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Kinds and Levels of Probiotics for Colored Chicken Breed

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ABSTRACT: Health risk issues caused by antibiotics as growth promoters as well as a change in meat preference to chickens led the exploration for alternatives. The study determined the best kind and level of probiotics to colored chicken in terms of growth performance, carcass quality and economic analysis. One Hundred Sixty Five (165) day-old chicks were randomly distributed into eleven treatments replicated thrice employing RCBD.

Comparable performance were observed on colored birds given different probiotics from 10 to 30% levels in terms of growth performance and carcass quality. However, giving the colored birds probiotics at 30% level resulted to a higher cost of feeds to produce a kilogram gain in weight.

KEYWORDS: feed conversion ratio, gain in weight, probiotics, sasso, wet feeding.

INTRODUCTION

Situation Analysis

Poultry raising specifically broiler production is a promising agro-based industry that provide livelihood in the countryside with considerable profit. Broiler provides the largest meat supply in the Philippines as compared to other livestock. Meat from broiler is preferred by most people in the world because it contains less fat laden with cholesterol that is detrimental to health and it is also much cheaper or affordable to most Filipinos.

The Philippine Statistics Authority (2020) reported the Philippines had a total inventory of chicken to an estimated 178.26 million birds from October to December 2019. Broiler went down by 12.2 percent (56.39 million) from its previous year's level of 64.22 million birds as of January 01, 2020. The top producing Region is the Central Luzon with 13.79 million broiler chicken or 24.5 percent of the total broiler chicken inventory.

Broiler are chickens raised for meat purposes and have originated from a native chicken called red jungle fowl of Indian Subcontinent. Due to the growing consumer demand for a cheaper poultry meat, the broiler industry improved tremendously through breeding and improved nutrition to increase the weight of breast muscle (de Jong *et al.,* 2012).

On the other hand, colored chicken breeds (e.g Sasso, Hubbard etc.) are dual purpose birds which are raised for both meat and egg. They are raised for meat consumption from 6 ½ to 9 weeks of age on its average weight of 1.297 kgs reared either in battery cages or deep litter floor (Yakubu and Madaki, 2017).

Due to a change to consumer preference, more and more consumers switch to "organic/free ranged or slow growing birds" as they believe these birds are far healthier, tastier and safer to consume than the conventionally produced fast-growing birds or we call broiler chickens. On the other hand, series of researches were conducted entire the world just to meet the growing demand of consumers using antibiotics and growth enhancer in the ration. The use of subtherapeutic doses of antibiotics to protect the animals against infections, improved the general health, growth performance and feed efficiency (Gadde *et al.,* 2018). These practices are perceived to lead to microbial resistance to the drugs in use, resulting in consumer concerns regarding residues in food products. The relatively recent ban of subtherapeutic doses of certain antibiotics as feed additives in the European Union led to a general decline in animal health (Castanon, 2007). Due to their various side-effects such as antibiotic resistance, destruction of beneficial bacteria in the gut, and dysbiosis (Alagawany *et al.*, 2018), the use of antibiotics in poultry feed as a growth promoter has been restricted in many countries around the world. Consequently, there is a growing interest in finding viable alternatives for growth enhancement and disease prevention in the poultry sector. Probiotics are considered alternative feed additives to antibiotics and can be defined as microbial food supplements which beneficially affect the host by improving its intestinal microbial balance (Khan and Naz, 2013).

Kinds and Levels of Probiotics for Colored Chicken Breed

Probiotics are one of the options in this regard for improving poultry production. Probiotics are defined as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host." They are available in various forms for use as feed additives. Probiotics as feed additives aid in proper digestion of feed hence make the nutrients available for faster growth. Immunity can also be improved by addition of probiotics to poultry diets. Moreover, probiotics aid in improving meat and egg quality traits. Various infectious diseases of poultry can be countered by use of probiotics in their feed. A proper selection of probiotic strains is required for gaining optimal effects. (Alagawany *et al.,* 2018). Probiotics present a potential alternative to the prophylactic use of antibiotics in feed animals. Also known as direct-fed microbials, probiotics are classified as live nonpathogenic microorganisms that are capable of maintaining a normal gastrointestinal microbiota (Ohimain and Ofongo, 2012).

Aside from the probiotics help in terms of growth parameters like feed conversion ratio (FCR), improved gain in weight it could also accounts to an improved quantity and quality of meat, eggs and milk (Musa *et al.,* 2009). Moreover, Van *et al.* (2006) pointed out the reduction on the contamination of eggs caused by *Salmonella* bacteria through the supplementation of probiotics. It has also been recorded that probiotics contributed to the increase in production and improved quality of eggs (Kurtuglo *et al.*, 2004).

Animal health is one of the top priority in the production chain regardless of the species. Probiotic organism has the ability to improved health condition of animals when adhered to digestive tract, hence, a better productivity (Isolauri *et al*., 2004) and improved immunological response of the host (Patel *et al.,* 2015) will be observed.

Probiotic's mode of action in terms of animal health and disease prevention based on adaptive immune system is very important. The intestinal lumen, is very rich not only on essential nutrients and good microorganisms but also pathogens which produces toxins and other harmful substances (Willing *et al.,* 2012). There is a barrier that is being produced by the epithelial cells which separates internal body tissues from lumen environment (Liao and Nyachoti, 2017) hence influencing intestinal cellular "stability" (Ng *et al*., 2009). The barrier is said to be first line of defense against pathogenic microorganisms namely: *Campylobacter, Clostridium, Eimeria* and *Salmonella* (Dalloul & Lillehoj, 2005; Stern *et al.*, 2001) which confirms the findings of Zhang and Kim, (2014); Lei *et al.* (2015) that it could also prevent diseases such as salmonellosis, campylobacteriosis or coccidiosis in the GIT (gut innate immunity), but with the continuous stress or disease the host is experiencing, this barrier can be disrupted (Willing *et al.,* 2012; Lee *et al*., 2016). Probiotics have been observed to restore the GIT mucosa barrier function in both in vitro and in vivo models (Garcia-Lafuente *et al*., 2001; Madsen *et al*., 2001). Borchers *et al.* (2009), stated that immune response of an animal should either be stimulated and suppressed. In a research conducted, researchers found out that through stimulation of the gastro intestinal immune response, the normal gut microbiota has the ability to support the defense system of the animal against pathogens (Yirga, 2015).

