Chapter 1: Introduction

Commercially available antibiotics have been utilized in poultry feed for the past decade to promote growth (Dono, 2014). These antibiotics helps to reduction of morbidity and mortality issues in poultry farming, but they can harm public health by developing drug resistant micro flora (Casewell et al., 2003). According to sources, European countries have prohibited the use of antibiotics in poultry diets due to their residual effects in animal tissues, which can lead to antimicrobial resistance in humans (Griggs and Jacob, 2005). It is vital for industries to find required alternatives to supply the feed for poultry in order to prevent the use of antibiotics (Cabuk et al., 2006). Phytogenic feed additives, prebiotics, probiotics, enzymes, organic acids, and essential oils are available to substitute antibiotics. Phytogenic feed additives are derived from plants that have antimicrobial properties. Their impacts on fat metabolism include hypocholesterolaemic effects (Saravanan and Ignacimuthu, 2015), antioxidant properties (Menon and Sudheer, 2007), and the ability to speed up digestion (Hernandez et al., 2004). Probiotics, prebiotics, and organic acids are three strategies that can improve poultry performance and reduce enteric diseases (Patterson and Burkholder, 2003). Many synthetic medications and growth promoters are given to broilers to help them grow quickly, but their use has a number of drawbacks, including expensive costs, negative side effects on bird health, and long residual properties. On the other hand, herbs or other products containing plant extracts, essential oils or main components of the essential oil are among the alternative growth promoters that are already being used in practice (Williams and Losa, 2001). Phytogenic feed additives are natural materials derived from various portions of the plant, usually in the form of powder or extracts are the major part in plant derived phytogenic product. Various green additives have been investigated in order to improve the growth performance and quality of poultry in antibiotic-free diets.

Citrus fruits are well-known for their antioxidant properties (Mokbel, 2006). Lemon (*Citrus limon*), a member of the Rutaceae family, contains limonoids, flavonoids, and phenolic compounds (Askar et al., 1998). The phenolic components of citrus and lemon peel have been proven to exhibit antioxidant properties in terms of lipid oxidation reduction. Because their extracts are abundant in bioactive chemicals like flavonoids and vitamin C, that have health benefits (Ibrahim et al., 2013; Moraes-

Barros et al., 2012).

Olive trees (*Olea europaea*) belonging to Oleaceae family are native to the Mediterranean region and now cover 10.3 million hectares worldwide (FAO, 2016). Olive leaf extract contains a wide range of phenolic chemicals. Oleuropein is the most significant phenolic compound found in olive leaves. Previous research showed that compounds present in olive leaves have a bioactivities, including antioxidant (Muji et al., 2011; Hamad, 2015), anti-inflammatory, pain reliever (Laaboudi et al., 2016), antimicrobial (Korukluoglu et al., 2010), antitumor and anticancer properties (Morsy and Abdel-Aziz, 2014; Boss et al., 2016).

Although, there are a few researches on the effects of lemon and olive leaves on poultry production, the combined effects of supplementation of lemon peels and olive leaves on growth performances, carcass characteristics and oxidative stability of meat in broilers has limited report. The present study was conducted to describe the combined effects of dietary dry and probiotic-fermented lemon peels and olive leaves on growth performance, carcass characteristics and oxidative stability of broiler meat.

1.1 Objectives

1.1.1 To find out the combined effect of lemon peels and olive leaves on growth performance, carcass characteristics and oxidative stability of meat in broiler.

1.1.2 To examine the combined effect of lemon peel and olive leaves on serum biochemical parameters of broiler.

1.1.3 To estimate the cost benefit analysis.

Chapter 2: Review of Literature

Scientists are trying to find new plants, particularly medicinal plants that have a positive influence on human health, as an alternative to antibiotic in broiler enhancing growth performance by reducing use of antibiotics. The chapter describes background of using several herbal plants and probiotics in poultry diet as a growth promoter which play a vital role to reduce the risk of antibiotic resistance in human through poultry meat consumption

2.1 Taxonomical classification of *Citrus limon*

Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Rutales
Family: Rutaceae
Genus: *Citrus*
Species: *Citrus limon*

2.2 Lemon (*Citrus limon*) and its composition

Medicinal plants have long been utilized for therapeutic purposes, and around 80% of the world's population consumes herbal remedies to treat sickness, particularly infectious disorders. This herbal medicine widely used in developing country than developed country (Junab et al., 2017). The problem of microbial resistance to the available antibiotics can made the traditional medicine can be used as a therapeutic natural agent. *Citrus limon* Burm, also known as the lemon tree, is a Rutaceae family plant native to Asia. Lemon fruit is high in nutrients, is an important part of a healthy diet, and has health advantages. Lemon contains flavonoids, vitamins, minerals, dietary fibers, essential oils, organic acids, and carotenoids, among other things. Lemon (*Citrus limon*) is a valuable medicinal plant grown for its alkaloids, which have anticancer and antibacterial properties (Chaturvedi et al., 2016**)**. Lemon (*Citrus limon*) can be used for skin care, weight loss, excellent digestion, constipation relief, eye care, and the treatment of scurvy, piles, peptic ulcer, respiratory disorders, gout, gums, and urinary disorders, in addition to its anticancer and antibacterial properties.

(Mohanapriya et al., 2013**)**. Lemon (*Citrus limon*) peel just become garbage and make pollution. Lemon (*Citrus limon*) peel rich in nutrient that can used as drugs and as dietary supplement too. These products have easily to find and affordable cost.

Table 1. Physiochemical parameters of *Citrus limon* peels.

Parameter	**Lemon Peels (% w/w)**
Protein	9.42
Fiber	15.18
Ash	6.26
Fat	4.98

Source: Somayeh et al. (2012).

2.3 Medicinal use of lemon (*Citrus limon)* peels

Citrus peel is a byproduct of the food industry. The fruit's peel is considered an edible part that is highly nutritious like as vitamin C, essential oils, and dietary fiber. Previous research have found that sweet orange and other citrus peels are also effective in reducing blood cholesterol (Trovato et al., 1996; Parmar and Kar 2008). The antimicrobial and antioxidant activity on lemon peel being associated with flavonoids and essential oil (Adham et al., 2015). Hesperidine and naringin, two flavonoids found in lemon peel, are essential chemicals that increase the activity of white blood cells and improve the body's defenses (Adham et al., 2015). The flavonoid has the ability to inhibit certain enzymes as well as scavenge free radicals. Citrus peels, as agro industrial waste, are the potential sources of essential oil (Fernandez-Lopez et al., 2005). The essential oils contained in the peels of *C. sinensis* have anti-bacterial (Prabuseenivasan et al., 2006) insecticidal and disinfectant properties (Parmar and Kar, 2007). Limonene of lemon peel is active against wide spectrum of antifungal and antimicrobial activity (Berk, 2016).

