GROWTH PERFORMANCE OF BROILER FED DIET CONTAINING DE OILED RICE BRAN SUPPLEMENTED WITH PROTEASE AND HALQUINOL

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CERTIFICATE

This is to certify that the thesis entitled, ***"GROWTH PERFORMANCE OF BROILER FED DIET CONTAINING DE OILED RICE BRAN SUPPLEMENTED WITH PROTEASE AND HALQUINOL"*** Submitted to the Department of Animal Nutrition, Genetics and Breeding, Faculty of Animal science and veterinary medicine, Sher-E-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of *MASTER OF SCIENCE (MS) in Animal Nutrition* embodies the result of a piece of bona fide research work carried out by *MD TAJUL ISLAM, Registration No. 20-11142* under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by him.

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Dedicated to

My

Beloved Parents

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LIST OF ACRONYMS AND ABBREVIATION

ABBREVIATION		FULL MEANING
ANOVA	=	Analysis of Variance
Avg.	=	Average
BWG	=	Body Weight Gain
DP	=	Dressing Percentage
e.g.	=	For Example
et al.	=	And Others/Associates
FC	=	Feed Consumption
FCR	=	Feed Conversion Ratio
G	=	Gram
i.e.	=	That Is
L	=	Liter
MS	=	Master of Science
No.	=	Number
SAU	=	Sher-e-Bangla Agricultural University
SE	=	Standard Error
SPSS	=	Statistical Package for Social Sciences
Viz.	=	Such As
hrs.	=	Hours
℃	=	Degree Celsius
/	=	Per
%	=	Percentage
±	=	Plus-Minus
:	=	Ratio
Wk.	=	Week
BCR	=	Benefit Cost Ratio

GROWTH PERFORMANCE OF BROILER FED DIET CONTAINING DE OILED RICE BRAN SUPPLEMENTED WITH PROTEASE AND HALQUINOL

ABSTRACT

The research was conducted to determine the effects of de oiled rice bran, protease enzyme and halquinol in feed on the performance of broiler chicken. A total of 816 day-old IR broiler chicks were allocated randomly to four treatment groups with six replications having 34 birds per replication. All the birds were assigned to four treatments such as T_0 (Control), T_1 (Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed), T_2 (Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed) and T_3 (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed). Result demonstrated that the highest body weight (g) was found in T_3 (1817.75 g) and lowest result was found in T_2 (1780.58 g) group. But, higher body weight was found in T_3 group than control group T_0 and that was statistically significant ($P<0.05$). The highest body weight gain was found in T_3 (1776.75 g) and lowest result was found in T_0 group (1744 g) and that was statistically no significant ($P>0.05$) difference. The highest result was found in T_2 (2379.39 g) and lowest result was found in T_3 group (2318.46 g) and that was statistically significant ($P<0.05$). The best FCR was found in T_3 (1.47) and worse FCR was found in T_1 and T_2 group (1.56) but better FCR was found in T_3 (1.47) than control group T_0 (1.54) and that was not statistically significant ($P>0.05$). Survivability rate (%) was higher in treated group T_3 than control group T_0. There was significant difference ($P<0.05$) in survivability rate (%). BCR was non significantly higher ($P>0.05$) in treatment group T_3 (1.49) than control group T_0 (1.41). The above research was found that body weight (g), body weight gain (g), survivability rate (%) and BCR were better result in T_3 group than other groups including control group T_0 (Basal feed). FCR was better in T_3 group than other groups including control group T_0 (Basal feed). Better result was found in T_3 (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed) group than control group.

CHAPTER I

INTRODUCTION

Poultry industry is one of the largest and fastest growing agro-based industries in the world. There is an increasing demand for poultry meat mainly due to its acceptance by most societies and its relatively low cholesterol content. Poultry meat, particularly broilers is superior to other types of meat available for human consumption for its tenderness, palatability and digestibility. Modern broiler strains of 4-5 weeks of age with good feed efficiency are able to supply superior protein in human diet, which is not possible for other animals. In order to build up a nation with good mental and physical health, dietary protein should include adequate amounts of animal proteins.

Protein deficiency has been taken as the major contributory factor in malnutrition. The per capita consumption of animal protein is only 16.5 g per day but the requirement is 120 g per day (Amin, 2005), which is quite inadequate for normal growth and development of the human body. Availability of meat in Bangladesh is 147.84 g per head per day (DLS, 2021-2022). Importance of poultry can hardly be ignored from nutrition and economic point of view. The poultry sub-sector is considered an important avenue to reduce poverty and malnutrition as well as unemployment problems of Bangladesh. Now a days Bangladesh is producing 400 million pieces of broiler which represents 60-70% of country's total poultry meat demand (Chowdhury, 2011).

Poultry population estimates differ depending on the source of information. According to numbers provided by the Government of Bangladesh's Livestock Department, the total chicken population is steadily increasing, from about 143 million birds in 2001 to 189.26 million birds in 2021 (BBS, 2021) and statistics of poultry farms operating in the year of 2017 showed that there were 150,000 poultry farms in Bangladesh. Among them annually produce 570 million tons of meat and 7.34 billion eggs. Modern and successful production of poultry meat contributes significantly to the agricultural economy of Bangladesh. Poultry plays a vital role in bridging the protein requirement of animal origin in Bangladesh. Of the many foods obtained from land and sea, man tends to have a preference for animal products such as meat, milk, eggs and fish. Meat holds an important position in our daily diet. It provides palatability and is a good source of essential amino acids, vitamins and minerals. Poultry meat shared second position of this meat production.

To alleviate unemployment problem and to meet the scarcity of animal protein within shortest possible time, commercial broiler production has become a specialized and speedy business at the present time for the people of the third world countries like Bangladesh. A good number of broiler farms have already been set up in every year. In broiler production, the quality of chicks, feed and water to be used had always received much attention. Broilers would not perform to their genetic potential in a poor nutrition. This is because; the quality of the feed depends highly on the quality of the raw materials and availability. On the other hands feed is the major input in poultry production constituting 70-75% of total cost of broiler production. One of the most effective ways for a profitable poultry industry is to reduce the input cost. There is a high demand of conventional feed ingredients for human consumption creating a competition between human and poultry for the same ingredients. The production levels of conventional feed ingredients are not proportionate enough to meet this high demand of poultry feed. The exorbitant cost of conventional feed ingredients necessitates formulating cost effective feed for broilers. Utilization of cheaper unconventional or certain locally available feed ingredients in place of conventional one has been widely advocated and practiced to mitigate this problem. Rice bran is a by-product of rice milling industry which converts into DORB when its oil content extracted in oil industry. Its composition varies according to the type of milling but it contains 15-22% oil, 11-17% protein, 6-14% fiber, 10-15% moisture and 8-17% ash. It is a good source of lysine and methionine.

As such rice bran is considered a suitable feed ingredient for livestock and poultry. During oil extraction chemical and heat treatments has given to rice bran. It seems reasonable to infer that; those treatments may change the quality of the nutrients presence in the bran that warrants investigations. On other hand, some nutrient profile would proportionately be higher in the DORB than rice bran due to oil extraction from rice bran. Other benefits include less susceptibility of DORB to the rancidity. Some researchers found that the nutritional value of DORB is equal to the value of RB in broiler diets when diets are adjusted for metabolizable energy by adding oil. Utilization of cheaper unconventional or certain locally available feed ingredients in place of conventional one has been widely advocated and practiced to mitigate this problem. However, the use of unconventional feedstuff for efficient poultry production is limited due to presence of undigestible components like fiber otherwise called as Non Starch Polysaccharides (NSP) (Adebiyi *et al*., 2010). The soluble non starch polysaccharide has an anti-nutritive effect in poultry by modifying intestinal viscosity and intestinal transit time. This results in reduction of diffusion and assimilation rates of various nutrients. Poultry being monogastric, lack the ability to produce the enzymes (cellulase, hemi-cellulase and beta-glucanase etc.) which are necessary to digest beta type of linkages in non-starch polysaccharides which is rich in cell wall of plant materials (Vooren, 2012). Supplementation of enzymes has been increasingly investigated and applied during the past decade as a means of enhancing production efficiency and increasing the effectiveness of nutrient utilization. Enzyme supplementation counteracts anti-nutritional effects of NSP, reduces the intestinal viscosity and the nutrient encapsulating effect of cell wall which in turn could result in increase in protein, starch and energy utilization (Slominski, 2011).

Bangladesh has rich in different unconventional or available raw material resources which can directly the performance of poultry production. The present study was therefore undertaken on the growth performance of broiler chickens fed the diet containing de oiled rice bran supplemented enzyme protease and halquinol with the following objectives:

1. To measure the efficacy of de oiled rice bran supplemented with protease enzyme & halquinol in broiler ration.
2. To find out a cost effective feeding trial among the treatments.

CHAPTER II

REVIEW OF LITERATURE

In recent years, there has been a steep rise in poultry production throughout the world. As a result, it is gradually becoming a major thrust in the world economy especially in the livestock sector. Rising prices of feeds certainly have reduced the profitable nature of broiler farming. For better utilization of feed and to improve feed efficiency, growth promoting feed additives viz. probiotics, prebiotics and herbal bio-enhancers are added to poultry ration. Most of the information available in the scientific literature pertaining to use of herbal supplements have been found in various species of poultry and therefore work on colored chicken has been reviewed based on the other poultry species. In this section, studies of use de oiled rice bran in feed on growth performance in poultry have been described.

