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COMPENSATORY GROWTH IN BROILER CHICKEN (Gallus gallus domesticus) UNDER DIFFERENT FEEDING REGIMEN

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ABSTRACT

To avoid rapid growth, boost weight gain while using less feed, and improve feed utilization, restriction—slowing broiler growth at early stages—was examined. An experiment with a completely randomized design was conducted to ascertain compensatory growth in broilers under varied feeding regimens: T1-Control, T2-10% Restriction, T3-5% Restriction, T4-Back to Standard Feed Intake, and T5-5% Overfed. All the treated groups are restricted at 25% during starter and vary only during grower stage. Two hundred male cobb broilers were distributed randomly to 5 treatments and replicated 4 times. Data on body weight, total weight gain, feed consumption, average daily gain, feed conversion ratio, broiler production index, and mortality rate were analyzed. Restricted fed birds had significantly lowered body weight and feed consumption at the starter stage but no significant effects on final body weight, total weight gain, and feed consumption during the grower stage. Moreover, no significant effects of restriction treatments on average daily gain and feed conversion ratio, however restricted birds were more efficient in conversion than control during starter stage. The restriction had no effect on broiler production index and mortality rate, however restricted fed birds were more efficient in performance, cost of production, and harvest recovery. Since restricted fed birds were slightly lighter than their assumed weight for age 35, full compensatory growth was not obtained. Restriction, on the other hand, resulted in improved performance by increasing feed utilization, harvest recovery, and lower production costs while preventing rapid growth

KEY WORDS: Compensatory Growth, Restriction, Broiler.

INTRODUCTION

Compensatory growth is characterized as an increase in growth rate after a period of feed restriction that is equal to or greater than the growth rate of animals fed ad libitum. It is the stage of accelerated growth that allows individuals who have had a time of growth depression to reach about the same size for their age as their consistently fed peers. (Oksbjerg, N., Therkildsen M., 2017).

Compensatory growth has been investigated in a variety of animals as a way to increase weight gain or improve food utilization. Feed restriction has been adopted in broiler production to prevent rapid growth, which is linked to ascites, lameness, mortality, and poor reproductive outcomes. Furthermore, early-stage feed restriction is useful for increasing feed efficiency. Although early feed restriction decreases growth performance, compensatory growth will be achieved during the refeeding period, allowing organisms to reach animal weight faster (Zhan, A. X. et al., 2007).

Broiler-type chicks are highly regarded for their rapid growth, meaty conformation, and excellent feed conversion. They are grown for around 5-6 weeks, and are generally poorer egg layers and lay brown-shelled eggs. Both male and female chicks are utilized for growing broilers. However, the males grow faster than females. Chicken broilers have been raised in small numbers around the house as backyard flocks or on the farm as a small home scale venture in the country, but they have now grown into a big commercial enterprise. Broiler farming is the Philippines' most specialized industry.

Feeding regimen is defined as a plan that specifies a diet, amount and schedule of nutritional intake (NCI Thesaurus, 2021). Ad libitum feeding and restricted feeding or compensatory gains are some of the different types of feeding regimen. Restricted feeding has two types: Qualitative and Quantitative feed restriction. Qualitative feed restriction is defined as limiting (specific) nutrient intake through dilution of the diet. Quantitative feed restriction is defined as reducing nutrient intake through reducing the amount of feed consumed. (Silva et.al, 2017).

A study in restricted feeding was conducted to examine the ability of animals to compensate in growth after a period of malnutrition. The study found out that the severity and duration of undernutrition, as well as the stage of development at the time of undernutrition, are some of the major factors affecting an animal's ability to recover from growth retardation

(Wilson and Osbourn, 1977). On the contray, restricted feeding in poultry can been achieved by reducing the amount of time the birds have access to food, as well as intermittent lighting, feed availability, quantitative feed limitation, and the use of low-energy, low-protein diets. From 6—14 weeks of age, it was reported that compensatory growth and better feed conversion in compensating turkeys are better than controls (Auckland et al.,1969, Auckland & Morris (1971a, 1971b).

