## BIBLIOGRAPHY

ACAY, RYAN P. APRIL 2011. Silkworm Pupa Meal as Feed Supplement for Growing-Finishing Broilers. Benguet State University, La Trinidad, Benguet.

Adviser: Madeline S. Kingan, MSc.

## ABSTRACT

The study was conducted to determine the response of broilers given different levels of Silkworm pupa. Specifically, it aimed to determine the effect of Silkworm pupa meal on the growth rate and feed consumption of broilers; to establish other uses of silkworm aside from silk and to determine the level of silkworm pupa that will give the best results in production.

No significant differences were noted in terms of the initial weight. After 24 days of trial feeding, the birds fed with silkworm pupa were heavier in final weights and gained more, and had better feed efficiency. The commercial feed consumption of the birds fed with silkworm pupa was increase due to the addition of silkworm pupa meal, resulting to higher gain in weight. Better ROIs were obtained from the birds given Silkworm pupa.

It is therefore concluded that Silkworm pupa meal can be incorporated in the growing-finishing ration for broilers with advantageous effects on growth. Furthermore, it is recommended that Silkworm pupa meal can be added in the broilers diet during the growing-finishing period to increase in weight.

**TABLE OF CONTENTS**

## INTRODUCTION

Animal husbandry has been practiced for thousands of years, since the first domestication of animals. Today, herd managers often oversee thousands of animals and many staff. Farms, stations and ranches may employ breeders, herd health specialists, feeders, and milkers to help care for the animals. Techniques such as artificial insemination and embryo transfer are frequently used, not only as methods to guarantee that females are bred, but also to help improve herd genetics. This may be done by transplanting embryos from stud-quality females into flock-quality surrogate mothers - freeing up the stud-quality mother to be reimpregnated. This practice vastly increases the number of offspring which may be produced by a small selection of stud-quality parent animals. This in turn improves the ability of the animals to convert feed to meat, milk, or fiber more efficiently, and improve the quality of the final product.

It is deplorable, that in spite of this tremendous development in agriculture, hunger and malnutrition still hover over the world, particularly Asia, which include the Philippines.

In Asia and indeed other developing countries of the world, fish meal is the most important conventional animal protein source, but its production, availability and cost is a major concern to animal nutritionists. Fish meal is very scarce and expensive and its inclusion in the diets for poultry hardly permits profitability. Fish meal is the only conventional animal protein source for poultry and poultry is in competition with human and other livestock for it which makes it very expensive and its inclusion in the diets results in less profitable poultry production.

Besides availability and high cost, the quality of fish meal is quite uncertain due to the use of different varieties, part of fish and different processing technologies in its production. In addition it is often contaminated with other ingredients such as sand, sawdust and fish bones and the use of chemicals for preservation often caused toxicity to poultry birds.

Unconventional protein sources such as silkworm pupa will be utilized in broiler production. In all these cases there will be reduction in feed cost and increased profitability without compromising the performance. Silkworm is silvery white in appearance and about 7.5-10 cm long when fully grown. Silkworm caterpillar is sparingly consumed by some local communities and picked up by scavenging domestic fowls in other communities. However information on the usefulness of these insect species as feed ingredient in poultry production is possible.

The concern of broiler grower today is to improve the production. This could be attained by improving the growth efficiency of producing birds with the use of silkworm pupa. With the sky rocketing price of farm inputs, efforts are directed toward reducing cost of production without compromising animal performance. In this connection, silkworm pupa will be added to the feeds of the birds to prove if it will improve the performance of the birds. The study aimed to determine the utilization of silkworm pupa as supplement in poultry ration. The result of this will be use by farmers and other researchers in animal production and also will be added to the body of knowledge already generated from other experiment in the field of agriculture.

The study was conducted to determine the effect of silkworm on the growth performance of broilers in terms of growth rate; and feed consumption, establish the

importance of silkworm which is not only in the production of silk, and determine the level of silkworm pupa that will give the best result.

