Effect of turmeric powder and zinc supplement on the growth performance and meat quality of Kadakhnath chicken.

KAZI ASMANY

Roll No.0119/04; Reg. no.617

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Department of Animal Science & Nutrition

Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram4225, Bangladesh

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Authorization

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This is to confirm that we have reviewed the aforementioned Master's thesis and found it to be complete and satisfactory in all areas, with all amendments requested by the thesis evaluation committee completed.

Professor Dr. Jannatara Khatun
Supervisor
Department of Animal Sciences and Nutrition, CVASU

Professor Dr. Goutam Buddha Das
Co- supervisor
Vice-Chancellor, CVASU
&
Professor ,Department of Animal Science and Nutrition, CVASU

Chairman of the Examination committee

Department of Animal Science and Nutrition
Faculty of veterinary medicine
Chattogram Veterinary and Animal Science University
Khulshi, Chattogram-4225,Bangladesh
September,2022

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Abstract

The purpose of the research is to evaluate how dietary supplements of zinc as a micro mineral, and turmeric powder as a herbal growth promoter, affected the Kadakhnath bird's ability to grow as well as its carcass features, meat quality, amino and fatty acid composition. Day one Kadakhnath Chicks were randomly allotted into five experimental groups: T0, T1, T2, T3 and T4 dietary groups. T0 is control group with basal diet whereas T1, T2,T3,T4 were given basal diets enriched with 1% turmeric powder, 1.5% turmeric powder, 1% turmeric powder with 0.5% zinc supplement and 1.5% turmeric powder with 0.5% zinc supplement respectively. Experimental trail was lasted for 75 days. The dietary treatments had no significant effect on the body weight gain and feed intake of the Kadakhnath bird at trail period. Feed conversion ratio of treatment group improved significantly ($p<0.05$) in comparison with control group .Turmeric powder with or without zinc supplement increase significantly ($p<0.05$) dressing weight of kadakhnath bird compared to control group. Turmeric powder with or without zinc supplementation does not affect the drip loss % of kadakhnath meat, but it significantly ($p<0.05$) reduces the pH, cooking loss percentage, and TBARS value of the meat. Through experimentation, it has been found that consuming zinc supplements along with turmeric powder significantly improves the oxidative stability of Kadakhnath meat. The amino acid and fatty acid composition of kadakhnath meat is unaffected by the dietary addition of turmeric powder with or without a zinc supplement. The cost-benefit analysis of the kadakhnath bird revealed that farmers may have benefit from including turmeric in poultry diets. In conclusion, adding of 1.5% turmeric powder in diet will improve FCR, meat quality and combined diet of turmeric and zinc will improve meat oxidative stability.

Keywords: Kadakhnath chicken, Turmeric powder, Zinc, Growth performance, Meat quality, Amino acid.

Chapter I: Introduction

The most significant and technologically advanced sector of Bangladesh livestock industry is poultry industry. Food security and meeting the need for high-quality animal protein are both significant goals of poultry meat. Poultry meat is a fantastic source of protein, which is necessary for growth and development. Additionally it is a source of vital micronutrients and vitamins for human body. It is discovered that the contribution of poultry meat to Bangladesh's is 37% of overall meat output. About 22–27% of the nation's overall supply of animal protein comes from chicken (Hamid et. al., 2017). With an existing population of 525 Million birds, broiler chicken is the most produced and consuming variety within the poultry industry. In Bangladesh the fastest-growing market in recent years has been local Sonali chicken, which contains a fair amount of meat content. The strongest consumer perception is for the native Deshi chicken, which is also the priciest. However, number of factors likes including chicken immunity, health, and productivity, pose a threat to the poultry industry's potential future expansion. The current environment and the industry's strategic future will continue to be significantly hampered by consumer confidence, product quality and safety, product types, and the introduction and re-emergence of diseases. Poultry is a direct source of zoonotic and food borne illnesses. The poultry business faces a significant problem in the eradication, elimination, and control of zoonotic and food borne infections. Additionally, a significant problem will continue to be the risks to the public's health from eating foods with high antibiotic residues. The idea of chicken production nowadays considers the relationships between animal immunity, wellbeing, and health in addition to illness prevention (Hafez et. al., 2020).