2.4 Taxonomical classification of *Olea europaea*

Kingdom: Plantae

Class: Magnoliopsida

Order: Lamiales

Family: Oleacaea

Genus: *Olea*

Species: *Olea europaea*

2.5 Olive (*Olea europaea*) and its composition

The olive, *Olea europaea*, is a small tree native to the coastal area of Mediterranean and is important oil producing crop. Olive cultivation has now spread to many new places in the world including the Kingdom of Saudi Arabia, especially in the northern region. Despite of the olive industry is being relatively new to the Kingdom, the production of olive oil has increased rapidly and olive tree gained special importance in the agriculture economy. It is considered a healthy source of fatty acids in our diets.

Table 2. The nutrient composition of olive leaves (OL)

Composition	OL (g/Kg)
Dry matter	921.5
Crude protein	85.0
Crude fat	45.0
Crude fiber	149.9
Ash	96.9
Nitrogen free extracts	545.0

Proximate analysis according to American Association of Clinical Chemistry (AACC) (2000)

2.6 Medicinal use of olive (*Olive europaea*) leaves

Olive leaves contain phenolic compounds such as oleuropein, hydroxytyrosol and tocopherol (Savournin et al., 2001). Bisignano et al. (1999) and Sudjana et al. (2009) demonstrated the antimicrobial and antioxidant activity of these phenolic compounds in vitro. Most of the phenolic compounds in the olive leaf extract have been shown to possess hypocholesterolaemic activities due to lowering the concentrations of serum and hepatic triglyceride and altering the metabolism of cholesterol (Romani et al.,

1999). Moreover, Bisignano et al. (1999) also reported the antimicrobial properties of other non-phenolic components of olive leaves such as aldehydes. The supplementation of olive leaves in feed improves the oxidative and microbial stability of pork meat (Paiva-Martins et al., 2009; Botsoglou et al., 2012) and turkey breast fillets (Botsoglou et al., 2010).

The main phenolic ingredient in olive leaves is oleuropein, a non-toxic secoiridoid that ranges from 17 percent to 23 percent depending upon the harvesting time of the leaves (Le Toutour and Guedon, 1992). Oleuropein has a number of pharmacological properties, such as anti-inflammatory (Visioli et al., 1998), antioxidant (Visioli et al., 2000), anti-cancer (Owen et al., 2000), anti-atherogenic (Carluccio et al., 2003), antimicrobial (Tripoli et al., 2005), and antiviral (Fredrickson and Group, 2000). Oleuropein enhanced lipid metabolism, stimulated protein digestion, and inhibited the absorption of triacylglycerol (Polzonetti et al., 2004). It has been reported that hydroxytyrosol, a main bioactive metabolite of olive leaf extract, is a strong naturally occurring antioxidant; and elenolic acid, another structural sub unit, has strong antiviral properties (Renis, 1975).

2.7 Probiotics

Probiotic is a broad term that refers to products that contain yeast cells, bacterial cultures, or both to stimulate microorganisms capable of altering the gastrointestinal environment to improve health and feed efficiency. Probiotics are living bacteria that are given to animal through their digestive tract and have a beneficial influence on their health (Kabir, 2009a). Bacterial strains from several genera are commonly utilized in animal feed, with *Lactobacilli, Bacilli, Streptococci, Bifidobacterii*, and *Sacharomcyces* types being the most prevalent. In poultry, probiotics reduce intestinal pH, produce bacteriocins, lysozyme, and peroxides, and boost the immune system (Panda et al., 2006).

2.7.1 Lactobacillus

Lactic acid bacteria are the most well-known type of probiotic. These are *Lactobacillus bulgaricus, Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus helveticus, Lactobacillus lactis, Lactobacillus salivarius, Lactobacillus plantarum, Lactobacillus helveticus, Lactobacillus helveticus, Lactobacillus lactis, Lactobacillus lactis, Lactobacillus saliva* (Kabir, 2009). Lactobacillus is also found in

the intestine of domestic fowls, where it competes with Salmonella, Campylobacter, Listeria, Enterococci and *E.coli* (Edens, 2003).

2.7.2 Saccharomyces

Saccharomyces are single-celled yeast that have a potential due to its improvement effect on performance as probiotic feed additive for poultry (Katoch et al., 2003). Broiler supplementation with *Saccharomyces cervisiae* was reported to significantly enhance body weight gain, feed consumption, and feed conversion efficiency (Shareef and Al-Dabbagh, 2009). *Saccharomyces cerevisiae* has a positive impact since it is a naturally rich supply of proteins, minerals, and B- complex vitamins (Hassanein and Soliman, 2010).

2.8 Effects of probiotics in broiler nutrition

The addition of probiotics to the diet has been found to improve growth performance, feed conversion in broilers and reduction in mortality in several studies (Jin et al., 1997; Yeo and Kim, 1997; Kumprecht, 1998).

2.9 Summary

It was seen from the following discussion that both lemon peels and olive leaves with probiotics have beneficial effects on broiler production. In this research, three beneficial natural growth promoters are combined together to observe its effect on growth performance carcass characteristics, serum parameters and meat quality in broiler.

Chapter 3: Materials and Methods

3.1 Study area

The experiment was conducted at experimental shed and analysis was performed in Post Graduate and Animal Nutrition Laboratory of Chattogram Veterinary and Animal Sciences University (CVASU), Khulshi, Chattogram, Bangladesh.

3.2 Study period

The research work was performed from August, 2020 to April, 2021. The broiler was reared from August, 2020 to September, 2020.

3.3 Lemon peels and olive leaves preparation

3.3.1 Collection of lemon peels and olive leaves

Lemon peels and olive leaves were collected from various places of Chattogram region. After collection these were dried at well maintained ventilated condition whereas temperature maintained 27-28°C. The dried peels and leaves were grinded by electrical grinder to make powder form and preserved into airtight plastic zipper bag at 4°C until mixing in the feed.