The study was conducted at Benguet State University Poultry Experimental Farm Balili, La Trinidad, Benguet from January 10 to February 23, 2011.

## REVIEW OF RELATED LITERATURE

Some insects are edible. In fact, most insects are edible, but there are a few species that are especially palatable, nutritious, and easily obtainable. Many species of insects are lower in fat, higher in protein, and have a better feed to meat ratio than beef, lamb, pork, or chicken. Insects are easy to rise. There is no manure forking. No hay bale lifting. No veterinary bills. You can raise them in an apartment without getting complaints (Grimaldi and Engel, 2005).

Generally silkworms are raised in a confined environment, where feed is harvested and brought to them to be fed, therefore after the silkworm die the pupae are easily collected and can be used as a supplemental protein source. Large quantities of silkworm pupae are produced as a byproduct of the silk industry. Silkworm meal has been used in feeding monogastric and ruminant species for many years in Asian countries. The meal contains the exoskeleton and the contents of the body cavity. Chitin, which is a component of the exoskeleton, contains approximately 25 % of the CP content, which is not composed of amino acids and is not digestible. The amount of silkworm meal that can be used is dependent upon the species it is being fed too. The fat component of the silkworm meal seems to be the component that limits its usage, when the fat content is reduced higher amounts can be fed. High level of silkworm meal can be fed to carp and layer chickens, but only a portion of the fish meal can be replaced in diets for broiler chick diets without depressing performance (Anonymous, 2005).

Silkworm pupae amino acids is natural nutrition food, which composed from a proportional small peptides and compound Amino Acids adopted bioenzymic directing

degraded technology. Silkworm amino acid consists of 18 kinds of amino acids (8 kinds acids is the necessary human acids). The amino acids content of the these 8 kinds of necessary human acids is twice as porky, four times as egg and ten times as milk. Because of having the advantage of balanced nutrition and appropriate proportion, these necessary human amino acids meet the requirement of FAO/WHO (UN Food and Agriculture Organization and the World Health Organization). Silkworm amino acid is a high-quality insect protein very suitable for human's demands. Silkworm contains potassium, Calcium, sodium, magnesium, iron, copper, manganese, zinc, phosphorus , selenium and other trace elements and vitamins A, E, B1, B2, carotene, Etc, all of these are indispensable element of the human body. Silkworm pupa is rich with unsaturated fatty acids, accounting for about 72.5% of total fat. Unsaturated fatty acids play an important role in maintain the normal physiological, keeping the cell membrane relative mobility to ensure cell having normal physiological function, accelerate cholesterol esterification that reduce blood cholesterol and triglyceride ,promote growth and development of infants and synthesis of prostaglandins, reduce blood clotting to improve the microcirculation, improve cell viability ,enhance memory and thinking ability, promote the digestion and absorption of fat-soluble vitamins (Solomon, and Yusufu, 2005).

Like many insect species, silkworm pupae are eaten in some cultures. In Korea they are boiled and seasoned to make a popular snack food known as beondegi. In China, street vendors sell roasted silkworm pupae. Silkworms have also been proposed for cultivation by astronauts as space food on long-term missions (Anonymous, 2007).

According to Silkworm Nutritional Information (2005), the chemical composition and the nutritional quality of protein of pupae of the silkworm were investigated. Investigations showed that the pupal powder contain 7.6% moisture, 71.9% crude protein, 20.1% fat and 4.0% ash on a dry matter basis. The mineral analysis indicated high K content with a low Na/K ratio and low heavy metal content.