Aside from poultry species, it has been observed on several studies that probiotics improve other farm animals as well. Farm animals can be affected greatly by biotic and abiotic-causing stress (e.g. hauling, management, diets etc.). Due to the following factors, these may lead to the disturbance of the intestinal ecosystem' balance and risk of having pathogenic infections. There are fantastic and significant effect of probiotics on the utilization and absorption of feed as it increases the total body weight of different farm animals which includes piglets (Li *et al.,* 2006; Casey *et al.,* 2007), goats, sheep (Chiofalo *et al.,* 2004), cattle, horses (de Rezende *et al.,* 2012)

Probiotics can be composed of one or many strains of microbial species, with the more common ones belonging to the genera *Lactobacillus, Bifidobacterium, Enterococcus, Bacillus*, and *Pediococcus* (Gaggia *et al.,* 2010). Probiotics and prebiotics maybe classified as functional food; that which affects bodily functions in a positive manner so as to improve health or if its effect extends to the physiological or psychological levels going beyond the traditional nutritional effect. Probiotics are live microorganisms which when administered in adequate amounts confer a beneficial health effect on the host. Lactic acid bacteria (LAB), *Bacillus* and *Bifidobacteria* are the most common types of probiotics (Parvez *et al.,* 2006)

Several good microorganisms are made known to the public and one of the beneficial probiotics is the Lactic Acid Bacteria (LAB). LAB are ubiquitous microorganisms which belong to a large group of bacteria that produces lactic acid as a by-product that renders benefits not only to crops but also for livestock production. LAB can grow and survive in acidic (low-pH) environments. They are generally considered safe for human consumption which other countries use to preserve food and noted to be good in the digestive systems. Some of their benefits are prolonging storage life by inhibiting food spoilage, enhancing flavors taste and textures, and preserve nutritive value by producing lactic acid as "fermentation metabolite" (Nordqvist, 2004).

Relating to animal production, an anaerobic and stinking livestock pen can be transformed into an odorless system when applied with LAB cultured organisms (DuPonte and Fischer, 2012). On the long run, through feeding or supplication in their drinkers can be of great help to enhance their immunity, foster a healthy gut flora, and aid in digestion (Corcionivoschi *et al.,* 2010, Fajardo *et al.,* 2012).

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The research conducted by Konstatinov *et al.* (2008) used bacteria such as *Lactobacillus sobrius* or *Lactobacillus paracasei* (Bomba *et al.,* 2002) to limit the pathogenic *E. coli's* intestinal colonization. In addition, a comparative study between Competitive Exclusion (CE) Culture and Mucosal Competitive Exclusion (MCE) Culture was conducted to test their efficacy for the elimination of *Salmonella* spp. infections and *Campylobacter* colonization in 210 chicks of broiler chicken respectively (Stern *et al.*, 2001). The results showed that there were more colonized *Salmonella* Typhimurium in the birds treated with CE than those birds treated with MCE but on the other hand, a more superior effect was displayed by the birds treated with MCE as compared to those birds treated with CE in the case of *Campylobacter* genus bacteria colonization.

On the other hand, IMO or the indigenous microorganism are members of useful microorganisms including filamentous fungi, yeast and bacteria that inhabits non-cultivated soil and surfaces of living things and are often found under bamboo trees which have the potential in improving soil fertility, phosphate solubilisers , biodegradation, plant growth promoters and nitrogen fixation (Tiquia and Michel, 2002; Umi and Sariah, 2006)

Ghosh *et al*. (2004) added that IMO could be used in the production of "compost tea" which could improve soil quality and through the beneficial microorganism's colonization eventually be the first line of defense to protect crops against microbial infections.

There are reported delightful benefits of IMO in animal production. The use of IMO solution in reducing the stinking smell of commercial piggeries and poultry farms have been observed through the action of the beneficial microorganisms hindering the multiplication of bad microorganisms/ pathogen which causes foul smell (Cho and Koyama, 1997).

Furthermore, Effective Microorganisms (EM) are anaerobic microorganisms that are somehow act the same function as the IMO which consists of lactic acid bacteria (Lactobacillus spp.), yeast (Saccharomyces spp.) and photosynthetic bacteria (Rhodopseudomonas spp.) (Zuraini *et al.,* 2010). They harvest energy from soil heat and the sun to convert gases such as ammonia, exudates from root system and soil organic fraction into amino acids, sugars and nucleic acids which are called building materials of cells. As they produce such materials, it helps in the growth, yield, quality and protection of vegetable crops (Olle and Williams, 2013; Global Partners, 2015).

From the above discussions, the use of different forms of probiotics offers more advantages in producing healthy animals, producing safe meat for human consumption. This will mot only provide safe meat but affordable meat for the family.

At present, the country is still importing poultry meat to fill up the demand due to fluctuating or inadequate supply. The inadequate supply could be attributed to low feed conversion ratio because of inferior quality of feeds.

The most common reason of problems for small poultry raising is the failure to supply a balanced starter feed. The second reason is the failure to supply fortified additive in correct proportions. With this two main problems, it could result to birds suffering from poor feathering, increase fatness that will lead to leg problems and on top of that is slow growth that definitely renders low income (https://www.gov.mb.ca/agriculture/livestock/ production/poultry/basic-feeding-programs-for-small-chicken-flocks.html, Manitoba,)

Hence, this study entitled "Kinds and Levels of Probiotics for Colored Chicken Breed (Hubbard)**"** was conducted to enhance the nutritive value of the available commercial feeds in the market, to increase the profit of the small to medium backyard poultry raisers despite the high cost of commercial feeds and also to contribute or generate higher revenue for the growth of our economy.

General Objectives

The study was conducted to determine the performance of colored chicken breed (Sasso) fed with different probiotics.

Specific Objectives

1. To determine the best type of probiotics on the growth performance of colored chickens.
2. To determine the effects of the different levels of probiotics on the growth performance of colored chickens.
3. To determine the dressing percentage and leaf fat percentage as affected by different probiotics.
4. To determine the profit above feed medicine and stock cost as affected by different probiotics.

Time and Place of the Study

The study was conducted at DMMMSU- NLUC Compound, Sapilang, Bacnotan, La Union from June 24 to August 24, 2020.

Definition of Terms

Ad libitum refers to the process of giving sufficient supply of water and feeds to the broilers daily.

Brooding refers to the process of providing heat to young chicks.

Carcass Weight refers to the weight of the dressed bird after removing the shanks, head, and internal organs.

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Colored Chicken/ Sasso refers to a dual type chicken reared for its meat and egg. It usually grows for 1.3 kg when reared from 6 to 9 weeks.

Effective Microorganism Activated Solution (EMAS) is a kind of probiotic which is activated from the pure cultured and strictly selected effective microorganisms.

Feed Conversion ratio is the ability of the bird to convert the feeds into kilogram gain.

Fermentation is the process of letting the feeds to be fermented by the different probiotics for a short period of time before feeding to colored breed chickens.

Indigenous Microorganism (IMO) is a kind of probiotic which is rich in indigenous microorganisms that were derived from undisturbed places like forest beds.

Kinds refers to the different probiotics used in the experiment like IMO, EMAS and LABS.

Lactic Acid Bacteria Serum (LABS) is a kind of probiotic in which its main microorganism is lactobacilli from yakult cultivated to become a serum. Ideal for enhancing the productivity of the animal host.