3.3.2 Fermentation of lemon peels and olive leaves

For the fermentation of feed, *Lactobacillus plantarum* and *Saccharomyces cerevisiae* were selected based on their acid, bile and heat tolerance levels. MRS broth used for growth of *Lactobacillus plantarum* and YM broth for *Saccharomyces cerevisiae* as per instructions of the manufacturer. Two steps fermentation process was applied to prepare the *Citrus limon* peels and *Olive europaea* leaves probiotics using a laboratory incubator. Initially, *Lactobacillus plantarum* culture was grown in MRS agar and *Saccharomyces cerevisiae* in yeast maltose broth (YMB). In the first inoculation of solid state fermentation, 1% of *Lactobacillus plantarum* was added and made it moisture content about 40% to make the fermentation process properly by adding adequate distilled water. The mixture was then fermented at 40°C for 2 days under repeating cycles of 5 hour of anaerobic and 3 hour of aerobic conditions. The second fermentation was performed by adding 1.0% of *Saccharomyces cerevisiae* strains and similarly fermented for 2 days at 40°C under aerobic conditions. The formulated probiotics mixtures were then air dried for 2 days until the moisture level was less than 15%. To determine the concentration of

microbes, 1 g of fermented mixture was used at 10-fold serially diluted with sterilized saline solution (0.85% NaCl) at room temperature and cultured in solid media. The culture plate was then incubated at 37°C for 24–48 hours, after which the numbers of colonies were counted and expressed as cfu/gm.

Table 3. The number of microbial strains of lemon peels and olive leaves probiotics.

Microbial strains in peels and leaves probiotics	**Microbes number (cfu/gm)**
Lactobacillus plantarum KCTC 3099	2.1×10^{7}
Saccharomyces cerevisiae KCTC 7928	1.2×10^{6}

3.4 Experimental birds

A total of 144, unsexed day old chicks Cobb 500 were purchased from Aga Agro Limited in Chattogram, Bangladesh. All the chicks were inspected for deformities and to ensure that they were of the same size. The chick's average body weight was kept consistent (43.59±0.05g).

3.5 Design of experiment

The layout of the experiment is presented in Table 4. For the experiment, a total of 144 birds was collected and randomly distributed in completely randomized design with following treatments: C as Control (Basal diet), D1 (Basal diet with 0.8% dry peels and leaves supplement on DM basis), D2 (Basal diet with 1.2% dry peels and leaves supplement on DM basis), F1 (Basal diet with 0.8% probiotic fermented peels and leaves supplement), F2 (Basal diet with 1.2% probiotic fermented peels and leaves supplement on DM basis) and AB (Antibiotic in water + basal diet). For antibiotic, Ciprofloxacin was used in this experiment. The dose of the antibiotic was 0.2 ml/ 1L water. The experiment was conducted in a completely randomized design consisting six treatments with three replications having eight birds in each.

Table 4. Design of experiment.

Dietary treatment groups	Replications	No. of birds per Replication	No. of birds per treatment
C=Control (Basal diet)	R1	8	24
	R2	8	
	R3	8	
D_1=(Basal diet with 0.8% dry peels and leaves supplement)	R1	8	24
	R2	8	
	R3	8	
D_2=(Basal diet with 1.2% dry peels and leaves supplement)	R1	8	24
	R2	8	
	R3	8	
F_1=(Basal diet with 0.8% probiotic fermented peels and leaves supplement)	R1	8	24
	R2	8	
	R3	8	
F2=(Basal diet with 1.2% probiotic fermented peels and leaves supplement)	R1	8	24
	R2	8	
	R3	8	
AB=(Basal diet + antibiotic in water)	R1	8	24
	R2	8	
	R3	8	
Total			144

3.6 Housing and Brooding

The experimental shed was brick made with one side open for ventilation which is guarded by collapsible metal gate. To maintain a uniform distribution of treatments and replications, bird cages were chosen at random. The replicate cages for each treatment were distributed randomly in different places of the house. Birds were kept in a wire-floored, closed cages, measured (3.5 ft.×1.63 ft. for 8 birds). Each cage had a round feeder at the first 2 weeks of age then feed was provided in tray to provide feed ad libitum

and one round drinker placed per cage to provide free access of water. Room temperature was maintained using 100W and 60W electrical bulbs and ceiling fans. The birds were exposed to continuous lighting. During brooding period, chicks were brooded at a temperature of 95°F, 90°F, 85°F, 80°F and 75°F for the 1st, 2nd, 3rd, 4th and 5th weeks, respectively. Temperatures were measured by using thermometer.

3.7 Preparation of shed and routine cleaning

The shed was properly cleaned and washed with bleaching powder and tap water. Cleaning was performed in the same way for brooding boxes, rearing cages, ceiling, feed storing racks and fans. After washing and disinfecting the house, it was given a week to dry properly. All doors and windows were sealed after drying. The room was fumigated for 24 hours by mixing formalin with potassium permanganate. A footbath with potassium permanganate was kept at the poultry shed's entrance and was changed on a regular basis. After housing the birds, routine cleaning practices were performed, which included daily cleaning of the floor. Waterers were also cleaned everyday with dish washing soap and water. Feeders were cleaned and washed weekly before being used further.

3.8 Experimental diets

Experimental diets were supplied to treatment groups from 1-35 days, when control groups received basal diets. The experimental diet was replaced with the same amount by the dry and probiotic mixed lemon peels and olive leaves meals. The ingredients and composition of the experimental diets are shown in Table 5.

Table 5. Ingredient and chemical composition of basal diet (per 100kg feed).

Ingredients	Starter (0-14 days)	Grower (15-35 days)
Maize	51.86	53.00
Wheat	2.00	2.00
Rice polish	2.50	3.20
Soybean meal	32.00	29.16
Fishmeal	4.00	3.50
Palm oil	3.50	5.00
DCP	1.79	1.79
Limetsone	1.15	1.15
NaCl	0.25	0.25
Choline clholide	0.06	0.06
Vitamin min premix	0.15	0.15
L-lysine	0.40	0.40
DL-methionine	0.22	0.22
Toxin binder	0.10	0.10
Antioxidant	0.01	0.01
Enzymes	0.01	0.01
Total	100	100
Chemical composition (Calculated)		
ME(kcal/kg)	3005.13	3108.34
CP(%)	22.16	20.78
Ca%	1.30	1.26
P%	0.72	0.70
CF%	3.76	3.68
EE %	3.67	3.68

3.9 Feeding of birds

All feed ingredients were bought from Alif traders, Khatunganj, Chattogram and mixed thoroughly as per formulation stated earlier. Feed was supplied at round feeder from 0-7 days and after 7 days linier feed was installed on cage. Round water were used for supplying fresh water.