The increase in growth rate of modern broiler chickens has been associated with high incidences of skeletal and metabolic diseases. These scenarios are most common in broilers that are fed ad libitum. Early-life undernutrition followed by full-feeding has been shown in studies to help alleviate these issues (Leeson and Zhubair, 1997).

On the other hand, male broilers limited in nutrient intake from 8 to 23 days caught up on body weight by 8 weeks of age and reported the same market weights, a slight increase in feed utilization, but no change in carcass weight (Plavnik and Hurwitz, 1988).

Nowadays, farms that raise broiler chickens suffer from skeletal ailments as a result of ad libitum feeding, which is why they can feel pressure in their knees. But this can be reduced with the use of compensatory growth. Furthermore, with restricted feeding, farmers can reduce their production costs.

MATERIALS AND METHODS

To determine the efficiency of compensatory growth, the study was conducted in Brgy. Maytalang I Lumban, Laguna utilizing the quantitative research design with experimental layout of Completely Randomized Design (CRD). Two hundred (200) male cobb broilers were distributed randomly into five (5) treatment groups replicated four (4) times with ten (10) samples per replication. The treatments used were: T1-Control/Ad libitum, T2-10% restriction, T3-5% restriction, T4-back to standard feed intake, and T5-5% overfed. These treatments were approved by a licensed animal nutritionist to ensure that the study would not violate animal welfare. All the treated groups were restricted 25% during starter and vary only during grower stage. Broiler chickens were housed in an intensive method. Commercial feeds were utilized and antibiotics were used as a sub-therapeutic measure to prevent diseases. Stunted broilers due to less feed intake and those who are experiencing leg problems were separated from the flock using card boards as divisions and were given separated feeds and water in order to catch up or at least recover. A total of 133 sample size were subjected to data gathering procedure from day 1 to 35 in a weekly basis. The data collected were organized, presented in textual and statistical tables, and evaluated using Analysis of Variance (ANOVA). ANOVA results that are significant were subjected to additional statistical analysis using Pairwise Mean Comparison (Least Significant Difference Test (LSD). Statistical Tool for Agricultural Research software was also utilized to help with the analysis. At the 5% level of significance, all hypotheses were evaluated.

RESULTS AND DISCUSSION

Body Weight

Body weight of the broiler chicken dictates its readiness to the market. Table 1 shows the average body weight of the broiler from the beginning to the end of the experiment at weekly intervals for each treatment. The highest body weight result among the treatments was observed in Treatment 1 with a mean value of 2,373.15 grams while Treatment 4 with a mean value of 2,148.29 grams was observed to be the lowest. In spite of that, during starter stage (week 3 and 4), there is a highly significant difference among treatments but no significant difference was detected during grower stage (week 5). This reflects that the different treatments do not significantly affect the final body weight even though they have shown significant difference in the middle stages of the experimental broilers. Thus, this implies that even the birds undergone restriction, they will still perform evenly as to the control group. Generally, during physical feed restriction period, growth rate decreases due to reduced feed intak (Jahanpour, H. et.al, 2017). Moreover, though ad libitum fed chickens produces the largest body weight, farmers and commercial farm owners asserted that broiler chickens with a live weight of above 2.2 kg are already rejected on the actual market.

This result is similar to the findings of Silva et al., (2017) where there is a reduced body weight at the end of the restriction period, however, chickens exhibited complete catch up growth within one week after the restriction period. Therefore, no significant effects found on their final body weight. Moreover, Jahanpour et al., (2017) found out that despite significant reduction in weight gain in chickens at the end of feed restriction, the difference in final weight between feed-restricted and control chickens was not significant. Although early feed restriction decreases growth performance, accelerated growth would be achieved during the refeeding period, allowing animals to gain weight faster resulting to improvement in body weight uniformity (Zhan, A.X. et.al, 2007).