Fermented silkworm pupae silage or untreated fresh SWP pastes were incorporated in carp feed formulations replacing fishmeal. The feed formulations were isonitrogenous (30.2-30.9% protein) and isocaloric (ME = 2905-2935 kcal/kg). Feeding under a polyculture system consisting of 30% each of catla (Catla catla), mrigal (Cirrhinus mrigala) and rohu (Labeo rohita) with 10% silver carps (Hypophthalmychthys molitrix) was carried out in ponds to evaluate the nutritive quality of SWP silage. Survival rate, feed conversion ratio and specific growth rate, respectively, were 84.2%, 2.10 and 2.39 for fermented SWP silage, 65.8%, 2.98 and 2.26 for untreated SWP and 67.5%, 3.16 and 2.20 for fishmeal indicating clearly that the fermented SWP silage was nutritionally superior to untreated SWP or fishmeal. The dietary influence on the proximate composition of whole fish was marginal (Khatun *et al.*, 2003).

## METHODOLOGY

### Materials

The materials used in this study are as follows: 160 heads of broiler chicks, brooding and rearing cages, disinfectant, vaccines, electric bulb, newspaper sheets, feeds, silkworm pupa, feeders, waterers, weighing scale and record book.

### Methodology

Preparation of brooding and rearing cages. Prior to the start of the study, all the brooders, feeders, and waterers were cleaned and disinfected. Old newspaper sheets were spread on the floor to prevent the chick from tripping on the floor and to serves as receptacle for the feeds of the chicks for the first few days. These were also help conserve heat inside the brooding cage and protect the chicks from draft. The lighting system was installed and brooder was lighted to make sure they are functional few hours before the chicks arrived.

Procurement of stocks . The broiler chicks were purchased from Agrimix Center, Perez Blvd, Dagupan City. Cobb broilers were used in the study.

Experimental design and treatment. Following the completely randomized design (CRD), the 160 broiler chicks were divided into four treatments. Each treatment was replicated four times with 10 birds per replication making a total of 40 birds per treatment.

The different treatments were the following:

$T_0$- 100 % commercial feeds (CF; Control)

$T_1$- 50 grams silkworm pupa meal / kg commercial feeds

$T_2$- 100 grams silkworm pupa meal / kg commercial feeds

$T_3$- 150 grams silkworm pupa meal / kg commercial feeds

Procurement and preparation of silkworm pupa meal. The oven-dried silkworm pupa meal was sourced from Lomon, Kapangan, Benguet. The preparation was done at the rearing area. The collected silkworm pupa (Figure 1) were oven dried first to 50 % moisture content (Figure 2) to remove the moisture then were ground (Figure 3) and incorporated to the feeds of the broilers (Figures 4 to 6).

Care and management of the birds. All the experimental birds were subjected to the same care and management. The differences were on the amount of silkworm pupa meal that was incorporated to the feeds of the birds. The control group was given commercial feeds only. The birds under treatment 1 were given 50 grams of silkworm pupa meal per kilogram of commercial feeds, while those under treatment 2 were given 100 grams of silkworm pupa meal per kilograms of commercial feeds. The treatments 3 birds were given 150 grams of silkworm pupa meal per kilogram of commercial feeds. The birds were given broiler starter mash for the first four weeks. Their feeds were shifted to the broiler finisher mash from the fifth week until the end of the study. The addition of silkworm pupa meal to the feeds of the birds were started from the 22nd day of brooding until the birds are 45 days old which is the end of the study. Feeding was at *adlibitum.* The amount of feeds to be offered were measured and recorded before they were given to the birds. Any leftover feeds for the day were also recorded to determine the feed consumption.

Medication water was available at all times. The chicks were fed thrice a day, at 6:00 am, 12 noon, and 5: 00 pm.

