



EFFECT OF REPLACEMENT CORN BY BROWN RICE ON PERFORMANCE OF CHICKEN PRODUCTION IN VIETNAM

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ABSTRACT

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Rice is a major staple food in Vietnam in which brown rice has been recognized as a potential feedstuff for poultry but data on nutritional value of this feed are lacking. In this study the using of brown rice as replacement of corn in chicken diet was evaluated. The body weight, feed intake and feed conversion ratio were recorded. In total, 192 day old chicks of country breed (*Ri lai*) were used in this study. Chickens were divided into four groups and reared at same conditions for 12 weeks. The first group as the control group fed on 100% corn, second group fed on 75% corn and 25% brown rice, third group fed on 50% corn and 50% brown rice and the last group fed on 25% corn and 75% brown rice. The average body weight of chickens among all the treatments was 1.7 kg per bird which was not significantly different ($P=0.44$). The total feed intake of chickens (4-5 kg) was recorded without significant difference ($P=0.23$), however the feed conversion ratio were significantly different ($P<0.05$) between treatments. This study considered as the first report that demonstrates the usefulness of brown rice as a potential alternative of corn for chicken diet in rural areas in Vietnam, especially on the prevailing conditions such as during high price spell of corn.

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INTRODUCTION

Vietnam is an agricultural country with around 70% of population living in rural area. Small-scale production of poultry plays an important role in household economy across rural areas (Vang, 2003; Burgos et al., 2008). Although farmers could use the commercial feeds ready to use that are sold in many animal-feed stores, majority of farmers in reality prefer to use corn as the additive to feed chickens according to their practical experience (FAO, 2014). Recently, the price of corn in Vietnam fluctuated from 0.35 USD to 0.5 USD per kilogram leads to impacting heavily on the production cost for farmers (USDA, 2015; Jonas et al., 2015, Luckmann et al., 2015). This might be ineffective if the rural farmers only depend on the corn in poultry production.

Rice is well-known as a major staple food in Vietnam contributed approximately 30% of the total world rice production (Chris, 2014). The rice with good quality is used as human food and the low nutrient rice is rejected for use as feedstuffs for ruminants and monogastric animals. Brown rice (BR) is among these rejected parts of rice production and has high potentiality for poultry production. This kind of rice are usually available in the rural areas in Vietnam but still not effectively used. It is definitely worth to use the brown rice in poultry production in Vietnam. Brown rice was suggested to replace corn in poultry farming in Vietnam due to the actual high price of corn (Kinh, 2015). A study of composition and energy value of brown rice by Asyifah (Asyifah et al., 2012) showed that it is a potential feedstuff for poultry production. The nutrients contained in brown rice are suitable for poultry rearing, especially chickens and broilers due to their high energy value and low fiber content as well as balanced amino acids. Moreover, the production costs could be lower because the source of brown rice in rural areas is commonly available and abundant. Additionally, a recent study on ducks in Vietnam reported that using of brown rice for duck rearing gave no differences in growth performance and could be used to replace corn without negative effect to the growth of ducks (Viet et al., 2015). However, there has been no practical experiment done for chicken rearing in the rural areas.

There were many chicken breeds used in rural farming in Vietnam and the hybrid breed called "*Ri lai*" (*Ri x LP*) is most common used because of the high living rate and meat quality (Vang et al., 1999; Van, 2002; Duc and Long, 2008). Additionally, the price of the chicken *Ri* per kilogram is normally much higher and has a preferable taste than broilers after 12 weeks raising. Thus, the chicken *Ri* was the "chicken of choice" to rearing in rural areas.

In Vietnam, the diets mixed corn with the concentrated feed such as the RTD-VinaS99 (S99) provided by companies were known as a common diet for raising chickens in rural areas. However, recently high changing of corn price negatively affected to chicken production and farmers. Furthermore, the aflatoxin produced from low quality corn could also be a major problem which causes high mortality of chickens and significant damage to their growth performance as well. Therefore, this study was aimed to investigate the effect of using different levels of brown rice and corn as the feed on growth performance within the chicken farming context situation in rural areas in Vietnam.

MATERIALS AND METHODS

Location

The experiments were carried out in the area of animal experiments in Hung Vuong University of Phu Tho, Vietnam from November 2015 to March 2016. This location is about 70 kilometers far from Hanoi, Vietnam.

Corn and brown rice source

Corn and brown rice were provided by local animal feed stores in Phu Tho, Vietnam. The feed RTD-VinaS99 were chosen as a fixed feed in 4 diets. The rate of corn and brown rice in diets was based on the demand of consumption of chickens through periods of growth.