Broiler chickens were only able to fully compensate from the mildest restrictions (Novel, et.al, 2009). This could explain why T3 has better compensation than T2. Despite the fact that T4 and T5 consumed more feeds than T2 and T3, as indicated in Table 3, their final body weights are still lower. This is related to the fact that broilers who are fed less have better feed efficiency (Zhan, A. X. et al., 2007).

According to Radulovic et al., (2021), catch-up growth could be explained during a period of restriction birds exhibit a low growth and a decreasing in the plasma concentrations of insulin-like growth factors, which may explain this lower growth. When food availability is restored, the birds grow at a rate greater than usual to reach the normal weight for its age. This accelerated growth observed, when the period of food restriction is terminated, could be due to a higher level of concentration of growth hormone (GH) observed in birds that passed earlier by a food restriction.

Table 1. Average cumulative weekly body weight of the experimental broilers in grams

Treatments	Mean cumulative weight, in grams				
	Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**
T1	194.50	560.64	1109.39 ^{a}	1784.43 ^{a}	2373.15
T2	204.00	565.93	969.36 ^{b}	1540.86 ^{b}	2211.14
T3	206.86	564.43	997.79 ^{b}	1583.29 ^{b}	2257.07
T4	197.57	557.29	956.86 ^{b}	1495.29 ^{b}	2148.29
T5	196.36	547.21	970.43 ^{b}	1573.14 ^{b}	2159.36
F	2.23	0.45	6.06	5.33	1.81
P	0.1151^{ns}	0.7734^{ns}	0.0042**	0.0071**	0.179 ^{ns}
CV (%)	3.55	3.99	5.08	6.03	6.07

Mean values followed by different letters in the same column are significantly different at p≤0.05 on Least Significant Difference Test.

** - highly significant (P<0.01)
* - significant (P<0.05)
ns - not significant (P>0.05)

Legend:
T 1- Control
T2- 10% Restriction
T3- 5% Restriction
T4- Back to STD FI
T5- 5% Overfed

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Total Weight Gain

The overall weight growth of the broiler chicken at the end of the experiment is referred to as the total weight gain. As shown in Table 2, Treatment 1 had the highest average total gained weight with a mean level of 2,329.33 grams while Treatment 4 earned a mean value of 2,105.29 grams had the lowest overall gain among treatments. Analysis of variance, however failed to detect significant difference on the total weight gain of the experimental animals. This indicates that the growth of the broiler chickens' overall weight performance could not be affected by feed restrictions.

Same results obtained from the experiment of Saber et al., (2011) which indicated that body weight gain of broilers was not significantly affected by feed restriction. Scientists found that after restrictive nutrition, broilers achieve almost the same amount of feeds or sometimes higher (relative to body weight) compared to individuals who received ad libitum feeding. In this way, broilers also consume a larger amount of energy through feed, which is necessary for achieving compensatory growth (Radulovic, et. al, 2021).

Table 2. Average total weight gain of the experimental broilers in grams

Treatments	Total weight gain, in grams
T1	2,329.33
T2	2,166.93
T3	2,212.36
T4	2,105.29
T5	2,116.72
F	1.81
P	0.1794^{ns}
CV (%)	6.17

Mean values followed by different letters in the same column are significantly different at p≤0.05 on Least Significant Difference Test.

** - highly significant (P<0.01)
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Legend:
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Feed Consumption

Feed consumption is the total amount of feed consumed by the experimental birds from day old to 35 day old. The average feed consumption from the different treatments was shown in Table 3. At week 5, Treatment 1 was observed to be the highest average amount of feed consumed among the treatments with a mean level of 1,123.38 grams while Treatment 2 with a mean level of 968.35 grams as the lowest. On the contrary, analysis of variance was not able to detect significant difference among treatments in week 5. It implies that restricted experimental birds consumed approximately the same amount of feeds of full-fed broilers at the final week of the experiment. The study of Radulovic et al., (2021) explained that after feed restriction, when compared with individuals who were fed ad libitum, scientists discovered that broilers who were restricted fed had almost the same relative feed consumption (relative to body weight).