Figure 1. Fresh Silkworm pupa

Figure 2. Oven-dried Silkworm pupa

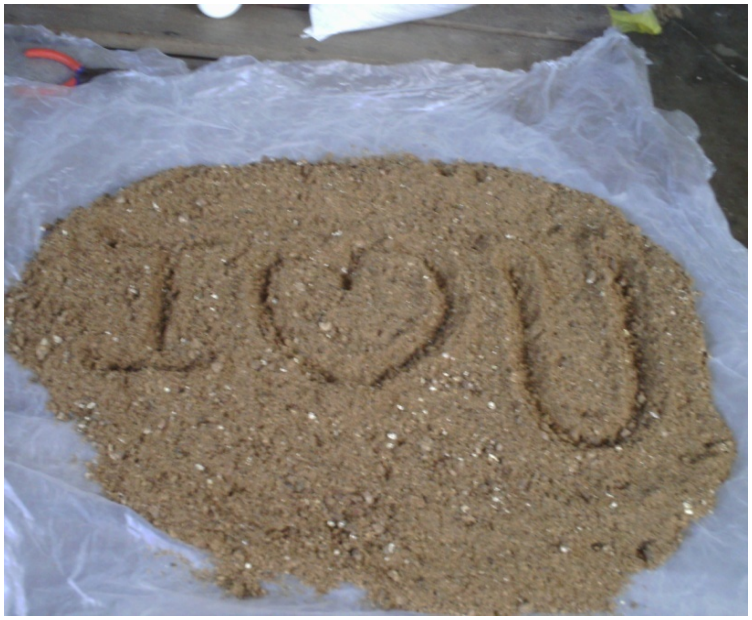

Figure 3. Ground Silkworm pupa


Figure 4. 300 grams of Silkworm pupa mixed with 6 kg of feeds


Figure 5. 600 grams of Silkworm pupa mixed with 6 kg of feeds


Figure 6. 900 grams of Silkworm pupa mixed with 6 kg of feeds

Data Gathered

The following data were gathered:

1. Initial weight (kg). This was obtained by taking the weight of the birds at 21 days of age.

2. Final weight (kg). This was obtained by taking the weight of the birds at 45 days of age.

3. Feeds offered (kg). This was taken by summing up the feeds offered to broilers during the experimental period.

4. Feeds left-over (kg). This was taken by summing up the weight of feed left-over during the experimental period.

5. Number of sick birds. This was taken by counting the number of sick birds in each treatment.

6. Number of dead birds. This was taken by counting the number of dead birds in each treatment.

7. Total gain in weight (kg). This was obtained by subtracting the initial weight to the final weight of the birds.

8. Total feed intake (kg). This was computed by taking the difference between the feed offered and the refused feed divided by the feed consumed.

9. Feed conversion ratio. This was obtained by dividing the total feed consumption by the total gain in weight.

10. Percentage mortality. This was obtained by dividing the number of dead birds by the initial number of birds multiplied by 100 %.

11. Percentage morbidity. This was obtained by dividing the number of sick birds by the initial number of birds multiplied by 100%.

12. Cost of feeds to produced a kilogram gain in weight. This was taken by multiplying the feed conversion efficiency by the cost of kilogram feed mixture.

13. Net profit (Php). This was obtained by subtracting the cost of production from the total sales.

14. Return on investment (ROI). This was obtained by using the following formula:

$$ROI = \frac{\text{Net Profit}}{\text{Total Cost of Production}} \times 100$$

Data Analysis

Analysis of Variance for CRD was used to analyze the data while Duncan's Multiple Range Test (DMRT) was used to compare treatment means.

## RESULTS AND DISCUSION

Initial and Final Weights

Table 1 presents the initial weights (21 days) of the birds in all treatments. Statistical analysis revealed that there were no significant differences among the treatment means. This implies that the bird were homogenous at the start of the study.

The final weights (45 days) of the broilers in all treatments are also shown in Table 1. The results indicate that the final weights of birds were affected by increasing the level of silkworm pupa meal added to their feeds. As you increase the level of silkworm pupa meal added to the feeds, the weight of the birds tends to increase. This increase in weights could be attributed to the high protein content of silkworm pupa meal which may have enhanced muscle deposition in the birds fed 50 to 150 g pupa meal.