3.10 Vaccination

Newcastle Disease (ND) and Infectious Bursal Disease (IBD) were routinely vaccinated in all of the birds. The vaccines were purchased from Divisional Livestock Office and transported in icebox to maintain the quality and function. To reduce stress, vaccinations were given early in the morning.

Table 6. Vaccination schedule.

Age of birds	Name of diseases	Name of the Vaccine	Route of Administration
4^{th} day	New Castle Disease	BCRDV (Live)	One drop in one eye
12^{th} day	Infectious Bursal Disease	IBD	One drop in one eye
18^{th} day	Infectious Bursal Disease	IBD	One drop in one eye
21^{th} day	New castle Disease	BCRDV (Booster)	One drop in one eye

3.11 Growth performance

After 35^{th} day of rearing, all the birds were sacrificed and data were collected. The parameters for measuring growth performance were recorded at weekly intervals as well as throughout the overall period of the study. Weight gain was calculated by deducting initial body weight from the final body weight of the birds. Feed intake was calculated by deducting left over from the total amounts of feed supplied to the birds. FCR was calculated dividing feed intake by the weight gain.

3.12 Carcass characteristics

On the 35th day, two birds were randomly picked and executed from each replication. Birds were de-feathered and treated as directed after proper bleeding out. Abdominal fat, liver, spleen, bursa, and gizzard were removed and weighed individually throughout the evisceration procedure. Dressed birds were weighed to determine the weight of the

dressed carcass. The weight of the total breast meat, thigh meat, and thigh bone were all reported.

3.13 Serum biochemical analysis

A 5 ml sterile syringe and a 23-gauge needle were used to collect blood samples from the jugular veins of two birds from each replicate. A 5 mL blood sample was taken from each bird and immediately transferred to a sterile tube without anticoagulant. The prepared serum was collected into the eppendorf tube by micropipette after the Clotted blood in the vacutainer tube was centrifuged at 3000 rpm for 20 minutes. Different blood parameters (cholesterol, triglyceride and HDL) were measured in the Post Graduate Laboratory under the department of Animal Science and Nutrition, CVASU using standard kits (BioMereux, France) and automatic analyzer according to the manufacturer'sinstruction.

3.14 Chemical composition of meat

Different organs were collected and weighed precisely and breast meat sample were collected in plastic zipper bag for proximate composition. Equivalent amount of breast meat sample was macerated in a meat grinder and stored in freezer at −20°C until analysis. From these samples, chemical analysis was performed according to the standardized formula by AOAC International (2006). The analysis of proximate components was carried out in the Nutrition Laboratory under the Department of Animal Science and Nutrition, CVASU, to determine the dry matter (DM), crude protein (CP), crude fiber (CF) ether extract (EE) and total ash (TA) of meat sample.

3.15 Oxidative stability of meat

Meat samples were kept in a refrigerator at 4°C up to the 4th week, and the thiobarbituric acid reactive substance (TBARS) values of the meat were determined from fresh, as well as refrigerated meat once a week for 1, 2, and 3 weeks, using the method described by (Du and Ahn, 2002). To calculate TBARS, 4 g of meat was placed in a test tube with an open mouth and 10 ml of solution 1 (20% trichloroacetic acid in 2M phosphoric acid) was added. To dilute it, 10 mL distiller water was added. The material was then homogenized with a homogenizer (Model: SR-30, Medline Scientific Ltd., UK), and the fluid was filtered with Whatman No. 1 filter paper. After filtering, 2 ml filtrate was transferred to a test tube and 2ml of 2- thiobarbituric acid (0.005 M in distilled water) was added. After that, the test tubes are placed in an 80°C water bath (WB-22, Witeg,

Germany). The test tubes are removed after 30 minutes and kept at room temperature until cooling. The absorbance of the solution was then measured by spectrophotometer (UV-2600, UV-ViIS Spectrophotometer, Shimadzu) with a wavelength of 530 nm.

3.16 Data analysis

All the data were entered into MS excel (Microsoft Office Excel-2010, USA). All data were analyzed using the General Linear Model (GLM) procedure of SAS Institute (2003). Duncan's multiple range tests were used to examine significant differences among the treatment means. All data was presented as SEM. The level of statistical significance was accepted at $P<0.05$.

Photographic Presentation

Image 1. Feed Preparation

Image 2. Weighing of birds

Image 3. Vaccination

Image 4. Inoculation of bacteria in agar

Image 5. Inoculation of bacteria in agar

Image 6. Colony count of bacteria

Photographic Presentation

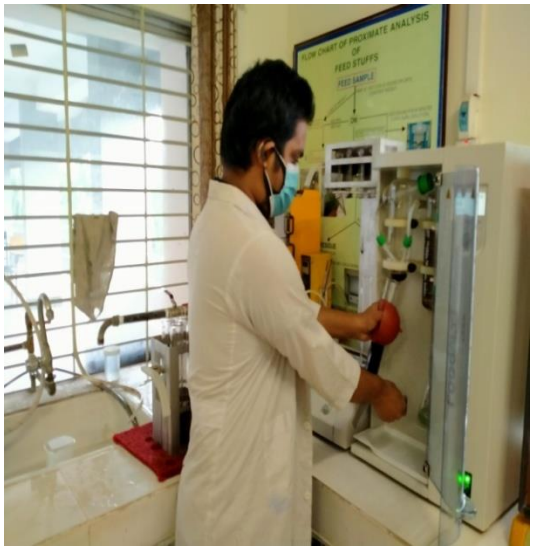

Image 7. Proximate analysis

Image 8. Proximate analysis

Image 9. Proximate analysis

Image 10. Proximate analysis

Image 11. TBARS analysis

Chapter 4: Results

4.1 Live weight

Throughout the entire trial, the live weight of the experimental birds was recorded from the first to the fifth week (Table 7). According to the weekly results, in 1^{st}, 3^{rd}, 4^{th} and 5^{th} week, the weight gain of birds had significantly ($P<0.05$) increased in all groups compared to the control and antibiotic treated groups. In overall live weight, D2 showed the highest (1949.50 g/bird) average live weight, while the control (C) group had the lowest (1789.96 g/bird).

