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Broiler Performance Index Based On Strains, Commercial Ration And Their Interaction

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Abstract – This work was aimed to evaluate strain and commercial rations (CR) as well as their interaction (strain*CR) toward broiler performance index (PI). 90 day old chicks (DOC) from each strain (Ross, Cobb and Hybro) were deployed in this work, thus the broiler total were 270. In addition 3 different commercial rations (CR) as follows; CR-A, CR-B, and CR-C were used in this work. Completely randomized design was applied with factorial 3x3 on 3 repetitions. Randomly broilers were put in 27 cages 1x1 meter. Each cage consist 10 broilers and equipped with water and feed container. The broilers were raised up to 35 days, feed and water available adlibitum. Brooder, vaccination and vitamin were evenly given to the broilers in the 27 cages. Measured variables were broiler proportion, ration consumed, and weight average, then it converted to PI. Data were analyzed with univariate via SPSS 21 software. Results showed that strain; CR and interaction between strain and CR was significant toward IP. Further test showed that strain Ross has highest IP the followed by Cobb and Hybro. Meanwhile highest PI on CR was CR-C then followed by CR-A and CR-B. This study concludes there was linkage between certain strain and CR.

Keywords – Broiler, Strain, Commercial Ration, Performance Index

I. INTRODUCTION

Broiler meat is a food product of livestock-based which is dominantly consumed in almost all countries in the world [1]. In everyday life, broiler meat plays a very important role as a food supply, both for industry and for public consumption. The world's consumption of chicken meat in the 2015-2020 periods grew about 1.68% per capita per year [2] In Indonesia, the broiler population grew about 2.31% during 2015-2019, while consumption per capita in 2020 rose to 11.6 kg from 8.6 kg in 2015 [3].

This increase in consumption and population has attracted interest of broiler breeding farm and feed mill industry. The breeding industry produces and markets broiler strains, while the feed industry produces and promotes the Commercial Ration (CR) brand. Therefore, the selection of strains and CR brands is the first step that needs to be understood in the broiler farming business. Strains are broiler breeds obtained from the breeding process for commercial purposes. However, the strains produced by each nursery have different advantages.

CR produced and marketed by the feed mill industry was designed to produce optimum production performance; its nutritional content was adjusted to meet the standard nutritional needs of broilers in general regardless of strain type. However, at farmers level there is a tendency to claim certain ration brands as favorite or best rations for their farms. As for strains, which is produced and marketed by breeding farms, there are several strains that are superior to breeders. This claim seems to provide opportunities and possibilities of compatible strains pairing with certain CR brands, or CRs suitable for certain strains.

Previous studies on the use of various CR brands had been conducted by [4.5]. These three researchers have succeeded in explaining that certain brands of CR have provided optimum broiler production performance. Unfortunately, those studies were

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merely conducted onto the same broiler strain. Furthermore, research on several types of strains fed a certain brand of CR has also been carried out by [6, 7,8,9], and reported that certain strains provide optimum production performance.

These researchers have successfully documented of good CR brands, as well as good strains. However, it has not been discussed about the possibility of certain strains for certain CRs, or certain CRs for certain strains, or the mutual influence (interaction) between strains and CR. Accordingly, this study aims to evaluate the effect of strain, the effect of CR, and the joint effect or interaction of the two (strain*CR) on the Performance Index (PI). The results of this study are expected to be additional information for farmers in improving the PI of their livestock.

II. Material And Method

Materials

The materials used in this research were:

1. 270 broilers DOC (unsexed), 90 Strain Ross, 90 Cobb, and 90 Hybro obtained from 3 different nursery companies.
2. CR from three feed mill companies namely; CR-A (commercial ration from A company); CR-B (commercial ration from B company); dan CR-C (commercial ration from C company). Nutrient ingredient those three brands are depicted on Table 1.
3. Battery cage on 1x1 meter as many 27 plots
4. Feed and water container.

Table.1. Chemical and nutrient composition of CR

CR-Perlakuan	DM* (%)	As* (%)	CP* (%)	CF* (%)	CF* (%)	ME* (kcal/kg)	Ca* (%)	P* (%)
CR-A	88.90	5.90	20.45	3.92	5.72	3.220.72	1.24	0.70
CR-B	89.04	5.54	21.58	3.49	6.01	3.215.60	1.05	0.71
CR-C	89.40	5.33	22.19	3.25	5.75	3.395.15	1.09	0.72

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DM (Dry Mater); As (Ash); CP (Crude Protein), CF (Crude Fiber); CF (Crude Fat); ME (Metabolizble Energy); Ca (Calcium); P (Phosphor)

CR-A (commercial ration from A company); CR-B (commercial ration from B company); CR-C (commercial ration from C company).