Table 1. Initial and final weights of the birds

| TREATMENT | WEIGHT | |
|---|---|---|
| | INITIAL (kg) | FINAL (kg) |
| Pure commercial feeds | 0.67[a] | 1.59[c] |
| 50 g silkworm pupa meal / kg commercial feeds | 0.66[a] | 1.68[bc] |
| 100 g silkworm pupa meal / kg commercial feeds | 0.68[a] | 1.74[ab] |
| 150 g silkworm pupa meal / kg commercial feeds | 0.67[a] | 1.81[a] |

Means with different letters are not significantly different at 5% by DMRT.

Total Gain in Weight

Table 2 presents the total gain in weight of the birds in the different treatments. Statistical analysis shows significant differences among the treatment means. One hundred fifty grams of silkworm pupa meal supplementation obtained the mean average of 1.14 kg, which is higher than that of the other groups. This implies that adding silkworm pupa meal to the feeds of the birds will positively affect the growth performance of the birds. The result revealed that supplementing 50g to 150g silkworm pupa meal on broilers ration numerically improve body weight gain and does not detrimentally affect the growth rate of the birds.

Feed Consumption

Table 3 presents the feed consumption of the birds in the different treatments in 24 days of trial feeding. Statistical analysis revealed the significant difference among treatment means. This finding implies that the birds given different amount of silkworm pupa meal consumed more than the control groups. The addition of the silkworm pupa meal to the feeds of the birds makes them more aggressive in consuming feeds. This is due to the fact that insects are nutritious and palatable (Grimalde and Engel 2005).

Table 2. Total gain in weight of the birds

| TREATMENT | TOTAL GAIN IN WEIGHT (kg) |
|---|---|
| Pure commercial feeds | 0.92[c] |
| 50 g silkworm pupa meal / kg commercial feeds | 1.02[b] |
| 100 g silkworm pupa meal / kg commercial feeds | 1.06[ab] |
| 150 g silkworm pupa meal / kg commercial feeds | 1.14[a] |

Means with different letters are not significantly different at 5% by DMRT.

Table 3. Feed consumption of the birds

| TREATMENT | FEED CONSUMPTION (kg) |
|---|---|
| Pure commercial feeds | 2.50[d] |
| 50 g silkworm pupa meal / kg commercial feeds | 2.59[c] |
| 100 g silkworm pupa meal / kg commercial feeds | 2.67[b] |
| 150 g silkworm pupa meal / kg commercial feeds | 2.74[a] |

Means with different letters are not significantly different at 5% by DMRT.

Feed Conversion Ratio

Table 4 presents the mean of feed conversion ratio of treatments. Statistical analysis showed significant differences between treatments. Birds given one hundred fifty grams of silkworm pupa meal had better FCR than any of the birds given one hundred grams and fifty grams which did not significantly different from each other and the control groups. This indicates that the addition of silkworm pupa meal of the birds makes them more efficient in converting feeds to flesh. The overall mean feed conversion ratio of the birds was 2.55.

Feed Cost to Produce a Kilogram of Broiler

Presented in the same table are the feed costs to produce a kilogram increase in body weight. Statistical analysis showed the significant difference among the treatment means. The birds given the highest amount of silkworm pupa meal (150 gram) has the higher feed cost to produce a kg gain in weight. There was a direct relationship between the level of silkworm pupa meal and the cost of feed to produce a kilogram gain due to the additional cost incurred in the procurement of silkworm pupa meal.

Table 4. Feed conversion ratio and feed cost to produce a kg of broiler

| TREATMENT | FEED CONVERSION RATIO | FEED COST (Php) |
|---|---|---|
| Pure commercial feeds | 2.71[a] | 70.00[d] |
| 50 g silkworm pupa meal / kg commercial feeds | 2.55[ab] | 75.29[c] |
| 100 g silkworm pupa meal / kg commercial feeds | 2.53[ab] | 80.17[b] |
| 150 g silkworm pupa meal / kg commercial feeds | 2.41[b] | 84.52[a] |

Means with different letters are not significantly different at 5% by DMRT.