In order to boost the rate of feed absorption and reduce the incidence of mortality brought on by a pathogen attack, poultry producers are utilizing growth-promoting and disease-preventive antibiotics to help chickens develop quicker in the least amount of time. The beneficial gut micro biota may become dysfunctional as a result of antibiotic use, and poultry infections may become more resistant. Many studies across the world have

identified these antibiotic residues in poultry meat, and they are thought to be one of the potential contributors to human pathogens developing resistance to these antibiotics. There is major worry over the presence of antibiotic residues in poultry meat and meat products that are above the maximum allowable levels (Khurram et. al., 2018). Antibiotic usage outside of therapeutic purposes results in a higher residual buildup than is medically required, which raises the risk of antimicrobial resistance. Human resistance is thought to emerge as a result of ingesting leftover medications through animal food products (such as meat and milk). In addition, commensal bacteria from animals are frequently present in fresh meat, which can act as a reservoir for resistant genes that can be transferred to pathogenic bacteria in people (Landers et.al., 2012). According to studies, more than 50% of broiler and layer meat samples taken from various parts of Bangladesh contained antibiotic residues (Sattar et. al., 2014 and Sarker et. al., 2018). According to a different study by Faiz and Bashe (2011), most of the pathogenic bacteria become resistant due to widely use of antibiotics. Bangladesh's high rate of antibiotic resistance poses a local, regional, and international hazard (Ahmed et. al., 2019).

On the other hand, black meat from the Kadaknath breed is incredibly tasty and well-liked. Tribals and adivasis residing in Madhya Pradesh's Jhabua District use its more valuable flesh to treat a variety of human illnesses. However, this requires an accurate scientific analysis. Kadaknath birds are extremely expensive and in high demand throughout the entire region. Additionally considered to be excellent sources of protein are meat and eggs (Rao and Thomas, 1984). Although the meat of this breed has an unattractive appearance, it has a delicious flavor (Panda and Mahapatra, 1989). The Oxygen radical absorbance capacity assay's determination of the antioxidant capacity of Kadaknath meat and a better ability to block the production of advanced glycation end products were used to prove the meat's superior functional properties (AGEs). The discovery of relatively undiscovered nutritional and functional benefits of Kadaknath meat has the potential to alter the way that people view meat intake (Sharma et. al., 2022). Kadaknath are used to reproduce exceptional germplasm that is suitable for home poultry farming because of their endurance, tolerance of heat and stress circumstances, and adaptation to warm and humid climates(Kumar et.al., 2021). But this particular breed

of chicken is not raised in Bangladesh under different climatic conditions. Thus, reared this kadakhnath chicken in Bangladesh under different climate conditions is important to know the feasibility of this chicken in Bangladesh.

Development of alternatives to antibiotics for food-producing animals, particularly poultry and livestock, is urgently needed in the agricultural sector. One of the many medicinal plants that hold promise for use as natural feed additives in chicken diets is turmeric (Curcuma longa Linn.). (Lagua et. al., 2021). The effects of turmeric are comparable to those of strong antibiotics like ciprofloxacin and cephalosporins. Consequently, turmeric can be used topically and internally to treat infections (Aiman , 2021). The use of turmeric powder as feed additives and supplements have been recommended as an alternative to antibiotics for broiler chicken production (Lagua et. al.,2021).Finding new potent antiviral chemicals is necessary since most viral diseases lack effective treatments, antiviral drug resistance is on the rise, and current antiviral therapies are expensive (Tomei et. al.,2005 and Lemoine et.al., 2013) . Additionally, not all antiviral treatments are well-tolerated, efficient, and satisfying (Clercq, 2002). Therefore, the growing need for antiviral agents will be more prominently displayed. Researchers are interested in plants as a rich source of phytochemicals with a variety of biological activities, including antiviral properties (Jassim and Naji, 2003 and Zorofchian et. al., 2013). Curcumin, a plant product, has a wide range of antiviral efficacy against many viruses, according to research. It has been proposed that antiviral and anticancer drugs should target the inosine monophosphate dehydrogenase (IMPDH) enzyme because of its rate-limiting role in the de novo production of guanine nucleotides. Curcumin which is a deraivatives of turmeric powder is recommended to use as a strong antiviral drug (Dairaku et. al., 2010).