Levels refers to the varying percentages/ration of application of the probiotics to the feeds.

Performance refers to final weight, gain in weight, feed consumption, feed conversion ratio, dressing percentage, leaf fat percentage, cost of feeds to produce a kilogram gain in weight and profit above feeds, stock cost and medicine.

Probiotics refers to the strain of live microorganisms that has the ability to improve the animal's health status and achieve better performance like IMO, EMAS and LABS.

Supplements are the different probiotics added to low-cost feed to increase its nutritive value.

Wet feeding is the process of feeding the broilers in a wet form. The feeds are wet by lactic acid bacteria serum, effective microorganism activated solution, and indigenous microorganism (IMO) solution or pure water.

METHODOLOGY

Research Design

One hundred eighty colored meat type breeds (Sasso) of chicks were used in the study. After 14 days of brooding, the chicks were distributed randomly into eleven treatments employing the Randomized Complete Block Design (RCBD) in three blocks. Each treatment had 15 chicks divided into three replications.

The treatments used were the following:

T_0 – Water (Negative control)
T_1 – Commercial Probiotics (Positive Control)
T_2 – 10% Lactic Acid Bacteria Serum (LABS)
T_3 – 20% Lactic Acid Bacteria Serum (LABS)
T_4 – 30% Lactic Acid Bacteria Serum (LABS)
T_5 – 10% Effective Microorganism Activated Solution (EMAS)
T_6 – 20% Effective Microorganism Activated Solution (EMAS)
T_7 – 30% Effective Microorganism Activated Solution (EMAS)
T_8 – 10% Indigenous Microorganism (IMO)
T_9 – 20% Indigenous Microorganism (IMO)
T_{10} – 30% Indigenous Microorganism (IMO)

Materials and Procedures

Construction of Cages

Prior to the arrival of the chicks, lumber, chicken wire and other materials for cage construction were purchased from the hardware store in the Municipality of Bacnotan, La Union. The dimension used for each cage was 2 ft. height x 2ft. width x 2.5 ft. long to come up with the standard floor area of one ft^2 per bird. The floor of cages was two feet above the ground. A commercial disinfectant and portable sprayer was used to disinfect the cages and the vicinity of the experimental area. All sides of the cages used for brooding the chicks were covered with sacks to maintain the required temperature. Six 30 wattage incandescent bulbs were used in the brooding cage to provide heat and lighting. Feeders and waterers were purchased and placed inside the cages prior to the arrival of the chicks. Individual containers were purchased to store the treatments [purified water, indigenous microorganism (IMO), effective microorganism activated solution (EMAS) and lactic acid bacteria serum (LABS). A portable top loading balance was used after brooding to determine the initial weight of the broilers before assigning them in the experimental diets. One week prior to the conduct of the experiment, the cages, waterers, feeders and the vicinity of the experimental area were disinfected to avoid diseases and pest infestation. In each experimental unit, five chicks were reared or a total of 165 chicks. The chicks were bought from a reliable agricultural outlet in the Municipality of Bacnotan, La Union.

Procedures in the Preparation of Indigenous Microorganism (IMO)

A kilogram of rice was cooked. The cooled cooked rice was placed in an earthen pot. The mouth of the container was covered completely with a cotton cloth and tied with rubber band which prevented small insects from getting in. The container was placed on the floor of the nearest undisturbed vegetation and was left there for three days when whitish moldy filaments formed in the cooked rice a kilogram of sugar was added and mixed thoroughly and positioned in a dark, cool place until it appeared muddy after seven days of fermentation.

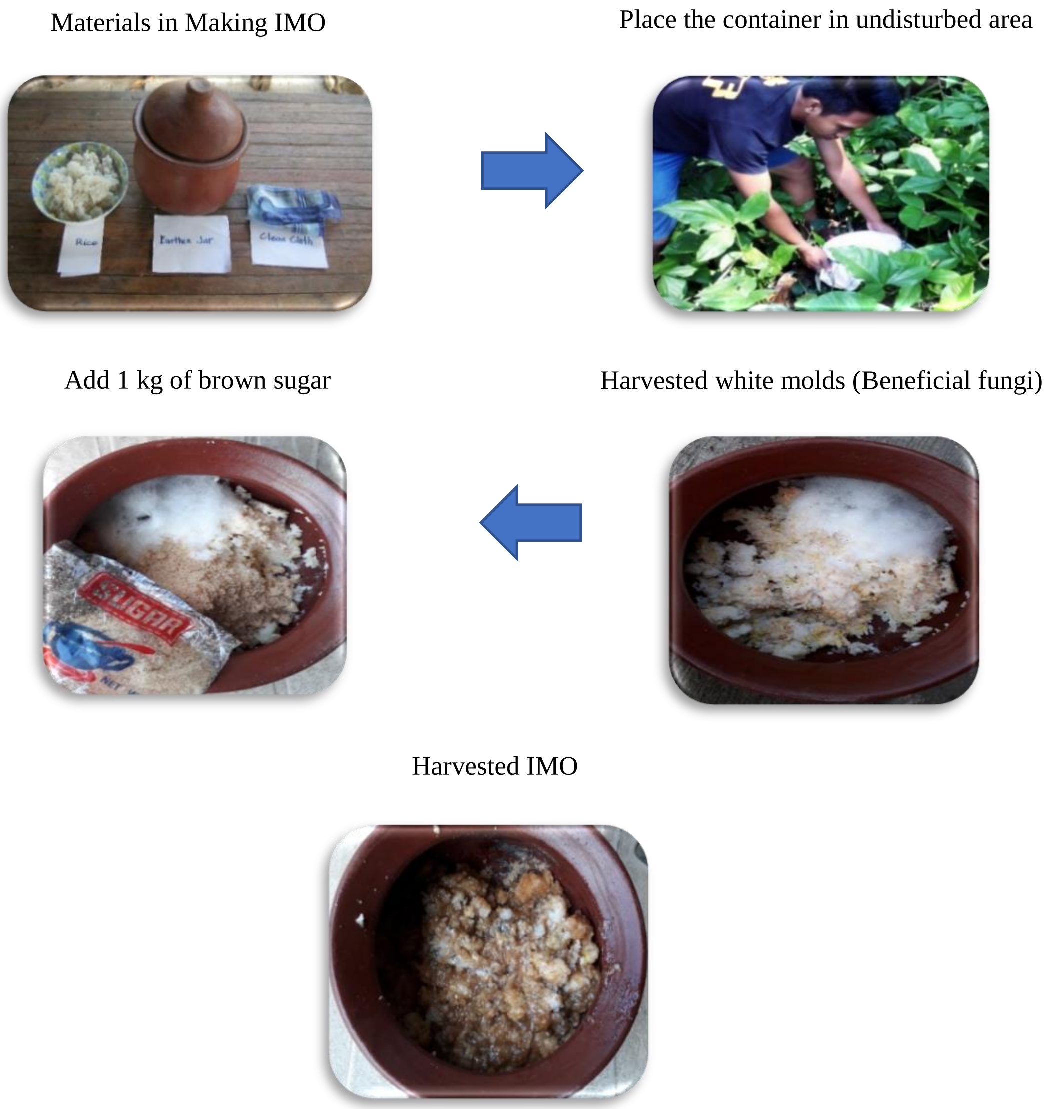

Fig 1. Procedures in the Preparation of Indigenous Microorganism (IMO).

