EFFECT OF DUCKWEEDS AND TARO LEAVES ON THE PERFORMANCE OF DUCK

A THESIS

BY

BOBY RANI SAHA

Registration No.: 1505013

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Semester: January-June, 2016

MASTER OF SCIENCE (MS)
IN
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DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

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December, 2016

DEDICATED
TO MY
BELOVED PARENTS

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ABSTRACT

An experiment was conducted in a suburb of Gaibandha District, to investigate the dietary effect of rice bran with duckweeds and taro (*Colocacia esculenta*) leaves on growth and egg laying performance of common ducks. Twenty female common ducks were divided into four groups with three replications named T_0 T_1 T_2 T_3 in a completely randomized design (CRD). T_0 group was control and fed with rice bran, T_1 group was fed with rice bran plus duck weed , T_2 with rice bran plus taro leaf and T_3 fed with rice bran plus taro leaf and duck weed. In the experiment, the dry matter of rice bran was found 89% and then 9.60% in duckweed and 21.6% in Taro leaves. The average daily weight gain per duck among treatments was significantly different ($P<0.05$), and was poorest in the T_0 group(4.65 gm/day/duck) 3.57 of basal diet of Rice bran and good in Rice bran plus taro leaf and duck weed compiled feed (5.66 gm/day/duck). In the study it was found that maximum average egg production rate was in T_3 (RB+DW+TL) group (Avg=28) than others and minimum founds in T_0 (RB) (Avg=22) group. Hematological value as PCV (41.17 ± 1.13), HBC (14.17 ± 1.13) and ESR (1.95 ± 0.30) was found significantly higher in T_3 (RB+DW+TL) groups ducks than others.

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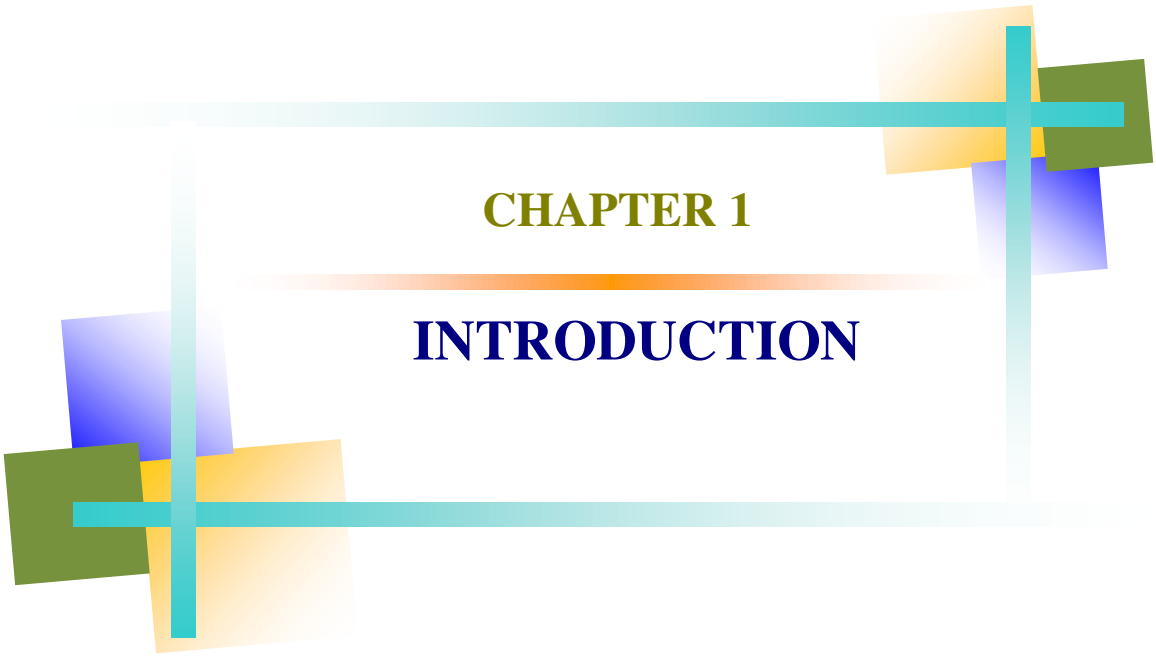

CHAPTER 1

INTRODUCTION

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INTRODUCTION

Bangladesh is a riverine country and 16488 km^2 area are haors, baors, canals, ponds and low lying water reservoirs, part of which can be efficiently utilized for duck production. Ducks are not competitors of chicken because their scavenging venue is different. Therefore, increased duck rearing does not necessary mean a cut in chicken production. Rather, it will be a great supplement to total poultry production. Duck ranked second place in supplying egg and meat and are traditionally reared under semi-scavenging system in Bangladesh (Rashid *et al*., 2009). Ducks are considerably cheaper to raise and more resistant to diseases than that of chicken. Ducks are efficient converter of insects, weeds and fallen seeds into meat and eggs. In some areas of Bangladesh, farmers prefer to rear ducks instead of chicken. For multiplication of duck, feeding, fertility and hatchability are the most important contributing factors to take care of fertility and hatchability are influenced by genetic background, physiology, nutrition and social behavior and environment (Warren and D. J. Farrell, 1990).

Poultry production is a common activity in Southeast Asia, and also a major source of livelihood for over a million people in the rural areas. In the last two decades, Asian duck production has become increasingly important, accounting for up to 87% of the world's duck population, and duck meat and egg production has increased more than four times (Chein Tai and Jui-Jane Liu Tair, 2001).

Keeping poultry makes a substantial contribution to household food security throughout the developing world. It helps diversify incomes and provides quality food, energy, fertilizer and a renewable asset in over 80 percent of rural households(Sonaiya and Swan, 2004).

Chickens produce about 76% and ducks produce 24% of total eggs in Bangladesh (Hossain and Chowdhury, 1989). In the development of poultry, a proper emphasis should be given on duck farming. Desi (indigenous) ducks produce egg of large size than Desi hens. Ducks have greater resistance to diseases than the chickens because of their higher scavenging ability and needed less care than that of chickens. Desi ducks in rural areas of Bangladesh are being raised under traditional free range in the house hold of the farmers economy, by exploiting the existing facility like natural feed sources in water logged areas. Though the

Desi ducks are poor producers of meet and eggs in comparison with those of exotic breeds, they are also more resistant to diseases under adverse condition (Rashid *et al*., 1995).

Among the avian species duck is considered as most versatile because it can subsist under a range of climatic and nutritional conditions (Lambio, 2002). Ducks are reared traditionally by poor farmers for their livelihood. Duck production is one component of integrated farming systems which are regarded as being part of a sustainable development in agriculture. They can be integrated with rice, orchards, cash crops, livestock and fish (Bui Xuan Men, Ogle R B and Preston T R, 1996). Thus, the stakeholders not only can develop their livelihoods without accumulating debts, but also can get extra income through off-farm and non-farm activities (Le Thanh Phong *et al*., 2007). Many people are unaware of the amazing potential of using ducks for egg production. Some breeds of ducks can lay more eggs than chickens, and ducks are generally hardier than chickens. There are also more nutrients in duck eggs, and many people consider ducks more entertaining. Worldwide, not only are people eating more duck eggs, ducks are taking a larger share of total egg production. Duck egg shells and their shell membranes are very strong. Whereas a chicken egg may leak if it has a crack, a duck egg rarely leaks. The membrane keeps the contents intact. In fact, if you are careful, you can probably break the shell of a duck egg into 1/4" size pieces and the membrane will keep it all together and it will not leak. This extra protection has evolved due to ducks laying their eggs in swampy and wet places. The shell of a duck egg is much smoother than a chicken egg – some people describe it as waxy (Metzer, 2012).

Low-cost duck production relies heavily on low-cost ingredients. These are often agricultural waste-products and by-products. Rice bran is used to describe the by-product remaining after the milling of brown rice to give white rice. It is rich in protein, lipids, vitamins B and E, and trace minerals (Saunders, 1986 and Warren and Farrell, 1990). Rice bran compares favorably with other cereal bran's in amino acid composition (Farrell, 1994).Many successful trials have been reported on using rice bran in layers and ducklings diets (Ghazalah *et al.*, 1990 and Farrell, 1994). The bran fraction contains 14-18% oil. Rice bran that has not been defatted is a useful binder in mixed feeds. Defatted rice bran can be used at higher levels than ordinary rice bran. Rice bran is often adulterated with rice hulls, as it should have a crude fibre content of 10-15% (Göhl, 1982).

At smallholder level, many farmers have not enough money to buy the high quality protein sources such as fish meal and soybean meal that are the basis of intensive livestock feeding system. However, they are able to grow many plants the leaves of which are relatively high in protein. Examples of these potential protein sources are the foliages from duckweed, water spinach, cassava, Taro and sweet potato.

Duckweeds (*Lemna* spp) are small green plants belonging to the family Lemnaceae. They grow on natural pond surfaces. They are fast growing and when adequately fertilized may contain up to 40% protein in DM (Porath *et al*., 1979; Bui Xuan Men *et al*., 1995; Skillicorn *et al*., 1993; Leng *et al*., 1995). Duckweed protein has a well-balanced array of essential amino acids, better than most vegetable proteins (Table 1) and closely resembles animal protein according to Culley and Epps (1978).

Taro (*Colocacica esculenta*) is a tropical food crop with high potential because of the high yield of the roots (or corms) and foliage. The leaves are rich in protein and are easy to ensile (Rodríguez *et al.,* 2009), a process which has been shown to reduce markedly the concentrations of calcium oxalate (Hang and Preston 2010), an anti-nutritional compound that causes irritation of the skin and mouth and can be a limiting factor in consumption of the fresh leaves according to Tiep *et al.* (2006). Silage made from the leaves and stems of Taro was successfully fed to ducks by Giang *et al.* (2010) and Chhay *et al.* (2011).

