# EFFECTS OF SUBSTITUTION OF CORN FOR COMMERCIAL RATION ON PERFORMANCE AND PLASMA CHOLESTEROL IN KUB CHICKENS

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# EFFECTS OF SUBSTITUTION OF CORN FOR COMMERCIAL RATION ON PERFORMANCE AND PLASMA CHOLESTEROL IN KUB CHICKENS

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**ABSTRACT**: The aim of the present study was to evaluate growth performance and plasma total cholesterol (TCHO) concentration of KUB chickens fed by substitution of commercial feed with corn in 1 of day-old chick of KUB were raised for 10 weeks in two dietary groups including only commercial feed (group A) and a commercial feed substituted by 30% corn (group B). Data were analysed by T-test. The results showed that there was no significant effect of the treatments on feed intake, body weight (BWG) and feed conversion ratio (FCR) in KUB chickens. Similarly, plasma TCHO concentration did not show any difference between two experimental rations. However, total income of commercial feed substituted with 30% corn was higher than commercial feed. It was concluded that corn could be used at 30% to substituted commercial feed without significantly affecting the KUB chicken performance and TCHO. Present research considered usefulness of corn as a potential alternative of commercial feeds in KUB chickens in Indonesia.

**Keywords:** KUB chickens, Feed Intake, Body Weight Gain, Feed Conversion Ratio, Commercial Feed, Corn

## INTRODUCTION

The use of native chicken in tropical countries varies among countries and from community to community within a region (Padhi, 2016; Yakubu et al., 2020). Recently, the poultry production in Indonesia has been given significant economic prospect especially towards provision of chicken carcasses in an effort to fulfill community demand of nutrition (Puspani et al., 2011; Harianto et al., 2019). Population of native chicken in Riau Province from year to year continues to increase along with consumer tastes towards native chicken. This fact is reflected in population growth and demand for native chickens, which has increased from year to year (Bakrie et al., 2003). According to the Central Statistics Agency the number of native chickens in 2014, 2015 and 2016 were 3,327,820, 3,746784 and 3,896,655, respectively (Central Bureau of Statistics, 2017). Indigenous chickens contributed in meat production about 292,710 tons in period 2011-2015. Recently, indigenous chicken production includes almost 16.7% of total of market share of commercial meat-type poultry in Indonesia (Tangendjaja, 1999). Considering this potential, solutions should be sought to increase population and productivity. To fulfil the demands of indigenous chicken meat in Indonesia, it has been followed by the finding of native KUB chicken as moderately improved native chicken breed. KUB chicken is a superior native chicken produced by the Indonesian Agency for Agricultural Research and Development, Indonesia (Hidayah, 2019). The KUB breed has some advantages such as high hatchability, low feed conversion ratio and high rates of egg production (160-180 eggs/year) (Sartika, 2016) as well as considering aa a meat type breed (Hidayah et al., 2019), in compared to their previous generations as well as local chickens.

One of the keys to success in maintaining KUB chicken is to meet their nutritional needs through the provision of rations that are in accordance with the standards of livestock needs. In general, farmers buy commercial rations that are marketed to have nutritional standards. The feed is the largest cost component, which is about 70% of the total production cost in poultry (Teguia and Beynen, 2005). Therefore, indirectly the ration is a determinant of the level of profits of farmers. The price of commercial rations sold in markets and poultry shops is considered very expensive by farmers. Therefore it is very important to look for ration giving strategies to reduce feed costs. One alternative that can be taken to reduce the cost of feed is to reduce the portion of the commercial ration provided by one of the raw materials that contain high calories to the performance of the chicken.

One of the main feed ingredients in poultry in preparing rations as an energy source is corn. This feed ingredient has several advantages including easy digesting, palatable and does not contain anti-nutritive substances. In addition, corn also contains xanthophyll substances which can increase the yolk on the yolk, feet and chicken carcass skin. Aside from being a feed source for carbohydrates, the ingredients of this ration are also a source of protein, namely: albumin, globulin, prolamin, glutelin, and nonprotein nitrogen. According to Scott (1982) yellow corn compound 3,370 kcal / kg of



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metabolic energy (EM), 8.6% crude protein, 3.9% fat, 2% crude fiber 0.02% calcium and 0.1% phosphorus. In addition, Suarni and Widowati (2007) stated that corn has other advantages including containing 12.19% dietary fiber which functions to reduce total cholesterol (TCHO), LDL levels and blood glucose. Another advantage of corn is that it contains vitamin A or carotenoid and vitamin E which functions as natural antioxidants that can increase the body's immunity and can inhibit degenerative cells. The content of several essential minerals, such as K, Na, P, Ca and Fe are also found in corn.