4.2 Average daily gain (ADG)

Overall highest average daily gain (54.46 g/b/d) was observed in D2 group and the lowest average daily gain (49.89 g/b/d) was recorded in control (C). D2 had significant ($P<0.05$) effect in ADG of birds in 1^{st}, 2^{nd} and 4^{th} week of age. It was found that, overall average daily gain increased significantly ($P<0.05$) in D2 group compared to control and antibiotic treated group (Table 7).

4.3. Average daily feed intake (ADFI)

Results showed that, overall there is no significant difference in average daily feed intake among the dietary treatment groups. Overall, the highest (78.43 g/b/d) average daily feed intake was observed in D1 group and the lowest (76.26 g/b/d) was found in F1 group (Table 7). In weekly basis, D2 had significant ($P<0.05$) effect in ADFI of birds in 1^{st} and 2^{nd} week of age.

4.4. Feed conversion ratio (FCR)

The FCR of different weeks of birds are shown in Table 7. In 1^{st} week, the superior FCR was found in F2 group (1.09). But in 2^{nd} week, the superior FCR value was found in F1 and F2 groups. At 5th week of age, D2 and F2 group showed superior FCR and C group showed higher FCR. The overall FCR value was also significantly ($P<0.05$) decreased in D2 (1.42) and F2 (1.42) group as compared to control and antibiotic treated group (Table 7).

Table 7. Effect of lemon peels and olive leaves on growth performance in broiler.

Parameters	Treatment						SEM	P Value
	C	D1	D2	F1	F2	AB		
1st week								
Initial wt (g)	43.67	43.58	43.38	43.46	43.79	43.67	0.08	0.07
Live wt (g)	150.92^{bc}	152.29^{abc}	154.13^{a}	152.84^{ab}	152.38^{abc}	150.75^{c}	0.47	0.01
ADG(g/b/d)	15.32^{c}	15.53^{bc}	15.82^{a}	15.62^{ab}	15.51^{bc}	15.30^{c}	0.06	0.01
ADFI(g/b/d)	18.63^{a}	17.65^{abc}	18.70^{a}	17.34^{bc}	16.92^{c}	18.31^{ab}	0.31	0.01
FCR	1.22^{a}	1.14^{bcd}	1.18^{abc}	1.11^{cd}	1.09^{d}	1.20^{ab}	0.02	0.01
2nd week								
Live wt (g)	355.75	359.96	372.71	362.09	363.50	360.29	2.98	0.10
ADG (g/b/d)	29.26^{b}	29.67^{b}	31.23^{a}	29.89^{ab}	30.16^{ab}	29.16^{b}	0.39	0.04
ADFI(g/b/d)	40.77^{ab}	40.08^{ab}	41.85^{a}	38.54^{b}	38.83^{b}	40.00^{ab}	0.60	0.04
FCR	1.39^{a}	1.35^{ab}	1.34^{abc}	1.29^{c}	1.29^{c}	1.37^{a}	0.02	0.01
3rd week								
Live wt (g)	795.54^{b}	826.04^{a}	843.88^{a}	834.29^{a}	832.75^{a}	826.13^{a}	8.03	0.03
ADG (g/b/d)	62.83	66.58	67.31	67.46	67.04	66.55	1.23	0.20
ADFI(g/b/d)	86.34	85.55	85.31	85.04	83.57	86.54	2.57	0.97
FCR	1.38	1.28	1.27	1.26	1.25	1.30	0.03	0.43
4th week								
Live wt (g)	1295.34^{b}	1396.50^{a}	1433.34^{a}	1404.96^{a}	1418.42^{a}	1341.88^{b}	14.75	0.001
ADG (g/b/d)	71.40^{c}	81.49^{ab}	84.21^{a}	81.52^{ab}	83.67^{a}	73.68^{bc}	2.57	0.03
ADFI(g/b/d)	108.35	115.45	113.03	113.81	117.75	114.48	1.92	0.10
FCR	1.52	1.42	1.35	1.40	1.41	1.55	0.06	0.28
5th week								
Live wt (g)	1789.96^{b}	1922.67^{a}	1949.50^{a}	1915.59^{a}	1935.38^{a}	1826.88^{b}	22.59	0.001
ADG (g/b/d)	70.66	75.17	73.74	72.94	73.85	69.29	3.31	0.83
ADFI(g/b/d)	133.54	133.41	127.36	126.56	126.60	126.81	3.21	0.64
FCR	1.89	1.79	1.74	1.75	1.72	1.84	0.08	0.76
1-5thweek (overall)								
Initial wt (g)	43.67	43.58	43.38	43.46	43.79	43.67	0.08	0.07
Final wt (g)	1789.96^{b}	1922.67^{a}	1949.50^{a}	1915.59^{a}	1935.38^{a}	1826.92^{b}	22.60	0.001
ADG (g/b/d)	49.89^{b}	53.69^{a}	54.46^{a}	53.49^{a}	54.05^{a}	50.95^{b}	0.64	0.001
ADFI(g/b/d)	77.53	78.43	77.25	76.26	76.74	77.23	0.36	0.08
FCR	1.55^{a}	1.46^{bc}	1.42^{c}	1.43^{c}	1.42^{c}	1.52^{ab}	0.02	0.001

^{abc} Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 8 birds per replication (n=24). C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; ADG = Average daily gain; ADFI = Average daily feed intake; FCR= Feed conversion ratio; SEM = Standard error of mean.

4.5 Blood serum parameters

Different blood serum parameters estimated have been presented in Table 8. Results indicated that, there was a significant (P<0.05) reduction in blood cholesterol, TG and LDL level in all treatment groups compared to control and antibiotic group. The cholesterol TG and LDL concentration in blood was lowest in F1 group. HDL value remained unchanged among all groups.

Table 8. Dietary effect of lemon peels and olive leaves on serum parameters of broiler.

Parameters	Treatments						SEM	P
	C	D1	D2	F1	F2	AB		Value
Cholesterol (mg/dl)	117.62^{a}	112.83^{ab}	102.34^{c}	99.30^{c}	104.1^{bc}	117.67^{a}	2.78	0.003
HDL (mg/dl)	64.46	67.82	70.07	73.60	74.13	68.11	2.10	0.16
LDL (mg/dl)	37.56^{a}	34.91^{ab}	23.60^{bc}	17.16^{c}	19.17^{c}	39.93^{a}	3.37	0.004
TG (mg/dl)	78.02^{a}	50.55^{bc}	43.32^{cd}	42.70^{d}	53.72^{b}	48.14^{bcd}	2.13	<.0001

^{abc} Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 2 birds per replication (n=6). C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; SEM = Standard error of mean; HDL= High density Lipoprotein; LDL= Low density Lipoprotein; TG= Triglyceride.