Poultry sector is a dynamic industry. All over the world, efforts continue for expansion of production, new production methods and for new poultry products. The general objective of this study is to determine the dietary effect of rice bran with duckweeds and taro (*Colocacia esculenta*) leaves on the growth and egg production of common ducks.

The specific objective of the present study are-

1. To know the effect of duckweeds and taro leaves on growth performance of duck
2. To know the effect of duckweeds and taro leaves on production and quality of duck egg
3. To determine the effect of duckweeds and taro leaves on haematological values of ducks

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2
REVIEW OF LITERATURE

Among the avian species duck is considered as most versatile because it can subsist under a range of climatic and nutritional conditions (Lambio, 2002). Also duck raising is inexpensive, requires non-elaborate housing facilities, and little attention and less space for rearing compared to chickens. Moreover, ducks are shown to be relatively hardy, and resistant to common avian diseases. The nutrient requirements are 20% crude protein and 2,800-2,900 kcal/kg metabolizable energy for the starter diet (first 3 weeks) and 17-18% protein and 2,900-3,000 kcal/kg metabolizable energy for the grower/finisher diet (PCARRD, 2006).

Due to the high cost of feeds, small scale raisers are encouraged to look on some other poultry species on which they can give some other feedstuff that are available on their locality. One of the poultry species that can be raised organically and subsist on a variety of feeds is the common duck that belongs to the cairina tribe. It is native of Central and South America, has a high reproductive rate, run in flocks, and is easier to manage (Fuller, 2004). Duck raising, one a small scale occupation but is slowly growing in importance to the meat industry. With the growing demand for poultry meat, the duck industry has commenced to follow the same pattern of the broiler industry. This could be seen in the establishment of more specialized business venture with modern poultry abattoirs, processing for better packaging and presentation to consumers. Animals perform better when feed with proper mixture of feed stuffs and plants. Plant leaves fed fresh make animals healthy and resistant to disease due to high vitamins and minerals contents. Some possible feedstuff used by duck raisers could be Rice bran, duck weed and taro leaves.

3.1 Common Duck

Duck is the common name for a large number of species in the waterfowl family Anatidae, which also includes swans and geese. The ducks are divided among several subfamilies in the family Anatidae; they do not represent amonophyletic group (the group of all descendants of a single common ancestral species) but a form taxon, since swans and geese are not considered ducks. Ducks are mostly aquatic birds, mostly smaller than the swans and geese, and may be found in both fresh water and sea water. Ducks are sometimes

confused with several types of unrelated water birds with similar forms, such as loons or divers, grebes, gallinules, and coots.

The word *duck* comes from Old English **dūce* "diver", a derivative of the verb **dūcan* "to duck, bend down low as if to get under something, or dive", because of the way many species in the dabbling duck group feed by upending; compare with Dutch *duiken* and German *tauchen* "to dive". This word replaced Old English *ened/ænid* "duck", possibly to avoid confusion with other Old English words, like *ende* "end" with similar forms. Other Germanic languages still have similar words for "duck", for example, Dutch *eend* "duck" and German *Ente* "duck". The word *ened/ænid* was inherited from Proto-Indo-European; compare: Latin *anas* "duck", Lithuanian *ántis* "duck", Ancient Greek *nēssa/nētta* (νῆσσα, νῆττα) "duck", and Sanskrit *ātí* "water bird", among others. A duckling is a young duck in downy plumage or baby duck; but in the food trade young adult ducks ready for roasting are sometimes labelled "duckling". A male duck is called a drake and the female duck is called a duck, or in ornithology a hen.

Nondescript local ducks are ubiquitous in the country and most smallholder farmers keep them under a subsistent level of management (Islam *et al*., 1997) in Bangladesh. Duck comprises about 10% of the total poultry population, occupying second place to chicken in the production of table eggs in the country. It is an important component of farming system and plays a significant role to 80 percent rural people of Bangladesh. It provides cash income and creates employment opportunity for rural people, particularly for small and landless farmers (Khan *et al*., 1999). It appears that the ducks can be raised cheaper than broiler and if market is properly organized. They are mainly kept in the traditional scavenging system, but in fact there is not only one system rather at least two different sub-systems: defined by the absence or presence of large water bodies with large water bodies being associated with big duck flocks from around one hundred to more than one thousand .

Common ducks are believed to have originated from the Mallard (Anas platyrhynchos). Some of the better known breeds of common ducks include the Pekin, Asylesbury, Rouen, Call, Indian Runner, Khaki Campbell, Cayuga, Albio, Maya, and Tsaiya. Different breeds and varieties of common ducks can interbreed and produce fertile offspring (William and Tirath, 2008).

Bangladesh is quite suitable place for rearing Duck. Ducks are omnivorous, feeding on aquatic plants and grasses, their roots, seeds, stems and leaves, and they also feed on terrestrial vegetation, including agricultural crops (Dye and Stai, 2004).

Duck population in Bangladesh has been reported to be 45.12 million (BER 2012) mostly of indigenous type although genetic dilution in some regions has occurred due to distribution of high yielding breeds or strains. Ducks in Bangladesh are traditionally reared as family poultry following free range scavenging system. Farmers, who cannot afford to keep large animals because of the big investment required, can easily maintain a few chicken or ducks within their homestead premises (Das *et al.,* 2008). Both duck eggs and meat from indigenous birds are very popular in many regions of the country and therefore play a vital role in the socio-economic structures of predominantly agricultural country. The geographical location, climate and environmental condition of Bangladesh in some northern and southern districts particularly coastal areas are favourable for successful duck production. This is due to availability of natural feed resources in large areas of lo w lying water reservoirs, abundant marshy land and water logged areas. Natural feed resources like aquatic weeds, various types of insects, tadpoles, earthworms, oysters, snails and crabs, a variety of small fishes, green forages and different fallen grains are good sources of nutrients for ducks. Ducks rank second, next to chicken in the country in terms of total egg and meat production (Ahmed, 1986). It has been stated that national share of egg production from commercial and family poultry is almost equal and that of meat production is 60:40 (Bhuiyan, 2011) in Bangladesh. Ducks are efficient converter of agricultural by-products like seeds, grain and grain by-products. In addition, garden left over, insects, green grasses, kitchen wastes, and all other human refusal are better utilized for feeding ducks if properly planned that could otherwise be wasted (Pervin *et al*., 2016)

Duck rising is a lucrative livestock industry in the globe because of its egg, meat and feather. Like chicken, ducks are reared for eggs and meat. Duck eggs are relatively larger, weighing about 4.5% of duck's body weight, compared to chicken, whose egg weight is only about 3.3% of the hen's body weight (Narhari, 2009). Moreover, ducks are more prolific than chicken and more adaptable to free-range system of rearing. They also grow faster than chicken. That is why; they are more popular in many European and Asian countries. They need simple housing, compared to chicken.

Moreover, duck meat is highly demandable for people of all over Bangladesh which is also considered as low cost, easy to handle, highly productive, adaptability to stressful environmental conditions, comparatively more resistant to common diseases. It serves dual purpose-egg and meat, which accounts for about 6.34% (42.68 million) of total poultry population (270.71 million), occupying second place next to chicken in the production level (Bangladesh Economic Review, 2010, and 2012). Similarly, in the report of Food and Agriculture Organization (FAO), it is evident that the position of Bangladesh with respect to duck meat and egg production is 11th and 4th, respectively among the Asian countries (Pingel, 2011).

There is an increasing demand for animal protein, and duck production may be able to help meet this demand (Solomon *et al*., 2016). Ducks are able to adapt to a wide range of environmental and natural conditions, which may be the reason for the increasing importance, and popularity of the duck industry in Bangladesh. The numerous waterways and the high temperature and humidity of this country provide an ideal environment for duck rearing.

3.1.1 Duck Egg

Duck eggs are excellent for general eating and baking purposes, even duck eggs typically have slightly higher cholesterol content than the average chicken egg. When eggs are eaten in moderation, the difference in cholesterol between duck and chicken eggs probably is insignificant for healthy people who get adequate exercise and eat sensibly. Market eggs must be cooled as soon after laying as is practical. The storage room should be kept at 7.2°C (45°F), with 80% relative humidity (Bell and Weaver, 2002). According to Sonaiya and Swan (2004) eggs set for the first six days are called new eggs, those between days 6 to 13 are in between eggs and eggs after day 13 are old eggs. Egg white viscosity differs in various areas of the egg. The height of the albumen is one of the principal characteristics used to judge interior egg quality. Height of 8 to 10 mm, are considered as indicators of superior interior quality. The quantity of thick albumen in the freshly laid egg is affected by genetics, duration of continuous production, and environmental factors. Egg quality and albumen quality deterioration in particular, can be slowed down significantly by maintaining egg temperature near the freezing point. Egg quality is affected by genetic, maternal and environmental effects (Cherry and Morris, 2008). According to as cited by (Bell and Weaver, 2002), the egg that held at 7.2°C, over a 7- day period had significantly

better quality when compared with the egg that held at 13.8°C. Quality determines the acceptability of a product to potential purchasers. The quality of eggs and the preservation of this quality during storage is a function of their physical structure and chemical composition. Egg white (albumen) characteristics showing good egg quality are thick albumin fullness and albumin transparency. The pH of eggs may give some indication of quality. As carbon dioxide escapes from egg white, the pH increases from near neutral (pH 7.0) to as high as 9.5. This is accompanied by the development of watery whites (Winter and Funk. 1960). Egg storage systems must me*et al*so interior quality to the maintained, indicated by a good proportion of a thick white, a firm and good flavour of yolk and albumen. The grade of table eggs depends to a major degree on the firmness or gel structure of the albumen (Leeson and Summers, 2001). The egg with affirm albumen have greater quantities of ovomucin. According to Daghir (2001) there are effects of high temperature and relative humidity on egg composition. The albumen weight in 20°C with 50% RH, are 37.5g. According to Daghir (2001), that high ambient temperature has a negative effect on egg quality. High temperature is known to increase respiratory rate, which alters the acid-base balance. Eggs in a hot environment should be collected more often and cooled quickly in a properly equipped egg storage room, to maintain their internal quality (Lengkey *et al*., 2012). Hatchability is an important economic trait in domestic poultry production (YUAN *et al*., 2013). It can be affected by genetic factors, age of breeder flock, nutrition, disease, egg quality, egg storage and incubation conditions.