Moreover, one of the major problems facing the poultry business is immune suppression, which has a negative impact on the ability of birds to produce and results in significant financial losses. However, zinc plays a critical role to increase bird immunity and ultimately protecting them from significant economic losses (National academy press, 1994) Zinc is a micromineral that is essential for proper nutrition and is involved in a

variety of biochemical processes, including gene expression and amino acid metabolism.In times of stress, zinc has been proven to be essential for the production of the antioxidant enzyme superoxide dismutase. However, broiler meat quality has improved due to the antioxidant activity of Zn supplementation, which also increases the meat's shelf life and improves its physical properties. Zinc has also been shown to promote the growth of immune cells by releasing cytokines and stimulating cell division.Zinc have well-known antibacterial properties (Jesline et. al., 2015). Due to their effectiveness and selectivity, especially in biological and pharmaceutical applications, nanostructured materials like zinc are gaining a lot of attention (Wu et. al., 2003; Fortner et. al., 2005 and Li et al., 2005). The ability of zinc to combat bacterial infections by producing nanoparticles is one of the least researched applications (Luo et. al., 2007). Birds require zinc as a trace mineral. It serves as a co-factor for the functioning of up to 300 enzymes and is essential for the appropriate development of glands, metabolic processes, and growth in chickens (Salim et. al., 2008). By improving intestinal epithelial shape and performance, zinc oxide has reduced the usage of antibiotics in feed and affected how nutrients are absorbed and digested by birds (Li et. al., 2001). Therefore, the overall zinc concentration in chicken feed, including supplementary zinc and endogenous zinc, ranges from 120 to 150 mg/kg (Cui et. al., 2004) .

A prospective breed to be developed for commercial poultry is Kadakhnath. The key issue with the development of this breed is that it is not consumer-cost-effective due to high rearing costs. The performance of the growth was boosted by the herbal growth enhancer turmeric powder, in addition to microminerals Zinc improves bird FCR. There is less research on Kadakhnath bird with supplementary diet. An experiment should conduct to improve FCR and commercialize the kadakhnath bird by using supplemental diets . Zinc is the most significant bioactive component for poultry and according to the availability and shelf life of herbal plants; turmeric may be the best choice as a supplement. Thus, it is hypothesized that synergistic effect of supplementation turmeric and zinc to Kadakhnath bird diet would increase growth performance, have favorable effects on improve meat quality and increase shelf life of meat.

1.1Objectives of the study

- To check the feasibility of commercial Kadakhnath farming in Bangladesh.
- To observe the synergistic effect of herbal growth promoter and zinc supplement on growth performance of kadakhnath bird.
- To study the quality of black meat.
- To analyze the amino acid and fatty acid profile of black meat.

Chapter II: Review of Literature

This chapter describes background of a new Variety of poultry and effects of herbal plants (turmeric powder) and zinc supplement on it in term of growth promoter and prebiotics. This study mainly concern about antibiotic residue and growth performance on herbal growth promoter with or without micronutrients.