Procedures Employed in Making Lactic Acid Bacteria Serum (LABS)

The Lactic Acid Bacteria Serum (LABS) was prepared using rice washing. Second rice washing was preferred due to cleaner and absence of foreign matters. The collected rice washing was poured on a container covered with a piece of cloth and was placed on an undisturbed area without direct exposure to sunlight, maintaining an ideal room temperature of about 30°C not exceeding 40°C for right fermentation. The rice washing was fermented for seven days. On the eight day, a kilo of brown sugar, a kilo of skim milk, and 100 ml of culture milk were added to 11 liter of fermented rice washing. The mixture was stirred thoroughly until the sugar and skim milk have been fully dissolved. The mixture was transferred in a bigger container covered with cloth and was fermented for 7 days in undisturbed area. After 15 days of fermentation, Lactic Acid Bacteria Serum (LABS) was harvested with a sweet-sour smell and taste.

Fig 2. Procedure in the Preparation of Lactic Acid Bacteria Serum (LABS).

Procedures in Making Effective Microorganism Activated Solution (EMAS)

The Effective Microorganism Activated Solution (EMAS) was produced by using one liter volume of Effective Microorganism or the mother culture, 1 kg of brown sugar was diluted in a one liter of water and lastly, twenty liters of tap water (non-chlorinated) was added. These ingredients were mixed in a clean basin, stirred thoroughly until homogeneous mixture was observed and stored in a clean bottle container. The containers were fully air-locked making the environment anaerobic which resulted in faster fermentation process. The accumulated gas were daily released inside the containers; the solution were kept away from direct sunlight and were stored on a room temperature for five days.

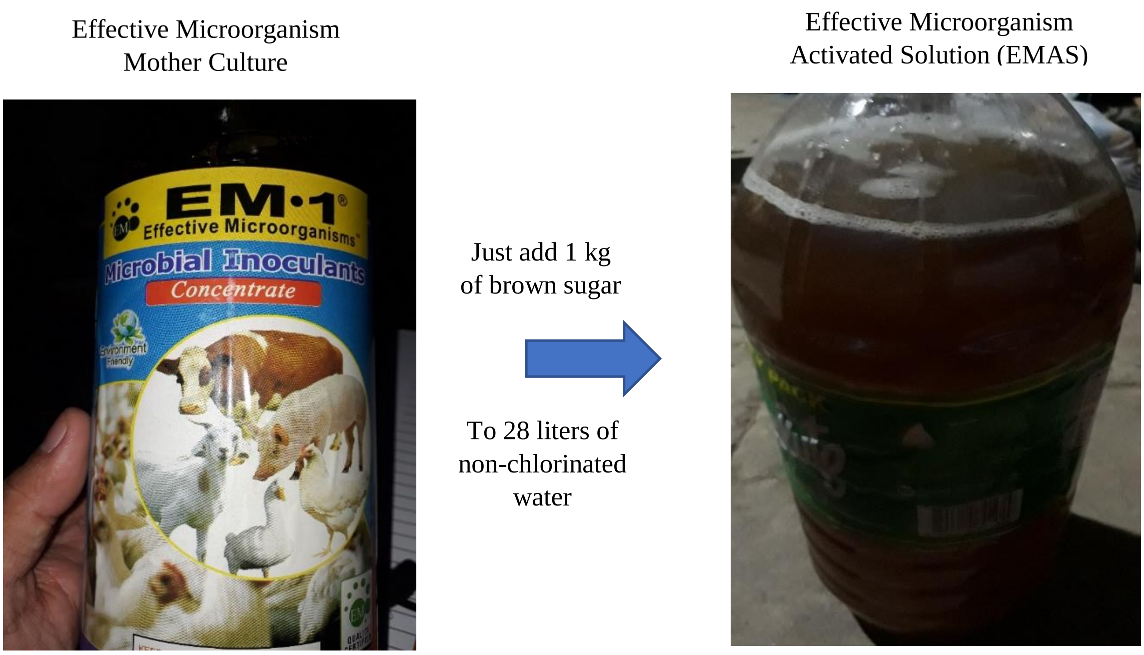

Fig 3. Procedures in the Preparation of EMAS

Preparation of Experimental Birds

Upon arrival, the chicks were given water with five percent sugar solution for 2 hours which provided them source of energy. Inside the brooding area, six 30 watt incandescent bulbs were used which provided the required heat to the chicks. As the chicks grew and develop their feathers, supplemented heat was gradually decreased. During brooding, the chicks were fed with Commercial Chick Booster. The chicks were given medicated water which promoted faster growth and good health. The chicks were brooded for 14 days.

Procedures in the Conduct of the Experiment

After brooding stage, five birds were grouped and weighed using a portable top loading balance used in determining their initial weight before the implementation of the treatments. All the data gathered were recorded. The researcher used the fishbowl technique on the distribution of the birds by using 11 pieces of paper written with the corresponding treatments and then drawn to represent a treatment. After the first block was finished wherein five birds were randomly placed in each cage, the researcher proceeded to the 2^{nd} and 3^{rd} blocks and repeated the same steps and procedures that was done in the first block. The lighting was shifted from incandescent bulb to fluorescent light.

The feeds that were used after brooding were gradually shifted from chick booster to broiler starter crumble, the researcher used low-cost BSC to test whether the probiotics could improve the feed quality subjected to corresponding treatments.

The treatment solutions were made by mixing 100 ml of each probiotics (LABS, EMAS and IMO) to 900 ml of tap water, 200 ml solution to 800 tap water and 300 ml solution to 700 ml of tap water, respectively.

Preparation of the Wet Feeds

In a pail, a liter of each treatment solution was added to two kilograms of commercial feeds and were thoroughly mixed until all the feeds were uniform in consistency. The pails were covered and allowed to stay undisturbed overnight to obtain a partially fermented feeds and to ensure the solution was fully absorbed prior to feeding. The researcher prepared the feed mixture thrice a week for the first two weeks of rearing then for the subsequent weeks, feed mixtures was prepared every day to ensure the freshness of the feeds.

Ad libitum feeding was strictly implemented throughout the rearing period following the treatments to allow the experimental birds to obtain optimum growth and development.