3.2 Rice Bran

Rice bran is a byproduct of the rice industry. The bran is the hard outer layer of rice grains that is removed when processing brown rice into white.

3.2.1 Composition

Rice bran is rich in protein and fat. It also contains high levels of the B-vitamins, vitamin E, and some trace minerals.

3.2.2 **Nutrient content of rice bran** (Batal and Dale, 2010)

- Dry matter: 91%
- Metabolizable energy: 2040 kcal/kg (1000 kcal/lb)
- Crude protein: 13.5%
    - Methionine: 0.17%
    - Cysteine: 0.10%
    - Lysine: 0.50%
    - Tryptophan: 0.10%
    - Threonine: 0.40%
- Crude fat: 5.9%
- Crude fiber: 13.0%
- Ash: 11.0%
    - Calcium: 0.10%
    - Total phosphorus: 1.70%
    - Non-phytate phosphorus: 0.24%

3.2.3 **Feeding Rice Bran**

Rice bran is prone to rancidity, has a high phytate content, contains an enzyme inhibitor (trypsin inhibitor), and is high in fiber (Gallinger *et al*., 2004). These characteristics have limited the use of rice bran in poultry diets. A maximum of 10-20% is recommended in broiler diets, depending on the geographical origin of the rice and the level of supplemental enzymes used (Martin and Farrell, 1998a).

Recommended inclusion levels in broiler diets vary from 10 to 20% (Gallinger *et al*., 2004 and Farrell, 1994, respectively). Gallinger *et al*. (2004) reported that inclusion of 20% rice bran in broiler diets resulted in reduced growth performance. In addition, adding just 10% rice bran reduced feed efficiency and tibia ash content. Others have recommended that rice bran not be include in diets of broilers less than 21 days of age (Martin and Farrell, 1998b).

Higher levels are possible with ducklings and laying hens (Farrel, 1994). While 60% rice bran has been successfully used in layer diets, an upper limit of 45% is more widely accepted (Farrell, 1994). The use of feed enzymes has had only limited success, although phytase has been shown to increase phosphorus availability (Farrell, 1994). When including

high levels of rice bran in duckling diets, the inclusion of 5% fish meal has been shown to increase growth performance (Martin *et al*., 1998).

The traditional diets for monogastric livestock, especially chickens and ducks, are based on rice, either paddy rice or rice by-products, such as broken rice and rice bran. As reported by Lung and Man (1999), broken rice and rice bran are widely used, and provide up to 80-90% of the energy in diets for growing ducks, and rice bran commonly accounts for 20% of the energy for both growing and breeding ducks. With the recent expansion of animal production, the demand, and consequently the price, for these feeds have increased. Since the price of rice also fluctuates widely, the profitability of duck production varies (Becerra, 1994). Some producers use commercial concentrates for feeding in intensive confined systems, which can give good performance results, but low profits.

Annually, rice mills produce large quantities of grain for export, as well as the by-products (rice husk, rice bran and broken rice). The broken rice is not as valuable as rice grain but it also can be exported or used locally for human consumption. Rice bran is the outer layer of the brown rice kernel (after separating the husk) which is removed while milling brown rice to white. Rice bran is a rich source of nutrients and a pharmacologically active compound and is currently used as livestock feed and for oil production (Tahira *et al.,* 2007). According to Houston (1972), rice bran often occupies 5-8 percent of paddy rice (whole grain). Commonly, in Vietnam, the rice mills have produced three kinds of rice bran: the initial bran (mixed with rice husk fragments) and two types of bran produced in the polishing process which are very fine and have higher nutritive value than the initial bran. In the Mekong Delta, rice bran is cheaper than paddy rice and broken rice so it is the most widely available feed resource for duck production.

On a experiment of Hussein *et al*., (2009) results indicated that rice bran (RB) resulted in non significant effect on Live Body Weight (LBW), Body Weight Gain (BWG), Mortality Rate (MR), Feed Consumption (FC) and Feed Conversion Ratio (FCR) of ducklings from one-day to 12 weeks of age. All studied parameters of plasma constituents of both male and female ducklings were not significantly affected by different treatments with the exception of plasma triglycerides and total cholesterol. Plasma triglycerides of male ducklings were significantly ($P<0.01$) decreased in the group fed diet contained 24 % RB only, whereas, it were significantly ($P<0.01$) decreased in the groups fed diets contained 16 and 24 % RB in female ducklings. Plasma total cholesterol of both male and female ducklings was

significantly decreased (P<0.05) in the group fed diet contained 24 % RB as compared to the control group. Carcass characteristics and quality were not significantly affected by different treatments with the exception of ether extract and total cholesterol content of both male and female duckling muscle which were significantly (P≤ 0.01) decreased by feeding RB at levels of 16 and 24 % as compared to the control group. The experimental treatments resulted in improvement net return and economical efficiency. These results indicated that RB could be used in ducklings diets up to 24 % to maximize the productivity and profitability in addition to the carcass quality and economical efficiency of Domyati ducklings.

According to (Samli *et al*., 2006) Rice bran is an energy and protein rich ingredient used in poultry feeding. To balance energy and protein requirements they examine the effects of rice bran on performance and egg quality during peak production of a commercial White laying strain of 22 week of age. Dietary treatments were consisted by inclusion of rice bran at 0, 5, 10 and 15% levels. Each treatment had 6 reps in which 12 birds were randomly assigned in wired fl oor battery cages equipped with nipple drinkers and through feeders. Layers accessed to feed and water freely. Lighting regimen was adjusted to 16h light/8h dark. The experiment lasted for 10 weeks. Overall results of the experiment indicated that rice bran could be included up to 10% without any adverse effect on laying performance, egg quality and digestive organs.

Ruan (2015) evaluate the effects of different dietary levels of rice bran (RB) in laying duck diets on performance, egg quality, oxidation status, egg yolk fatty acid composition, and hepatic expression of fatty acid metabolism-related genes. Longyan females (1080) with similar BW at 19 wk of age were randomly assigned to 6 dietary treatments, each consisting of 6 replicates of 30 birds. The basal diet (I) was a typical corn-soybean ration while the experimental diets (II to VI) substituted RB for corn and wheat bran and a small reduction of soybean meal. The level of substitution in diets (II to VI) was 6%, 12%, 18%, 24%, and 30%, respectively. The experiment lasted for 12 wks. Average egg weight and daily egg mass decreased linearly as the level of RB inclusion increased (P<0.001) and feed conversion ratio linearly increased (P<0.001).

Rice bran was added in poultry feed by replacing 20% maize or 15% wheat. Significant difference in weight gain, feed consumed, Feed Conversion Ratio (FCR), dressing percentage, pancreas weight, feed cost/chick, feed cost/kg live weight and feed cost/kg

dressed meat was observed. Insects and larvae were found to be dead in PRB (processed rice bran). The highest weight gain (growth rate), feed efficiency and dressing percentage were obtained in chicks fed on T4 which also showed the minimum feed cost/kg live weight and feed cost/kg dressed meat. Thus, acetic acid treatment combined with extrusion cooking improved the nutritive value of rice bran and also minimized the toxic factors. T2 (RRB = raw rice bran) exhibited poor performance. The pancreas weight of chicks was normal by feeding extruded rice bran. PRB can be an excellent substitute of maize and wheat for good quality of poultry feed. It can improve nutritional quality of poultry feed which has been reflected by the performance of PRB in different parameter of chicks. It is helpful to give high yield of chicks and to utilize a by-product (rice bran) as good quality feed ingredient for value addition of poultry feed (Shaheen *et al*., 2015).

Morrison (1959) claimed that rice bran and germs removed in milling rice contains 12.4% protein and 13.6% fat with 11.6% fiber, a composition which plays a very important role in the body processes and which insures a fairly high gain in weight. A major rice bran fraction contains about 13% oil and 44% of highly unsaponifiable components. It also contains a major amount of dietary fibers like beta glucan, gum and pectin. The oil present in the rice bran is a rich source of vitamin E, vitamin B, minerals and other essential acids.

3.3 Duckweed

Duckweed species are small floating aquatic plants found worldwide and often seen growing in thick, blanket-like mats on still, nutrient-rich fresh and brackish waters. They are monocotyledons belonging to the botanical family *Lemnaceae* and are classified as higher plants, or macrophytes, although they are often mistaken for algae. The family consists of four genera, *Lemna, Spirodela, Wolffia,* and *Wolffiella,* among which about 40 species have been identified so far. All species occasionally produce tiny almost invisible flowers and seeds, but what triggers flowering is unknown. Many species of duckweed cope with low temperatures by forming a special starchy .survival" frond known as a turion. In cold weather, the turion forms and sinks to the bottom of the pond where it remains dormant until warmer water triggers resumption of normal growth (Journey *et al*., 2001).