2.1. Background

In developing countries, the fastest growing agricultural sub-sector is poultry. Growing populations driven the demand for meat and eggs. So why the global poultry sector is expected to grow. In this context, the sector is facing few challenges. Poultry is a major asset to poverty alleviation (Mottet and Tempio, 2017). Controlling diseases, maximum production, quality of product, and reasonable production costs have been the main challenges of the poultry sector. The main goal of poultry sector meeting per capita consumption and welfare to humans necessitates continuous efficiently and less the antibiotics application (Hafez et al., 2020). Commercialize the Poultry Sector damaging severely backyard poultry rearing which was the strength of food security and key to poverty alleviation in the developing countries including Indian sub continent. Currently, interest in native chickens grows due to focus on natural healthy foods. Demand for Kadaknath black meat has increased in ongoing Corona pandemic crisis due to the expectations of the improved immunity status of human beings(Sharma et. al., 2022). Through stimulating immunity and enhancing resistance to stress Herbal Growth promoter can improve health (Krauze, 2021).

2.2. Kadakhnath

Image 2.1: Kadakhnath chicken

Kadakhnath - a special indigenous chicken of Indian sub continent. It originated from Madhya Pradesh, India. According to NBAGR India have 19 breeds of native chickens; kadaknath is one among them. The tribes of Bhil and Bhilala reared them for centuries. Its specialty is flesh and internal organs are black. So that it Known as Black Meat Chicken (BMC) and also the only black meat chicken breed of Indian sub continent. Kadakhnath found in 3 varieties feathers color, such as: Jet black, penciled and golden. It called hardy breed because of adaptability to all climatic conditions and highly resistance to disease. Its meat has distinctive taste, texture and flavor. Kadakhnath meat is rich in protein. Protein percentage is around 25%, also rich source of amino acid. Lower in cholesterol; 0.73 to 1.37% while broiler chicken has 13 to 25%. Kadakhnath meat is rich with vitamins B1, B2, B6, B12, C and E.Also good source of niacin, calcium, phosphorus, iron, nicotinic acids etc. Black meat has some medicinal Properties. It is refer as medicinal food in nervous disorder, habitual abortion, sterility, abnormal menstruation (menoxenic). Melanin pigment in black meat has sildenafil citrate, which act as vasodilator and increase blood flow to the heart and acts as Viagra.Eggs of kadakhnath rich in amino acids and less in cholesterol so that good food source for old age people and growing kids. Its eggs also help to treat migraine, asthma, acute or chronic inflammation of the kidney (nephritis) etc. (Nadamadum Vangi Nattu Kozhi (Tamil); Narayanan and Duraisamy). It Protects Eyesight and boost energy (Singh, 2019).

2.2.1. Highlights of kadaknath

- Protein Percentage is 25% which is higher of all chicken breeds.
- Fat content is found to be lowest of all chicken breeds 0.73-1.05%.
- Rich in minerals like niacin, calcium, iron, nicotinic acid and vitamins B1, B2, B6, B12, C and E.
- High Levels of 18 amino acids.
- Source of Antioxidant.

(Source: Singh, 2019.Health benefits of kadakhnath chicken.)

2.2.2. Nutrition Value comparison with Hybrid Poultry

No	Properties	Other Chicken Breeds	Kadaknath Chicken
1	**Protein content**	18-20 %	25- 27%
2	**Fats**	13 – 25 %	0.73 – 1.03%
3	**Cholesterol**	218.12 mg / 1000mg	184.75 mg/ 1000mg
4	**Linolenic Acid**	21%	24%

[Source: Kadaknath Chicken Farming, Health Benefits to disadvantages, Agrikit, 2020]

2.2.3. Characteristics of kadakhnath

Docs (Day Old Chicks) are bluish to black color with irregular dark stripes over the back. Adult plumage varies from silver and gold-spangled to bluish-black without any spangling. The skin, beak, shanks, toes and soles of feet are slate like in color. The comb, wattles and tongue are purple. Internal organs show intense black coloration. Blood is darker than normal due to melanin deposition. Average adult body weight of cock is 1.5 kg and hen is 1.0 kg.The eggs are light brown in color and average egg weight: 46.8 gms (Singh, 2019). It gains body weight of 865 g at 20 weeks. First egg is high (185 days) and the egg production potential of this breed is somewhat less (50 to 55 eggs in 40 weeks). Egg production up to 52 weeks was 90 to 105 eggs and the annual egg production is in the range of 120 to 140 eggs. This breed has good fertility (80 to 85%) and hatchability (83 to 90%) status, and low yolk to albumen ratio (0.51). lean meat (0.11 to 0.52% abdominal fat) as compared to broiler meat (1.74 to 1.85% abdominal fat) (Haunshi and Prince, 2021).