2.1 Nutrient composition of DORB

Rice bran (RB) is a by-product of rice milling industry which converts into DORB when its oil content extracted in oil industry. Its composition varies according to the type of milling but it contains 15-22% oil, 11-17% protein, 6-14% fibre, 10-15% moisture and 8-17% ash (Sharif M. K., *et. al*., 2014). It is an abundant source of antioxidant compounds such as tocopherols, γoryzanol and other phenolics (Aguilar-Garcia, C., et. al., 2007), which helps in health benefits including lowering blood cholesterol, decreasing platelet aggregation and anti-inflammation (Lai P., *et. al*., 2009). It is a good source of lysine and methionine (Dale N., 1997). As such RB is considered a suitable feed ingredient for livestock and poultry. During oil extraction chemical and heat treatments has given to RB. It seems reasonable to infer that; those treatments may change the quality of the nutrients presence in the bran that warrants investigations. On other hand, some nutrient profile would proportionately be higher in the DORB than RB due to oil extraction from RB (Houston D. F., 1972 & Warren B. E. and Farrell D. J., 1990). Other benefits include less susceptibility of DORB to the rancidity. Some researchers found that the nutritional value of DORB is equal to the value of RB in broiler diets when diets are adjusted for metabolizable energy by adding oil (Farrell D. J., 1994). Considering availability of DORB and contains higher amount of protein and carbohydrate, the study was conducted to examine the performance of broiler fed on iso-caloric and iso-nitrogenous diets containing either RB or DORB and assess the economics of its addition in broiler diet. Materials and Methods Ration and birds RB and DORB were collected from the same batch of oil extraction of oil industry to confirm the similarities of the nutrients other than oil and analyzed for chemical composition according to (AOAC., 2005). Then two types of iso-nitrogenous (23%) and iso-caloric (3000 kcal/kg) diets were formulated. The amount of protein increased 22.2% in DORB than protein content in RB due to extraction of oil. The main sources of protein in diet was protein concentrate (60% CP), Soybean meal (45% CP), RB and DORB. The ingredients content rearranged to make the ration iso-nitrogenous.

Table 1: Chemical composition (g/100g DM) of DORB

Parameter	DORB (%)
Crude protein	17.85
Crude fiber	14.80
Ether extract	1.60
Ash	14.30
Nitrogen free extract	51.45

(**Source:** Islam K. M. S., *et. al.*, 2018**)**

2.2 Effects of use de oiled rice bran in feed on growth performance

Ruckshana I. L., *et al*. (2022) rice bran (RB) was fermented by baker's yeast (Saccharomyces cerevisiae) along with urea to know the effect on crude fiber (CF) and crude protein (CP) level as well as fed broiler to know the effects on the growth performance. At the end of the trial, total 9 broilers (one bird/replicate cage) were slaughtered to collect blood sample and to determine carcass characteristics. Due to fermentation of RB by yeast, significant ($P<0.05$) increase were observed in proximate components. Crude protein has increased at 7.72%, but crude fiber has decreased at 2.3%

in YUFRB. Significantly ($P<0.05$) higher live weight (1418 g/bird), cumulative weight gain (1348 g/bird), and better (1.69) feed conversion ratio (FCR) was observed in 7.0% YUFRB group. Better performance observed in 3.5% YUFRB group ($P<0.05$) than control. Dressed carcass weight observed more or less similar in all the dietary groups ($P>0.05$). Cholesterol concentration was low in fermented groups ($P<0.05$). It can be concluded that fermentation of rice bran by baker's yeast along with urea improves protein content and reduces fiber contents; its addition in broiler diet improves growth performances and lowers cholesterol level in broiler.

Mst. Azrinahar *et al*. (2021) conducted to investigate the changes of the nutritive value of yeast (Saccharomyces cerevisiae) fermented De-oiled rice bran (DORB) and its impact on broiler growth and mineralization in bone. DORB was fermented using 2.0% yeast at 60% moisture content for 24 h in an anaerobic condition. After 28 days of feeding trial birds from each replication were slaughtered to collect blood sample and tibia. Highest pH ($P<0.05$) reduction was occurred in FF group. Fiber and Phytate-P level were decreased in all the fermented groups compare to the control group ($P<0.05$). Feed conversion ratio was lower ($P<0.05$) in FF (1.73) than the other groups. Tibia ash was increased in fermented groups than unfermented group ($P<0.05$). It could be concluded that the fermentation of DORB using yeast adding urea, wheat flour or both caused desirable chemical changes and this changes have positive effect on growth performance, bone mineralization in broiler.

Islam K. M. S. *et al*. (2018) compared the effect of rice bran (RB) and de-oiled rice bran (DORB) based diet on growth performance, carcass characteristics and blood metabolites. All chicks were allocated randomly into two dietary groups (7.0% RB and 7.0% DORB) having 4 replications of 12 birds following completely randomized design. After a 35 days feeding trial few birds were slaughtered for carcass traits and blood samples were collected. Live weight gain, feed intake and feed conversion ratio of two groups were similar ($p>0.05$) but dressing percentage was higher for the broilers in RB group ($p<0.05$). Blood urea and phosphorus levels were higher in DORB group ($p<0.05$). Feed cost was 1.22 BDT (Bangladesh currency) lower due to the inclusion of DORB. Moreover, cost of production was reduced by 0.84 BDT per kg broiler for DORB group. Considering above findings, inclusion of DORB in the diet of commercial broilers would be effective to reduce production cost without hampering the performance of broiler.

Nitul Saikia and Ahmed H. F. (2014) carried out and experiment the diet containing 0 (control), 10, 15 and 20 per cent of DORB for 6 weeks. At the end of the feeding period, 5 birds from each group were slaughtered for study of the carcass characteristics. The dressing percentage, eviscerated yield and giblet yield were comparable among the groups. The percent moisture, protein, fat and total ash content of the meat did not vary significantly ($P>0.05$) among the groups. The blood glucose, total serum protein, albumin and albumin: globulin (A: G) ratio were comparable among the groups. Concluded that that DORB inclusion up to 20 level in the diet does not have any significant effect on the blood constituents and carcass characteristics of broilers.

Ajay Kumar (2014) suggest that dietary rice bran improves colonization resistance against Salmonella in mice. Rice bran could have important role in prevention of enteric infections in resource scarce populations and further human clinical studies are required. Rice bran may also be evaluated for supplementing diets of food animals to prevent Salmonella infections and therefore could have a potential role in food safety.

Puminn and Ornprapun (2003) conducted two experiments to evaluate broiler performance and mineral utilization of defatted rice bran diets supplemented with commercial enzyme phytase alone or a combination of phytase and xylanase under two different environmental temperatures. In both experiments, using up to 25% defatted rice bran in diets was not detrimental to broilers. The beneficial effect of high fat level can overcome some problems associated with high phytate phosphorus and non-starch polysaccharide in defatted rice bran. As a result, birds fed 25% defatted rice bran diet had the highest body weight gain. Since the price of rice bran was cheaper than other major ingredients, use of 25% defatted rice bran diet lowered feed cost per weight gain of broilers. From the growth performance and feed cost per weight gain of birds, supplemental enzyme did not alleviate the adverse effects of heat stress.

Denbow (2000) since cellulose is insoluble in water, the possibility of cellulose fermentation in ceca of chicken is very low because only fluid or very small particles are allowed entrance to the ceca. Farrell *et al.* (1998) reported that there was a significant decline in growth rate and food intake of chicks with increasing rice bran inclusion (0, 20, and 40%, respectively). Farrell and Martin (1998) found tibia ash declined with increasing rice bran inclusion in diets. Zinc and manganese in ash tended to decline while magnesium tended to increase.

Adrizal *et al*. (1996) conducted to determine the influence of dietary concentration of defatted rice bran (DRB) and phytase and fiber degrading enzyme (FDE) supplementation of DRB containing diets on performance, characteristics of selected parts of the gastrointestinal tract, and tibia ash of broiler chickens. No significant differences among dietary treatments were observed for weight gain and feed efficiency of broilers from 4 to 35 d of age. The MEn values of the DRB diets were greater ($P<0.01$) than those of the CS diet, although phytase supplementation of the DRB diet, with or without FDE, reduced ($P<0.01$) MEn. Phytase supplementation did not affect percentage tibia ash of chicks fed the DRB diet. The results show that up to 22.5% dietary DRB can be used successfully for broiler chickens when diets are supplemented with available P and fat.

Ravindran *et al.* (1995) concluded that microbial phytase supplementation generally improves phytate phosphorus utilization in poultry by 20-45% and also Improves protein and amino acid digestibility. Farrell (1994) reported that the inclusion of different type of protein (plant origin versus animal protein) in rice bran diets affected the performance of the birds as well. Warren and Farrell (1991) conducted experiments in growing chickens and adult cockerels, rice bran increased the excretion of calcium significantly and of phosphorus and magnesium no significantly, when added in increment amounts of 0 to 50%.

Purushothaman, M. R. *et al*. (1990) 120 one-week-old broiler chickens were given isonitrogenous and isoenergetic diets containing 0, 10, 15 or 20% de oiled rice bran (DORB) for 5 weeks. Weight gain, feed intake, feed conversion ratio, nutrient digestibility (except crude fiber) and balance of nitrogen and calcium among groups did not differ significantly. Results indicated that 20% DORB could be included in broiler diets without any effect on performance. Warren *et al*. (1990) reported that substitution of defatted rice bran at 7-21% in a basal diet improved growth and feed conversion ratio of broilers from 3-13 days of age.