4.6. Chemical composition of meat

Table 9 displays the values for Dry matter (DM), Ether extract (EE), Crude protein (CP), and Ashe contents in meat. Crude protein levels in the treatment groups differed significantly (P<0.05) when compared to the control group. The crude protein was the highest in F2 group among others. The ash content and ether extract differed significantly (P<0.05) in treatment groups compared to control. The highest value of ash content and ether extract was found in D2 group and lowest in antibiotic group.

Table 9. Dietary effect of lemon peels and olive leaves on chemical composition of broiler meat.

Parameter	Treatment						SEM	P Value
	C	D1	D2	F1	F2	AB		
DM (%)	26.78	25.36	26.41	25.63	26.52	25.17	0.35	0.18
CP (%)	21.70^{c}	22.83^{b}	22.50^{b}	22.66^{b}	25.04^{a}	23.16^{b}	0.17	<0 .0001
Ash (%)	1.22^{a}	1.19^{a}	1.33^{a}	1.26^{a}	1.16^{a}	0.88^{b}	0.05	0.002
EE (%)	0.96^{b}	0.45^{c}	1.43^{a}	1.37^{a}	0.97^{b}	0.35^{c}	0.04	< 0.0001

^{abc} Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 2 birds per replication (n=6). C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; SEM = Standard error of mean; DM= Dry matter; CP=Crude protein; EE=Ether extract.

4.7 Carcass characteristics

Relative organ weight and carcass characteristics are presented in Table 10. The carcass parameters significantly differed (P<0.05) in terms of dressed weight, drumstick weight, and abdominal fat weight compared to control. Highest dressed weight value was observed in F1 group (64.18) where as lowest value was observed in antibiotic treated group (50.75). The lowest abdominal fat weight was observed in D2 group (0.96) where as highest in control group (1.84).

Table 10. Dietary effect of lemon peels and olive leaves on carcass characteristics of broiler meat.

Relative wt (% of live wt)	Treatment						SEM	P Value
	C	D1	D2	F1	F2	AB		
Dressed wt	60.56^{a}	62.91^{a}	62.09^{a}	66.10^{a}	64.18^{a}	50.75^{b}	2.19	0.01
Breast meat wt	11.82	12.85	12.82	15.12	14.78	12.64	0.78	0.09
Thigh wt	4.57	4.46	4.50	4.78	4.50	3.71	0.18	0.06
Drumstick wt	5.02^{a}	4.94^{a}	5.22^{a}	5.29^{a}	4.96^{a}	3.80^{b}	0.16	0.001
Head wt	3.13	3.52	3.30	3.22	3.12	2.41	0.23	0.25
Spleen wt	0.07	0.08	0.12	0.09	0.06	0.11	0.013	0.25
Heart wt	0.47	0.47	0.41	0.42	0.40	0.40	0.03	0.56
Bursa wt	0.15	0.15	0.16	0.17	0.11	0.15	0.013	0.47
Liver wt	1.51	1.98	1.89	1.87	1.76	1.55	0.13	0.15
Gizzard wt	2.73	2.77	2.84	2.77	2.56	2.80	0.12	0.79
Abdominal fat wt	1.84^{a}	1.78^{a}	0.96^{b}	1.37^{ab}	1.64^{a}	1.33^{ab}	0.14	0.04

^{abc} Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 2 birds per replication (n=6).

C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive

leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; SEM = Standard error of mean; wt=Weight.

4.8 Oxidative stability of meat

A significant decrease in TBARS value was observed among all treatment groups both in fresh meat sample as well as the refrigerated meat samples up to 3 weeks ($p<0.05$). At week 1st, 2nd and 3rd, the lowest TBARS value was observed in AB group (3.44 µmol MDA/100g of meat), F2 (9.01) and F2 (12.27) group respectively whereas the highest value was observed in control group throughout the experiment.

Table 11. Dietary effect of lemon peels and olive leaves on TBARS value of broiler meat.

Period	TBARS value in treatments (µmol MDA/100g of meat)						SEM	P Value
	C	D1	D2	F1	F2	AB		
Fresh (0 day)	1.55^{a}	0.37^{c}	0.46^{c}	0.61^{bc}	0.51^{c}	0.89^{b}	0.08	<.0001
1st week	12.47^{a}	5.64^{b}	4.30^{b}	5.22^{b}	5.11^{b}	3.44^{b}	0.67	<.0001
2nd week	19.17^{a}	14.52^{ab}	15.47^{ab}	11.04^{b}	9.01^{b}	11.22^{b}	1.64	0.0320
3rd week	33.03^{a}	20.29^{bc}	24.88^{b}	16.17^{cd}	12.27^{d}	14.07^{cd}	1.44	<.0001

[abc] Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 2 birds per replication (n=6). C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; SEM = Standard error of mean; TBARS= Thiobarbituric acid reactive substances; MDA= Malondialdehyde.

4.9 Cost-benefit analysis

Cost-benefit analysis of birds rearing in this experiment is represented in Table 12. The result showed that D2 had significantly ($P<0.05$) higher profit than control and antibiotic treatment group. Net profit was highest in D2 (34.63 tk) groups which is close to F2 (33.86 tk) but significantly ($P<0.05$) differed from control group (25.96) and antibiotic group (26.07).

Table 12. Effect of lemon peels and olive leaves on cost benefit analysis of broiler.

Parameters	Treatments						SEM	P Value
	C	D1	D2	F1	F2	AB		
Live weight(kg)	1.79[b]	1.92[a]	1.95[a]	1.91[a]	1.93[a]	1.83[b]	0.02	0.001
Feed intake/bird (kg)	2.71	2.74	2.70	2.67	2.68	2.70	0.01	0.09
Feed cost/bird (tk)	111.23	112.54	110.85	109.43	110.12	110.82	0.52	0.08
CVO cost/bird(tk)	75.00[c]	75.00[c]	75.00[c]	76.00[b]	76.00[b]	79.00[a]	0	-
Total cost (tk)	186.23[b]	187.54[b]	185.85b	185.43[b]	186.12[b]	189.82[a]	0.52	0.01
Selling price (tk)	232.69[b]	249.95[a]	253.44[a]	249.03[a]	251.60[a]	237.50[b]	2.94	0.001
Net profit (Tk)	46.46[b]	62.40[a]	67.59a	63.60[a]	65.48[a]	47.68[b]	3.04	0.001
Net profit/kg (Tk)	25.96[b]	32.41[a]	34.63[a]	33.22[a]	33.86[a]	26.07[b]	1.26	0.01

[abc] Means in a row with no common superscripts significantly differ (P<0.05).