However, during starter stage (week 3 and 4), highly significant differences were detected among treatments. These stages are the period of feed restriction for all the treated groups where in treated broilers were given less than 25% amount of feeds compared to Control which were fed in satiety.

The highest total feed consumption of birds was found on treatment 1 with a total of 127,487 grams feed consumed while the lowest was on Treatment 2 with a total of 108,511 grams of consumed feeds. This conclude that the control treatment utilized 127.49 kg of feeds which is equivalent to Php4,305.65 for a total of 40 samples, but the T2 used only 108.51 kl of feeds for the same number of samples which when converted is equal to Php3,637.87. Similar findings were stated on the study of Jahanpour et al., (2017) in which a significant difference was observed between average consumption of chickens in starter period fed restricted with different intensity and also between in control group. However, in the finisher period, there was no significant difference between treatments and control. In the total period, average consumption of restricted chickens was lower than controls.

In feeding the birds, quantitative feed restriction approach was employed. It restricts the amount of feed provided to the animals on a daily basis, which has a number of advantages, some of which is that it helps enhance feed utilization and it lowers the cost of production for farmers. Quantitative feed restriction also allows a more even feed distribution resulting in a lower feed competition (Arrazola et al., 2019). In contrary, ad libitum feeding, which allows the animals to eat as much as they want, is not particularly appealing due to the higher cost of feed (BalaKesava, 2017). Furthermore, chickens under this feeding strategy usually experience skeletal and metabolic diseases because of increased fat deposition, and when it happens, farmer’s revenue is affected (Leeson, et.al, 2018).

Table 3. Average feed consumption of the experimental broilers in grams.

Treatments	Mean cumulative feed consumption, in grams				
	Week 1	Week 2	Week 3	Week 4	Week 5
T1	123.75^{b}	386.23	663.20^{a}	890.63^{a}	1123.38
T2	126.08^{b}	388.38	517.20^{b}	745.35^{b}	968.35
T3	127.48^{ab}	389.05	514.40^{b}	605.20^{c}	1036.35
T4	127.38^{ab}	389.78	518.78^{b}	605.45^{c}	1043.60
T5	130.63a	379.50	514.75^{b}	603.80^{c}	1070.88
F	3.70	1.68	639.44	73.60	1.71
P	0.0274*	0.2068^{ns}	0.0000**	0.0000**	0.2003^{ns}
CV (%)	2.04	1.67	0.9527	4.31	8.22

Mean values followed by different letters in the same column are significantly different at p≤0.05 on Least Significant Difference Test.

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* - significant (P<0.05)
ns - not significant (P>0.05)

Legend:
T 1- Control
T2- 10% Restriction
T3- 5% Restriction
T4- Back to STD FI
T5- 5% Overfed

Average Daily Gain

Average daily gain is defined as the average amount of weight a market animal will gain each day during the feeding period (Kinder, 2013). In terms of daily gain, Treatment 1 exposed the highest gain with a mean level of 66.5 while the lowest is Treatment 4 with a mean level of 60.15. Even so, analysis of variance failed to detect significant difference in cumulative average daily gain among treatments. It conveys that despite being subjected to early stage physical feed limitation, the average daily growth of broilers in the finisher stage was unaffected.

There is no significant difference during booster stage since treatments has not yet been applied and the broiler chicks were not yet exposed to restriction. However, in starter stage, a period of 25% restriction among all the treated groups, detected highly significant difference. This shows that the ADG of the restricted broiler chickens was lower than of control as they were exposed to same amount of feed limitation. While in grower stage, where in different amounts of feed restriction were applied, also failed to locate any significant differences. It alludes that even restricted birds’ ADG during starter stage were lower than of control, they can easily and shortly catch-up during the recovery period, which is the grower stage. Also, the grower stage signifies the accelerated stage of the birds fed restricted as they almost caught the full fed birds’ daily gain as quickly as they reach their marketable weight and age.

These findings were similar on the experiment conducted by Silva et al., (2017) where restricted fed broilers showed slight decreased in ADG especially during the period of restriction but did not showed any discernible differences between the treatments. Same results obtained from the experiment of Mosco (2019). According to them, ad libitum fed chickens showed a numerically higher ADG compared to the restricted fed group but no significant differences were detected.