Thomas and Skadhauge (1988) noted that the cecum is the main location for microbial degradation of dietary fiber and for absorption of the fermentation products in chicken.

Zombade *et al.* (1982) determined the feeding value of raw and parboiled rice bran for broilers. They found that parboiled rice bran, which was the by-product from the milling of paddy rice that was subjected to steam treatment and dried before milling, promoted growth of broilers when added at 15% in diet. Scott *et al.* (1982) referred that chicken does not possess cellulose in its digestive tract. Scott *et al.* (1982) stated that chickens may derive some energy from the hemicelluloses under the acid conditions in the proventriculus and gizzard.

2.3 Properties of de oiled rice bran

Dip Dutta *et al*. (2018) Showed that tensile, flexure and chirpy impact strengths of composites increased for certain percentages of DORB (Tensile & Flexure strength for 5% and impact strength for 10% of DORB) although gradual decreasing trend were observed for further addition of DORB. Water absorption increased monotonously by addition of DORB. With regard to mechanical strength, DORB can be potential reinforcing materials for natural composites.

An experiment was carried out Anuradha P., *et al*. (2015) by to determine the effects of palmyra sap on fermentation characteristics and chemical composition of fermented rice bran. The palmyra sap was mixed with rice bran ensiled in a plastic container and incubated for six days. The results showed that palmyra sap improved fermentation quality by reducing final p^H, NH_3, and increasing lactic acid. Fermentation reduced dry matter, crude fiber, crude fat, phosphorus, NDF, and ADF, but increased of crude protein contents of rice bran. It can be concluded that 10% palmyra sap could be utilized to improve fermentation characteristics and nutritive value of ensiled rice bran. Nantaprapa Nantiyakul *et al*. (2012) referred that the fresh, non-heat-treated rice bran is preferred for the recovery of intact oil bodies from rice bran.

H. R. Sharma *et al*. (2007) concluded that the functional properties such as water absorption, water solubility, bulk density, and enzyme susceptible starch of rice bran improved significantly after stabilization. Farrell (1994) stated that the nutritional value of defatted rice bran is generally equal to the value of full fat rice bran in chicken diets when oil is added to equalize for metabolizable energy. Jiaxun Tao (1989) told that bran is a poor conductor of heat. Consequently, oven drying and steam retorting did not perform as effective as microwave in heat penetration. Microwave energy leads to disruption of weak hydrogen bonds because of dipole rotation of free water molecules. Within the penetrating depth of microwave energy, dipole moment causes molecular friction and heats the bran uniformly throughout.

Houston (1972) noted that defatted rice bran is slightly lighter in color and is considerably bulkier than ordinary bran, which has a bulk density of 36.8-40.0 g/100 ml. Ravindran *et al.* (1991) found that metabolizable energy of defatted rice bran is about 75% of that of the full fat rice bran. Warren and Farrell (1991) reported that Australian rice bran was found to contain phytate at levels of 2.3-4.0%. Rice Bran Industries, Inc. (1987) portion of the rice grain comprises 17-30% of the total proteins in the whole grain, 95-100% of the oil, 60-70% of the vitamins, and 70-75% of the minerals including a high percentage of calcium and iron.

2.4 Economic Importance of Rice Bran

Normand *et al*. (1987) reported that rice bran was also found to increase water retention in the feces, which can be beneficial to human health. Sayre *et al.* (1985) found that the most prominent utilization of bran is extracting the oil from it, either for food uses or for industrial applications. It is estimated that about 100,000 metric tons annually of edible oil are extracted from rice bran in Japan. Palacpac (1982) found normally, the coarse bran (bran from abrasive mills or friction mills) accounts for 6-11% of the brown rice weight, and polish accounts for 2-3%. Ventura (1974) showed that the inclusion of rice bran or a hot water extract of rice bran has a preventative action on caries. Houston (1972) noted in the United States, the predominant use for rice bran is as feed for stock and poultry. Bran is most widely used as feed for ruminants such as cattle, sheep, water buffalo, and bullocks, though it can also be fed to mono-gastric animals such as swine and horses.

2.5 Ways to improve the utilization of DORB

- Solid state fermentation
- Exogenous enzyme supplementation
- Supplementation of deficient nutrient

Solid state fermentation: Ideal substrates for Solid State Fermentation (SSF) operations are generally considered to be wastes from the agro industrial sector. SSF is used to make the raw material more valuable (Mai, K., *et. al*., 2006). The nutritional values of agro industrial materials that can be employed in the animal and aqua feed industries have reportedly been improved by SSF. SSF technology also helps in increasing the protein quality and nutrient digestibility. Apart from this, this technique has proved to be very helpful and ideal in increasing the levels of nutrients and their bioavailability. This technology increases the value of agricultural products lying waste and opens up new possibilities for their use (Nwokoto E., and Bragg D., 1977 & Tocher D. R., 2003). Hazardous nutrients can be eliminated or reduced by using microorganisms with SSF technology. The USFDA has Generally Recognized as Safe (GRAS) Rhizopus oryzae, a fast growing fungus that reproduces by means of hydrophobic sporangiospores that expand rapidly after maturation. Therefore, Rhizopus oryzae is usually chosen to ferment DORB. It is clear from the above explanation that SSF technology is very efficient and economically viable method in enhancing the nutrient profile and reducing toxic anti-nutrients present in DORB (Ranjan A., 2018).

Exogenous enzyme supplementation: The majority of the ANFs in DORB are protein based and heat labile except for phytate. The Non-Starch Polysaccharide (NSP) content of DORB is likewise relatively high, with arabinose and xylose predominating (Turchini G. M., 2009). Some nutritional components may not be digested properly as a result of this. Many plant materials contain phytic acid, an ANF that chelates with different macro and micronutrients and impairs the digestion of those nutrients. In various fish species, dietary microbial phytase supplementation has been found to be very promising for reducing the harmful effects of phytate and improving the fish's ability to absorb nutrients and thrive. Fish lack the NSP digestion enzymes; hence Non-Starch Polysaccharide (NSP) is regarded as an unusable energy source for them. By interfering with digestion and absorption, NSP lowers the energy concentration of the feeds and decreases the digestibility/bioavailability of nutrients (Warren B. E., and Farrell D. J., 1991). Additionally, NSP obstructs the ability of digestive enzymes to reach their substrates. The addition of dietary NSPase to plant based feed stocks enhances nutrient utilisation and lowers faecal waste discharge into the environment. It has been demonstrated that NSPase improves fish growth performance, feed conversion and protein utilisation efficiency. Exogenous Non-Starch Polysaccharidases (NSPase) may have advantageous effects due to the hydroxylation of NSP, which enhances carbohydrate digestibility or because it enhances the digestibility of other nutrients. As was mentioned above, DORB contains a number of ANFs and NSPs that prevent rice bran from being utilised as a source of nutrients. Thus enzyme supplementation is crucial to increasing the use of DORB in fish diet (Aguilar-Garcia C., et. al., 2007).

Supplementation of deficient nutrient: It is well known that plant based components always contain some AntiNutritional Factors (ANFs) and typically lack several crucial amino acids and fatty acid (Sharif M. K, *et. al*., 2014). High levels of plant proteins in aqua feed lead to an imbalance in essential amino acids, which impairs growth, reduces feed consumption and raises feeding costs. According to reports, adding extra amino acids and fatty acids to fish diet can help them grow and stay healthy. Lysine and methionine supplements dramatically increased the growth rate, feed effectiveness and protein digestibility of fish fed a plant based diet (Dale N., and Batal, A., 1997). The addition of commercially available feed grade lysine to plant protein based aqua feed dramatically lowers the dietary crude protein need of the fish. It was found that adding L-lysine at a rate of 1.4% and L-methionine at a rate of 0.4% in DORB based diet greatly improved Labeo rohita growth performance (Ranjan *et al*., 2019). In order to increase the use of the DORB based diet, it may be effective to supplement any essential amino acids that are low in it. The marginal farmers who only utilise DORB to feed carps will find this method to be of great benefit. According to reports, growth of fishes can be enhanced by adding n-3 fatty acids (EPA and DHA at a rate of 0.5%) in a diet based on DORB. Eicosapentaenoic acid (EPA, 20:5n-3), Docosahexaenoic acid (DHA, 22-6n-3) and other important fatty acids are needed to enhance fish growth, immunity and stress tolerance (Lai P., *et. al*., 2009).

2.6 Effects of protease enzyme on birds and animal rearing

Our study demonstrated that dietary protease supplementation increased and decreased the BWG and FCR, respectively, in broiler chickens. Our findings complement the existing data from previous studies, which display increases in the growth performance of pigs (Choe *et al*., 2017; Min *et al.,* 2019; Park *et al.,* 2020 and Lee *et al*., 2020) and chickens (Brenes *et al*., 1993 and Yuan *et al*., 2015) following dietary protease supplementation in the aforementioned livestock.

Proteases play a critical role in multiple physiological factors regarding dietary protein degradation, protein turnover, cell division, blood coagulation, the transport of polypeptide hormones, and the activation of zymogens (Chambers *et al*., 2001). In particular, proteases can optimize feed protein implementation in poultry livestock (Angel *et al*., 2011). In addition, a previous study has demonstrated that proteases employed as feed additives could serve to supplement the effects of endogenous pepsin and pancreatic enzymes via the augmentation of hydrolysis and solubilization of protein *in vitro*. These effects were confirmed *in vivo*, where improved protein and fat digestibility coupled with greater growth performance have been identified (Fru-Nji *et al*., 2011). Similarly, (Ding *et al.*, 2016) have reported that supplementation with 300 mg/kg of protease in diets significantly elevates the activity of trypsin within the pancreas and 21 d villus height and/or crypt depth ratio within the duodenum, the jejunum, and the ileum.