Methode

This study applied completely randomized design with factorial 3x3 and each factor repeated 3 times [10], total trial units were 27. First factor was strain of broiler (Ross, Cobb and Hybro), meanwhile second factor was CR-A, CR-B, and CR-C. treatment design as follows;

Ross+CR-A	Cobb+CR-A	Hybro+CR-A
Ross+CR-B	Cobb+CR-B	Hybro+CR-B
Ross+CR-C	Cobb+CR-C	Hybro+CR-C

Location and Duration

This study has been done in broiler farming in Gowa regency South Sulawesi, Indonesia from June through August 2020.

Raising procedures

1. A total of 270 DOC broiler were put randomly to the 27 trial cages. Each cage consist 10 broilers.
2. Each cage was equipped with water and feed containers.
3. 25 watt lamp for heating during 2 weeks.
4. Feeding and drinking water mixed with vitamins carried out adlibitum
5. ND vaccination 2 times; on1-3 days via eyes drop and on 20-21 days via drinking water.
6. Weight proportion of live broiler, harvested-weight, FCR were calculated, on 35 days.

Variable

The measured variables are; percentage of weigh live broilers, body weight at harvest, total feed consumed, and broiler harvest age. Furthermore, these variables are transformed into the Performance Index (PI) formula as follows [11];

$$PI = \frac{(PLB)(W)}{(FCR)(HA)} x100 \quad \text{..... (1)}$$

Where;

PLB : Percentage of live broiler

W : Broiler weight

FCR : Feed Conversion Ratio (=total consumed feed (kg): broiler weight total (kg)

HA : Harvest age (35 days)

The reasons for using PI are; (i) Due to the partnership pattern of broiler cultivation, the award of achievement bonuses to farmers (plasma) is based on the achievement of PI. (ii) PI indicators already cover other production performance such as; feed intake (grams/day), body weight (kg/head), feed conversion (FCR), and harvest age, as in formula (1). Criteria PI < 300 (very poor); 301-325 (enough); 326-350 (good), 351-400 (very good), >400 (excellent) [12].

Data Analysis

Data analyzed with Anova-factorial based on randomized design 3 x 3 with 3 repetitions by SPSS 21 software [10]. The equation as follows;

$$Yijk = \mu + Ai + Bj + ABij + \epsilon ijk \quad \text{..... (2)}$$

i = 1, 2, 3,……a j = 1,2,3.....,b and k =1.2.3,.....k

Where:

Yijk : An observation on treatment, block and repetition

μ : Grand mean

Ai : Treatment effect

Bj : Block effect

ABij : Interaction between treatment and block effects

ϵijk : Error effect from treatment and block as well as repetition

If the results of the analysis showed a significant effect ($p<0.05$), a further test (post hoc test) was carried out with the Least Significant Difference (LSD). The aim was to compare the mean values (Mean Difference=MD) of each treatment. This test is also known as multiple t test (multiple t test), so it was very appropriate to be used for testing the average value of the treatment.

III. Result And Discussion

Statistical Resume

Table 2 depicts statistical resume, standard deviation which shows data variations, meanwhile small standard deviation reflects the uniformity of data. Figures on the Table 2 are PI values from each strain based on CR from A, B, and C companies. Strain Ross and Cobb reached highest PI on CR-C, meanwhile strain Hybro dominant on CR-A. Over all based on [12] strain Ross and Cobb reach highest IP with "very good", and Hybro stood on good criteria.

Table 2. Statistical resume

Strain	CR	Mean	Std. Deviation
Ross	CR-A	377.00	5.292
	CR-B	355.33	27.062
	CR-C	358.33	10.786
Cobb	CR-A	344.67	1.528
	CR-B	354.33	9.504
	CR-C	362.00	54.836
Hybro	CR-A	342.33	15.177
	CR-B	337.67	6.429
	CR-C	337.00	5.292

Treatment Effect

Table 3. depicts treatment such as strain, CR and interaction between strain and CRB showed a significant effect ($p<0.05$). In the partial eta squared column, the strain gives a value of 0.706 which means that the ability of the strain to explain its effect on the PI was 70.6%. The same explanation applies to CR and strain and CR interactions which have partial eta squared 51.7% and 60.3%, respectively.