Data Gathered

1. Initial Weight (kg) at day 14. This was gathered by weighing 5 birds per replication at the start of the study, 14 days after brooding period by using a portable top loading balance. The total weight was divided by 5 to represent the mean weight

2. Final Weight (kg) after 64 days. This was gathered by weighing 5 birds per replication after rearing for 64 days by using a portable top loading balance.

3. Gain in Weight (kg). This was computed by subtracting the initial weight from the final weight of the birds.

4. Feed Consumption (kg). This was computed by adding the total weight of the feed in wet form consumed by the birds throughout the duration of the study.

5. Feed Conversion Ratio. This was computed by dividing the feed consumed to the gain in weight of the birds.

6. Cost of Feed to Produce a Kilogram Gain in Weight. This was computed by multiplying the Feed Conversion Ratio (FCR) to the price per kilogram of the dietary ration (Php).

7. Dressing Percentage (%). This was computed by dividing the carcass weight (kg) to the live weight (kg) multiplied by 100.

8. Leaf Fat Percentage (%). This was computed by dividing the leaf fat weight (g) to the Carcass weight (kg) multiplied by 100.

9. Profit Above Feed, Medicine and Stock Cost. This was computed by subtracting the cost of feeds, cost of probiotics, medication and stock from the sale value of the birds at 64 days old.

Analysis of Data

All data gathered were analyzed using Analysis of Variance (ANOVA) in Randomized Complete Block Design, difference between and among treatment means were further tested using Tukey's Honest Significant Differences (HSD) Test.

RESULTS AND DISCUSSION

Initial Weight of Birds

The initial mean weight of the birds assigned to the different treatments was 340 grams (Appendix Table 1). Analysis of Variance revealed no significant differences among the treatment means.

Final Weight of Birds

The final weight of birds as affected by different kinds and concentrations of probiotic solution is shown in Table 1. The final weight ranged from 1.33 to 1.46 kgs. The result showed no significant differences as influenced by the treatments indicating that the birds had comparable weights at the end of the study.

The result conformed to the result of the previous study conducted by Yousefi and Karkoodi (2007) that the body weight changes were not significantly different among treatment groups or was not affected by the dietary probiotic supplementation. Arslan *et al.* (2004) reported too that probiotics had no significant ($P \leq 0.05$) effect on growth in broilers.

On the other hand, the foregoing result contradicts with previous study of Abdel-Hafeez *et al.,* (2017) that chicks fed diets supplemented with probiotic, prebiotic and synbiotic (with and without feed restriction) exhibited higher body weight and feed efficiency than chicks fed the control diets.

Table 1. Mean Final Weight of Birds (kg) as Affected by Different Kinds and Concentrations of Probiotic Solution Added to the Base Ration.

Kinds and Concentration of Probiotic Solution	Final Weight (Kgs)
T_0 – Water	1.31
T_1 – Commercial Probiotics	1.33
T_2 – 10% LABS	1.43
T_3 – 20% LABS	1.43
T_4 – 30% LABS	1.42
T_5 – 10% EMAS	1.38
T_6 – 20% EMAS	1.46
T_7 – 30% EMAS	1.42
T_8 – 10% IMO	1.45
T_9 – 20% IMO	1.44
T_{10} – 30% IMO	1.38

Likewise, Song *et al.* (2014) reported, too a significant increase in body weight gain in broilers fed with probiotics Lactobacillus, Bifidobacterium, coliforms and Clostridium species.

Further, the result corroborates to the study of Kabir *et al.* (2004) that live weight gains were significantly higher (P<0.01) in birds supplemented with probiotics as compared to the control group at all levels during the 2nd, 4th, and 6th weeks of age, both in vaccinated and non-vaccinated birds. Other study (Apata, 2008) demonstrated increased liveweight gain in probiotic fed birds.

Moreover, the result conformed to the study of Chitra *et al.* (2004) that inclusion of probiotic and ascorbic acid both independently and simultaneously either in feed or in drinking water to broilers had made significant (P≤ 0.01) improvement in body weight of commercial broilers. Gupta (2004) also reported higher body weight gain in broilers after supplementation of probiotics at the field level.

Total Gain in Weight (kg) of the Birds

Table 2 shows the total mean gain in weight of the birds as affected by feeding with BSC wet with different kinds and concentrations of probiotic solutions. Analysis of variance revealed no significant differences on the gain in weight of the birds reared during the 1st week, 3rd week, 4th week, 6th week, 7th week and the final gain in weight.

On the other hand, significant differences on the gain in weight during the 2nd and 5th week of rearing were observed. During the 2nd week of rearing, the birds fed with BSC wet with 10% LABS solution (T_1) have the heaviest gain in weight with a mean of 0.25 kg which significantly differed to that of the control (water T_0) with a mean of 0.16 kg, but is comparable to the gain in weight of all the other birds fed with BSC feeds wet with different kinds and concentrations of probiotic solution. Kessler *et al.* (2000) stated that an initial slow growth rate increases at a certain age span until achieve a maximum rate (acceleration), and decreases gradually (deceleration). The occurrence is called the inflection point of the curve, which relates maximum growth to age and changes shape from concave to convex.

Table 2. Mean Gain in Weight of the Birds (kg) Fed with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.

Kinds and Concentrations of Probiotic Solution	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Final GW
T_0 – Water	0.15	0.16^{b}	0.25	0.13	0.87^{c}	0.10	0.10	0.97
T_1 – Com. Probiotics	0.13	0.21^{ab}	0.19	0.14	0.09^{bc}	0.11	0.11	0.99
T_2 – 10% LABS	0.14	0.25^{a}	0.21	0.14	0.11^{abc}	0.11	0.12	1.09
T_3 – 20% LABS	0.15	0.22^{ab}	0.21	0.15	0.13^{ab}	0.11	0.12	1.09
T_4 – 30% LABS	0.14	0.24^{a}	0.23	0.17	0.87^{c}	0.10	0.12	1.08
T_5 – 10% EMAS	0.12	0.22^{ab}	0.23	0.14	0.10^{bc}	0.11	0.13	1.04
T_6 – 20% EMAS	0.15	0.21^{ab}	0.24	0.13	0.14^{a}	0.10	0.15	1.12
T_7 – 30% EMAS	0.15	0.23^{a}	0.22	0.13	0.11^{abc}	0.12	0.12	1.08
T_8 – 10% IMO	0.14	0.23^{a}	0.27	0.14	0.12^{abc}	0.10	0.12	1.11
T_9 – 20% IMO	0.16	0.21^{ab}	0.25	0.12	0.09^{bc}	0.12	0.14	1.10
T_{10} – 30% IMO	0.16	0.20^{ab}	0.22	0.14	0.87^{c}	0.11	0.12	1.04

*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's HSD Test.