Within the present study, CP, DM, and amino acid (lysine, methionine, cysteine, threonine, isoleucine, leucine, histidine, and tryptophan) digestibility and energy retention were linearly raised in broilers using protease supplemented diets when compared with broilers fed non-protease supplemented diets. This response in the sampled broilers is in agreement with findings discovered by Freitas et al., whose team observed higher CP digestibility using corn-soybean-based diets supplemented with increased levels of protease in 42 day old broilers (Freitas *et al.,* 2011). In addition, Angel et al. have found that exogenous protease supplementation at 0.01%−0.08% improves the Arginine, Threonine, Isoleucine, Asparagin, Lysine, Histidine, Serine, and Cysteine of apparent amino acid digestibility in broiler chickens (Angel *et al*., 2011). Meanwhile, plant protein, like soybean meal, is rich in anti-nutritional factors, in particular protease inhibitors that can suppress the activity of the proteolytic enzymes trypsin and chymotrypsin (Erdaw *et al.*, 2017). A reduction in the activity of these enzymes may lower the protein digestibility and amino acid availability of vegetable-based diets. Osmanyan *et. al.* (2018) have reported that increases in PEPT1 and $b^{0,+}$AT mRNA expression within the jejunum is correlated with increases in digestible amino acids and protein for broiler supplementation from 100% to 114%. In the current study, protease supplementation increased the expression of amino acid transporters within the duodenum, the jejunum, and the ileum of broilers.

2.7 Function of halquinol

Halquinol is a quinolone but its mechanism of action is different from quinolones (FAO and WHO, 2018). It is an antimicrobial, antifungal, and antiprotozoal substance (Maíra F., *et al*., 2016 and Habib M. A., *et al*., 2020). Halquinol has a mechanism to slow peristalsis in the gut, thus helping to increase the absorption of nutrient from the gut (Kandepu N., et al., 2012). Furthermore, it does induce a minimum bacterial resistance (Habib M. A., *et al*., 2020). In countries such as Thailand, Brazil, India, Colombia, Indonesia, Bangladesh, and Peru it is used as a feed additive in poultry (Maíra F., *et al*., 2016 and Costa M. C., et al., 2017) and growth promoter in swine.

Present study shows that halquinol has a significant effect on the body weight and body weight gain of sonali chicken and best result was found in the birds supplied with halquinol 1g/ kg feed in group T_3. It was also found that the average feed intake of sonali chicken in different dietary treatment during experimental periods were significantly ($P<0.05$) varied and highest feed intake was found in the birds supplied with halquinol 1g/ kg feed in T_3 group. In this study it was also found that halquinol has a significant effect on the feed conversion efficiency of sonali chicken. The birds supplied with halquinol 1g/ kg feed (T_3) converted feed to meat most efficiently than other treatment groups. This result was observed may be due the antimicrobial property of the halquinol. Halquinol has activity against a wide variety of bacteria, fungi, protozoa and mycoplasmal organisms (Cosgrove and Baines, 1978). Among Gram-negative acteria, it is effective against *Escherichia coli*, *Salmonella typhimurium, Proteus vulgaris* (Cosgrove and Forster, 1980; Cosgrove *et al*., 1981). Halquinol has activity against *Vibrio anguillarum*, gram-negative bacteria which is the causal agent of vibriosis in fishes and also effective against *Vibrio parahaemolyticus* (Austin et al., 1982). Halquinol has significant antimycoplasmal activity being active against different species of mycoplasma, viz: Mycoplasma synoviae, Mycoplasma gallisepticum, *Mycoplasma agalactiae var bovis*, *Mycoplasma hyopneumoniae* and *Mycoplasma hyorhinis* (Cosgrove and Baines, 1978). Among protozoa, halquinol has good activity against *Cryptosporidium parvum* (Armson *et al*., 1999). Thus keeps the gut healthy and active as a result more efficient absorption of nutrients through the intestine which ultimately improves the body weight, body weight gain, feed intake, and feed efficiency than the control group (T_0). Halquinol also prevents and controls many types of nonspecific diarrhea. Its unique anti-peristaltic activity promotes better absorption of nutrients.

Kompiang *et al*. (1997) reported that the effect of halquinol supplementation in the 20 and 30% cassapro rations on the performance of the chickens has a significant effect on feed intake ($P<0.025$), weight gain ($P<0.0005$) and FCR ($P<0.0005$). The feed intake of the birds fed 30% cassapro ration was lower than those of 20% cassapro. Kompiang (1983) also found a similar observation that halquinol has no effect on the feed intake. Present study also revealed that dressing percentage, liver, heart and gizzard weight was not significantly ($P>0.05$) differed among the experimental birds. The dressing weight, breast meat weight, thigh meat weight, liver weight and shank weight were significantly differed among the experimental groups due to anti-peristaltic activity of Halquinol which promotes better absorption of nutrients that directly helps in their weight gain.

CHAPTER III

MATERIALS AND METHODS

3.1 Statement of the experiment

The experiment was conducted at Ulukhola, Ketun, Gazipur with 816 (IR) day old broiler chickens for a period of 4 weeks from 6th January 2022 to 2nd February, 2022 to assess the growth performance of chickens fed diet containing de oiled rice bran. The analysis for broiler was carried out in the Department of Animal Nutrition laboratory.

3.2 Collection of experimental birds

Day old broiler chicks were purchased from Index Agro Farm outlet Gazipur, Dhaka.

3.3 Layout of the experiment

The chicks were divided into 4 groups, were assigned as 4 treatments i.e. T_0, T_1, T_2 and T_3 among which T_0 were controlled group i.e. basal feed without de oiled rice bran. Treatment consist of-

T_0-Control, Basal feed without DORB

T_1-Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed

T_2- Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed

T_3- Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed.

Table 2: Experimental layout showing the distribution of birds of the experiment

Distribution of treatments and birds						**No. of birds**
T_0R_5(34)	T_1R_6(34)	T_3R_5(34)	T_3R_6(34)	T_2R_3(34)	T_0R_1(34)	204
T_3R_4(34)	T_2R_2(34)	T_1R_5(34)	T_0R_6(34)	T_2R_1(34)	T_0R_2(34)	204
T_0R_3(34)	T_1R_4(34)	T_3R_2(34)	T_2R_4(34)	T_3R_1(34)	T_1R_1(34)	204
T_0R_4(34)	T_1R_3(34)	T_3R_3(34)	T_2R_6(34)	T_2R_5(34)	T_1R_2(34)	204
Total birds						**= 816**

3.4 Preparation of experimental house

The experimental house was sweeping and remove the hard particle from the floor and then cleaned by forced water using a hose pipe and the disinfected by spraying disinfectant solution (phenyl mixed water) followed by Iosan (3ml/liter water) before starting the experiments. Cleaned by phenyl mixed water spray with quaternary ammonium compound (5ml/liter water). After drying, the experimental shed was divided into 24 pens of equal size (41 sqft) using wood and wire net. The height of each pen was 85cm and a stocking density was 1.2 square feet/bird. Rice husk was used as litter materials at a depth of 6cm. All feeders, waterers and other necessary equipment's were also properly cleaned, washed and disinfected, subsequently dried and placed before arrival of chicks. Brooding was done by electric bulbs in each pen.

3.5 Experimental diets

Starter and grower commercial Astha broiler feed were purchased from the market. Starter and grower diet were enriched with following elements:

Table 3: Nutrient contents in starter and grower broiler ration

Name of the elements	Starter broiler ration %	Grower broiler ration %
Moisture (Max.)	11	11
Crude Protein	22-22.5	21-21.5
Crude Fat (Min.)	6	6.5
Crude Fiber (Max.)	4	4
Calcium (Min.)	0.90	0.90
Phosphorus (Min.)	0.45	0.45
Methionine (Min.)	0.55	0.52
Lysine (Min.)	1.30	1.25
ME (Min.) Kcal/kg	3000	3100

(**Source**: Astha Feed, 50 kg feed packet)

The feeding program was divided into two phases including starter and grower diets that were fed from 0 to 14 days and 15 to 28 days respectively.

3.6 Collection of experimental litter

Rice husk was collected from local rice mill.

3.6.1 Processing of litter

Rice husk was air dry by spreading in the floor and then spray with disinfectant, finally store it for time being used.

3.6.2 Allotment of litters

Placement of different litters on different experimental units was made randomly at a depth of about 3 cm. Every replication required 15 kg of litter.

3.7 Source of feed

Day old chicks were supplied broiler starter feed for the first 15 days, broiler grower for 16-28 days. All feeds were procured from local feed mill which was in the form of crumble and pellet respectively are presented in the Appendix Table 9.

3.8 Management practices

The management practices followed during the whole experimental period is briefly stated below:

3.8.1 Litter management

A fresh, clean and dried litter material was used as litter in every pen at a depth of 3cm. The litter of every pen was well covered by newspaper up to the first 3 days. After first two-week upper part of the litter with droppings were removed and rest of litter were rotated. After third week of age of birds, droppings were cleaned from the surface level of litter but new litter was not added and each week the litter was braked out with a belcha to break its compactness and maintain proper moisture.