Several previous studies have shown that replacing some commercial rations with corn does not reduce chicken performance. For instance, Puspani et al. (2011) revealed that substitution commercial feed up to 20% with corn did not alter feed consumption and FCR in broiler chicken. Winarti and Wiranti (2013) fed diet substitution of broiler commercial feed with corn up to 40% did not adverse growth and FCR in native chickens. Furthermore, Munira et al. (2016) in their research results reported that there were no significant difference on feed intake, body weight gain (BWG), carcass weight and carcass percentage of super native chickens when fed fermented 10% rice bran in ration compared to control. These findings indicate that one alternative that can be done in an effort to reduce the cost of raising chickens both broilers and native chickens is to replace some commercial rations with energy source feed ingredients.

To our knowledge, there have been no reports regarding the effect of substitution of commercial feed with corn on performance and plasma TCHO in KUB chicken. Therefore, the purpose of this study was to determine the effect of substitution of commercial feed with corn on performance and plasma TCHO in KUB chickens. In addition, evaluation of corn energy source for economical broiler production also was evaluated.

## MATERIALS AND METHODS

This research was carried out at the Poultry Division Field Laboratory, Faculty of Agriculture and Animal Science, State Islamic University of Sultan Syarif Kasim Riau, Indonesia in 2018.

### Ethical approval

Chickens were handled and managed accordance with the recommendations in the Guide for the Care and Use of Animal, at the Faculty of Agriculture and Animal Science, State Islamic University of Sultan Syarif Kasim Riau, Pekanbaru, Indonesia.

### Animals and ration

This study used 50 DOC KUB chickens purchased from local breeding farms and placed in 2 enclosures (25 per plot). All birds were distributed with uniform body weight and water was provided *ad-libitum*. One day before the experiment. Placement of chickens into the cage was done randomly. Chicken was put into the cage done two weeks after the cage was cleaned and washed. Likewise, the treatment was given randomly. The size of the enclosure for each unit is 75 cm x 60 cm width and 60 cm height. Each cage was equipped with a ration container and drinking water container. This study consisted of 2 treatments, each consisting of 25 chickens. The treatment ration and water were given ad libitum. Chicken were raised for 10 weeks. Experimental rations consisted of two treatments, namely 100% of commercial feed and 70% commercial feed + 30% corn. The commercial feed was purchased from PT Charoon Pokphan Ltd, Pekanbaru (Table 1), while the composition of nutrient content of treatment is shown in Table 2. The parameters measured were performance including feed intake, (BWG) and feed conversion ratio (FCR), concentration of TCHO in blood plasma.

**Table 2 -** The percentage of nutrient content of Corn and Commercial ration

| Nutrient | Corn* | Commercial ration |
|---|---|---|
| Crude Protein (%) | 8.6 | 23.50 |
| Crude Fiber (%) | 2 | 1.88 |
| Crude Fat (%) | 3.9 | 5.87 |
| Ca (%) | 0.02 | 0.29 |
| P (%) | 0.1 | 0.15 |
| ME (Kcal/kg) | 3,370 | 3,050 |

* Scott et al. (1982). Ca: Calcium, P: Phosphor, ME: Metabolizable Energy; *Commercial feed: CP511 PT, Charoen Pokphand, Indonesia; **Mineral Premix: Supplemented for kg of the diets: Vit. A, 12000 IU; D3, 2000 IU; E, 20 mg; K3, 3 mg; B2, 7 mg; B3, 12 mg; B5, 3 mg; B12, 0.03 mg; biotin, 0.1 mg; choline chloride, 300 mg; Mn, 130 mg; Fe, 70 mg; Zn, 60 mg; Cu,12 mg; I,1 mg; Se, 0.2 mg, and adequate antioxidant.

