results suggest that the optional DBR promoted chicken growth by 25% DBR is not relevant to the ability of feed conversion but it is caused by the increased intake (Table 3).

The main factors affecting the conversion ratio in poultry include genetics, age, and feed quality. In the current experiment, we used the same chicken variety and age. Another study reported that feed conversion was not significantly different when Ross 308 chickens fed cassava flour mixed with universal concentration (UC+Cas) gained weight higher than chickens fed a commercial diet (Jeremiah et al., 2015).

Table 4 The Feed conversion ratio (FCR) of 13 weeks-old chickens

Treatment	T0 (control)	T1 (DBR=20%)	T2 (DBR=25%)	T3 (DBR=30%)	P-value
FCR ratio	4.36 ± 0.64	3.71 ± 0.60	3.35 ± 0.59	3.37 ± 0.60	0.186

Notes: Values shown are each average of 30 chickens (±SD) with 3 replicates

CONCLUSION

This study finds that the optional inclusion of DBR in the basic diet for the better growth of local chicken (*Gallus domesticus*) is 25%. This performance of the chicken growth is likely due to feed intake (FI). The result is similar to findings from Fasuyi et al., in which the application of 10-20% of DBR resulted in better growth of young birds and up to 30% in older poultry (2018). Similarly, another study demonstrated that the inclusion of 25% DBR only (without basic diets such as soybean, sunflower, fish milk, and maize) caused a similar effect on broiler growth compared with control (basic diets) (Kuleile et al., 2019). This finding suggests that DBR can be used to substitute conventional protein sources and reduce production costs. Yet, in this present study, further investigation is required to find different types of basic diets supplemented with DBR and the meat quality of chicken after taking DBR.

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