3.8.2 Feeder and waterer space

One round feeder and one round waterer with a capacity of 3kg feed & 1.5-liter water were provided for birds of 12 in each replicate group or every pen. The feeders and waterers were placed in such a way that the birds were able to eat and drink conveniently.

3.8.3 Brooding

The birds were placed randomly in equal-sized (41 sqft) of 24 pens. The experimental birds were brooded in respective pens having light provision provided with 100-watt electric bulb by using metal board as chick guard. The bulb was hanged at a height of 30cm in the middle of each pen. Brooding temperature was kept at 35°C in the first week of age. It was decreased gradually at the rate of 3°C in each subsequent week until they were adjusted to normal environmental temperature of the house. During first week, the experimental feed was supplied on line feeders and waterer was used for supplying drinking water in each pen.

3.8.4 Lighting

Initially, it was planned to expose birds to a continuous lighting of 23 hours 30 minutes and a dark of 30 minutes at mid-night in each 24 hours. The intensity of light was 20-25 lux. This schedule was maintained although except when power-break occurred during the day.

3.8.5 Feeding and watering

In each pen, three feeders and three waterers were provided according to their space and number. Feed and water were supplied *ad-libitum* to the bird. Feed were supplied to the experimental birds daily, once in the morning and again in the afternoon. The clean water was supplied at the same time of feed. Feeder was washed after each week and the waterer was washed twice daily.

3.8.6 Methods of feeding

All crumble and pellet dry feed and water were supplied *ad-libitum* to all birds throughout the experimental period in all treatments. Clean water was made available for birds at all times. The feed continuously provided for broiler is essential for them to express their genetic potential. The fodder also needs to be delivered in a clean, uniform, and easy to access way.

3.8.7 Immunization

All the birds were vaccinated (Table-3.2.) against the new castle disease and infectious bronchitis combined name Ma_5 $Clone_{30}$ (Intervet) at the age of 3rd day of age as per the instruction of vaccine manufacturer. At the age of 9th birds were vaccinated by infectious bursal disease named D78 (IBD Intermediate) from intervet as per instruction and again boostered it at the age of 16th name GM 97 IBD intermediate plus) from hipra. At the age of 21st done the new castle disease vaccine live from ceva name (New-L) as per the instruction of vaccine manufacturer. All vaccine was collected from local market and maintain the cooling chain properly.

Table 4: Vaccination schedule followed for the experimental birds

Age of the bird	Name of Vaccine	Dose of diluted Vaccine	Route of administration
3rd day	IB+ND	1 drop in each eye	Intraocular/Eye drop
09th day	Gumboro Vaccine (D78)	1 ample for 500 Birds	D/W
16th day	Gumboro Vaccine (GM97)	1 ample for 500 Birds	D/W
21st day	New Castle Disease	1 ample for 500 Birds	D/W

3.8.8 Medication

For the treatment of bacterial and protozoan infections, medication was done during experimental period. The following medicines were used According to manufacturer of DOC Company:

1. Cosumix plus (Novartis, Bangladesh Ltd.) was added @ 1.0-1.5g per liter drinking water at the age of 4 weeks.
2. Rena-K (Renata Ltd) was used to prevent protozoan infection at 3 week of age.

3.8.9 Sanitation

Adequate or strict hygienic and appropriate sanitation programs of the experimental house were taken during experimental period. Feeders and waterers were sanitized once a week by using phenyl solution. More ever, free movements of persons, predator animals were restricted in the experimental house. The entrance point and veranda were kept clean and solution of bleaching powder and potassium permanganate ($KMnO_4$) was kept in foot bath alternatively. The outside of the experimental house and the feed storage room were also kept clean.

3.8.10 Recording of temperature and relative humidity

During the experimental period the temperature and relative humidity of the experimental house and pens were recorded one times a day (7 AM) with the help of digital thermometer and hygrometer these devices have the ability to memories the maximum and minimum temperature and humidity. The average temperature was 20-25°C and the relative humidity was 14 to 77%.

3.8.11 Post-mortem examination of birds

Disease and dead birds were send to the pathology laboratory, Department pathology, SAU, Dhaka to carry out the post-mortem examination. The proper presentation of carcasses for postmortem inspection involves uniform and consistent feather removal, feet removal, opening of carcasses, evisceration, and shackling. For example, each carcass must be opened to expose the organs and body cavity for proper examination by the inspector.

3.9 Data collection and record keeping

During 4 weeks of rearing period all data were collected, recorded and calculated replication wise for each treatment in the following way:

a) Body weight: Average live weight of day old broilers was determined at the beginning and then at end of the week.

b) Feed intake: Weekly feed intake was calculated as total experimental feed supplied to the birds weekly by deducting total left over feed collected daily for a week in each replication.

c) Mortality: Death of birds was recorded daily in replication wise for each treatment to calculate mortality.

d) Temperature and humidity: Temperature and humidity of the experiment were hold once daily during experimental period.

3.10 Statistical design and data analysis

The collected data were calculated on different variables were subjected to analysis of variance in a Completely Randomized Design (CRD) (Steel and Torrei, 1980). Significant differences between treatment means were separated by least significant difference (LSD).

CHAPTER IV

RESULTS AND DISCUSSION

Results obtained from the present study have been presented and discussed in this chapter with a view to study the effect of mint leaf on broiler production. The data are given in different tables and figures. The results have been discussed and possible interpretations of the research are given under the following headings.

4.1 Production performances

In this chapter, discussed the effect of mint leaf on broiler production that helps the body growth of broiler chicken. The chicks were randomly divided into five experimental treatment groups. The four groups were T_0 (Basal feed), T_1 (Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed), T_2 (Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed) and T_3 (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed). The performance traits *viz*. body weight, body weight gain, feed consumption, FCR, weekly feed consumption, weekly body weight gain, weekly FCR, dressing percentage, different dressed organ weight, survivability rate, benefit cost ratio and immune parameter were discussed in this chapter.

4.1.1 Body weight

Table 5 showed that the effect of different level of de oiled rice bran on body weight was discussed. The relative body weight (g) of broiler chickens in the different treatment groups T_0, T_1, T_2 and T_3 were $1785.00^a \pm 10.16$, $1795.98^b \pm 1.52$, $1780.58^a \pm 12.12$ and $1817.75^c \pm 8.47$ respectively. The highest result was found in T_3 (1817.75 g) and lowest result was found in T_2 group (1780.58 g) and that was statistically significant ($P<0.05$). Results also expressed that the body weights also different among the treatment groups having statistical significance ($P<0.05$) and the treated group T_3 had higher body weight than control. The higher body weight was in T_3 group might be due to combined effect of protease enzyme and halquinol. These results are contradictory with the findings of Adrizal *et al*. (1996) who found that no significant differences (P>0.05) among dietary treatments were observed for weight gain in broiler diet containing de oiled rice bran and halquinol.

4.1.2 Body weight gain

Table 5 showed that the effect of different level of de oiled rice bran on body weight gain was discussed. The relative body weight gain (g) of broiler chickens in the different treatment groups T_0, T_1, T_2 and T_3 were 1744.00±10.15, 1754.98±1.53, 1744.78±14.85 and 1776.75±8.47 respectively. The highest result was found in T_3 (1776.75 g) and lowest result was found in T_0 group (1744 g) and that was statistically no significant (P<0.05) difference. The result of present study is supported by the previous findings of P. Anuradha (2015) concluded that maintaining the maximum fiber level along with incorporation of xylanase as fiber degradable enzyme in feed may have better cost benefit ratio than that of low fiber diet without xylanase. Here result showed that body weight gain was non significantly (P>0.05) higher in treatment group T_3 than control group T_0. Mortality rate was significantly (P<0.05) lower in enzyme supplemented high fiber group, when compared to control group. There was no significant (P>0.05) variation among the treatment and control group in terms of Feed Conversion Ratio (FCR).

The result of present study also supported by the previous findings of Mst. Azrinahar (2021) concluded that fermentation of DORB can decrease anti-nutritional factors (Phytate-P) which can result positive impact on the performance of broiler and availability of phosphorus and increase strength of bone. Fermented DORB can increase tibia ash content in broiler and decrease blood cholesterol level. After 28 days of feeding trial feed conversion ratio was lower (P<0.05) in FF (1.73) than the other groups concluded that the fermentation of DORB using yeast adding urea, wheat flour or both caused desirable chemical changes and this changes have positive effect on growth performance, bone mineralization in broiler.

4.1.3 Feed consumption

Table 5 showed that the effect of different level of de oiled rice bran on feed consumption was discussed. The relative body weight (g) of broiler chickens in the different treatment groups T_0, $T_{1,}$ T_2 and T_3 were $2358.80^{a}\pm21.99$, $2370.78^{b}\pm19.77$, $2379.39^{bc}\pm15.14$ and $2318.46^{d}\pm11.37$ respectively. The highest result was found in T_2 (2379.39 g) and lowest result was found in T_3 group (2318.46 g) and that was statistically significant ($P<0.05$).

The results are consistent with the previous findings of K M S Islam (2018) showed that RB can be replaced by using DORB as it can supply more protein and reduce the required amount of other protein rich ingredients which are high in price and DORB found suitable to use in broiler diet in comparison to RB considering its quality and cost effectiveness for production of broiler. After a 35 days feeding trial live weight gain, feed intake and feed conversion ratio of two groups were similar ($P>0.05$) but dressing percentage was higher for the broilers in RB group ($P<0.05$). Adrizal (1996) results shown that up to 22.5% dietary DRB can be used successfully for broiler chickens when diets are supplemented with available P and fat. Body weight and feed to gain ratio of broilers from 4 to 35 d of age were not affected by DORB concentration.