3.3.1 Morphology

Duckweed species are the smallest of all flowering plants. Their structural and functional features have been simplified by natural selection to only those necessary to survive in an

aquatic environment. An individual duckweed frond has no leaf, stem, or specialized structures; the entire plant consists of a flat, ovoid frond. Many species may have hair-like rootlets which function as stability organs (Journey *et al*., 2001).

Species of the genus *Spirodela* have the largest fronds, measuring as much as 20 mm across, while those of Wolffia species are 2 mm or less in diameter. *Lemna* species are intermediate size at 6 - 8 nm. Compared with most plants, duckweed fronds have little fiber - as little as 5 percent in cultured plants **-** because they do not need structural tissue to support leaves or stems. As a result virtually all tissue is metabolically active and useful as a feed or food product. This important characteristic contrasts favorably with many terrestrial crops such as soybeans, rice, or maize, most of whose total biomass is left behind after the useful parts have been harvested (Journey *et al*., 2001).

3.3.2 Distribution

Duckweed species are adapted to a wide variety of geographic and climatic zones and can be found in all but waterless deserts and permanently frozen polar regions. Most, however, are found in moderate climates of tropical and temperate zones. Many species can survive temperature extremes, but grow fastest under warm, sunny conditions. They are spread by floods and aquatic birds.

Duckweed species have an inherent capability to exploit favorable ecological conditions by growing extremely rapidly. Their wide geographic distribution indicates a high probability of ample genetic diversity and good potential to improve their agronomic characteristics through selective breeding. Native species are almost always available and can be collected and cultivated where water is available, including moderately saline environments (Journey *et al*., 2001).

3.3.3 Growth conditions

The natural habitat of duckweed is floating freely on the surface of fresh or brackish water sheltered from wind and wave action by surrounding vegetation. The most favorable circumstance is water containing decaying organic material to provide duckweed with a steady supply of growth nutrients and trace elements. A dense cover of duckweed shuts out light and inhibits competing submerged aquatic plants, including algae. Duckweed fronds are not anchored in soil, but float freely on the surface of a body of water. They can be dispersed by fast currents or pushed toward a bank by wind and wave action. If the plants

become piled up in deep layers the lowest layer will be cut off from light and will eventually die. Plants pushed from the water onto a bank will also dry out and die. Disruption of the complete cover on the water's surface permits the growth of algae and other submerged plants that can become dominant and inhibit further growth of a duckweed colony (Journey *et al*., 2001).

3.3.4 Production rates

Duckweed reproduction is primarily vegetative. Daughter fronds bud from reproductive pockets on the side of a mature frond. An individual frond may produce as many as 10 generations of progeny over a period of 10 days to several weeks before dying. As the frond ages its fiber and mineral content increases and it reproduces at a slower rate. Duckweed fronds can double their mass in two days under ideal conditions of nutrient availability, sunlight, and temperature. This is faster than almost any other higher plant. Under experimental conditions their production rate can approach an extrapolated yield of four metric tons/ha/day of fresh plant biomass, or about 80 metric tons/ha/year of solid material. This pattern more closely resembles the exponential growth of unicellular algae than that of higher plants and denotes an unusually high biological potential. Average growth rates of unmanaged colonies of duckweed will be reduced by a variety of stresses: nutrient scarcity or imbalance; toxins; extremes of pH and temperature; crowding by overgrowth of the colony: and competition from other plants for light and nutrients. Actual yields of fresh material from commercial-scale cultivation of *Spirodela, Lemna,* and *Wolffia* species at the Mirzapur experimental site in Bangladesh range from 0.5 to 1.5 metric tons/ ha/day, which is equivalent to 13 to 38 metric tons/ha/year of solid material (Journey *et al*., 2001).

3.3.5 Nutritional value

Fresh duckweed fronds contain 92 to 94 percent water. Fiber and ash content is higher and protein content lower in duckweed colonies with slow growth. The solid fraction of a wild colony of duckweed growing on nutrient-poor water typically ranges from 15 to 25 percent protein and from 15 to 30 percent fiber. Duckweed grown under ideal conditions and harvested regularly will have a fiber content of 5 to 15 percent and a protein content of 35 to 45 percent, depending on the species involved. Data were obtained from duckweed colonies growing on a wastewater treatment lagoon and from a duckweed culture enriched with fertilizer. Duckweed protein has higher concentrations of the essential amino acids, lysine

and methionine, than most plant proteins and more closely resembles animal protein in that respect (Journey *et al*., 2001).

Duckweed is a monocotyledon species of the family Lemnaceae adapted to grow in water at temperatures between 6 and 33^0C (Leng *et al.,* 1995). It is a small floating aquatic plant that grows very well on stagnant ponds and is commonly found throughout tropical countries (Leng *et al.,* 1995). Crude protein yields of between 6 and 10 tonnes/ha/year have been recorded when the N content in the water is in the range of 10 to 30 mg/liter (Nguyen Duc Anh, 1997b). Not only the yield but also the crude protein of duckweed responds to the nutrient content of the water, increasing from 15% in DM with 10 mg N/liter to 40% crude protein in DM with 60 mg N/litre (Rodriguez and Preston, 1996). Many trials have been carried out using duckweed as the major feed to raise fish, pig, chicken and also ducks. The use of duckweed as poultry feed has been recognized by many authors (Haustein *et al.,* 1987, 1990; Islam *et al.,* 1997; Leng, 1999; Samnang, 1999). Duckweed has high crude protein content and a well balanced amino acid profile and is also a good source of vitamins and minerals for livestock (Landolt and Kandeler, 1987; Men *et al.,* 2001). Even though the moisture content of duckweed can be the first limiting factor for chickens, duckweed can play important role in poultry feeding.

Duckweeds have received research attention because of their great potential to remove mineral contaminants from waste waters emanating from sewage works, intensive animal industries or from intensive irrigated crop production. Duckweeds need to be managed, protected from wind, maintained at an optimum density by judicious and regular harvesting and fertilised to balance nutrient concentrations in water to obtain optimal growth rates. When effectively managed in this way duckweeds yield 10-30 ton DM/ha/year containing up to 43% crude protein, 5% lipids and a highly digestible dry matter. Duckweeds have been fed to animals and fish to complement diets, largely to provide a protein of high biological value. Fish production can be stimulated by feeding duckweed to the extent that yields can be increased from a few hundred kilograms per hectare/year to 10 tonnes/ha/year. Mature poultry can utilise duckweed as a substitute for vegetable protein in cereal grain based diets whereas very young chickens suffered a small weight gain reduction by such substitution (Leng *et al*., 1995).

Duckweed grows well in waste water and can double its weight in 24h (Leng *et al.,* 1995). Duckweed leaves have a low fiber content and the protein content can be as high as 35%

(Leng *et al.,* 1995; Bui Huy Nhu Phuc *et al*., 2000). In terms of protein production, grown under ideal conditions it can produce 10 tonnes of protein per hectare per year. This compares with soybean which produces less than 1 tonne/year. Under experimental conditions the annual production reached 183 tonnes/ha of DM, however, under practical conditions a yield of up to 30 tonnes of DM/ha is more feasible (Leng *et al.,* 1995). Withappropriate fertilization of the pond water the protein content can be as high as 35-40% in the dry matter (Le Ha Chau, 1998). It has been shown that fresh duckweed can replace completely the soybean meal in diets of growing ducks with no reduction in growth rate (Bui Xuna Men *et al.,* 1995).

3.4 Taro leaves

Taro commonly refers to the plant *Colocasia esculenta*, the most widely cultivated species of several plants in the Araceae family which are used as vegetables for their corms, leaves, and petioles. Thus, this article describes the "dasheen" form of taro; another variety of taro is known as *eddoe* or *Colocasia antiquorum*. Other species of taro include giant taro (Alocasia macrorrhizos), swamp taro (Cyrtosperma merkusii), and arrowleaf elephant's ear (Xanthosoma sagittifolium).

Taro (*Colocasia esculenta* (L.) Schott) is an ancient crop grown throughout the humid tropics for its edible corms and leaves, as well as other traditional uses. It occupies a significant place in the agriculture of the Asia-Pacific Region and supplies much-needed protein, vitamins and minerals, in addition to carbohydrate energy (Inno Onwueme, 1999). The New Cocoyam (also referred to as "Giant Taro") is a member of the family of Araceae, of which there are one hundred genera and more than fifteen hundred species. Their preferred habitats are in tropical or subtropical environments which are moist and shady. Some are terrestrial plants while others are vines, creepers, or climbers. Many species of the Araceae are also epiphytes. The major edible species are classified in two tribes and five genera: Lasioideae (*Cyrtosperma* and *Amorphophallus*); and Colocasiodeae (*Alocasia*, *Colocasia*, and *Xanthosoma*). Taro (*Colocasia esculenta* [L.] Schott) is considered as a single polymorphic species.

The leaves of the Taro species (*Colocia esculenta, Alocasia macrorrhiza, Xanthosoma sagittifolium*) have attracted attention because they are rich in protein, and good sources of vitamins and minerals. Taro species are found growing in the wild state in mountain areas, in forests and in ponds and other water surfaces (Ngo Huu Toan and Preston, 2007; Pheng

Buntha *et al.,* 2008). The taro leaf has a high nutritional value (Du Thanh Hang and Preston, 2009); however, it has an anti-nutritional substance, calcium oxalate, which is found in all parts of the plant, causing irritation in the throat and mouth epithelium and indirectly affecting the feed intake. The influence of calcium oxalate can be reduced by ensiling with molasses (Malavanh Chittavong *et al.,* 2008), or by ensiling the leaves and stems together without any further additive (Rodríguez and Preston 2009; Du Thanh Hang and Preston, 2010; Nguyen Tuyet Giang and Preston, 2011).