However, the results of the study of Wang et al., (2007) did not match with this result. In their study, ADG was slightly improved in feed restricted broilers. The phenomenon of compensatory growth in broilers has been the subject of numerous researches with the conclusions being variable and often conflicting.

Table 4. Mean cumulative average daily gain of broiler chicken

Treatments	**Mean average daily gain**			
	Booster Stage	**Starter Stage**	**Grower Stage**	**Cumulative ADG**
T1	37.16	87.41^{a}	84.10	66.55
T2	37.25	69.64^{b}	95.80	61.91
T3	37.12	72.78^{b}	96.25	63.21
T4	36.74	67.00^{b}	93.28	60.15
T5	38.58	73.28^{b}	83.75	60.48
F	0.33	7.27	0.96	1.81
P	0.8535^{ns}	0.0018**	0.4558^{ns}	0.1793^{ns}
CV (%)	6.57	7.92	14.02	6.17

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* - significant (P<0.05)
ns - not significant (P>0.05)

Legend:
T 1- Control
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T4- Back to STD FI
T5- 5% Overfed

Feed Conversion Ratio

Feed conversion efficiency refers to a broiler chicken's ability to convert the feeds it consumes into body weight. It also serves as an indicator how efficient a performance is (Faylon, 2006). Efficiency in feed conversion, when combined with good animal health and a favourable environment, boosts profit at constant prices (Valerozo, E. 2021). The lower the value of feed conversion ratio, the better the efficiency. (Tabledebates, 2018).

The average cumulative feed conversion ratio of the broiler chicken was presented in Table 5. Treatment 1 had the highest average value of feed conversion ratio with a mean level of 1.82 while Treatment 3 had the lowest with an average value of 1.62. Analysis of variance, failed to detect significant difference on the cumulative feed conversion efficiency of the experimental birds treated with different amount of feed restriction. But despite of not being significantly different, it still conveys that the treatment group of fed restricted birds has better feed efficiency than control group.

Similar findings found on the study of Bondari, et.al, 1998. Body weight gains during the period of restriction were generally decreased in proportion to that of feed consumption so that the feed conversion of restricted fed birds was slightly similar to controls, thus did not detected any significant differences. However, even though feed consumption was reduced, the feed conversion ratio was better for all the restricted groups than for controls. Furthermore, early-stage feed restriction is useful for increasing feed efficiency (Ren, H. et.al, 2007). Birds which had achieved the body weight in a short period of time will have the feed efficiency improved due to a decreasing in their maintenance requirements (Leeson & Summers, 2005).

Nevertheless, during starter and grower stage, significant differences were detected. During these stages, restricted fed birds showed numerically lower feed conversion rate value than full fed birds which mean better efficiency of conversion of feeds consumed into kilos. During the recovery period, T2 (less 10%) has the most efficient feed conversion followed by T3 (less 5%). Based on these results, it conveys that the greater amount of feed restriction would result in better feed conversion. This is related to the fact that broilers who are fed less have better feed efficiency (Zhan, A. X. et al., 2007).

In the study of Qotbi et al., (2017), it is indicated that given the lower weight of the chicks, the absolute amount of nutrients required for maintenance will decrease. Since with the occurrence of compensatory growth, restricted chicks reach at the same age the weight of chickens fed complete diet, it is assumed that more nutrients are spent towards growth, and better feed efficiency is achieved. These observations could be explained through increased absorption of available amino acids or via increased synthesis of digestive enzymes during the food restriction period. Feeding regimens affect activity of proteolytic enzyme, so that trypsin activity in broilers under intermittent feeding increased compared to the chickens fed ad libitum. It was also reported that reducing the amount of feed increased fat digestibility in chickens. Perhaps, the above mechanisms contributed to the relative improvement of feed conversion rate at the end of restriction period.