On the 5th week of rearing, the birds fed with BSC feeds wet with 20% EMAS solution (T_6) registered the highest (0.14 kg) gain in weight which significantly differed to the birds of T_0, T_1, T_4, T_5, T_9 and T_{10} spanning from 0.87 to 0.10 kg, but comparable to the birds of T_2, T_3, T_7 and T_8 ranging from 0.11 to 0.13 kg. This conform to the findings of Samli *et al.* (2007) that there are fantastic and significant effect of probiotics on the utilization and absorption of feed as it increases the total body weight of different farm animals which was exhibited by chickens and turkeys (Torres-Rodriguez *et al.,* 2007).

When probiotics are administered with the unchallenged group, results showed significantly higher body weight, body weight gain or immune organ weights, whereas no differences were observed in the challenged groups. In addition, birds receiving probiotics had lower mortality, with reduction in lesions. Overall, this is an indication that supplementation of probiotics in ovo may improve performance and offer immunity against infection (Pender *et al.* 2016).

This implies that probiotics had taken effect as it improved the weight of birds (Pender *et al.* 2016) from the first few weeks of rearing but as it reached the inflection point, the ability of the birds to convert the feeds into its body weight decreased. (Yakubu and Madaki, 2017).

Anjum *et al.* (2005) reported that multi-strain probiotics (protexin) supplementation in the diet significantly (P≤0.05) improved body weight gain in broilers.

Kinds and Levels of Probiotics for Colored Chicken Breed

Sherief and Sherief (2011) reported that significantly higher body weight is recorded on broiler flocks that received probiotics. Zhang and Kim (2014) reported an overall increase in body weight gain in chicken fed with multi-strain probiotics compared with that in control group fed basal diet. Mansoub (2010) reported significant increase in body weight of broilers fed with *Lactobacillus acidophilus* and *Lactobacillus casei*. Amer and Khan (2011) showed that the supplementation of probiotic (*Lactobacillus acidophilus*, *Bacillus subtilis, Saccharomyces cerevisiae* and *Aspergillus oryzae*) indicated significant increase body weight gain after 6 weeks of experiment.

Cao *et al.* (2013) found that supplementation the broiler diets with a single strain of Lactobacillus (*Enterococcus faecium*) significantly improved the BW and BWG compared to the control. A consistent improvement in BWG of chickens fed a culture of Lactobacillus has also been reported (Awad *et al.,* 2009).

Feed Consumption of Birds

The weekly feed consumption of the birds as affected by feeding with BSC wet with different kinds and concentrations of probiotic solution is shown in Table 3. Result revealed no significant differences among the treatments on the 1st, 2nd, 3rd, 4th, 5th, and 7th week of rearing. The feed consumption of the birds during the 1st week of rearing ranges from 0.39 to 0.45 kg, on the 2nd week ranges from 0.60 to 0.66 kg, on the 3rd week ranges from 0.56 to 0.61 kg, on the 4th week ranges from 0.48 to 0.67 kg, on the 5th week ranges from 0.52 to 0.59 and on 7th weeks of rearing ranges from 0.73 to 0.87 kg.

Likewise, analysis of variance on the total feed consumption as affected by feeding with BSC wet with different kinds and concentrations of probiotic solution revealed no significant differences between the treatments with means ranging from 3.95 to 4.29 kg.

On the other hand, result on the feed consumption of the birds on the 6th week of rearing has significant differences among the treatments where the birds fed with BSC wet with LABS 20% (T_3), EMAS 10% (T_5) and IMO 10% (T_8) attained the highest feed intake (0.68 kg), but comparable to the other treatments except for the birds of T_0 (BSC wet with water). The result of this study is in agreement to the findings of Engberg *et al.* (2009) where wet feeds increase villi length which leads to increased animal's food uptake, nutritional uptake, weight gain, food utilization, feed conversion and egg production. Likewise, it also lowers sugar content by 77% and a 3% higher crude protein.

Table 3. Mean Feed Consumption of Birds (kg) as Affected by the Different Kinds and Concentrations of Probiotic Solution Added to the Feeds.

Kinds and Concentrations of Probiotic Solution	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Total FC
T_0 – Water	0.45	0.61	0.60	0.48	0.54	0.62^{b}	0.78	4.08
T_1 – Com. Probiotics	0.44	0.64	0.58	0.54	0.56	0.66^{ab}	0.77	4.19
T_2 – 10% LABS	0.41	0.63	0.56	0.49	0.55	0.66^{ab}	0.85	4.16
T_3 – 20% LABS	0.41	0.63	0.60	0.57	0.59	0.68^{a}	0.80	4.29
T_4 – 30% LABS	0.40	0.65	0.60	0.55	0.52	0.64^{ab}	0.81	4.17
T_5 – 10% EMAS	0.39	0.65	0.57	0.54	0.52	0.68^{a}	0.84	4.20
T_6 – 20% EMAS	0.42	0.61	0.61	0.54	0.56	0.67^{ab}	0.87	4.28
T_7 – 30% EMAS	0.40	0.62	0.60	0.56	0.57	0.67^{ab}	0.84	4.26
T_8 – 10% IMO	0.43	0.61	0.61	0.50	0.59	0.68^{a}	0.84	4.27
T_9 – 20% IMO	0.41	0.66	0.60	0.53	0.54	0.66^{ab}	0.75	4.16
T_{10} – 30% IMO	0.42	0.60	0.56	0.49	0.53	0.63^{ab}	0.73	3.95

*Means in a column followed by the same letter are not significantly different at 0.05 level of Tukey's HSD Test.

Feeding viable *Lactobacillus* at 1100 $mgkg^{-1}$(4.4 x 107 colony forming units (cfu) kg^{-1}) increased daily feed consumption, egg size, Nitrogen and Calcium retentions (Nahashon *et al*., 1996). Shareef (2009) reported that probiotic (*Saccharomyces cervisiae*) supplementation of broilers had significantly increased feed consumption.

Feed Conversion Ratio

The feed conversion ratio of the chickens fed with BSC wet with different kinds and concentrations of probiotic solution is shown in Table 4. Analysis of variance revealed significant differences between the chickens under the different treatments reared for 64 days.

Kinds and Levels of Probiotics for Colored Chicken Breed

The feed conversion ratio has significant differences (*p<0.01*) wherein birds at T_9 (fed with BSC wet with 20% IMO) were the most efficient (3.80) and significantly differed to the birds of T_0 and T_1 which ranges from 4.22 to 4.27 but comparable to all other treatments.

The result implies that the birds fed with natural probiotics are more efficient in converting the feeds intake in gaining heavier body weight. It corroborates the findings of Kurtuglo *et al.* (2004) that a positive impact was noted on the feed conversion ratio when probiotics is added on the diet of chickens. Likewise, there is also a significant result upon the administration of the probiotic on the animal's growth, modulation of intestinal microbiotas' activity (Mountzouris *et al.,* 2007). Some studies reported that probiotic supplementation in the diet can improve BWG and FCR in chickens (Nayebpor *et al.* 2007; Apata, 2008; Ignatova *et al.* 2009; Sen *et al.* 2012).