4.1.4 Feed conversion ratio (FCR)

Table 5 showed that the effect of different level of de oiled rice bran on feed conversion ratio was discussed. The relative feed conversion ratio of broiler chickens in the different treatment groups T_0, $T_{1,}$ T_2 and T_3 were 1.54±0.01, 1.56±0.02, 1.56±0.02 and 1.47±0.01 respectively. The best FCR was found in T_3 (1.47) and worse FCR was found in T_1 and T_2 group (1.56) but better FCR was found in T_3 (1.47) than control group T_0 (1.54) that was not statistically significant ($P>0.05$). The effect of supplementation of de oiled rice bran with protease enzyme and halquinol on corrective feed conversion ratio was non significantly ($P>0.05$) better in treatment groupT_3 than control group T_0. The better FCR in T_3 group might be due to the effect of Basal feed with 50 kg DORB, 200g protease enzyme and 500g halquinol per metric ton of feed.

Purushothaman, M. R. (1990) showed that feed conversion ratio and nutrient digestibility (except crude fiber) among groups did not differ significantly on broiler diet containing DORB. Results indicated that 20% DORB could be included in broiler diets without any effect on performance.

Table 5: Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on body weight (BW), Body weight gain (BWG), total FC and FCR of broiler chicken

Treatments	Body weight±SE (g)	Body weight gain±SE (g)	Total FC±SE (g)	FCR±SE
T_0	1785.00^a±8.16	1744.00±10.15	2358.80^a±21.99	1.54±0.01
T_1	1795.98^b±1.52	1754.98±1.53	2370.78^b±19.77	1.56±0.02
T_2	1780.58^a±12.62	1744.75±14.85	2379.39^{bc}±12.14	1.56±0.02
T_3	1817.75^c±8.47	1776.75±8.47	2318.46^d±11.37	1.47±0.01
Mean±SE	**1794.83±5.16**	**1755.12±5.40**	**2356.86±9.52**	**1.53±0.01**

Here, T_0 = Control, T_1 = Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed T_2 = Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed, T_3 = Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed. Values are Mean±SE (n=24) one-way ANOVA (SPSS, Duncan method).

- ✓ Mean with different superscripts are significantly different ($P<0.05$)
- ✓ Mean within same superscripts don't differ ($P>0.05$) significantly
- ✓ SE = Standard Error

4.2 Weekly body weight gain

Figure 1 showed that the weekly body weight gain (g) of broiler chicken was discussed. At first week, the body weight gain (g) was found 214.75 in all group because brooding was same. In case of 2nd week, the highest body weight gain (g) was found in T_3 (409.48) and lowest in T_0 (382.81); In case of 3rd week, the highest body weight gain (g) was found in T_3 (611.81) and lowest in T_0 (583.6) and in case of 4th week, the highest body weight gain (g) was found in T_3 (628.17) and lowest in T_0 (602.34).

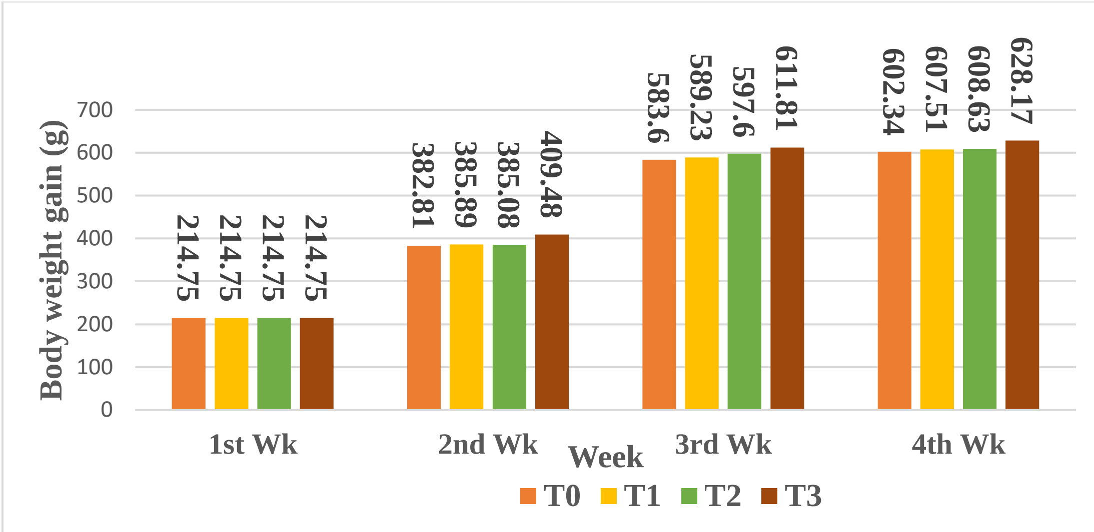

Figure 1: Weekly body weight gain

4.3 Weekly Feed Consumption

Figure 2 showed that the weekly feed consumption (g) of broiler chicken was discussed. At first week, the feed consumption (g) was found 222.13 in all group because brooding was same. In case of 2^{nd} week, the highest feed consumption (g) was found in T_2 (472.48) and lowest in T_3 (454.78); In case of 3^{rd} week, the highest feed consumption (g) was found in T_0 (747.88) and lowest in T_3 (718.71) and in case of 4^{th} week, the highest feed consumption (g) was found in T_2 (952.12) and lowest in T_0 (929).

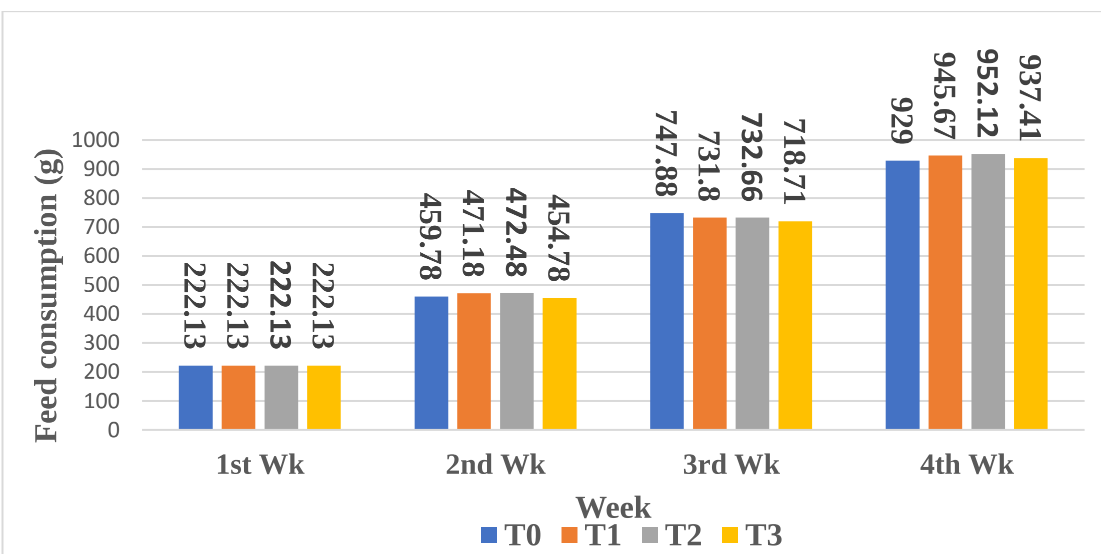

Figure 2: Weekly Feed Consumption

4.4 Weekly Feed Conversion Ratio

Figure 3 showed that the weekly feed conversion ratio of broiler chicken was discussed. At first week, feed conversion ratio was found 1.03 in all group because brooding was same. In case of 2nd week, better feed conversion ratio was found in T_3 (1.11) and worse in T_2 (1.23); In case of 3rd week, better feed conversion ratio was found in T_3 (1.17) and worse in T_0 (1.28) and in case of 4th week, better feed conversion ratio was found in T_3 (1.47) and worse T_1 (1.56) and T_2 (1.56). The result is in harmony with the finding of Warren *et al*. (1990), who reported that substitution of defatted rice bran at 7-21% in a basal diet improved growth and feed conversion ratio of broilers from 3-13 days of age.

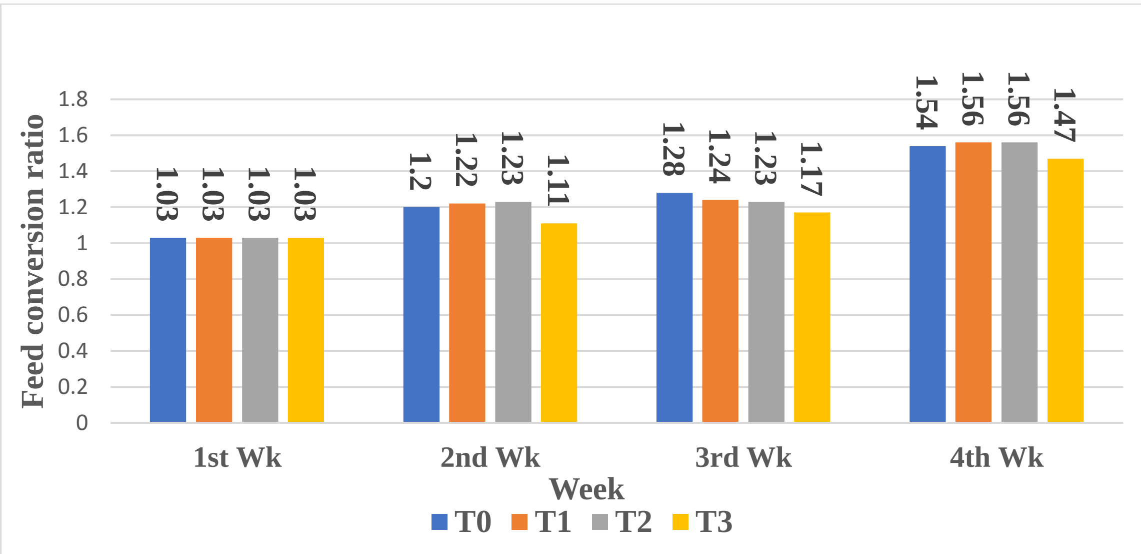

Figure 3: Weekly feed conversion ratio

Here, T_0 = Control, T_1 = Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed T_2 = Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed T_3 = Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed. Values are Mean±SE (n=24) one-way ANOVA (SPSS, Duncan method).