2.3. Turmeric

Turmeric (Curcuma longa) grows in forests of Southern Asia including India, Indochina, Indonesia, nearby Asian countries, and Pacific Islands including Hawaii. Turmeric was use as traditional culinary and medicinal purpose going back to pre-history (Debjit Bhowmik et al., 2009).Turmeric is a ground root that belongs to Curcuma longa and curcumin is its active compound. Curcumin;a yellow pigment that gives turmeric its yellow color. For centuries in cooking and cosmetics turmeric is being used. Turmeric has antioxidant, antimicrobial, anticancer and anti-inflammatory properties. By inhibiting lipoxygenase and cyclooxygenase, thereby reduce the leukotrienes, thromboxanes, and prostaglandins level. Topical turmeric use in psoriasis and wound healing, but limited use due to color and odor (Bolognia , 2020). Curcuma genus has a old history of medicinal applications (Akarchariya et al., 2017; Dosoky and Setzer, 2018). This genus has 120 species; among thoses, Curcuma longa L. (Curcuma; Turmeric) is widely recognized; it grow mostly in warm climate throughout the world (Wu, 2015). However, taxonomic identity of the genus is difficult due to its short period of flowering (Jadhao and Bhuktar,

2018). The most used part of this plant is rhizomes (Lakshmi et al., 2011), composed of variety of compounds, including the bioactive non-volatile curcuminoids (curcumin, dimethoxy-, and bisdemethoxy-curcumin) and the compounds present in volatile oil (mono and sesquiterpenoids) (Itokawa et al., 2008; Lobo et al., 2009). Turmeric is mainly use as spice and food additive, widely used to palatability and storage stability through its specific yellow color, taste, and antioxidant potential (Surojanametakul et al., 2010). Turmeric rhizomes' organoleptic features are yellowish color, aromatic odor, and slightly bitter taste (Duraisankar and Ravindran, 2015).

2.3.1. Health benefits of turmeric

According to (Bhowmik et al., 2009). Some Benefits of Turmeric powder are-

- Natural antiseptic and antibacterial agent, use in severe degree burns
- Natural liver detoxifier
- Natural anti-inflammatory without the side effects
- Natural painkiller and cox-2 inhibitor
- Natural treatment for arthritis and rheumatoid arthritis
- Stop the growth of new blood vessels in tumors.
- Heal and assists in remodeling of damaged skin
- Use in treatment of psoriasis and other inflammatory skin conditions.

2.3.2. Chemical composition of turmeric

Chemical Composition	Percentage
Ar-Curcumene	6.11
Zingiberene	2.97
α- Bisabolene	1.48
α- Sesquiphellandrene	2.81
Benzene	1.48

1-Ethyl-4-Isobutylbenzene	2.62
Ar-tumerone	61.79
Curione	12.48
Benzaldehyde	1.44
Silane	0.84
1,2,3,5-Tetremethylbenzene	1.42
Phenol	3.45
4-methylcarbanilonitrile	1.09

[Source: Liju et Al., 2011]

Quality of commercial turmeric products can be varied.In rhizomes, powders, and extract (curcumin) products found curcumin, demethoxycurcumin , and bisdemethoxycurcumin . On the other hand, turmeric oil and oleoresin products have ar-turmerone , α-turmerone , and β-turmerone at high volume(Li et.al.,2011).