Experimental design

Total of 192 newly hatched chickens of local breed (*Ri x LP*) were purchased from a commercial hatchery. The birds were randomly divided into four groups (one control and three experimental groups) of 48 birds in each. Each group was replicated three times with 16 birds per replicate. The experimental diets were formulated as described in Table 1. The concentrated feed was RTD-VinaS99 used as a fixed feed. The value of nutrition composition of the feeds RTD-VinaS99, corn and brown rice was shown in Table 2.

Table 1. Experimental designs and diets

Experiment	1 - 21 day			22 – 35 day			> 35 day		
	BR (%)	Corn (%)	S99 (%)	BR (%)	Corn (%)	S99 (%)	BR (%)	Corn (%)	S99 (%)
Group 1 ^a	0	65	35	0	68	32	0	73	27
Group 2 ^b	16.25	48.75	35	17	51	32	18.25	54.75	27
Group 3 ^c	32.5	32.5	35	34	34	32	36.5	36.5	27
Group 4 ^d	48.75	16.25	35	51	17	32	54.75	18.25	27

^acontrol group with only corn and S99, ^breplacing 25% corn by BR, ^creplacing 50% corn by BR and ^dreplacing 75% by BR.

Table 2. Nutrition composition of the feeds

Ingredients	Unit	RTD-Vina S99	Corn	Brown rice
Energy of metabolism	kcal/kg	2700	332.9	327.10
Crude protein	%	44	7.93	8.0
Calcium	%	2.5 - 4.5	0.09	0.06
Phosphorus	%	2.0 – 3.5	0.15	0.24
Fiber	%	6.0	3.05	0.60
Lysine	%	2.7	2.5	ND
Methionine + Cysteine	%	2.6	1.56	ND

(Source: provided by the company RTD and National Institution of Animal Science)

ND: not determined

Housing

Birds were housed on rice husk shavings (10 cm height) in 4 similar rooms of the same facility with room climate. Each room was 3.2 x 1.4 m with 12 pens of approximately 2 m² each; the studied chicken density was 0.10 m²/bird. Electronic light was provided for 24 h as a heat source for the first 10 days of age and 10 h of normal light per day during experimental period. The birds were vaccinated against infectious bursal disease (d 7 and d 25) and Newcastle disease (d 2 and d 28). The procedures of caring were following as given by the Viet Nam National Animal Science Institute.

Performance and feed conversion rate

The body weight of chickens was weighed weekly. Feed consumption was summarized to calculate the feed conversion ratio (FCR) and the average daily weight gain (ADG) at the same times.

Statistical Analysis

The data collected from experiments for body weight, feed intake, ADG, and FCR were evaluated and analyzed statistically to show the differences between experimental groups. Statistical analysis was performed as described by Thien (2009) using the software SPSS version 20.0 by the one-way ANOVA test. Differences among treatments were considered to be statistically significant if P-values was less than 0.05. All data were expressed as means.

RESULTS

The results concerning total average body weight gain, the total average feed intake and the feed conversion ratio in different experimental groups were summarized in Table 3.

Table 3. Chicken performance of using corn and brown rice in the diet

Parameter	Group 1 (control group)		Group 2 (75% corn + 25% BR)		Group 3 (50% corn + 50% BR)		Group 4 (25% corn + 75% BR)		P-value
	$\bar{X} \pm m\bar{x}$	Cv (%)	$\bar{X} \pm m\bar{x}$	Cv (%)	$\bar{X} \pm m\bar{x}$	Cv (%)	$\bar{X} \pm m\bar{x}$	Cv (%)	
Hatch (g)	36.23 ± 0.34	0.93	35.92 ± 0.31	0.86	35.56 ± 0.31	0.87	35.83 ± 0.30	0.84	0.51
12 wks (g)	1715.10 ^a ± 38.47	2.24	1657.29 ^{ab} ± 37.04	2.22	1641.15 ^{ab} ± 42.48	2.58	1631.77 ^{ab} ± 30.37	1.86	0.44
TWG (g)	1678.87 ^a ± 38.48	2.29	1621.37 ^{ab} ± 37.01	2.28	1605.59 ^{ab} ± 42.39	2.64	1595.94 ^{ab} ± 39.36	2.46	0.44
TFI (g)	4338.96 ^a ± 65.33	1.51	4299.16 ^{ab} ± 57.16	1.32	4365.62 ^{ab} ± 73.19	1.68	4521.25 ^{ab} ± 59.11	1.31	0.23
FCR	2.58 ^a ± 0.03	1.16	2.65 ^{ab} ± 0.03	1.13	2.71 ^{ab} ± 0.06	2.21	2.83 ^b ± 0.03	1.06	0.03

$\bar{X} \pm m\bar{x}$: Means ± standard errors mean.