Table 3. Tests of Between-Subjects Effects

Dependent Variable: Performance Index						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	4056931.704	1	4056931.704	8538.911	.000	.998
Strain	53178.741	2	26589.370	55.965	.000	.706
CR	918.519	2	459.259	.967	.009	.517
Strain*CR	2085.037	4	521.259	1.097	.003	.603
Error	8552.000	18	475.111			
Total	4121666.000	27				

a. R Squared = .868 (Adjusted R Squared = .809)

Strain Effect on PI.

Table 3 showed that the strain has a significant effect ($p<0.05$) on the PI. To compare the mean value (Mean Difference=MD) of each strain, a post hoc test of Least Significant Difference (LSD) was performed. This test is known as the multiple t tests, so it was very appropriate to be used for testing the average value of the treatment [10].

Table 4. Comparison of PI mean based on Strain.

(I) Strain	(J) Strain	MD=Mean Difference (I-J)	Std. Error	Sig.
Ross	Cobb	89.89*	1.275	.000
	Hybro	97.89*	1.275	.000
Cobb	Ross	-89.89*	1.275	.000
	Hybro	8.00	1.275	.721
Hybro	Ross	-97.89*	1.275	.000
	Cobb	-8.00	1.275	.721

*The mean difference is significant at the 0.05 level.

The MD value in Table 4 was obtained from i minus j. If the MD value is positive, it means that i is greater than j ($i > j$), and negative if the value of $i<j$. The PI comparison between Ross with Cobb and Hybro resulted in a positive and significant MD ($p<0.05$), which means Ross' PI was higher than Cobb and Hybro. The comparison between Cobb and Hybro resulted in a positive MD (8.00) but not significant ($p>0.05$), while the comparison between Hybro and Ross and Cobb gave a negative value. Overall Table 3 informs that the Ross strain produced the highest PI, following Cobb, and the lowest was Hybro.

The results of this study are similar to previous studies which reported that different types of influence had a significant effect ($P<0.05$) on body weight gain, feed consumption and feed conversion efficiency [7, 13], and morphometrics/body size [9]. Meanwhile [14], besides from reporting a significant effect ($p<0.05$) of the strain on carcass weight as well as pointed out one of the strains that gave the best performance. Although previous studies did not measure the PI (Performance Index) as is done in the current study, the three studies have measured PI-forming elements such as feed intake, body weight at harvest, and feed conversion.

Furthermore, results from [8 and 15] have reported and designated two strains; Ross and Cobb as broiler strains that provide the highest production performance. Worked on *"Economic Profitability of Broiler Farm Comparing the Two Commercial Broiler Strain"*, recommended Cobb as a strain that gave higher profitability than Lohmann [16]. Those results is close to the results of the current study which also suggested Ross and Cobb as strains that gave a better PI [8, 15 and 16].

Each strain has advantages and disadvantages. There are 6 strains which been bred on people farm and it has been consumed globally. From those 6 strains, at least there 3 strains are the most popular, Ross, Cobb dan Hybro [17]. Strain Ross developed with the advantage of FCR performance, faster growth, so that the focus of genetic development was directed to having strong legs to support a large body [17]. Cobb strains were developed to have good FCR, fast growth, and good quality of meat. While the Hybro strain, produced by Hybro Indonesia, which has the ability to produce thick meat on the chest, focuses on survival for tropical areas such as Indonesia [17, 18].

CR Effect on PI

On the Table 3, CR treatment showed significant effect ($p<0.05$) on PI. Further tests using the LSD technique (Table 5) showed that the ratio of MD between broilers fed CR-A and CR-B rations was positive, but negative for CR-C (-11.11). The comparison between CR-B against CR-A and CR-C gave a negative value of -2.22 and -13.33 and was significant ($p<0.05$). Meanwhile the comparison among CR-C with CR-A and CR-B gave a positive value of 11.11 and 13.33 and significant ($p<0.05$). This description informs that CR-C produces the highest PI following CR-A and CR-B.