2.3.3. Phytochemical composition of turmeric plants

Alkaloid in turmeric powder could be used as management of cold (Gill et. al., 1992). Turmeric plant can lower cholesterol, preventing cytotoxins and have antioxidant property due to having saponin and flavenoid. Tannin correct diarrheal and dysentery types disorder (Okwu et al., 2006). Flavenoids have ability to scavenge biological radicals and superoxide anions radicals and also exhibits anti - inflammatory, anti - allergic, analgesic and antioxidant properties (Gill et. al., 1992). Tannin exerts antimicrobial activities by iron deprivation and hydrogen bonding (Scalbert, 1991). Tannins are astringent in nature and treat intestinal disorders (Dharmananta, 2003).

Phytochemicals	Composition (%)
Alkaloid	0.76±0.01
Saponin	0.45±0.00
tannin	1.08±0.02
Sterol	0.03±0.01
Hydrogen cyanide	0.82±0.00
Flavenoid	0.40±0.01
Phenol	0.08±0.03

(Source: Ikpeama et al., 2014)

2.3.4. Nutritional composition of Turmeric

Principle / constituents	Nutrient value (kcal)	Percentage of RDA (%)
Energy	354.0	17
Carbohydrates	64.90	50
Total fat	9.88	33
Protein	7.83	14
Cholesterol	0	0
Dietary fiber	21	52.50
Vitamins		
Pyridoxine	1.80	138
Folates	39	10
Niacin	5.14	32
Riboflavin	0.23	18
Vitamin A	0	0
Vitamin C	25.90	43
Vitamin E	3.10	21
Vitamin K	13.40	11
Electrolytes		
Potassium	2525	54

Sodium	38	2.50
Minerals		
Manganese	7.83	340
Calcium	183	18
Copper	603	67
Iron	41.42	517
Magnesium	193	48
Phosphorus	268	38
Zinc	4.35	39.50

(Source: Ahmad et. al, 2020)

2.3.5. Uses of turmeric

- Turmeric is one of the most popular functional foods (Tsuda et. al.,2018)
- Used in dyslipidemia, stomach disorders, arthritis, and hepatic diseases (Tayyem et. al., 2006)
- Act as tonic supplement (Delgado-Vargas, 2002)
- Have antifungal, antimutagenic, and antibacterial activities (Leung et. al., 1980)
- Help inflammatory and degenerative eye disorder (Mazzolani et. al.,2013)
- Due to its antioxidant and anti-inflammatory effects it is used in Chronic and acute Kidney disease (Gupta et al., 2013).

2.3.6. Effect of turmeric in Poultry nutrition

Turmeric has many positive effects on animal health and welfare. Turmeric is an excellent feed additive for animal nutrition and health due to its bioactive compounds antioxidant, anti-inflammatory, antibacterial and antiviral properties (Dono, 2013). Egg production and Lactobacillus spp. counts increase in Layer bird at diets with turmeric powder supplementation (Kosti et al., 2020). Turmeric show DPPH radical-scavenging activity and among all plants additives, turmeric exerts the highest total antioxidant capacity, followed by cumin (Durrani et al., 2006).Turmeric aid to baby chicks or chickens suffering wry neck through providing Vitamins B and E (Lisa ,2015). Turmeric efficacy of in poultry feed alternative to antibiotics are proved by recent feed trail (Dono ,

2013). Turmeric rhizome powder in poultry diet check morbidity and mortality of chickens (Al-Kassi et. al., 2011). Turmeric in poultry feed cause no public health issue (Dono, 2013). Moreover, it is proved that Turmeric (Curcuma longa) as feed additives effective against aflatoxin-induced mutagenicity (Soni et al., 1992). Turmeric supplementation on poultry diet enhanced the growth rate and weight of chickens effectively (Kumari et al., 2007). Turmeric stimulates digestive system and promotes intestinal lipase, maltase, and sucrose activities and also secretion of pancreatic amylase, lipase, chemotrypsin and trypsin (Platel and Srinivasan ,1996).