However, the findings in this study did not match to the results of Lee & Leeson (2021). It was found out that increasing restriction intensity in feed restriction period significantly reduced the average conversion rate of chickens compared to chickens with complete diet.

Table 5. Average feed conversion ratio of the experimental birds

Treatments	Mean feed conversion ratio			
	Booster Stage	Starter Stage	Grower Stage	Cumulative FCR
T1	1.34	1.86^{a}	2.82^{a}	1.82
T2	1.33	1.81^{a}	2.12^{c}	1.69
T3	1.34	1.61^{b}	2.23^{bc}	1.62
T4	1.36	1.74^{ab}	2.32^{bc}	1.70
T5	1.36	1.59^{b}	2.62^{ab}	1.70
F	0.22	3.15	3.19	1.91
P	0.9207^{ns}	0.0455*	0.0441*	0.1603^{ns}
CV (%)	4.03	7.82	13.33	6.01

Mean values followed by different letters in the same column are significantly different at p≤0.05 on Least Significant Difference Test.

** - highly significant (P<0.01)
* - significant (P<0.05)
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Legend:
T 1- Control
T2- 10% Restriction
T3- 5% Restriction
T4- Back to STD FI
T5- 5% Overfed

Broiler Production Index

Broiler Production Index (BPI) is the best indicator of overall performance of broiler chickens. It serves as the score for efficiency. The factors involved are the harvest recovery, average live weight, harvestable age, and feed conversion efficiency. Using this method, one can compare the performance of one broiler house from another broiler houses. Basically, the higher the score of BPI, the better is the performance (Faylon, P, 2006).

Table 6 presents the scores of the different treatments in terms of BPI. Treatment 3 with a mean level of 366.42 has the highest production index while Treatment 1 with a mean level of 348.97 got the lowest score in broiler production index. Numerically, treated groups were higher than of controls. However, analysis of variance failed to detect significant difference in the production indexes among treatments. Despite the fact that they were not statistically different, it still signifies that restricted fed birds are more efficient compared to birds that were fed ad libitum when it comes to production performance.

While in terms of feed cost per kilogram of broiler produced, which is also one of the indicators in determining the relative efficiency of production by dividing the cost of feed over total weight gained (Faylon, 2006), T3 is also the most cost-efficient among treatments with a rate of Php57.56 total feed cost per live weight while T1 had the highest cost of production with a rate of Php64.78 total feed cost per live weight. It then signifies that a broiler flock rose in a compensatory growth approach would help a farmer to lessen their production cost.

The same results were found in an overall conclusion in the study of Saber (2011). It was stated that feed restriction by means of compensatory growth lead to the improvement of farm economy. Restriction feeding may offer more economical advantage than ad libitum feeding regimen (Novel, et.al, 2009).

The results in this experiment based on BPI matched with the study of Seidavi (2017) which did not found any difference in production index but the cost of each live broiler was significantly reduced after restricted diet. It was concluded that feed restriction could be a profitable choice for farmers, as marketable weight can be achieved using lower amounts of feed.

Table 6. Average broiler production index of the experimental birds

Treatments	Mean broiler production index
T1	348.97
T2	359.07
T3	366.42
T4	351.77
T5	350.88
F	0.18
P	0.9444^{ns}
CV (%)	9.57

Mean values followed by different letters in the same column are significantly different at p≤0.05 on Least Significant Difference Test.

** - highly significant (P<0.01)
* - significant (P<0.05)
ns - not significant (P>0.05)

T2- 10% Restriction
T3- 5% Restriction
T4- Back to STD FI
T5- 5% Overfed

Mortality Rate

The rate of mortality is the measure of the number of deaths of broiler chicken in relation to the population. The measure of mortality begins when the treatments are applied. Stunted growth, metabolic disease (lameness), and sudden death syndrome (SDS) are the causes of mortality.