**Table 2 -** Composition of nutrient content of Treatment

| Nutrient | 100% of Commercial feed | 70% commercial feed + 30% corn |
|---|---|---|
| Crude Protein (%) | 23.50 | 22.01 |
| Crude Fiber (%) | 1.88 | 4.21 |
| Crude Fat (%) | 5.87 | 7.42 |
| ME (Kcal/kg) | 3,050 | 3,055 |



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### Growth performance

Feed intake and BWG were recorded weekly throughout the experiment. Feed intake was corrected for body weight taking account of mortality if any. Feed intake was calculated as a difference between the amount of feed supplied to the birds and the amount of feed that remained at the end of each feeding period. BWG was calculated as a difference between the final and initial birds weight during each of the weighing periods. Feed intake and BWG were recorded at week 1 to week 10 and FCR was calculated as a ratio between feed intake and BWG for each period.

### Analysis of plasma total Cholesterol

The TCHO was determined with Microlab 300 (Vital Scientific, Netherland) as per the manufacturer's instructions. Samples were assayed together and in a random sequence for each sample.

### Statistical Analysis

Data obtained were analyzed by T test. Significant differences will be given in the symbol $p<0.05$. Data to be displayed was ± SEM which is processed by SPSS commercial software (2007). Before data processing was performed, all raw data was performed by the Thompson test to eliminate outlier data using the test level ($p<0.05$), then proceed with data analysis.

## RESULT AND DISCUSSION

### Feed Intake

Weekly feed intake of the birds is shown in Table 3. T test results of feed intake, did not show significant effect ($P>0.05$). Feed intake during the entire experimental period, ranging from 406.31 to 400.6 g/bird/week, respectively. This shows that substitution commercial feed with corn up to 30% did not affect feed intake. The result was consistent with previous work (Puspani et al., 2011) who revealed that substitution of commercial feed with corn up to 20% did not alter feed intake in broiler chickens. Similarly, Winarti and Wiranti (2013) who reported that substitution of broiler commercial feed with corn even up to 40% did not significantly change feed intake in native chickens. It seems that substitution of broiler commercial feed with corn did not alter feed intake thereby the composition of nutrients such as crude protein and energy metabolism in between two treatments given to KUB chickens still adequate to maintain their growth.

It is well know that level of protein and feed energy will affect the consumption of feed. Feeds that contain relatively similar protein and energy cause the same consumption of feed (Astuti, 2012). According to Parakkasi (1985) chickens consume rations mainly to meet their energy needs. Chickens cannot adjust to their rations precisely but consume more energy if their feed energy levels are low (Anggorodi, 1994). However, as shown at Table 2, the average feed intake of KUB chicken fed with substitution commercial feed with corn was 400.6 gram/bird/week higher than previous study (Munira et al., 2016) who found that the average of feed intake of KUB chickens was 307.80 grams /bird/week when fed a basal control diet prepared in 10-week. The reason for these discrepancies on feed intake due to KUB chickens is unknown. Such differences also might be attributed the size of the feed ingredient composition, feed formulation and feed pellet quality and management including environmental management, feed and water availability to the birds, disease control, and stocking density (Ferket and Gernat, 2006; Kuleile et al., 2020). These results also may imply that KUB chickens have a low nutrient requirement for maintenance and growth compared to broiler chickens. The trend of average weekly feed intake of KUB is shown in Figure 1. As shown in Figure 1 during the first 7 weeks, the average feed intake in chickens on both experimental rations increased gradually and showed similar trends. There was no increase in the feed intake of chickens during 8$^{th}$ and 10$^{th}$.

**Table 3.** Average of feed intake of KUB chickens provided with commercial feed or substitution commercial feed with corn (gram/bird/week)

| Age (week) | Control (broiler commercial feed) | 30% substitution |
|---|---|---|
| 1 | 99.52 | 90.96 |
| 2 | 188.6 | 183.20 |
| 3 | 265.6 | 244.80 |
| 4 | 334.8 | 339.68 |
| 5 | 413.4 | 409.60 |
| 6 | 532.4 | 545.80 |
| 7 | 559.2 | 546.60 |
| 8 | 557 | 549.20 |
| 9 | 556.2 | 546.20 |
| 10 | 556.4 | 550.00 |
| Average | 406.312 | 400.604 |