Data presented as the mean value of 3 replicate groups with 8 birds per replication (n=24). C= Control; D1= Basal diet with 0.8% Dry lemon peels and olive leaves; D2= Basal diet with 1.2% Dry lemon peels and olive leaves; F1=0.8% probiotic fermented lemon peels and olive leaves; F2=1.2% probiotic fermented lemon peels and olive leaves; AB= Basal diet with antibiotic; SEM = Standard error of mean; CVO =Chick, Vaccination and Other (Probiotic, antibiotic etc.); Tk=Taka.

Chapter 5: Discussion

In this study, the effects of combination of dry and probiotic mixed lemon peels and olive leaves on weight gain, FCR, blood serum parameters, meat composition and carcass characteristics were investigated. Finding of this study are discussed below.

5.1 Weight gain, Feed intake and Feed conversion ratio (FCR)

Supplementation of dietary lemon peel and olive leaves of this study found significant improvement in ADG and FCR compared to control and antibiotic treatment groups. The findings of our present study are consistent with Sahu et al. (2019) showed a significant enhancement of ($P<0.05$) weight gain in broiler when supplemented combined essential oils from lemon peel and orange peel (200 mg/kg). According to Siyal et al. (2016), broiler chicken fed with 1.5 and 3.0 % orange peel gained weight noticeably more than control which is slightly similar to our study. Akbarian et al. (2013) reported no significant effects of dietary orange peel extract (OPE) and lemon peel extracts (LPE) on the weight gain, feed intake, or feed conversion ratio of broiler when supplemented with OPE at 0 and 200mg/kg feed and LPE at 0, 200, and 400mg/kg feed, which is in contrast to our research results.

Shafey et al. (2013) stated that body weight increased at 3rd week of age with 15 g/kg olive leaves diet but reduced with 30 and 50 g/kg olive leaves diet. In our study, the highest live weight gain was found in 1.2% olive leaves dry and 1.2% olive leaves probiotic respectively which is close to Shafey et al. (2013). Another study revealed that daily body weight gain, feed intake and FCR improved in all treatment groups supplied with alcoholic extract of olive leaves (Erener et al., 2020). It can be explained that the olive leaves powder include phenolic chemicals, which resemble steroid hormones in both structure and function. These hormones enhance basic metabolic rate since they are growth hormones, and phenolic chemicals contribute to improved feed digestibility and increased nutrient utilization (Guinda et al., 2004). Additionally, the olive leaves powder contains a variety of compounds and glycosides that act as antioxidants. It's possible that the addition of olive leaves powder to the diet improve productivity features like as body weight, feed consumption rate, and feed conversion coefficient because olive leaves powder contains numerous nutrients that improve feed utilization. Oleuropein compound, which represents for 73% of all phenolic compounds, was the most important of the seven phenolic compounds recognized by the HPLC system used to analyze olive leaves

powder. The results were consistent with earlier research by (Bouaziz et al., 2008), which proved that adding olive leaves to the diet by 25 g/kg caused a significant increase in body weight, weight gain, and dietary conversion coefficient when compared to the control treatment. Additionally, adding 20 g/kg of olive leaves powder increased body weight, weight gain, and dietary conversion coefficient in the sixth week of the chick's life (Tarek et al., 2013).

In compared to control groups, probiotic-treated groups showed a significant improvement in FCR. Similar outcomes were seen in a study where it was determined that giving a probiotic based on *Lactobacillus* lowered FCR by 3.5% (Vicente et al., 2007). *Lactobacillus plantarum* enhanced ADG and FCR in broiler in an experiment by (Peng et al., 2016). Jin et al. (1998) showed improved weight gain in broiler fed *Lactobacillus sp.* Again, *Lactobacillus* aids the growth of butyric acid producing bacteria that produces butyric acid and this acids can promote growth performance in the host (Duncan et al., 2004; Huyghebaert et al., 2011). Another study, it was evident that supplementation of *Saccharomyces* in broiler significantly reduced FCR (Gil de los Santos et al., 2005). A study by Shareef and Al-Dabbagh (2009) showed that addition of *Saccharomyces cerevisiae* at a rate of 1.5, 2 and 2.5% resulted significant increase in weight gain of broiler chicks. The reason for promoting weight gain could be due to its direct nutritional effects on host body (Patterson and Burkholder, 2003).

In compared to antibiotic group, treatment groups showed a significant improvement in FCR and ADG.

5.2 Serum biochemical parameters

Supplementation of dietary lemon peel and olive leaves of this study found significant improvement in LDL, Cholesterol and Triglyceride compared to control and antibiotic treatment groups. Erener et al. (2020) reported that supplementation of olive leaf extracts in broiler diet increased the plasma cholesterol and HDL concentration compared to control which is almost similar with the current study. Additionally, broiler cholesterol levels increased with 2% of olive leaves added to the diet, while TG and LDL levels were remain unchanged (Sateri et al., 2017). Another broiler trial by Nafea and Hussein (2018) showed that adding 5, 10, and 15 g/kg of olive leaves powder to the diet lowered cholesterol while increasing HDL and LDL levels in serum. Due to the presence of phenolic compounds, which demonstrated a hypocholesterolemic action in rats, the

maximum level (1.6%) of olive leaves in diet considerably lowered cholesterol level (Fki et al., 2007).

Nobakht (2013) showed that dried citrus pulp had desirable effects on the reduction of blood cholesterol , LDL which is slightly similar to our study because the citrus fruit is a rich source of pectin (Hong et al., 2012). *Citrus* peel extract has previously been shown to increase the amount of total protein in the blood of chickens, which may be due to an improved nutrient absorption (Akbarian et al., 2013). Two flavonoids present in lemon peel, hesperidine and naringin, are vital substances that boost the body's defenses by boosting white blood cell activity (Adham, 2015).