3.4.1 **Distribution** (Heuzé *et al.*, 2015)

Taro is native to India and the Malay peninsula, and is now cultivated throughout tropical and subtropical Asia, Pacific Islands (including northern Australia), the Caribbean and tropical Africa (from East to West). It was recently introduced in the southern USA. Optimal growth conditions are temperatures of 21-28°C, with an annual rainfall between 1800 and 2700 mm. Taro is found from sea-level up to an altitude of 1000 m or, close to the equator, 2300-2700 m. It tolerates a wide range of sunlight conditions, from full sun to shaded conditions in intercropping systems with coconut, coffee or cocoa trees. Wetland cultivars perform best on heavy soil with high-moisture-holding capacity, and pH ranging from 5.5 to 6.5. They tolerate flooded conditions and some varieties can grow under water. Dryland cultivars prefer well-drained, deep, loamy and friable soils. They are drought hardy and tolerate waterlogged conditions and slight frosts.

3.4.2 **Nutritional value of Taro** (Adejumo *et al.*, 2013)

The use of taro in animal and poultry nutrition is however limited by the presence of anti-nutritional factors such as tannins, saponins, oxalates, phytates, and hydrocyanide. Processing techniques such as boiling or cooking, soaking, ensiling and drying have been shown to reduce the effects of these anti-nutritional factors on the animals. Corms of cocoyam are known to supply easily digestible starch, substantial amount of protein, thiamine, vitamin C, riboflavin, niacin, as well as significant amounts of dietary fiber. Leaves of taro are eaten as vegetable by human, having β carotene, iron, protein, vitamins and folic acid which protects against anemia. The major nutrient in taro corms is dietary energy. The most abundant minerals in *Colocasia esculenta* are potassium, phosphorus, magnesium, and calcium. Figure 1, 2 and 3 show the nutrient composition of taro, chemical characteristics of taro leaves, mineral contents of Colocasia esculenta and Xanthosoma sagittifolium and chemical composition of differently processed taro leaves respectively.

Parameters	Raw oven dried	Raw sundried	Raw cabinet-dried	SWCC	CWCC	FWCC
Dry matter (%)	90.57	88.42-89.53	89.87	88.06	88.64	87.90
Crude protein (%)	5.17	4.93-7.07	5.07	6.56	6.13	7.44
Crude fiber (%)	2.97	2.70-3.90	2.83	3.75	3.55	3.45
Ether extract (%)	0.57	2.47-2.93	0.50	2.86	2.76	2.63
Ash (%)	2.87	0.50-1.10	2.77	0.95	0.75	0.88
Carbohydrate (%)	79.00	73.43-78.93	78.70	73.90	75.46	73.50
ME (Kcal/kg)	NA	2958.34	NA	2943.70	2966.82	2956.52

SWCC= soaked taro; CWCC= cooked taro; FWCC= fermented taro
Source: Olajide et al. (2011); Ndabikunze et al. (2012)

Figure 1: Nutrient Composition of Taro

Parameters	Ensiled taro leaves	Dried taro leaves
Dry matter (%)	18.30-22.60	92.20
As % in dry matter		
Crude protein (%)	25.90-26.30	26.70
Crude fiber (%)	17.10	15.20
Organic matter	8.30-8.53	8.70
Calcium oxalate	0.11	1.10

Source: Chhay et al. (2007); Pheng et al. (2008)

Figure 2: Chemical Characteristics of Taro leaves

Processing	Dry matter (%)	Crude protein (%)	Crude fiber (%)	Ash (%)	Oxalates (mg/100g)
Fresh leaves	13.70	25.30	11.40	10.50	760.00
Drying by sunlight	88.40	25.60	11.30	13.30	600.00
Soaking	17.20	25.60	11.50	10.50	570.00
Cooked	9.60	25.60	11.30	10.40	360.00
Ensiled	17.00	25.30	11.00	10.50	350.00

Source: Hang and Preston (2010)

Figure 3: Chemical Composition of Differently Processed Taro leaves

3.4.3 **Feeding Processes** (Heuzé *et al*., 2015)

Due to their oxalate content, it is recommended to soak, wash or cook taro corms and dry or ensile leaves before feeding them to livestock. Ensiling taro leaves with sugarcane molasses (4%) decreased the oxalic acid content from 2.2% to 0.3% on a DM basis. Ensiling with sugarcane syrup (5%) decreased oxalic acid content from 3.08% to 0.11%, although dried leaves contained 1.1%. Boiling sun-dried taro corms reduced their oxalate, tannin and saponin contents.

3.5 Hematology of duck

It has been documented that use of blood examination is a way of assessing the health status of bird along with diagnosis and clinical monitoring of any disease (Kenneth and Dorothee, 2010). This is because it plays a vital role in physiological, nutritional and pathological status of organisms (Jain, 1993). Haematological parameters are related to the blood and blood-forming organs. Improving the productivity of any animal necessitates the understanding of its physiology including hematological characteristics. Hematological studies are usually undertaken to establish the diagnostic baselines of blood characteristics for routine management practices of farm animals (Orji *et al*., 1986). For example, hematological constituents usually reflect the physiological responsiveness of the animal to its external and internal environments and thus serve as a veritable tool for monitoring animal health.

CHAPTER 3

MATERIAL AND METHODS

CHAPTER 3

MATERIAL AND METHODS

4.1 Study Area

The experiment was conducted from January 2016 to May 2016 in a household of Gaibandha.

4.2 Experimental treatments and design

The ducks were grouped randomly as T_1, T_2, T_3 and T_4. Each group comprised of five ducks and was allocated to different respective treatment. The initial body weights of each duck were recorded. The egg production, body condition, body weight and haematological parameters were also recorded on post treatment. Adult common female ducks were fed a basal diet of rice bran and assigned to 4 dietary treatments with five birds per group in a Completely Randomized Block Design (CRBD), as follows:

1. **T_1 = Rice Bran (RB):** 80% RB, 20% Soybean (Sb)
2. **T_2 = Rice Bran + Duck weed (DW):** 40% RB, 40% DW, 20% Sb
3. **T_3 = Rice Bran + Taro leaf (TL):** 40% RB, 40%TL, 20% Sb
4. **T_4 = Rice Bran + Taro leaf + Duck weed:** 40% RB, 20% TL, 20% DW, 20% Sb

From the above observation, the following were computed:

I. Body weight gain (kg): This was obtained by subtracting the initial weight from the date of weighing the weight of the ducks.
II. Total gain in weight (kg): This was obtained by subtracting the initial weight from the final weight of the ducks.
III. Feed consumption (kg): This was taken by subtracting the total feed offered from the total feed left over.
IV. Feed Conversion Ratio (FCR): This was obtained by dividing the total feed consumption by the total gain in weight.

4.3 Birds and housing

Common ducks (n=20) of 20 – 23 weeks age where all were female, were purchased from farmers and raised in pens (5 ducks per pen) for four month, made from bamboo and wood with dimensions of: width 0.5 m, length 0.5 m and height 0.5 m. There were spaces in the pen floor to let the feces go through. The house was made of bamboo with a thatch roof and open sides to facilitate ventilation.

4.4 Feeding and management

First; all ducks were treated with anthelmintic piperazine citrate, doses of 1 gm for 7 ducks. After seven days of deworming, all ducks were vaccinated against duck plague virus disease. The ingredients were fed as a completely mixed ration. The ducks were vaccinated against bird flu before the experiment started. Water and feed was supplied as ad-libitum.

The duckweed (Photo 6) and Taro leaves (Photo 7) were collected from areas around the University where they were growing naturally. Rice bran and soybean meal was bought from the market. Feeds were offered three times per day at 07:00 am, 11:30 am and 4:30 pm; water was freely available.

The duckweed (Photo 6) was collected each morning and mixed immediately with the rice bran in quantities sufficient for one day. The leaves and stems of Taro leaf were combined and chopped into small pieces before mixing with the rice bran. After harvest the leaves were chopped into small pieces of around 2-3 cm of length and supplied to ducks.