- ✓ Mean with different superscripts are significantly different ($P<0.05$)
- ✓ Mean within same superscripts don't differ ($P>0.05$) significantly

4.5 Survivability rate%

Data presented in figure 4 showed that the survivability rate (%) of the experimental study was described. The relative survivability rate (%) of broiler chicken in different treatment groups T_0, T_1, T_2 and T_3 were 93.14, 91.67, 90.2 and 95.59 respectively. Survivability rate (%) was higher in treated group T_3 than control group T_0. There was significant difference ($P<0.05$) in survivability rate (%). The better result was found in T_3 (95.59) group due to effect of Basal feed with 50 kg DORB, 200 g Enzyme Protease and 500 g Halquinol per metric ton of feed.

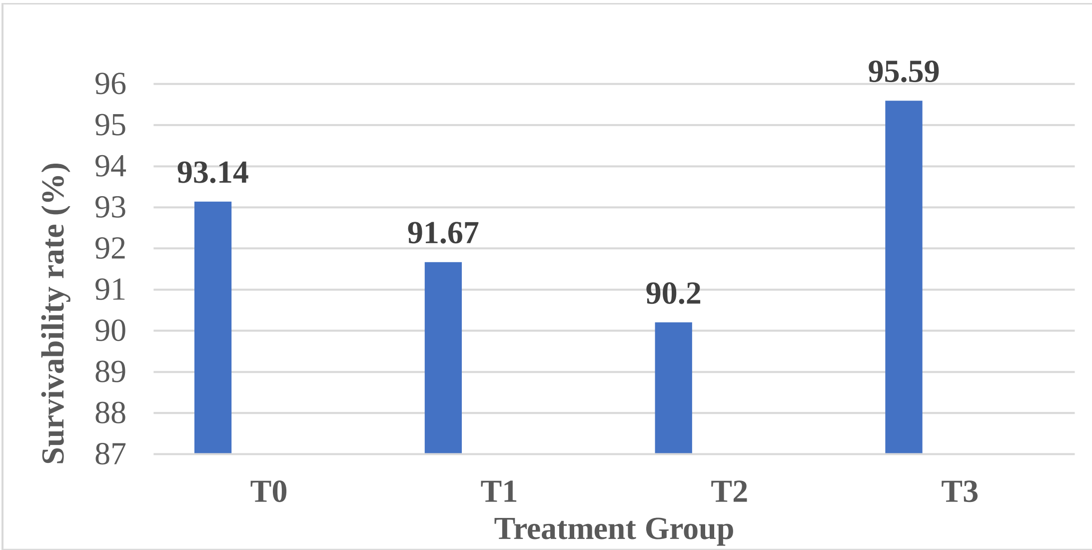

Figure 4: Survivability rate (%)

Here, T_0 = Control, T_1 = Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed T_2 = Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed T_3 = Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed. Values are Mean±SE (n=24) one-way ANOVA (SPSS, Duncan method). LS = level of significance.

- ✓ Mean with different superscripts are significantly different ($P<0.05$)
- ✓ Mean within same superscripts don't differ ($P>0.05$) significantly
- ✓ SE = Standard Error

4.6 Cost benefit ratio analysis

Cost benefit ratio analysis was discussed in the Table 6. Benefit cost ratio (BCR) of the experimental study in different treatment groups T_0, T_1, T_2 and T_3 were 1.41, 1.38, 1.36 and 1.49, respectively. BCR is non significantly higher ($P>0.05$) in treatment group T_3 than control group (T_0). This is might be due to the effect of Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed.

Table 6: Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on benefit cost ratio (BCR)

Treatments	Total cost±SE (Tk./Bird)	Sell price±SE (Tk./Bird)	Profit±SE (Tk./Bird)	BCR±SE
T_0	184.47±4.14	260.60±2.79	76.13±1.47	1.41±0.02
T_1	188.03±4.19	261.63±4.62	73.6±0.39	1.38±0.01
T_2	201.42±5.38	271.85±0.72	70.43±5.17	1.36±0.03
T_3	180.64±2.42	269.01±6.18	88.37±14.91	1.49±0.06
Mean±SE	**188.64±4.21**	**265.77±3.89**	**77.13±2.51**	**1.41±0.03**

Here, T_0 = Control, T_1 = Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed T_2 = Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed T_3 = Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed. Values are Mean±SE (n=24) one-way ANOVA (SPSS, Duncan method). LS = level of significance.

- ✓ Mean with different superscripts are significantly different (P<0.05)
- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE = Standard Error

CHAPTER V

CONCLUSION AND RECOMMENDATION

An experiment was carried out with 816 day-old IR broiler chicks at Ulukhola, Ketun, Gazipur for a period of 4 weeks from 6th January 2022 to 2nd February, 2022 to study the growth performance of broiler chickens fed the diet containing de oiled rice bran, proease enzyme and halquinol. All the birds were assigned to four treatments such as T_0 (Control), T_1 (Basal feed with 50 kg DORB and 500g Halquinol per metric ton of feed), T_2 (Basal feed with 50 kg DORB and 200g Enzyme Protease per metric ton of feed) and T_3 (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed) having 6 replications to each. The number of birds in each replication was 34. The parameters evaluated in this study were the bird's performance like body weight, body weight gain, feed consumption, FCR, weekly body weight gain, weekly feed consumption, weekly feed conversion ratio, survivability rate% and BCR on broiler rearing. The highest body weight (g) was found in T_3 (1817.75 g) and lowest result was found in T_2 (1780.58 g) group. But, higher body weight was found in T_3 group than control group T_0 and that was statistically significant ($P<0.05$). The highest body weight gain was found in T_3 (1776.75 g) and lowest result was found in T_0 group (1744 g) and that was statistically no significant ($P>0.05$) difference. The highest result was found in T_2 (2379.39 g) and lowest result was found in T_3 group (2318.46 g) and that was statistically significant ($P<0.05$). The best FCR was found in T_3 (1.47) and worse FCR was found in T_1 and T_2 group (1.56) but better FCR was found in T_3 (1.47) than control group T_0 (1.54) and that was not statistically significant ($P>0.05$). In case of 4th week, the highest body weight gain (g) was found in T_3 (628.17) and lowest in T_0 (602.34); the highest feed consumption (g) was found in T_2 (952.12) and lowest in T_0 (929) and better feed conversion ratio was found in T_3 (1.47) and worse T_1 (1.56) and T_2 (1.56). Survivability rate (%) was higher in treated group T_3 than control group T_0. There was significant difference ($P<0.05$) in survivability rate (%). BCR was non significantly higher ($P>0.05$) in treatment group T_3 (1.49) than control group T_0 (1.41). The above research was found that body weight (g), body weight gain (g), survivability rate (%) and BCR were better result in T_3 (Basal feed with 50 kg DORB, 200g

Enzyme Protease and 500g Halquinol per metric ton of feed) than other groups including control group T_0 (Basal feed). FCR was better in T_3 group (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed) than other groups including control group T_0 (Basal feed). It was concluded that better result was found in T_3 (Basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed) group than control group. Therefore, the research recommended that broiler rearing with basal feed with 50 kg DORB, 200g Enzyme Protease and 500g Halquinol per metric ton of feed could be used on broiler production for better performance and profitability.