^{a,b} Means within each row with the same superscript letter are not significant (P>0.05); CV: Coefficient of Variation; Wks: Weeks; TWG: total weight gain; TFI: total feed intake

Body weight gain

The initial weight of day old chicks was around 35 grams. After 12 weeks, the live weight gain was approximately 1.7 kilogram per bird. The final average weight gain was highest in the group 1 (1715.10 g, P<0.05) and lowest in the group 4 (1631.77 g, P>0.05). There were no significant differences between the body weight gain of chickens using corn and brown rice at different levels (P=0.44).

Feed intake and feed conversion

The feed intake was highest in group 4 (4521.25 g, P>0.05) and lowest in group 2 (4299.16 g, P>0.05). However, there were no significant differences of feed intake between different groups (P = 0.23). On the other hand, the feed conservation ratio was significantly different (P = 0.03) among experimental groups. Differences were observed between group 1 (FCR = 2.58) and group 4 (FCR = 2.83) due to P < 0.05 (P = 0.02), but there were no differences (P > 0.05) between group 1 and group 2 (FCR = 2.65) and group 3 (FCR = 2.71). Additional, all rearing conditions for each experimental group were identical and maintained during the period of the experiment. The mortality rate was 4.2% (2 birds) in the control group and 2.1% (1 bird) in each experimental group.

DISCUSSION

Vietnam is considered as a rich country with rice yields over the world (Bernhard Liese et al., 2014). However, high potential of using agricultural by-products from rice after processing has still been limited in usage in Vietnam. Some parts of rice including polishings (Ali MA et al., 1995, Rahman et al., 2005), rice bran (Wang et al., 1997) and rice grain that is undesirable for human consumption (Alias et al., 2008) demonstrated as feedstuffs for ruminants and monogastric animals. Brown rice was found to have a good potential as feed ingredients in the poultry industry (Asyifah et al., 2012). Analyses of nutrients of brown rice have shown that it has a high energy value (327.10 kcal/kg), low fiber content (0.60%) and is balanced in amino acids (Asyifah et al., 2012). This study considered as the first trial to examine the using of corn and brown rice for chicken feeding.

The live body weights of chickens in 4 treated groups were approximately 1.7 kg after 12 weeks feeding and no differences were found between using corn and brown rice. This strongly suggest that farmers could consider using brown rice as an alternative feedstuff to corn. Moreover, our findings on the growth performance of chickens using the studied diets agree with the biological growth performance of local chicken lines "*Ri lai*" (*Ri x LP*) in Vietnam.

The total feed intake of chickens was around 4.5 kg and no significant differences were found between groups ($P = 0.23$). However, the FCR was significantly different between the group 1 and group 4 and difference within the group 1 on their growth performance and feed intake. This may be attributed to the high difference in the sex of chickens within the group 1. There were 38 (79.16%) male chickens while only 10 (20.84%) female chickens within group 1, but there were equal number of male (20-25) and female (23-28) chickens between group 2, group 3 and group 4. This is in good agreement with the study on the ability of the growth performance of male chickens which was observed by Dayhim et al., 1992. Based on our findings, consequently, the diets (no. 1, 2 or 3) can be selected based on each condition in rural areas. Similar to our findings, a recent study of using brown rice with replacement of proportion of corn in diets for super meat ducks by Viet et al. (2015) showed no significant differences in growth performance of ducks fed with various levels of brown rice. Therefore, the growth performance has shown that brown rice can be used in chicken and duck production as a positive solution replacing corn due to rapid changing of prices of corn. It is also a good choice for farmers as well as the areas with redundancy of rice in Vietnam such as Mekong river delta areas.

To the best of our knowledge, there is no published information available on using brown rice with corn in chicken diets to compare the data of the present study about the feed intake in chicken production in Vietnam. However, studies from other countries showed that there were many alternative feeds for chickens rearing instead of corn only. The soybean, for instance, is also an alternative feedstuff to replace corn (Lee and Garlich, 1992). However, the replacement depends on the available feeds in each area and regions.

CONCLUSION

This study showed for the first time that body weight gain, feed intake and feed efficiency did not significantly differ when corn was substituted by mixtures of corn and brown rice in different ratios. This provides a basis for selection of either corn or brown rice according to the prevailing conditions in many rural areas in Vietnam. Moreover, it is considered as a new evidence for optional selection of corn and brown rice in poultry nutrition in Vietnam with the situation of high price of corn. Effective using of brown rice as a substitute of corn is a good solution for chicken production in Vietnam.

COMPETING INTEREST

The authors declare that having no competing interests.

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