The results of the current study are in line with studies conducted by [4, 5, 19]. These three researchers reported a significant effect of CR on PI or the variables forming PI. The three of them also pointed out one of the best CR brands than several CR brands that were tested. This difference in effect was probably due to the different levels and nutritional composition of each CR used. As was the case in the current study, the CR that gave the highest PI was CR-C, which had the highest crude protein content of the other two CRs (see Table 1). Long before stated that in poultry nutrition, most of the attention was paid to protein nutrition, because of the role of protein as the main constituent of biologically active compounds for body remodeling and growth [20, 21].

Table 5. Comparison of PI mean based on CR

(I) CR	(J) CR	MD=Mean Difference (I-J)	Std. Error	Sig
CR-A	CR-B	2.22	10.275	0.097
	CR-C	-11.11	10.275	0.000*
CR-B	CR-A	-2.22	10.275	0.097
	CR-C	-13.33	10.275	0.000*
CR-C	CR-A	11.11	10.275	0.000*
	CR-B	13.33	10.275	0.000*

*The mean difference is significant at the 0.05 level.

Interaction Effect on PI

Interaction between strain and CRB on the Table 3 showed a significant effect ($p<0.05$) on PI. Interaction can be interpreted as a joint effect between strain and CR. These results are close to the results of previous studies by [22] who reported a significant interaction effect between strains with certain types of rations on body weight and FCR. Body weight and FCR are indicators that affect the formation of IP. According to [10, 23, 24, and 25] interactions will be easier to understand if they are presented in the form of a line graph, where the interaction is indicated by the intersection or intersection of lines that representing the treatment, Figure 1.

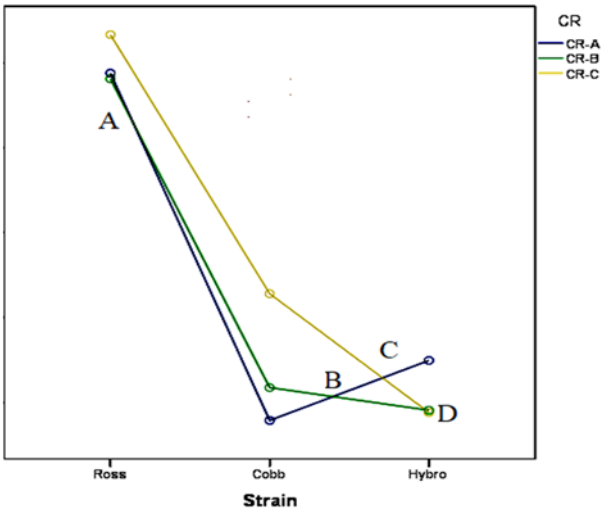

Fig 1. Interaction between Strain and CR

Fig.1 depicts the intersection of lines (interactions) at four spot, A, B, C, and D. The location of these spot according to [10, 22 and 23] can be interpreted that at point A there was an interaction between Ross*CR-A, and Ross*CR-B. On the B spot there was an interaction between Cobb*CR-A and Cobb*CR-B, on C spot there was an interaction between Hybro*CR-A and Hybro*CR-C, while on D spot the interaction occured between Hybro*CR-B and Hybro*CR-C. This description concludes that there was an interaction or joint effect between strains and CR at various treatment levels.

Research Limitations

Certain limitations of this work such as incomprehensive of all strains and CR brands which exist on the market that been deployed in this work. From 6 strains on the market, only 3 strains were used in this work. As well as for CR, there are 7 brand produced by feed mill, however just 3 brands been included. In this regards, author has limitation for searching all types strain and CR brands. Therefore, it is hoped that future studies will consider strains and CRs that have not been studied.

IV. Conclusion

This study concluded that strain, CR and their interaction (Strain*CR) have a significant effect on broiler PI. There was a tendency for certain strains to link to certain CR brands. The results showed that the Ross strain produced the highest PI compared to Cobb and Hybro. Meanwhile, the CR that produced the highest PI was CR-C following CR-A and CR-B. The results of this study also concluded that there was a joint effect or interaction between strains and CR at various levels of treatment.

V. Acknowledgement

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Author Declaration

(i) I declare that this manuscript has not been published and also never submitted to the other Journal.

(ii) I also declare that there is no known conflict of interest from the beginning of field work up to publishing this manuscript.

(iii) This research was conducted without any financial support from the government and other institutions

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