CHAPTER VI

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CHAPTER VII

APPENDICES

Appendix I. Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on body weight (BW) (g/bird) of broiler chicken

Treatment	Replication	1st wk	2nd wk	3rd wk	4th wk
T_0	R_1	255.75	590.50	1172.60	1742.6
	R_2	255.75	590.70	1165.10	1785.8
	R_3	255.75	590.30	1164.30	1790.2
	R_4	255.75	590.90	1154.10	1812.7
	R_5	255.75	590.80	1152.70	1774.1
	R_6	255.75	590.40	1150.20	1804.6
T_1	R_1	255.75	617.30	1200.10	1790.6
	R_2	255.75	614.30	1188.20	1798.3
	R_3	255.75	617.60	1205.20	1796.5
	R_4	255.75	614.40	1199.20	1800.0
	R_5	255.75	615.40	1204.20	1798.3
	R_6	255.75	619.40	1205.30	1792.2
T_2	R_1	255.75	617.40	1190.20	1760.5
	R_2	255.75	618.30	1205.70	1787.2
	R_3	255.75	619.50	1183.20	1809.1
	R_4	255.75	619.40	1203.10	1735.1
	R_5	255.75	624.50	1201.10	1778.2
	R_6	255.75	626.50	1187.10	1813.4
T_3	R_1	255.75	630.50	1260.50	1800.3
	R_2	255.75	640.50	1230.50	1841.6
	R_3	255.75	636.50	1245.30	1799.4
	R_4	255.75	642.50	1250.60	1833.3
	R_5	255.75	645.50	1242.10	1797.3
	R_6	255.75	650.40	1245.60	1834.6

Appendix II. Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on body weight gain (BWG) (g/bird) of broiler chicken

Treatment	Replication	1^{st} wk	2^{nd} wk	3^{rd} wk	4^{th} wk	Total BWG
T_0	R_1	214.75	390.50	580.50	596.15	1701.6
	R_2	214.75	387.70	589.70	594.92	1744.8
	R_3	214.75	383.30	579.30	609.58	1749.2
	R_4	214.75	372.31	591.90	603.07	1771.7
	R_5	214.75	380	578.80	615.72	1733.1
	R_6	214.75	383.07	581.40	594.61	1763.6
T_1	R_1	214.75	398.75	548.30	609.33	1749.6
	R_2	214.75	369.73	601.30	597.08	1757.3
	R_3	214.75	383.07	599.60	608	1755.5
	R_4	214.75	396.92	587.40	596.15	1759.0
	R_5	214.75	373.07	589.40	594.92	1757.3
	R_6	214.75	393.85	609.40	639.58	1751.2
T_2	R_1	214.75	372.31	594.40	603.07	1719.5
	R_2	214.75	378.30	595.30	615.72	1787.2
	R_3	214.75	389.50	604.50	594.61	1768.1
	R_4	214.75	394.40	601.40	613.33	1694.1
	R_5	214.75	369.50	603.50	627.08	1727.2
	R_6	214.75	406.50	586.50	598	1772.4
T_3	R_1	214.75	430.50	619.50	616.15	1759.3
	R_2	214.75	390.50	610.50	624.92	1800.6
	R_3	214.75	396.50	599.50	649.58	1758.4
	R_4	214.75	392.50	621.50	641.07	1792.3
	R_5	214.75	415.50	599.50	605.72	1756.3
	R_6	214.75	431.40	620.40	631.61	1793.6

Appendix III. Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on feed consumption (FC) (g/bird) of broiler chicken

Treatment	Replication	1st wk	2nd wk	3rd wk	4th wk	Total FC
T_0	R_1	222.13	442.53	806.5	930.24	2401
	R_2	222.13	423.43	714.5	929.5	2289.56
	R_3	222.13	474.44	733.2	935.26	2365.03
	R_4	222.13	436.52	704.5	936.5	2299.65
	R_5	222.13	491.34	802.3	907.28	2423.05
	R_6	222.13	490.44	726.3	935.26	2374.13
T_1	R_1	222.13	480.03	712.3	928.2	2342.66
	R_2	222.13	478.01	725.3	927.2	2352.64
	R_3	222.13	466.03	721.6	1001.6	2411.36
	R_4	222.13	468.03	708.6	926.2	2324.96
	R_5	222.13	478.01	801.5	947.5	2449.14
	R_6	222.13	457.01	721.5	943.3	2343.94
T_2	R_1	222.13	475.29	701.5	987.2	2386.12
	R_2	222.13	484.59	705.5	978.5	2390.72
	R_3	222.13	467.49	709.5	947.3	2346.42
	R_4	222.13	478.67	761.5	935.2	2403.5
	R_5	222.13	463.37	812.5	931.2	2429.2
	R_6	222.13	465.47	705.5	933.3	2326.4
T_3	R_1	222.13	462.53	741.5	918.45	2348.57
	R_2	222.13	463.43	714.5	922.41	2322.47
	R_3	222.13	444.44	713.2	937.57	2317.34
	R_4	222.13	476.52	723.5	926.88	2349.03
	R_5	222.13	431.34	703.3	916.59	2273.36
	R_6	222.13	450.44	716.3	915.10	2303.97

Appendix IV. Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on feed conversion ratio (FCR) of broiler chicken

Treatment	Replication	1st wk	2nd wk	3rd wk	4th wk
T_0	R_1	1.03	1.13	1.39	1.56
	R_2	1.03	1.09	1.21	1.56
	R_3	1.03	1.24	1.27	1.53
	R_4	1.03	1.17	1.19	1.55
	R_5	1.03	1.29	1.39	1.47
	R_6	1.03	1.28	1.25	1.57
T_1	R_1	1.03	1.20	1.30	1.52
	R_2	1.03	1.29	1.21	1.55
	R_3	1.03	1.22	1.20	1.65
	R_4	1.03	1.18	1.21	1.55
	R_5	1.03	1.28	1.36	1.59
	R_6	1.03	1.16	1.18	1.47
T_2	R_1	1.03	1.28	1.18	1.64
	R_2	1.03	1.28	1.19	1.59
	R_3	1.03	1.20	1.17	1.59
	R_4	1.03	1.21	1.27	1.52
	R_5	1.03	1.25	1.35	1.48
	R_6	1.03	1.15	1.20	1.56
T_3	R_1	1.03	1.07	1.20	1.49
	R_2	1.03	1.19	1.17	1.48
	R_3	1.03	1.12	1.19	1.44
	R_4	1.03	1.21	1.16	1.45
	R_5	1.03	1.04	1.17	1.51
	R_6	1.03	1.04	1.15	1.45

Appendix V. Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on survivability rate % of broiler chicken

Treatment	Replication	No. of birds	No. of dead birds	No. of birds survived	Survivability rate%
	R_1	34	3	31	91.18
	R_2	34	4	30	88.24
	R_3	34	0	34	100.00
T_0	R_4	34	3	31	91.18
	R_5	34	2	32	94.12
	R_6	34	2	32	94.12
	Total	204	14	190	93.14
	R_1	34	3	31	91.18
	R_2	34	5	29	85.29
	R_3	34	0	34	100.00
T_1	R_4	34	5	29	85.29
	R_5	34	2	32	94.12
	R_6	34	2	32	94.12
	Total	204	17	187	91.67
	R_1	34	4	30	88.24
	R_2	34	3	31	91.18
	R_3	34	4	30	88.24
T_2	R_4	34	5	29	85.29
	R_5	34	2	32	94.12
	R_6	34	2	32	94.12
	Total	204	20	184	90.20
	R_1	34	1	33	97.06
	R_2	34	2	32	94.12
	R_3	34	2	32	94.12
T_3	R_4	34	0	34	100.00
	R_5	34	1	33	97.06
	R_6	34	3	31	91.18
	Total	204	9	195	95.59

Appendix VI: Effect of using different diet containing de oiled rice bran, protease enzyme and halquinol on benefit cost ratio (BCR)

Treatments	Replications	Total Cost (Tk./Bird)	Receipt per Bird (Tk./Bird)	Profit (Tk./ Bird)	Benefit Cost Ratio (BCR)
T_0	R_1	189.36	256.08	66.72	1.35
	R_2	171.87	241.68	69.81	1.40
	R_3	186.31	276.48	90.17	1.48
	R_4	174.52	258.21	83.69	1.47
	R_5	183.33	261.4	78.07	1.42
	R_6	201.45	269.77	68.32	1.33
T_1	R_1	203.49	267.0	64.49	1.31
	R_2	181.11	255.68	67.57	1.41
	R_3	198.06	264.43	66.37	1.33
	R_4	182.34	267.61	85.27	1.46
	R_5	177.56	255.43	77.87	1.43
	R_6	185.62	259.66	74.04	1.39
T_2	R_1	190.85	269.52	78.67	1.41
	R_2	201.93	268.84	66.91	1.33
	R_3	203.43	265.80	62.37	1.30
	R_4	209.52	273.34	63.82	1.30
	R_5	204.45	282.5	78.05	1.38
	R_6	198.35	271.11	82.76	1.36
T_3	R_1	176.49	262.32	85.83	1.48
	R_2	188.39	271.60	83.21	1.44
	R_3	187.21	279.64	92.43	1.49
	R_4	156.51	253.65	97.14	1.62
	R_5	173.45	262.6	89.15	1.51
	R_6	201.76	284.24	82.48	1.40

Appendix VII: Broiler house temperature (^0C)

Days	Maximum	Minimum
01	34.20	27.10
02	33.60	26.40
03	33.30	26.80
04	33.70	25.70
05	31.30	25.30
06	31.40	26.20
07	30.60	24.60
08	31.60	25.50
09	30.50	23.10
10	31.10	24.50
11	32.60	25.40
12	30.30	24.10
13	29.60	23.50
14	29.70	23.10
15	28.60	24.20
16	30.30	22.20
17	29.40	22.30
18	28.40	21.50
19	29.90	22.90
20	27.10	21.40
21	26.90	22.90
22	27.40	20.00
23	28.90	20.30
24	27.20	19.10
25	25.90	20.80
26	26.70	19.50
27	24.50	19.30
28	23.40	18.80

Appendix XIII: Relative humidity (%)

Days	Maximum	Minimum
01	55	14
02	59	17
03	61	15
04	57	17
05	54	15
06	61	14
07	49	26
08	51	20
09	63	21
10	73	18
11	65	16
12	52	14
13	67	20
14	64	19
15	61	22
16	65	15
17	49	16
18	56	17
19	55	18
20	66	23
21	52	17
22	67	15
23	77	16
24	65	17
25	59	21
26	61	18
27	72	16
28	71	19