In addition, *Bacillus coagulans*-supplemented broiler feed significantly improved final and daily weight gain, feed conversion ratio and survival rate, when compared to the un-supplemented control group, and is recommended to replace growth promoters in broiler production (Awad *et al.* 2009; Francesca *et al.* 2010; Huyghebaert *et al.* 2011; Kral *et al.* 2012; Zhou *et al.* 2010).

Table 4. Mean Feed Conversion Ratio (FCR) of Chickens as Affected by Feeding with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.

Kind and Concentrations of Probiotic Solution	Feed Conversion Ratio**
T_0 – Water	4.22^{a}
T_1 – Com. Probiotics	4.27^{a}
T_2 – 10% LABS	3.82^{b}
T_3 – 20% LABS	3.93^{ab}
T_4 – 30% LABS	3.85^{b}
T_5 – 10% EMAS	4.03^{ab}
T_6 – 20% EMAS	3.83^{b}
T_7 – 30% EMAS	3.94^{ab}
T_8 – 10% IMO	3.85^{b}
T_9 – 20% IMO	3.80^{b}
T_{10} – 30% IMO	3.81^{b}

*Means in a column followed by the same letter are not significantly different at 0.01 level of Tukey's HSD Test.

Naik *et al.* (2000) valuated the effect of different probiotics *Lactobacillus* acidophilus, *Saccharomycs cerevisiae* and their combination) on the performance of broilers and reported that supplementation of *Lactobacillus* to the basal diet at 0.05% improved feed efficiency in broilers as compared to unsupplemented controls. Safalaoh *et al.* (2001) showed that effective microorganisms (probiotics) improved feed efficiency in broilers alone or with antibiotics, which is more pronounced at the higher dosage (30g/kg feed). Upendra and Yathiraj (2002) observed that supplementation of *Lacto-sacc* at 250g/ton of feed resulted in an improvement of FCR, which was 10.8% better over that of control. Gupta (2003) supplemented broiler diets with different strains of *Lactococci* and *Bacitracin.* He observed that all the diets showed lower ($P \leq 0.05$) FCR than control. Chitra *et al.* (2004) reported that inclusion of probiotics and ascorbic acid both independently and simultaneously either in feed or in drinking water to broilers had made significant ($P \leq 0.01$) improvement in total feed consumption and feed efficiency during summer season. Gupta (2004) also observed that supplementation of probiotics improved FCR in broilers at the field level. Anjum *et al.* (2005) observed that there was significant ($P \leq 0.05$) improvement in feed conversion ratio after supplementation of multi-strain probiotics (protexin) in broilers; however, no improvement in feed intake was observed.

Dressing and Leaf Fat Percentage of Birds

The dress and leaf fat percentage of birds as affected by feeding with BSC wet with various probiotics is presented in Table 5. Analysis of variance revealed no significant differences among the treatments both on the dress and leaf fat percentage of birds. The mean dress percentage ranges from 68.40 % to 76.38% while the leaf fat percentage ranges from 0.74 to 1.39%.

The result on dressing percentage conformed to the studies conducted by Moreira *et al.* (2001), Maiorca *et al.* (2001) and Correa *et al.* (2003) noted no significant effect on broiler performance and carcass yield in response to probiotic supplementation.

These results are in agreement with those of Adil *et al.* (2011) who reported that the carcass characteristics of broiler chicken fed diets supplemented with organic acids showed no significant ($P > 0.05$) differences between various treatments.

Table 5. Mean Carcass Traits of Chickens Fed with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.

Kinds and Concentrations of Probiotic Solution	Dressing Percentage	Percent Leaf Fat
T_0 – Water	74.17	1.27
T_1 – Commercial Probiotics	72.86	1.36
T_2 – 10% LABS	69.14	1.02
T_3 – 20% LABS	69.97	0.90
T_4 – 30% LABS	68.40	1.29
T_5 – 10% EMAS	72.41	1.12
T_6 – 20% EMAS	76.38	0.82
T_7 – 30% EMAS	72.73	1.05
T_8 – 10% IMO	70.66	1.39
T_9 – 20% IMO	72.17	0.99
T_{10} – 30% IMO	71.84	0.74

However, other studies contradict to the result wherein probiotics supplementation has a significant effect on carcass yield, live weight gain, immune response, and prominent cut up meat parts (Soomro *et al.*, 2019). Likewise, results of other studies revealed that dressing percentage were in line with other researchers who reported that the dressing percentage was increased by the addition of probiotics (Saiyed *et al.*, 2015). Toghyani and Tabeidian (2011) reported too that carcass characteristics were improved by the addition of prebiotic in broiler diet which might be related to inhibition of colonization of intestinal pathogens and improved utilization of nutrients (protein and energy) in diet. Kabir *et al.* (2004) and Falaki *et al.* (2010) found that probiotic increases significantly ($P < 0.01$) carcass yield in both vaccinated and non-vaccinated broiler chicks. Furthermore, Mahajan *et al.* (1999) found that the mean values of hot dress weight, cold dress weight, and dressing percentage were significantly ($P < 0.05$) higher in broilers fed probiotic.

On the other hand, the result of the study on leaf fat contradicts to the findings of other studies. Salma *et al.* (2007), reported that dietary supplementation of bacteria (*Rhodobacter capsulatus*) could improve fatty acid profile in broilers. Also a positive correlation between intra muscular fat content of breast muscle and shear force was also observed in the study of Yang *et al.* (2010). In a study conducted by Mateova *et al.* (2008), a decrease in serum cholesterol level and total lipids was observed after feeding *Lactobacillus fermentum* probiotic at 10^9 cfu/g and oligosaccharide prebiotics to broilers.

The result implies that fat deposition is a parameter that is more important to slow growing birds and cannot be seen due to earlier slaughter (64 days) compared to other studies where birds are being slaughtered at 120 days (Sakomura *et al.,* 2005).

Cost of Feed to Produce a Kilogram Gain in Weight

Table 6 presents the cost of feed consumed to produce a kilogram gain in weight of broilers as affected by the different kinds and concentrations of probiotic solution supplemented to the feeds. Analysis of variance revealed significant result *($p<0.05$)* wherein the birds fed with BSC wet with 30% EMAS solution have the highest cost of feeds consumed with a mean of PhP122.85, while the lowest was obtained by the birds in T_3 (BSC wet with 10% LABS solution) with mean of PhP107.62.

Comparison among treatment means revealed that birds fed with BSC wet with 10% LABS significantly had the cheaper cost of feeds to produce a kilogram gain in weight compared to those wet with 30% EMAS but comparable to the cost of feeds to produce a kilogram gain in weight in the treatments wet with plain water, commercial probiotics, 20% LABS, 30% LABS, 10% EMAS, 20% EMAS, 10% IMO, 20% IMO and 30% IMO.