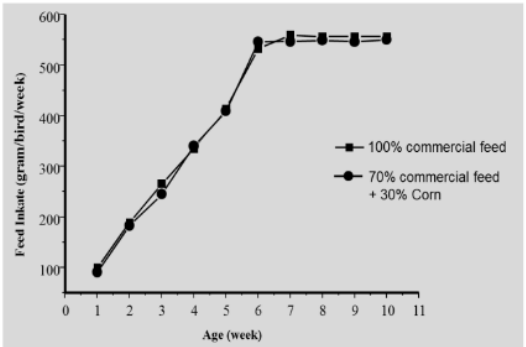


**Figure 1 -** Effects of experimental rations on the weekly feed intake of KUB chickens.



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**Body weight gain**

Results of BWG of birds fed with experimental diets are presented in Table 4. The results of data analysis showed that the substitution of commercial feed with 30% corn did not significantly ($p>0.05$) affect BW gain in KUB chickens. The average BW gain during 10 weeks old of was 487.0 and 420.5 g/head/week, control and substitution treatments, respectively. These results confirmed with previous work (Winarti and Wiranti, 2013) who found that reported that substitution of feed with corn up to 40% did not significantly alter BW gain in native chickens. This results might be attributed by feed intake were also similar of the two treatments. Visualization of the average weight gain of super native chickens during the study is shown in figure 2. As shown in Figure 2 that during the first 5 weeks, the average BW gain in chickens on both experimental rations increased gradually and showed similar trends. However, during 5th and 10th the average BW gain increased sharply. It seems that substitution broiler commercial feed had higher trend than control diet during 5th and 10th. This shows that it is advisable to carry on keeping the KUB chickens until 10th week as the chickens consumed more feed and gained gradually. These results indicate that the 5th week was the period of the beginning of gradually growth which then continuously growth in sharply trend up to 10th week.

**Table 4** - Effect of partial replacement of broiler commercial feed with corn on BW gain in KUB chickens (gram/bird/week)

| Age (week) | Control | Substitution |
|---|---|---|
| 1 | 63.92 | 64.00 |
| 2 | 99.28 | 122.72 |
| 3 | 166.48 | 190.84 |
| 4 | 233.88 | 243.12 |
| 5 | 331.84 | 368.32 |
| 6 | 396.16 | 491.16 |
| 7 | 487 | 548.52 |
| 8 | 546.32 | 639.40 |
| 9 | 604.04 | 719.12 |
| 10 | 689.4 | 818.24 |
| Average | 487.00 | 420.54 |

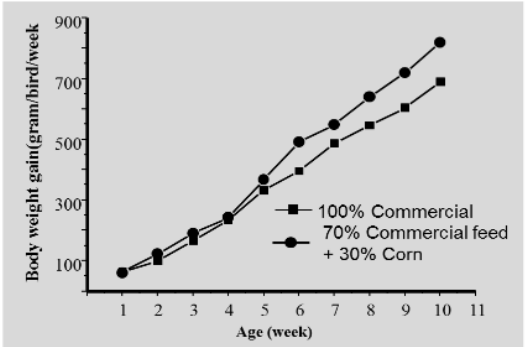


**Figure 2.** Average of BWG of KUB chickens in feeding substituted with corn

**Feed conversion ratio**

The average FCR for 10 weeks g /bird/week raised from lowest to highest respectively 4.78 and 5.0 as in Figure 3. The results of the data analysis show that the replacement of commercial rations with corn did not significant effect ($P>0.05$) on FCR. The results of this study were not much different from the results of the study of Munira et al. (2016) who demonstrated that the average FCR in super native chickens up to 10 weeks of age with substitution of fermentation rice bran was ranging from 4.1 to 4.9

**Economics of production**

Economic analysis as influenced by substitution commercial feed with 30% corn is shown in Table 5. Total input cost per bird was calculated on the basis of total feed cost and cost of chicks and cost management. As KUB chicken fed on substitution commercial feed with 30% corn the cost of experimental ration decrease. Net profits were obtained for the group compared to fed by 100% of commercial feed.