Table 7 presents the average number of deaths of the experimental broilers treated with different level of feed restriction. Treatments 1 and 3 had the highest rate of mortality with a mean level of 28% (2 deaths) while Treatments 2, 4, and 5 had the lowest with a mean level of 14% (1 death). Thus, analysis of variance failed to detect significant differences in terms of mortality rate. Sudden death syndrome (during the 4th week of life) and lameness (at 5th week) were the causes of deaths in T1 while stunted growth (at their 3rd week) due to low feed intake during brooder stage caused 2 deaths in T3. Mortality in broiler farm is inevitable (Prabakaran, 2003) assuming 5% mortality in the broilers flock annually under optimal condition (Faylon, 2006). Stunted birds were not able to recover even they were separated from the flock. According to Inglis (2019), there is no cure for this disease.

The increase in growth rate of modern broiler chickens has been associated with high incidences of skeletal diseases. These scenarios are most common in broilers that are fed ad libitum. In addition, sudden death syndrome (SDS) is a metabolic problem that occurs in all countries where broilers are grown rapidly under intensive conditions. Mortality may start as early as 3 to 4 days, but most often peaks at around 3 to 4 weeks of age, with the affected birds being found dead on their back. (Vasdal, G. et.al. 2019). According to Philippines Recommends for Broiler Production (2006), the cause of this condition is unknown but it is suspected to be a result of physiologic and nutritional interactions. It is believed that a combination of low level or bioavailability of biotin and stress associated with rapid growth could precipitate SDS. No signs of symptoms, chickens suddenly convulse and die within 1–2 minutes with no premonitory signs. Induce a period of initial slow growth through physical feed restriction and/or use of low-nutrient density rations can reduce the incidence of the condition.

Early-life undernutrition has been shown in studies to help alleviate these issues (Leeson and Zhubair, 1997). Many investigators have reported a reduction in mortality rate following feed restriction. Another advantage in reducing the initial growth in chickens is a decreasing in mortality caused by metabolic disorders and skeletal disorders, which had a great prominence in the modern strains selected for rapid growth (Lesson, 2007). This could provide the greatest economic incentive for implementing early feed restriction by allowing for more birds to be marketed from a flock. (Saleh, E. A, 2005).

Table 7. Average mortality rate of the experimental birds

Treatments	Mean mortality rate

T1	28%
T2	14%
T3	28%
T4	14%
T5	14%
F	0.18
P	0.9452^{ns}
CV (%)	184.43

** - highly significant (P<0.01)
* - significant (P<0.05)
ns - not significant (P>0.05)

Legend:
T 1- Control
T2- 10% Restriction
T3- 5% Restriction
T4- Back to STD FI
T5- 5% Overfed

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATION

Summary of Findings

The results of the study can be summarized as follows:

1. Analysis of variance detected highly significant differences in terms of body weight during period of 25% restriction at starter stage (week 3 and 4). But failed to detect significant difference in terms of final body weight and total weight gain.
2. A highly significant difference was detected during the period of 25% restriction (week 3 and 4) in terms of feed consumption but failed to detect significant difference in week 5. A total of 127.49 kg of feeds was consumed by T1, the highest among the treatments while a total of 108.51 kg of feeds was consumed by the birds in T2, the lowest among the rest of the treatments.
3. The cumulative average daily gain (ADG), cumulative feed conversion ratio (FCR), broiler production index (BPI), and mortality rate observed in the experimental birds was not significantly different from each other. However, broilers undergone feeding restriction showed numerically lower feed conversion efficiency and harvest recovery. Scores of restricted fed birds are also numerically higher than of control.

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CONCLUSIONS

The final body weight and total weight gain of the experimental birds are not significantly different with each other, this proves that broiler chickens will perform even at restricted feeding. Since restricted fed birds final body weight were slightly lighter than their assumed weight for the age of 35 (based on cobb broiler feeding standard), full compensatory growth was not achieved and the increased in weight gain did not manifest with the use of feed restriction.

Despite the fact that ad libitum fed birds had the highest final body weight of 2.3 kg, broiler chickens with a live weight of above 2.2 kF are already rejected on the actual market. Therefore, feed restriction is useful to prevent rapid growth in broiler production.