Morbidity and Mortality rate

There were chicks that died but this was incurred during the brooding or the pre-experimental period. But the good health of the birds was maintained all throughout the study period.

Return on Investment

Table 5 showed the returned on investment in the different treatments. Even though this was not subjected to statistical analysis, it is shown their higher profits were obtained from the birds with silkworm pupa meal added to their feeds. This implies that supplementing silkworm pupa on broilers ration resulted to a higher income than feeding commercial feeds purely.

Table 5. Net return and return on investment

| PARTICULARS | $T_0$ | $T_1$ | $T_2$ | $T_3$ |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Cost of feeds (Php) | 3,864 | 3,830.4 | 3,785.6 | 3,733.8 |
| Cost of silkworm pupa meal (Php) | 0 | 245 | 485 | 715 |
| Cost of stocks (Php) | 1,250 | 1,250 | 1,250 | 1,250 |
| Cost of medicines (Php) | 268 | 268 | 268 | 268 |
| Cost of bulbs (Php) | 200 | 200 | 200 | 200 |
| Cost of disinfectant (Php) | 25 | 25 | 25 | 25 |
| Fixtures rental (Php) | 100 | 100 | 100 | 100 |
| Total cost (Php) | 5,707 | 5,918.4 | 6,113.6 | 6,291.8 |
| Total sales (Php) | 6,360 | 6,720 | 6,960 | 7,240 |
| Net income (Php) | 653 | 801.6 | 846.4 | 948.2 |
| ROI % | 11.44 | 13.54 | 13.84 | 15.07 |

## SUMMARY, CONCLUSION AND RECOMMENDATION

### Summary

The study was conducted to determine the effect of different levels of silkworm pupa on the growth performance of cobb broilers. One hundred sixty day-old broiler chicks were distributed at random following the completely randomized design (CRD) into four treatments. Each treatment was replicated four times with ten birds per replication, making a total of 40 per treatment. The treatments were $T_0$- pure commercial feeds or 0% silkworm pupa meal, $T_1$- 50 grams silkworm pupa meal/kg of commercial feeds, $T_2$- 100 grams silkworm pupa meal/kg of commercial feeds, $T_3$- 150 grams silkworm pupa meal/kg of commercial feeds.

The result of statistical analysis showed no significant differences in term of initial weight. Significant differences were observed in the final weight, total gain in weight, feed consumption, feed conversion ratio and feed cost to produced a kilogram of broilers.

Although the Return on Investment (ROI) values were not subjected to statistical analysis, higher ROI's was obtained from the birds supplemented with silkworm pupa meal compared to the control group. The highest ROI was observed in the birds given 150 grams of silkworm pupa meal was 15.07% followed by these fed 100 grams and 50 grams ROI values of 13.84% and 13.54% respectively. Lowest ROI of 11.46% was observed in the control group.

### Conclusion

Based on the results of the study, the addition of silkworm pupa meal on the broiler ration gives an advantage in terms of final weight, total gain in weight and feed conversion ratio. Therefore, it is concluded that silkworm pupa meal can be incorporated in the feed growing-finishing broilers to enhance growth and feed efficiency.

Recommendation

Since supplementing silkworm pupa meal on broilers ration resulted to higher income, it is recommended that silkworm pupa meal should be added in broiler diets during the growing-finishing period.

However, a similar study may be conducted to evaluate the effect if the level of silkworm pupa meal is increased beyond 150 g.

## LITERATURE CITED

ANONYMOUS. 2005. Fish Meal Facts and Figures. Fish Meal Information networks (FIN). College Yard, Lower Dagnal Street, St Albans. A13 APA U.K. Association of Official Analytical Chemistry.

ANONYMOUS. 2007. Silkworm as Food. Retrieved July 31 2010 from http://www.wormspit.com/wormfoods.htm.