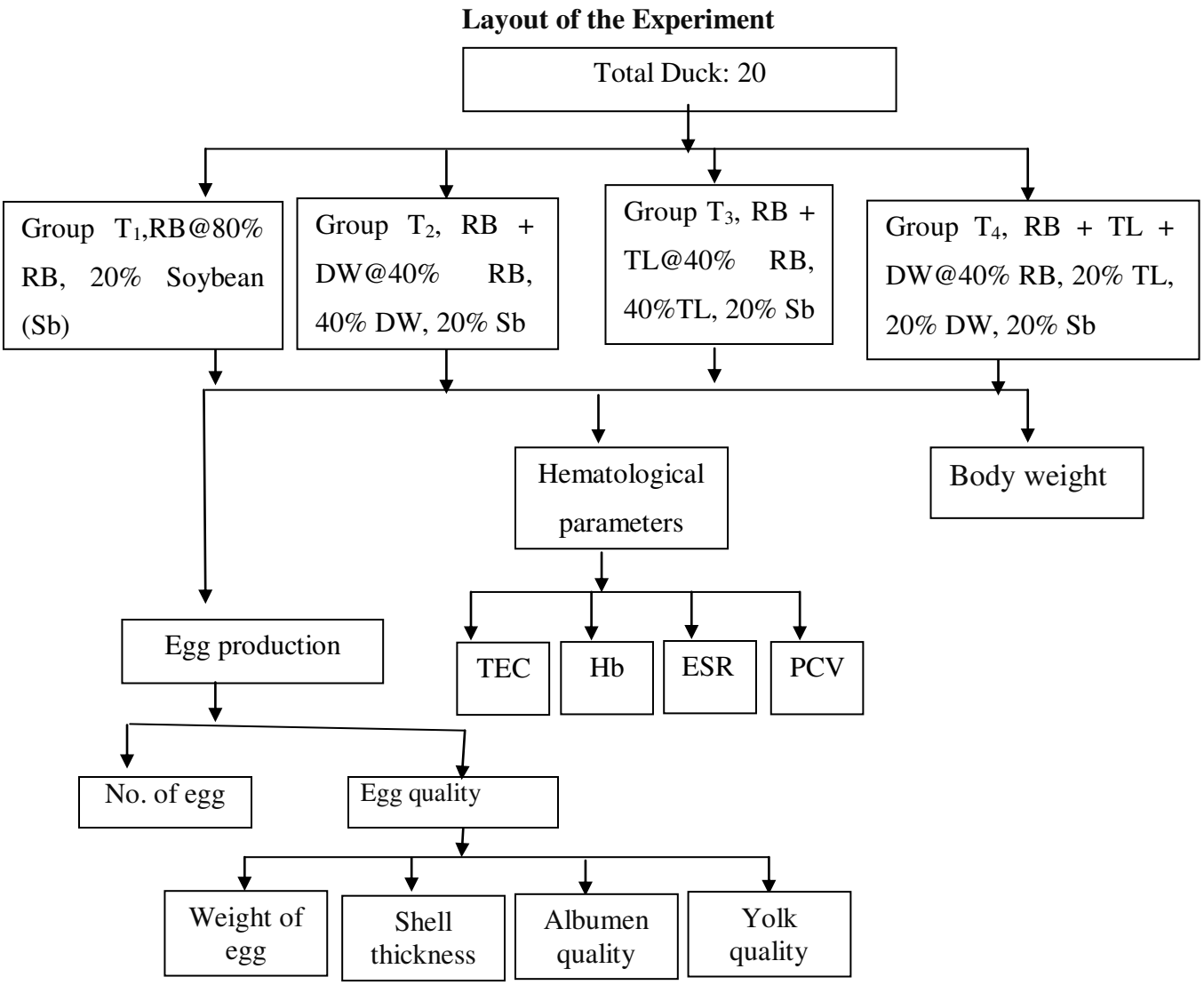

Figure 4: Layout of the experimental design (each group consisting of five duck)

Photo Plates

Figure 5: Common Duck of Experiment

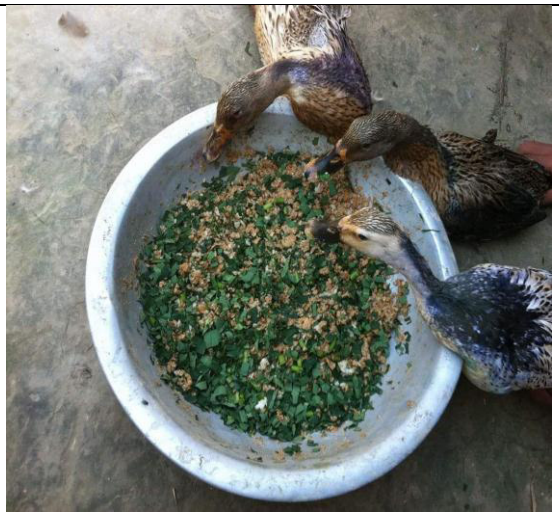

Figure 6: Feeding of Experimental Duck

Figure 7: Duckweeds

Figure 8: Taro Plants

Figure 9: Rice Bran

Figure 10: Weighing feed

Figure 11: Duck - Laying egg

Figure 12: Keep recording by numbering on egg

3.5 Hematological test

Blood was collected aseptically with sterile syringe and needle either from heart or from the wing vein of four different groups of birds. The ducks were bled between 9 and 10.30 am from a punctured wing vein to aspirate 7 ml of blood from each duck. Two milliliter of each blood sample was discarded into Ethylene Di-amine Tetra Acetic acid (EDTA- .2 mg / ml of blood) treated Bijou bottles for hematological assay. The remaining 5 ml of each blood sample were allowed to coagulate to produce sera for blood chemistry measurements. Blood samples were collected from four groups to study the effect of experiment at blood serum level and the following parameters were observed:

(a) Total erythrocyte count (TEC)
(b) Hemoglobin estimation (Hb)
(c) Packed cell volume (PCV)
(d) Erythrocyte sedimentation

Blood samples were analyzed within 3 hours of their collection for total erythrocyte, hematocrit (PCV), hemoglobin and erythrocyte sedimentation rate (ESR) according to the methods described by Dein. Erythrocyte count (RBC) was done in a hemocytometer chamber. PCV was measured by the microhematocrit method with 75 x 16 mm capillary tubes filled with blood and centrifuged at 3000 rpm for 5 min. Differential count of leukocytes was made from blood smears stained with Wright's dye and each type of cell was counted with a laboratory counter. Hemoglobin concentration (HBC) was also measured by the cyanmethemoglobin method. Various hematological indices like mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were calculated from results obtained. Erythrocyte sedimentation rate (ESR) was determined within six hours of sample collection according to the methods described by Orji *et al.* (1986). Clotting time was determined using the glass slide method.

3.5.1 Determination of Total erythrocyte count (TEC)

Total erythrocyte count was done following the method described by Lamberg and Rothstein (1977). Well-mixed blood sample was drawn with red blood cell diluting pipette exactly up to 0.5 marks of the pipette. Outside of the tip of the pipette was wiped with cotton. Then the pipette was immediately filled with the red cell diluting fluid (Hayem's solution) up to 101 marks. The free end of the pipette was wrapped around with the rubber

tube stretching to both the ends and held with thumb and middle finger. The content of the pipette was mixed thoroughly by shaking with 8-knot motion for 3-5 minutes. Then the counting chamber was placed with special cover glass under microscope using low power (10X) objectives. After discarding 2 or 3 drops of fluid from the pipette, a small drop was placed to the edge of the cover glass on the counting chamber as the entire area under the cover glass was filled by the fluid. One-minute time was spared to allow the cells to settle on the chamber under the cover glass. Taking 5 larger squares (4 in the 4 corners and the central one) of the central large square, the cells were counted from all the 80 small squares (16 x 5) under high power objectives (45X). After completion of counting, the total number of RBC was calculated as number of cells counted x 10, 000 and the result was expressed in million/µl of blood.

3.5.2 Determination of Hemoglobin concentrations (Hb)

The N/10 hydrochloric acid was taken in a graduated tube up to 2 marks with the help of a dropper. Well-homogenized blood sample was then drawn into the Sahli pipette up to 20 cm. mark. The tip of the pipette was wiped with sterile cotton and the blood of the pipette was immediately transferred into the graduated tube containing hydrochloric acid. This blood and acid were thoroughly mixed by stirring with a glass stirrer. There was a formation of acid hematinic mixture in the tube by hemolysing red blood cells by the action of hydrochloric acid (HCL). The tube containing acid hematin mixture was kept standing in the comparator for 5 minutes. After that distilled water was added drop by drop. The solution was mixed well with a glass stirrer until the color of the mixture resembled to the standard color of the comparator. The result was read in daylight by observing the height of the liquid in the tube considering the lower meniscus of the liquid column. The result was then expressed in gm %. The above procedure was matched by the Helligehemometer method as described by Lamberg and Rothstein (1977).

3.5.3 Determination of Packed cell volume (PCV)

The citrated well mixed blood sample was drawn into special loading pipette (Wintrobe pipette). The tip of the pipette was inserted up to the bottom of a clean, dry Wintrobe hematocrit tube. Then the Wintrobe tube was filled from the bottom by pressing the rubber bulb of the pipette. As blood came out, the pipette was slowly withdrawn but pressure was continued on the rubber bulb of the pipette so as to exclude air bubbles. The tip of the pipette was tried to keep under the rising column of blood to avoid foaming and the tube

was filled exactly to the 10 cm mark. Then the Wintrobe hematocrit tube was placed in the centrifuge machine and was centrifuged for 30 minutes at 3000 rpm. Then, the hematocrit or PCV was recorded by reading the graduation mark; the percent volume occupied by the hematocrit was calculated by using the following formula as described by Lamberg and Rothstein (1977).

$$PCV\% = \frac{\text{Height of the red cell volume in cm}}{\text{Height of total blood in cm}} \text{ X } 100$$

3.5.4 Determination of Erythrocyte sedimentation rate (ESR)

The fresh anticoagulant blood was taken into the Wintrobe hematocrit tube by using special loading pipette exactly up to 0 marks. Excess blood above the mark was wiped away by sterile cotton. The filled tube was placed vertically undisturbed on the wooden rack for one hour. After one hour the ESR was recorded from the top of the pipette. The result was expressed in mm in 1st hour.

3.6 Egg production record

Egg production was recorded for each duck at the same time each day during laying period. The incidence of broken eggs and soft-shelled eggs were identified and recorded. The number of eggs laid on successive days by a particular duck determined the length of each sequence and the number of pauses in each hen's oviposition determined the number of sequences. For each layer the length of laying sequence was determined on the day the last egg of the current clutch was laid.

3.6.1 Egg quality

Egg qualities wear measured from those eggs laid by duck of different treatment group. Measured egg qualities wear egg weight, shell dry weight, fresh albumin weight, fresh yolk weight, egg shell thickness, height of the thick albumin, height of the yolk, width of the yolk, width of the egg and diameter of the egg albumin. For quality determination egg weight was recorded by an electric weighing balance. The length of egg was measured by a slide calipers. The width was also estimated by slide calipers. The eggs wear then carefully broken down on a glass plate (40 x 20cm) to determine the internal egg qualities.

3.6.2 Weight of different egg component

The method outlined by Chowdhuri (1988) was followed for partitioning different egg components. At first, egg was broken on glass plate. Then the yolk was separated carefully from albumin with the help of a spatula and transferred to a previously weighed petridish by a spatula and weighed. Precautions wear taken at all stages to avoid rupture of yolk.