In probiotic treated group, the cholesterol also reduced. *Lactobacillus* was found to reduce blood cholesterol in broiler in a study (Salarmoini and Fooladi, 2011) which justifies the current research. It could be due to assimilation of cholesterol by *Lactobacillus* and reducing serum cholesterol which was proved in vitro in pig in a study by Gilliland et al. (1985). A study found that probiotic, *Lactobacillus plantarum* lowered the cholesterol, in serum in rats though no significant differences was found in serum HDL level (Huang et al., 2013). Addition of *Saccharomyces cerevisiae* in layer diet resulted a significant reduction in blood cholesterol in an experiment (Hassanein and Soliman, 2010).

5.3 Proximate analysis

Supplementation of dietary lemon peel and olive leaves of this study found significant improvement in CP(%), Ash(%) and EE(%) compared to control and antibiotic treatment groups. Significant amounts of sodium, calcium, potassium, iron, and other minerals like copper, magnesium, zinc, and phosphorus are present in olive leaves (Chand and Azeez, 2018). The minerals could make meat more ash-rich. Khaksefidi and Rahimi's study from 2005 found that including probiotics in the diet enhanced the moisture, CP, and Ash in the leg and breast meat of broilers. According to Podolian (2017), the thigh muscle of poultry contained higher amounts of calcium, phosphorus, iron, zinc, magnesium, and copper, which raised the meat's ash content. The same study discovered that adding probiotics to broiler diets increased the production of vital amino acids such lysine, histidine, arginine, threonine, valine, methionine. leucine and phenylalanine in pectoral muscle. This resulted in the increase of protein percentage of meat.

The experiment by Pietras (2001) reported that when given probiotic (*Lactobacillus acidophilus* and *Streptococcus faecium* bacteria) on the whole rearing period, the meat

had significantly higher protein content, while crude fat and total cholesterol contents tended to decrease. In an investigation by Khaksefidi and Ghoorchi (2006) showed that probiotic fed chickens the leg and breast meat were higher in moisture, protein and ash content as compared to control. The lowest fat content in D1 group may have resulted from increased fat metabolism in birds due to increased vitamin C content from lemon peel. However, the higher dose of olive and lemon had increased ether extract in meat which can be explained by individual variation of birds.

5.4 Carcass characteristics

In this present study in supplementation of dietary lemon peel and olive leaves meal both dry and fermented groups reported a significant increase in dressing percentages when compared to the control and antibiotic groups. According to Siyal et al. (2016), broiler chicken that had orange peel supplements of 1.5 and 3.0% had a considerably higher carcass weight and dressing percentage than the control. Citrus peel extract, which also contains numerous vitamins with antioxidant properties, can reduce the growth of harmful bacteria, promote the development of probiotic microflora, and boost nutrient absorption in the intestinal epithelium. All of these factors could have influenced nutrition use and, as a result, enhanced weight gain and carcass yield. The availability of significant levels of citric acid in the lemon peel, which may increase fat metabolism, could explain the lower belly fat content in the dried lemon peel supplemented groups (Fik et al., 2021).

When olive leaves are substituted for 15, 30, or 50 g/kg of wheat bran in the broiler, no significant effect of olive leaves on carcass features with a considerable reduction of the eviscerated carcass weight (Shafey et al., 2013). Omar (2015) found that the addition of olive pulps to broiler did not change the carcass properties. The inoculation of probiotics with olive leaves may have enhanced the relative breast weight. According to Mehr et al. (2007), broiler breast percentage increased when commercial probiotics were included in the feed which is similar to our study.

5.5 Oxidative stability of meat

Supplementation of dietary lemon peel and olive leaves of this study found significant improvement in TBARS value in every weeks compared to control and antibiotic treatment groups. Lemon peel has always been used in herbal medicine and is a significant source of bioactive chemicals. Lemon peel is a good source of phenols, beta carotene, flavonoids and vitamin C. Hesperidines is one of the most important flavanone

isolated from orange peel has shown antioxidant effects in experimental rats (Galati et al., 1996; Tirkey et al., 2005).

Lower peroxide values were found in treatments including olive leaves to broiler feed, which were capable of delaying the beginning of the oxidative process (Marangoni et al., 2017).The synergistic effects of probiotics, which also act as antioxidants, and olive leaves, which contain phenolic compounds that neutralize free radicals, are the causes of the reduction of TBARS value (Wang et al., 2017).

5.6 Cost benefit analysis

A significantly higher net profit was obtained from all dietary groups in comparison with control and antibiotic treatment groups ($P<0.001$). The highest net profit was obtained from D2 group which was followed by F2 group. Sahu et al. (2019) observed that adding lemon and orange peel to the diet increases the net return per bird, which is consistent with our findings. Islam et al. (2020) observed that supplementation of dietary olive leaves increases the net return per bird which also similar to our study.

Chapter 6: Conclusion

The objective of the research was to determine how combined supplementation of dry and fermented lemon peels and olive leaves meals improved growth performances, including carcass features, blood parameters, meat quality, and oxidation stability of meat. Statistically remarkable result was observed on ADG and FCR of birds in all treatment groups other than control and antibiotic treated group. The blood LDL level, total cholesterol and total triglyceride were found lower in treatment groups compared to control group. The results showed that there was a significant difference in crude protein, ash and ether extract between the treatment groups and the control group. The TBARS value of fresh and refrigerated meat reduced in all treatment groups compared to control. In terms of cost and benefit, the net profit improved in all the treatment groups compared to control. Considering all the parameters from this study, treatment D2 group produced the best results among all other treatment groups. The study concludes that dry and fermented mixed lemon peels and olive leaves meal might be a potential feed supplement with basal diet as it is grow everywhere in Bangladesh as an alternative to antibiotic. However, a long term investigation with larger sample size is suggested for increasing sensitivity and validity of the study under field condition.

Chapter 7: Recommendation

Probiotics and phytobiotics are both used effectively over the world as growth promoters. Lemon peels and olive leaves are an economical and widely available product that can be used as a source of feed for poultry. The peels and leaves and their combination with probiotics can both be effective alternatives for using antibiotics to produce meat. Again, organic meat is becoming progressively popular around the world, and these additives may turn up in the industry that produces organic meat. All dietary groups showed better results compared to control, however, 1.2% of dry peels and leaves are recommended for better growth performance in broiler. These parameters could have a great impact on human health. However, future research on these parameters could lead to new improvements in the animal industry and human health by using a bigger sample size.

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