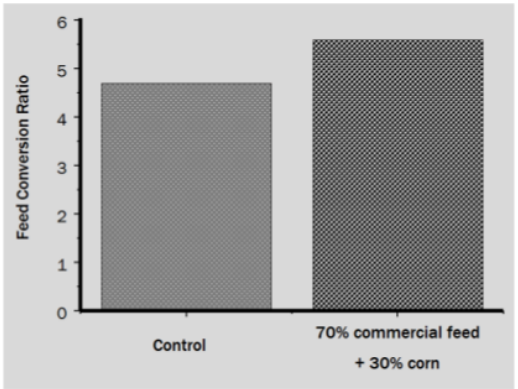


Figure 3 - Effects of experimental rations on the weekly feed conversion ratio of KUB chickens

**Table 5 -** Economic analysis of feeding commercial feed and substitution of commercial feed with corn to KUB Chickens (in Indonesian Rupiah)

| Parameters/rations | Control (broiler commercial feed) | 70% commercial fee + 30% corn |
|---|---|---|
| Cost* of feed | 577,500 | 502,500 |
| Cost of chicks | 350,000 | 350,000 |
| Cost of management | 350,000 | 350,000 |
| Total cost | 1,277.500 | 1,202.500 |
| Sale revenue | 2,000000 | 2,000000 |
| Average | 722,500 | 797,500 |

*Based on Indonesian currency



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**Total cholesterol**

The results of the study of commercial feed substitution with corn feed ingredients on TCHO of KUB chicken plasma is shown in Figure 4. Based on statistical analysis, there is no effect of experimental rations TCHO levels ($p>0.05$). Study of plasma metabolites in bird enables metabolic change to be evaluated that are due to the effects of many factors, including pharmacological condition physiological state, age, husbandry condition, and genetic type (Meluzzi et al., 1991; Gayathri et al., 2004; Erwan et al., 2014, 2017, 2020). The average TCHO level in the control and substitution with 30% corn was 154.52 mg/dl and 166.42 mg/dl included in the normal range according to finding of Mangisah (2003) who explained that normal chicken blood cholesterol levels ranged from 125-200 mg/dl.

Partial substitution of commercial feed with corn feed ingredients did not affect TCHO. No differences TCHO levels presumably correlated to feed ingredients both treatments were similar. This result shows that substitution 30% commercial broiler feed with corn still could be tolerate on plasma metabolite especially TCHO in plasma. TCHO derived from feed plays an important role, because it is the main sterol in the body and the cell surface components and intracellular membranes. De novo cholesterol biosynthesis is much influenced by stress factors of super native chickens. Overal these results indicated that KUB chicken fed by substitution commercial feed with 30% corn did not adverse performance and plasma cholesterol .

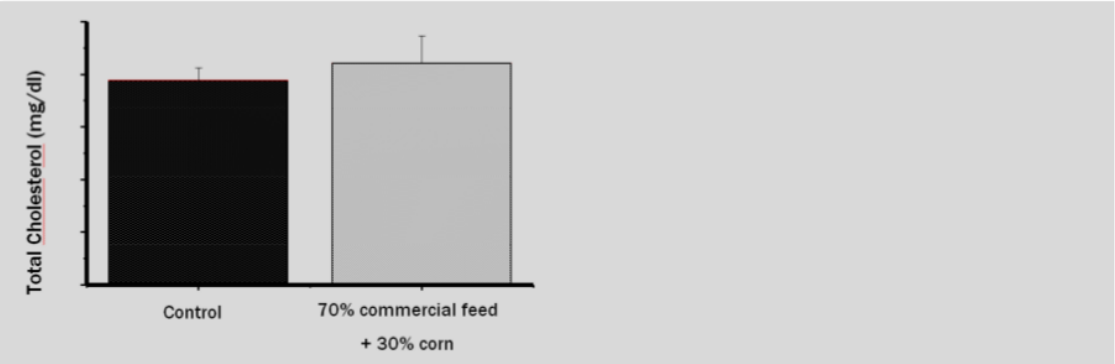


Figure 4 - Effects of experimental rations on total cholesterol in KUB chickens

## CONCLUSION

It is concluded that corn could be used up to 30% to substitute commercial feed in diets of KUB breed chickens (local breed) could reduce cost of production without change growth performance and plasma cholesterol level in local breeds of broiler chickens. A future study will explore on the effect of using 30% to substitute commercial feed on performance and plasma metabolites in other poultry species.

## DECLARATION

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**Availability of data**

The data can be availed to the journal upon request.

**Consent to publish**

Not applicable

**Conflict of interest**

The author declares they have no competing of interests.

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