The shell of the broken eggs wear rinsed and washed thoroughly in tap water keeping the membranes intake. The washed shells with membrane were immersed in a beaker of water for removal of the shell membranes. The shell and shell membranes wear oven dried separately at 105 cover night keeping them in a glass petridish. On the following day, oven dried shell and shell membranes were taken. Finally the following calculations were made for different components suggested by Chowdhuri (1988).

1. Fresh yolk weight: (weight of yolk + weight of petridish)-weight of petridish.
2. Fresh albumin weight: (Weight of w*et al*bumin + weight of petridish)-weight of petridish.

3.6.3 Shell thickness

After removing of shell membrane, shell thickness (mm) was measured by screw gauge.

3.7 Data collection and analyses

The ducks were weighed at the start and afterwards at 7-day intervals. Feeds offered and refused were recorded daily and representative samples taken every 7 days to determine N following procedures of AOAC (1990) and DM by micro-wave radiation (Undersander *et al*., 1993).

3.8 Statistical analysis

Growth rates of the ducks were calculated as the linear regression of average live weight of the ducks per pen (Y = g) on time (X = days). Data were analyzed by analysis of variance using Completely Randomized Design with factorial arrangement of time and treatments (Steel and Torrie, 1986). All analyses were performed by Mstat and SPSS program.

CHAPTER 4

RESULTS AND DISCUSSION

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Chemical composition

The crude protein content of the duckweed (Table 1) was at the lower end of the range (14 to 40% CP in DM) reported by Rodríguez and Preston (1996) and Keansombath Lampheuy (2003). The crude protein in the Taro leaf silage was similar to what was reported (24.8% in DM) by Rodriguez and Preston (1999) for leaves of New Cocoyam (*Xanthosoma sagittifolium*), a plant from the same family as Taro (*Colocacia esculenta)*. The crude protein in water spinach was slightly higher than values reported by Kean Sophea and Preston (2001) and Le Thi Men and Preston T. R. (1997), where the range was from 18 to 20% in DM. These authors showed that the protein content was increased by fertilization with urea or biodigester effluent N. It was also apparent from their data that the crude protein in the biomass of water spinach was dependent on the actual proportions of leaves and stems in the material harvested, as the stems had only some 25% of the level of protein found in the leaves.

Table 1: Chemical composition of feed ingredients

Feed Ingredients	DM, %	CP in DM, %
Rice bran	89.0	11.4
Duckweed	9.60	23.6
Taro leaf	21.6	22.7

4.2 Growth rate

Development and growth are closely associated processes. Body weight and examined body measurements showed an increasing trend with age in different groups ($P < 0.0001$). DM intakes, final live weight and daily weight gain were similar for supplements of duckweed and rice bran, both of which were better than the supplement with taro leaf silage. The growth rate with Taro leaf silage was inferior to that reported by Giang *et al*. (2010) for a mixed diet of rice bran and taro leaf made from combined leaves and stems. In the present experiment the taro leaf silage was prepared without additives, which may have had a negative effect on palatability of the feed when mixed with the rice bran. It has been shown that the quality of the taro leaf is better when taro stems (which are rich in soluble sugars) are combined with the leaves in the ensiling process (Rodríguez and Preston, 2009).

Table 2: Effects of duckweed and taro leaves on growth performance of ducks

Treatment group	1st week Avg. body weight (g/duck) ± SEM	2nd week Avg. body weight (g/duck) ± SEM	3rd week Avg. body weight (g/duck) ± SEM	4th week average body weight (g/duck) ± SEM	Avg. Body weight gain (g/day/duck) ± SEM
T_0	1524.83 ± 4.42	1561.24 ± 5.69	1834.42 ± 10.54	2082.25^{b} ± 12.75	4.65^{b} ± 1.65
T_1	1533.50 ± 4.41	1570.31 ± 5.58	1875.65 ± 10.55	2114.67^{ab} ± 12.56	4.84^{ab} ± 1.62
T_2	1538.67 ± 4.38	1580.43 ± 5.53	1892.37 ± 10.61	2137.25^{ab} ± 12.66	4.99^{ab} ± 1.61
T_3	1527.27 ± 4.21	1585.67 ± 5.49	1905.43 ± 10.51	2201.30^{a} ± 12.69	5.66^{a} ± 1.60
P-value	0.5457	0.6327	0.5612	<0.0001	<0.0001

SEM: Standard Error of the Mean

$^{a–d}$ Mean values in the same column with no common superscript differ significantly ($P < 0.05$).

Very little research has been done on the effects of including duckweed in diets for growing poultry. However in experiments on duckweed as a source of protein for laying hens it was possible to replace up to 40% of the diet with duckweed without problems. Dried duckweed was included in the diets of two commercial strains of laying hens at 0, 15, 25, and 40% inclusion (Hausten *et al.,* 1990). Egg production and egg weights were compared with those of hens fed a standard isocaloric and isonitrogenous control diet. At all levels of duckweed, hens maintained egg production and had mean egg weights similar to layers fed a control diet. Eggs from Leghorn hens fed 15 and 25% duckweed had higher protein content than control eggs. Also the addition of duckweed to the diets significantly increased yolk pigmentation, an important commercial application for this plant (Hausten *et al.,* 1990). Growth is a complicated process and is controlled by genetic and environmental factors. Genetic factors are described by genotypes and sexes. Brody (1945) stated that growth rate shows variation according to organs and tissues.

In this study highest body gain found in the group of Rice Bran + Duck weed + Taro leaf in male duck (2.06 kg) and lowest found in Rice Bran + Taro leaf group in male duck (1.49kg).

4.3 Week wise Production of Egg

Table 3: Effects of duckweed and taro leaves on egg production of duck

Trait		Egg laying period				
		1st week	2nd week	3rd week	4th week	Average
No. of eggs/ week	T_0	20	21	23	24	22^d
	T_1	21	23	25	27	24^c
	T_2	22	25	25	30	25.5^b
	T_3	21	28	30	33	28^a

In the study it was found that on an average egg production rate increased maximum in T_3 group (Avg = 28) than others and minimum founds in T_0 (Avg = 22) group.

4.4 Egg Values of different Experiment

The differences of attributed factors especially egg weights. Although improved performance is attributed to increased egg weight, subsequent performance differences cannot be fully explained by egg weight differences. The mean weight of eggs laid by ducks at the beginning of the experiment period was 70.8 g and it has increased with the ducks' age up to 80.2 g (Tab. 3). The variance of this trait took the highest value at the beginning of the season (11.2%) and then has decreased gradually. The greatest values of length, width and eggshell area were found in eggs towards the end of the experiment period, while lower values of these traits (statistically significant) were noted at the beginning of the experiment. Earlier research (Górski *et al*., 1998) found duck eggs from the maternal strain P77 of greater length (65.5 mm) and width (48.8 – 49.5 mm). The egg shape index ranged from 72.8 to 75.0 % and it did not differ significantly statistically in the subsequent evaluations. Similar or lower values of the egg shape index for Common ducks in the strain A44 and A55 were calculated by Mazanowski *et al*. (2005). Percentage of eggshell in the egg ranged from 9.6 to 10.1% and it was the greatest at the beginning of the experiment period (Tab. 4). A lower part of eggshell in the egg of Common ducks were obtained by Mazanowski *et al*. (2005), while a greater fraction was found by Niewiarowicz and Płotka, (1989). In this experiment the numeric data gathered was analyzed statistically and the mean values (x) and the coefficient of variation values (v) of the studied traits were calculated.

Table 4: Effects of duckweed and taro leaves on egg quality of duck

Trait		Egg laying period				
		1st week	2nd week	3rd week	4th week	Average± SEM
Egg weight (g)	T_0	68.5	69.2	72.3	75.2	71.3^{b} ± .61
	T_1	69.7	71.3	73.6	74.5	72.3^{b} ± .88
	T_2	69.8	73.2	75.3	77.3	73.9^{b} ± .58
	T_3	70.8	75.6	78.4	80.2	76.3^{a} ± .42
Egg length (mm)	T_0	58.6	60.7	61.5	62.5	60.8^{c} ± .34
	T_1	59.2	62.5	63.4	64.9	62.5^{b} ± .45
	T_2	60.8	61.2	62.8	64.3	62.3^{b} ± .75
	T_3	61.9	63.8	64.1	65.1	63.7^{a} ± .61
Egg width (mm)	T_0	43.2	44.8	45.2	46.5	44.9^{b} ± .32
	T_1	44.3	45.6	46.3	47.2	45.9^{b} ± .37
	T_2	43.8	44.7	45.6	46.8	45.2^{b} ± .02
	T_3	45.0	47.2	47.7	48.8	47.2^{a} ± .13
Egg shape index (%)	T_0	70.1	71.2	72.4	73.3	71.8^{a} ± .88
	T_1	71.3	72.4	73.5	74.2	72.9^{a} ± .63
	T_2	70.9	71.8	72.6	73.5	72.2^{a} ± .85
	T_3	72.8	74.1	74.5	75.0	74.1^{a} ± 78

Means in the rows with different letters differ significantly ($P \leq 0.05$)