Birds from the treated groups ate a total of 66 kg less feed than the controls. T2 has the highest amount of saved feeds with a total of 18.98 kg, which is equal to Php 667.78. In a large broiler flock, cost savings would be substantial. Among all the treatments, T3 is the most efficient in terms of feed cost per kilogram of broiler produced as well as in terms of Broiler Production Index.

Feeding broilers to satiety can lead to obesity-related problems. Lameness in broiler chickens is a primary welfare concern as it is considered painful. Reduced growth of lame birds also affects farm profitability. Restriction feeding can reduce these problems and total mortality can decrease by restriction. Another advantage in reducing the initial growth in chickens is a decreasing in mortality caused by metabolic disorders and skeletal disorders, which had a great prominence in the modern strains selected for rapid growth (Lesson, 2007).

Broiler chicken’s cumulative average daily gain and cumulative feed conversion ratio was not affected by feeding restriction. Although the result in cumulative FCR is not statistically significant, there is a tendency to increase feed conversion ratio with restriction feeding approach. Birds which had achieved the body weight in a short period of time will have the feed efficiency improved due to a decreasing in their maintenance requirements (Leeson & Summers, 2005).

During starter stage of broiler chickens is the best stage to undergo feed restriction and may offer more economical advantage. According to Seidavi, A, 2017, growth needs in the early period, especially in the first 2 weeks, is much higher than needs for maintenance. Thus, any nutritional deficiencies can lead to deterioration if these early 2 weeks already undergone feed restriction. On the other hand, the best feeding program based on the results is Treatment

3. Reduced performance by early nutrient restriction can be overcome by compensatory growth providing the restriction is not too severe.

Furthermore, tudies on the impact of physical feed restriction on poultry performance show that feed restriction is having positive effects. (Seidavi, 2017). Although full compensatory growth was not obtained, restricted fed birds exposed better feed utilization, higher score of efficiency performance, more cost-efficient per kilogram of broiler produced, lower cost of production, and better harvest recovery. Yet, since compensatory growth studies until now has inconsistent and varying results, more research is needed because this strategy is not well understood.

RECOMMENDATIONS

In order to achieve full compensatory growth, milder restriction was recommended at starter stage. Feed restriction, either qualitative or quantitative should be started as much as not early as starter stage.

The severity and duration of feed restriction in Treatment 3 is recommended. Feed restriction in broilers often lead to feather pecking leading to decreased feather coverage. Feather coverage score is also considered a welfare indicator. Feather traits, such as feather growth and fault bars can be used as an indirect measure of nutritional status, body condition, and stress. Therefore, feathering can be a variable to check nutrition of broiler during feed restriction.

Some studies used supplements at the period of compensatory growth. Based on these studies, the use of supplements during catch up growth may reduce fats and produces leaner chicken meat. It is also possible, as suggested by some workers, that the birds in their study, even though in negative energy balance, were able to gain weight due to change in body composition: they used fat reserves and deposited more lean tissues. If an animal loses a certain percentage of its body weight during a restriction, recovery will be slow and body fat levels will be reduced (Radulovic, et.al, 2021). Therefore, continue the study until slaughtering to check fats is recommended.

A large number of studies have been conducted on the phenomenon of compensatory growth in broilers, and the results obtained are inconsistent and often contradictory. The reasons for these discrepancies should be sought primarily in the different design of applied programs (method of growth restriction, start of application, duration, restriction level, type of diet provided after restriction). The phenomenon of compensatory growth in broiler chickens remains complex because the physiological, nutritional, metabolic, and endocrine aspects involved are still not well understood. Thus, further research is recommended since this approach is not recommended by genetic companies. (Radulovic, S. et. al, 2021).

Aside from broilers, the use of other subject animals is recommended. Qualitative and skip-a-day feed restriction should also be applied but always consider the subject animal, its strain, duration of malnutrition, as well as the severity of the program. These factors can affect the animal's ability to completely recover.

Furthermore, the result of this experiment could be used or adapted by the farmers for it would be beneficial since compensatory growth may reduce their production cost.

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