Table 6. Mean Cost of Feeds to Produce a Kilogram Gain in Weight of the Chickens and Profit Above Feed, Medicine and Stock Cost of Chickens as Affected by Feeding with BSC Wet with Different Kinds and Concentrations of Probiotic Solution.

Treatment	Cost of Feeds (Php)*	Profit (Php)
T_0 – Water	113.92^{ab}	71.06
T_1 – Commercial Probiotics	118.53^{ab}	68.15
T_2 – 10% LABS	107.62^{b}	87.95
T_3 – 20% LABS	115.40^{ab}	79.32
T_4 – 30% LABS	117.64^{ab}	76.49
T_5 – 10% EMAS	114.29^{ab}	76.74
T_6 – 20% EMAS	114.02^{ab}	83.62

T_7 – 30% EMAS	122.85[a]	71.16
T_8 – 10% IMO	110.70[ab]	86.54
T_9 – 20% IMO	115.67[ab]	79.74
T_{10} – 30% IMO	122.67[a]	67.37

*Means in a column followed by the same letter are not significantly different at 0.05 level of HSD Test.

The result implies that the cost of feeds to gain a kilogram gain in weight of birds was significantly affected by wet feeding with the use of different kinds and levels of probiotics. If growth performance and feed efficiency are increased in commercial farming, then the costs of production are likely to be reduced. Also, if the chicken flock is able to resist disease and survive until they are of marketable size, the subsequent cost of medication and overall production costs would be reduced drastically (Torres-Rodriguez *et al.,* 2007). Which was in accordance to the report of Gutierrez-Fuentes *et al.* (2013) when they evaluated the effect of a commercial lactic acid bacteria-based probiotic (FloraMax-B11) and the results showed an increase in body weight and improvement in feed conversion upon using the probiotic.

The cost benefit analysis showed that the increase in body weight of 100 g, when converted to a cost benefit ratio, suggested that for every $ 1 spent on this probiotic there was a cost benefit of 1:22.57. The results of the study also conform to the finding Anjum *et al.* (2005), the researchers concluded that protexin probiotic supplementation is beneficial for better weight gains, feed efficiency and economic efficiency in broiler chicks. Their study revealed that per bird total return average on sale was $1.59 at total average expenditure of $0.982. The net per bird income was $0.611 on average. This indicated that supplementation of broiler starter and finisher diets with protexin at 100 g/t in starter and 50 g/t in finisher diets were economically beneficial and encouraging where treated groups generated more profit than the control group (Anjum *et al.,* 2005).

Profit Above Feed, Medicine and Stock Cost

The profit above feed medicine and stock cost of birds as affected by feeding with BSC wet with various natural supplements is presented in Table 6. Analysis of variance revealed no significant differences on the profit above feed, medicine and stock cost. Birds fed with BSC wet with 10% LABS gained the highest profit with a mean of 87.95Php while the lowest profit was those birds fed with BSC wet with 30% IMO with a mean of 67.37Php.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was conducted at DMMMSU-NLUC, Bcnotan, La Union from June 24 to August 24, 2020 to determine the best type of probiotics, to determine the effect of the different levels of probiotics on the growth performance of colored chickens, to determine the dressing percentage and leaf fat percentage and also to determine the profit above feed, medicine and stock cost as affected by different probiotics.

One hundred eighty chicks were used in the study. After 14 days of brooding, the chicks were distributed randomly into eleven dietary treatments employing the Randomized Complete Block Design (RCBD) in three blocks.

The following are the salient findings of the study:

1. The highest gain in weight of the birds during their 1st week of rearing was achieved both by those fed with BSC wet with 20% IMO (T_9) and BSC with 30% IMO (T_{10}) with 0.16 kg, on the 2nd week by T_2 (BSC with 10% LABS) with 0.25 kg, on the 3rd week by T_8 (BSC with 10% IMO) with 0.27 kg, on the 4th week by T_4 (BSC with 30% LABS) with 0.17 kg, on the 5th week by T_6 (BSC with 20% EMAS) with 0.14 kg, on the 6th week by T_9 (BSC with 20% IMO) with 0.12 kg and on the 7th week by T_6 (BSC with 20% EMAS) with 0.15 kg, while the total gain in weight was attained by those fed with BSC with 20% EMAS (T_6) with 1.12 kg.

2. The birds that consumed the least amount of feeds during the 1st week of rearing were those fed with BSC wet with 10% EMAS (T_5) with 0.39 kg, on the 2nd, 3rd, 4th, 7th week and the total feed consumption was recorded by T_{10} (BSC with 30% IMO) with 0.60 kg, 0.56 kg and 0.49 kg, 0.73 kg and 3.95 kg respectively, by T_4 (BSC with 30% LABS) and T_5 (BSC with 10% EMAS) on the 5th week both with 0.52 kg and by T_0 (BSC with water) with 0.62 kg on the 6th week.

3. The most efficient birds in converting the feeds they consumed to carcass were those with the lowest FCR such as the birds of T_{10} (BSC with 30% IMO) on the 1st week of rearing with 2.57, the birds of T_2 (BSC with 10% LABS) on the 2nd week (2.50), the birds of T_5 (BSC with 10% EMAS) on the 3rd week (2.46), the birds of T_4 (BSC with 30% LABS) on the 4th week (3.24), the birds of T_6 (BSC with 20% EMAS) on the 5th week (3.94), the birds of T_9 (BSC with 20% IMO) on the 6th, 7th week and the final FCR with 5.39, 5.48 and 3.80 respectively.

4. The highest dressing percentage was achieved by the birds fed with BSC wet with 20% EMAS (T_6) with 76.38%.

5. The highest profit was attained by the birds of T_8 (fed with BSC wet with 10% (IMO) with PhP86.54 per bird.

CONCLUSIONS

Based on the result of the study, the following conclusions were derived:

1. The best type of probiotic used for growth performance of colored chickens is the Effective Microorganism Activated Solution (EMAS).

2. Supplementation of 20% level of probiotics could result to better growth performance of colored type chickens such as heavier gain in weight, greater feed consumed and a more efficient feed conversion.

3. Supplementation of 20% EMAS to the bird's feed gave the highest dressing percentage and on the same manner the lowest leaf fat percentage could be achieved when supplemented with 30% IMO.

4. Higher profit above feed medicine and stock cost could be obtained by supplementing the feeds of the birds with 10% IMO.

RECOMMENDATIONS

Based on the conclusions, the following are highly recommended:

1. To attain the highest total gain in weight, the feeding of the birds with BSC supplemented with 20% EMAS (T_6) is recommended.
2. To attain the highest dressing percentage, the feeding of the birds with BSC suplemented with 20% EMAS (T_6) is recommended.
3. To attain the highest percent leaf fat of the birds, the feeding with BSC supplemented with 10% IMO (T_8) is recommended.
4. To attain the highest profit per bird, the feeding with BSC supplemented with 10% IMO (T_8) is recommended.

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