Table 5: Effects of duckweed and taro leaves on egg quality of duck

Trait		Egg laying period				
		1st month	2nd month	3rd month	4th month	Average
Eggshell weight (g)	T_1	6.9	7.2	7.5	7.9	7.4±0.21
	T_2	7.1	7.5	7.8	8.1	7.6±0.23
	T_3	6.8	7.1	7.3	7.6	7.2±0.14
	T_4	7.2[a]	7.9	8.1[b]	8.3[b]	7.9±0.17
Eggshell proportion in egg (%)	T_1	10.3	10.1	10.0	9.9	10.1±0.25
	T_2	10.5	10.2	10.1	9.8	10.2±0.25
	T_3	10.2	10.0 ab	9.9	9.5	9.9±0.22
	T_4	10.1[a]	9.9	9.8	9.6[b]	10.1±0.20
Eggshell thickness (mm)	T_1	0.361	0.381	0.384	0.385	0.378±0.01
	T_2	0.371	0.386	0.385	0.386	0.382±0.02
	T_3	0.375	0.390 [a]	0.388	0.389	0.386±0.015
	T_4	0.379[a]	0.391	0.387	0.387[a]	0.386±0.015
Eggshell colour (% of white)	T_1	53.7	54.2	55.1	55.9	54.7±2.34
	T_2	55.2	56.8	56.9	57.1	56.5±3.05
	T_3	57.1	57.2	57.3 [a]	57.4	57.3±3.54
	T_4	58.6[a]	57.4	57.2	56.6[a]	57.5±3.60

Means in the rows with different letters differ significantly ($P \leq 0.05$)

Table 6: Effects of duckweed and taro leaves on egg quality of duck

Trait		Egg laying period				
		1st week	**2nd week**	**3rd week**	**4th week**	**Average ± SEM**
Albumen weight (g)	T_0	42.1	43.4	45.8	46.7	44.5 ± .58
	T_1	43.5	45.7	46.7	48.3	46.1 ± .43
	T_2	42.8	44.9	46.2	47.4	45.3 ± .48*
	T_3	43.9	49.6	47.9	49.5	47.7 ± .51
Yolk weight (g)	T_0	19.8	20.7	22.3	24.5	21.8 ± .28
	T_1	20.4	22.2	24.7	26.3	23.4 ± .65
	T_2	19.3	21.4	22.8	26.2	22.4 ± .52
	T_3	20.7	24.9	25.1	28.7	24.9 ± .47**
Albumen proportion in egg (%)	T_0	60.7	60.1	59.9	59.0	59.9 ± .38
	T_1	61.0	60.5	60.1	59.5	60.3 ± .57
	T_2	60.5	59.9	59.7	58.6	59.7 ± .42*
	T_3	61.2	59.7	59.4	57.1	59.4 ± .53
Yolk proportion in egg (%)	T_0	27.1	28.3	29.4	30.5	28.8 ± .75*
	T_1	28.2	28.9	30.0	31.5	29.7 ± .63
	T_2	28.4	30.1	30.5	31.9	30.2 ± .51**
	T_3	28.7	30.4	30.7	33.1	30.7 ± .46

Note: * significant at ($p<0.05$), ** significant at ($P<0.01$).

Eggshell thickness of the evaluated pedigree strains ranged from 0.379 to 0.391 mm. In the research by Górski *et al*. (1998) duck eggs from the strain A44 and A55 were characterized by a greater eggshell thickness (0.400 mm), similarly to duck eggs from the reserve flock P22 (0.430 do 0.450 mm) evaluated by Sochocka and Różycka, (1990). During the experiment period the eggshell colour darkened and this was confirmed by the decreasing values of whiteness percentage in the subsequent evaluations - from 58.6 to 56.6%. The egg content analysis (Table 5) showed that the yolk weight and the percentage of yolk in the egg have increased during the reproductive period. The content of yolk in the egg (%) showed some significant differences between the evaluations. The percentage of yolk during the entire experiment was smaller (30.7%) than the results obtained by Górski *et al*. (1998) and

Mazanowski *et al*. (2005) in eggs of Common ducks from the pedigree strains A44 and A55, which were subjected to intensive selection. Whereas the weight was increasing, while its percentage decreased with the duck age. Yolk colour intensity was low at 3.4 to 3.6 points. This trait depends mainly on the contents of carotenoids in duck fodder. Yolk intensity evaluated in earlier research (Górski *et al*., 1998; Książkiewicz, 1999) was higher. Yolk density determined with the scales program ranged from 0.447 to 0.513 g/cm3 and was greater than the density of both egg white fractions – 0.348 to 0.443. Research by Mazanowski *et al*. (2005) showed lower yolk densities for Common duck eggs (from 0.374 to 0.392 g/cm3) and egg albumen (from 0.327 to 0.357 g/ cm3). pH values of yolk and both thick and thin albumen were increasing in subsequent evaluations. The values of egg albumen pH 4) were lower, while the yolk pH values were higher than in Mazanowski *et al*. (2005) research. In contrast Mazanowski and Adamski (2003) research on duck eggs from the maternal strains have shown lower values of yolk pH (from 5.46 to 5.50), while thick albumen pH (8.78 to 8.96) and thin albumen pH (8.77 to 8.89) were similar or higher than our results.

3.9 Hematological values

Aspects of the hematological values of the local duck of southeastern Erythrocytes count (RBC), Packed cell volume (PCV) and Hemoglobin concentration (HBC) values were generally lower in ducks as compared to drakes. While PCV and HBC values were significantly higher in males ($P<0.01$ and $P<0.05$ respectively), the difference observed in RBC values was however not statistically significant. Similarly, the erythrocyte sedimentation rate (ESR) recorded for males was significantly ($P<0.05$) lower than that of the females.

Table 7: Effects of duckweed and taro leaves on blood parameters

Parameters	Mean + SE	
Total Erythrocytes Count (TEC) x 106/mm^3	T_0	3.01 ± 0.21
	T_1	3.09 ± 0.32
	T_2	3.11 ± 0.41
	T_3	3.13 ± 0.11
Packed cell volume (PCV) %	T_0	40.21 ± 2.14
	T_1	41.01 ± 2.03
	T_2	41.09 ± 2.30
	T_3	41.17 ± 1.13 **
Hemoglobin concentration (HBC) %	T_0	13.27 ± 2.31
	T_1	14.01 ± 1.41
	T_2	14.09 ± 1.85
	T_3	14.17 ± 1.13*
Erythrocytes sedimentation rate (ESR) mm/hr	T_0	1.73 ± 0.40
	T_1	1.90 ± 0.50
	T_2	1.85 ± 0.20
	T_3	1.95 ± 0.30 *

Note: * significant at (p<0.05), ** significant at (P<0.01).

The overall mean values of TEC, PCV and HBC recorded in the present study were higher than the1.72 x 106 mm^3, 38.09%, 11.64 g/dl and 18.21 x103 mm^3 respectively, reported by Ola *et al.* (2000) for local muscovy ducks of southwestern Nigeria. These workers reported overall averages from birds of different ages reared either extensively or semi-intensively while our birds were maintained permanently under intensive care and were aged about 28 weeks at the time of bleeding. It is possible that in this study superior values reflect the effects of better nutrition, housing and health status usually associated with intensive management. This is further supported by the 3.6 x106 mm^3 erythrocyte number reported by Sturkie (1986) for adult Dabbling ducks and the fact that TEC, PCV and HBC values obtained by Ola *et al.* (2000) in adult ducks aged about 30 weeks also compared favorably with our figures for adult ducks.

Again, the PCV value of common duck is similar to that of adult Common ducks but higher than that of the Indian native duck and lower than those of the Diving and Babbling ducks (Sturkie, 1986.). These differences may be attributed to species and breed differences. Oluyemi (1998) and Nwosu (1979) had suggested that the apparent superiority in PCV and hemoglobin concentrations observed in tropical breeds of poultry over exotic breeds, might be due to inherent physiological traits in these local breeds involving their hemopoetic systems. This probably enhances the dissipation of useless energy, which could be used for productive purposes.

In this study TEC, HBC and PCV values were higher in males. This is at variance with the higher values of the same parameters obtained in females by Ola *et al.* (2000) in local ducks of southwestern Nigeria. Again, method of rearing and age of the birds may have contributed to these discrepancies. Mean HBC of males and females reported here on the other hand, were similar to those reported for Diving duck but different from the figures reported for adult female Mallards (Ola *et al.,* 2000). Orji *et al.* (1986), reported strong species and sex effects on avian hematological parameters.

The ESR range of 1.63 mm/hr to 1.95 mm/hr with significantly higher values for females than for males, is consistent with a literature reports in other avian species (Orji *et al.,* 1986; Sturkie, Textor, 1978) which suggests that mean ESR for birds generally, range from 0.5 mm to 9 mm per hour with lower values occurring in males.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

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Demands for animal protein are increasing and duck production may be able to meet this demand. As ducks are able to adapt to a wide range of environmental conditions the importance and popularity of duck industry is increasing. Ducks have a remarkably rapid growth production rate during their life. For smallholder farmers, there are likely to be significant economic benefits from the opportunity to fatten common ducks and get eggs using natural resources (rice bran with taro leaves and duckweed) that are widely available in Bangladesh. In the experiment, ducks were fed with duck weed and taro leaves with basal diet to know the effect of duck weed and taro leaves on the performance of duck. The implication from the experimental result is that Taro plant has a higher nutritive value than the combination of rice bran and duckweed. Supplementing rice bran with fresh duckweed and taro leaf supported growth rates of g/day in common ducks. The Taro plant is easily cultivated in most tropical latitudes, has yields of high biomass .These characteristics facilitate its use as the basis of complete diets for growing ducks, thus reducing the need for purchase of expensive feed supplements from off the farm. The improved meat carcass, color of the skin and the egg yolk, when ducks had access to the green feeds, with most pronounced effects for taro leaf, makes the products more attractive to the customers. More research is needed in order to ascertain if the apparent capacity of common ducks to eat large quantities of duckweed and taro leaves really is a comparative advantage and, if so, how this can best be used to increase the performance of duck and the economic benefits to small scale poor farmers.

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