GRIMALDE and ENGEL. 2005. Evolution of Insects. Cambridge University Press.

KHATUN, R., M.A.R. HOWLIDER, M. M. RAHMAN and M. HASANUZZAMAN 2003. Replacement of fish meal by silkworm pupae in broiler diets. Pak. J. Biol. Sci., 6: 955-958.

SILKWORM NUTRITIONAL INFORMATION (SNI). 2005. Silkworm nutritional information. Retrieved July 31, 2010 from www.http.//client;bso02/c/myDocuments/Silkworm.html.

SOLOMON, S.G. and I.I. YUSUFU 2005. The Amino acid profile, proximate and mineral composition of silkworm caterpillar (Anaphe infracta) meal as possible alternative to fish meal in the diets of cultural fish species. Department of Fisheries and Aquaculture.

## APPENDICES

Appendix Table 1. Initial weight of the birds (kg)

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| $T_O$ | 0.66 | 0.65 | 0.67 | 0.69 | 2.67 | 0.67 |
| $T_1$ | 0.66 | 0.68 | 0.66 | 0.65 | 2.65 | 0.66 |
| $T_2$ | 0.72 | 0.65 | 0.67 | 0.67 | 2.71 | 0.68 |
| $T_3$ | 0.68 | 0.67 | 0.64 | 0.70 | 2.69 | 0.67 |
| GRAND TOTAL | | | | | 10.72 | |
| GRAND MEAN | | | | | | 0.67 |

A N A L Y S I S  O F  V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 0.0005 | 0.000167 | $0.34^{ns}$ | 0.49 | 5.95 |
| Error | 12 | 0.0059 | 0.000492 | | | |
| CORRECTED TOTAL | 15 | 0.0064 | | | | |

ns = Not Significant Coefficient of Variation=3.31%

Appendix Table 2. Final weight (kg)

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| To | 1.58 | 1.57 | 1.60 | 1.61 | 6.36 | 1.59 |
| T1 | 1.65 | 1.71 | 1.66 | 1.70 | 6.72 | 1.68 |
| T2 | 1.68 | 1.80 | 1.71 | 1.77 | 6.96 | 1.74 |
| T3 | 1.78 | 1.90 | 1.72 | 1.85 | 7.25 | 1.81 |
| GRAND TOTAL | | | | | 27.29 | |
| GRAND MEAN | | | | | | 1.71 |

A N A L Y S I S O F V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 0.1065 | 0.035506 | 13.62** | 3.49 | 5.95 |
| Error | 12 | 0.0313 | 0.002606 | | | |
| CORRECTED TOTAL | 15 | 0.1378 | | | | |

**Highly Significant Coefficient of Variation= 2.99%

Appendix Table 3. Total gain in weight (kg)

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| To | 0.92 | 0.92 | 0.93 | 0.92 | 3.69 | 0.92 |
| T1 | 0.99 | 1.03 | 1.0 | 1.05 | 4.07 | 1.02 |
| T2 | 0.96 | 1.15 | 1.04 | 1.10 | 4.25 | 1.06 |
| T3 | 1.10 | 1.23 | 1.08 | 1.15 | 4.56 | 1.14 |
| GRAND TOTAL | | | | | 16.57 | |
| GRAND MEAN | | | | | | 1.04 |

A N A L Y S I S  O F  V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 0.0990 | 0.03299 | 11.05** | 3.49 | 5.95 |
| Error | 12 | 0.0358 | 0.002985 | | | |
| CORRECTED TOTAL | 15 | 0.2348 | | | | |

**Highly Significant  Coefficient of Variation=5.28%

Appendix Table 4. Feed consumption (kg)

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| To | 2.47 | 2.49 | 2.51 | 2.53 | 10 | 2.50 |
| T1 | 2.57 | 2.60 | 2.58 | 2.61 | 10.36 | 2.59 |
| T2 | 2.66 | 2.69 | 2.65 | 2.68 | 10.68 | 2.67 |
| T3 | 2.73 | 2.72 | 2.76 | 2.75 | 10.96 | 2.74 |
| GRAND TOTAL | | | | | 42 | |
| GRAND MEAN | | | | | | 2.63 |

A N A L Y S I S  O F  V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 0.1284 | 0.0428 | 102.72** | 3.49 | 5.95 |
| Error | 12 | 0.0050 | 0.000417 | | | |
| CORRECTED TOTAL | 15 | 0.1334 | | | | |

**Highly Significant  Coefficient of Variation=0 .78%

Appendix Table 5. Feed conversion ratio

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| $T_O$ | 2.68 | 2.71 | 2.70 | 2.75 | 10.84 | 2.71 |
| $T_1$ | 2.60 | 2.52 | 2.58 | 2.49 | 10.19 | 2.55 |
| $T_2$ | 2.77 | 2.34 | 2.55 | 2.44 | 10.10 | 2.53 |
| $T_3$ | 2.48 | 2.21 | 2.56 | 2.39 | 9.64 | 2.41 |
| GRAND TOTAL | | | | | 40.77 | |
| GRAND MEAN | | | | | | 2.55 |

A N A L Y S I S  O F  V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 0.1833 | 0.06109 | 4.06* | 3.49 | 5.95 |
| Error | 12 | 0.1804 | 0.015031 | | | |
| CORRECTED TOTAL | 15 | 0.3636 | | | | |

* Significant  Coefficient of Variation=4.81%

Appendix Table 6. Feed cost to produce a kg of broiler (Php)

| TREATMENT | REPLICATION | | | | TOTAL | MEAN |
|---|---|---|---|---|---|---|
| | I | II | III | IV | | |
| $T_O$ | 69.16 | 69.72 | 70.28 | 70.84 | 280.00 | 70.00 |
| $T_1$ | 74.73 | 75.57 | 75.01 | 75.85 | 301.16 | 75.29 |
| $T_2$ | 79.89 | 80.73 | 79.61 | 80.45 | 320.68 | 80.17 |
| $T_3$ | 84.25 | 83.96 | 85.08 | 84.80 | 338.09 | 84.52 |
| GRAND TOTAL | | | | | 1239.93 | |
| GRAND MEAN | | | | | | 77.50 |

A N A L Y S I S  O F  V A R I A N C E

| SOURCE OF VARIATION | DEGREES OF FREEDOM | SUM OF SQUARES | MEAN SUM OF SQUARES | COMPUTED F | TABULAR F | |
|---|---|---|---|---|---|---|
| | | | | | 0.05 | 0.01 |
| TRT | 3 | 470.3137 | 156.7712 | 480.59** | 3.49 | 5.95 |
| Error | 12 | 3.9145 | 0.326206 | | | |
| CORRECTED TOTAL | 15 | 474.2282 | | | | |

**Highly Significant  Coefficient of Variation= 0.74%

Appendix Table 7. Return on investment

| PARTICULARS | TO (Php) | T1 (Php) | T2 (Php) | T3 (Php) |
|---|---|---|---|---|
| Feeds | 3,864 | 3,830.4 | 3,785.6 | 3,733.8 |
| Silkworm pupa | | 245 | 485 | 715 |
| Stocks | 1,250 | 1,250 | 1,250 | 1,250 |
| Medication | 268 | 268 | 268 | 2680 |
| Bulb | 200 | 200 | 200 | 200 |
| Disinfectant | 25 | 25 | 25 | 25 |
| Fixtures Rental | 100 | 100 | 100 | 100 |
| TOTAL | 5,707 | 5,918.4 | 6,113.6 | 6,291.8 |
| SALES | 6,360 | 6,720 | 6,960 | 7,240 |
| NET INCOME | 653 | 801.6 | 846.4 | 948.2 |
| ROI% | 11.44% | 13.54% | 13.84% | 15.07% |