2.3.7. Effect of turmeric on growth performance and meat quality of poultry

An inclusion of turmeric at 500g /1 kg feed increased body weight of birds, this significant increase in body weight may be due to antioxidant activities of turmeric (Durrani et. al., 2006).Turmeric powder can improved meat quality (i.e., decreased lightness values, increased pH and dry matter content of meats (Kanani et. al.,2017). The fact is turmeric can enhance nutrient metabolism and improve digestion. Turmeric are rich in atsiri oil and curcumin content (Al-Sultan and Gameel, 2004). Atsiri oil improves digestive tracts function (small intestine) and stimulates digestive enzymes production which results in improved digestion and nutrients metabolism (Darwis et al., 1991). No influence on body weight gain and daily feed intake of chickens at different dietary treatments. Broilers exhibited better feed efficiency which fed turmeric supplemented diets. A significant decrease in abdominal fat is shown in study (Nouzarian et.al., 2011). Turmeric has potentiality on growth performance, dressing percentage and cholesterol profile in broilers, and its use at 1.5% turmeric through feed show most effective results (Muhammad Arslan et. al., 2017). Turmeric powder can be recommended as feed additives alternative to antibiotics for chicken (Lagua et. al., 2021).Turmeric has positive effect on meat quality and it increase carcass weight and dressing percentage (Raskar et.al., 2019). Detrimental effects of heat stress on meat quality can remove by dietary supplementation of turmeric (Kanani, et. al., 2017). Turmeric positively affected important quality parameters including cooking loss and TBARS (Kilic et. al., 2021). Turmeric powder

increasing dietary supplementation levels except for the 10 gm/kg level has positive effects on bird's performance and gut microflora. Two gm turmeric powder per kg feed may be an alternative to feed antibiotics due to positively improved FCR (Ürüşan et. al., 2017). Zinc has antioxidant activity which plays major roles in poultry nutrition (Prasad, 2007).

2.3.8. Effect of turmeric on Serum lipid profile of poultry

Turmeric increases the high density lipoprotein (HDL) of serum (Kermanshahi et. al., 2006). Turmeric regulates total cholesterol level, total triglycerides level and very low density lipoprotein (VLDL) levels of blood serum (Kermanshahi et. al., 2006).Serum lipid profile can easily regulate through turmeric supplementation on diet (Chattopadhyay et. al., 2004). Turmeric powder inclusion on diet reduces serum triglyceride concentration (Nouzarian et. al., 2011). Curcumin improves liver activites through reducing serum triglycerides, LDL cholesterol and blood glucose levels (Emadi and Kermanshahi, 2007; Seo et al., 2008; Gandhi et al., 2011).

2.3.9. Effect of turmeric on nutrient digestibility of poultry

Turmeric powder has potentiality on increasing nutrient digestibility; therefore, it can be an alternative for feed additive in broiler chicken diet (Sundari et al., 2014). Small intestine structure plays an important role in nutrient digestion and absorption (Lenhardt and Mozes, 2003); however, manipulation in the feed may alter villus height to crypt depth ratio, and absorptive area of intestine (Fasina et al., 2006).The supplementation of Turmeric may decrease gut inflammation, increase nutrients digestibility and metabolic activity (de Beer et al., 2008; Buchanan et al., 2008; Giannenas et al., 2010). Curcumin lowered the intestinal crypt depth. 200 mg/kg feed curcumin supplementation enhanced the growth performance and fat metabolism, and increased villus absorptive area of small intestine, resulting in improved nutrients absorption(Rajput et al., 2013). Use of turmeric powder at 2.5, 5 or 7.5 g/kg diet improved egg production, egg quality, nutrient digestibility and serum metabolic profile. It may be referred as a feed additive in laying

hens' nutrition. 5 g turmeric per kg of feed show best result.(Fawaz et. al., 2022). Digestibility of crude protein, crude fat, ash and the biological value of protein increased with increasing level of dietary turmeric (Dalal and Kosti, 2018).

2.4. Zinc supplement on poultry nutrition

Zinc is mandatory for growth, maintenance, bone development, feather development and enzyme structure in poultry.In the total diet Zinc inclusions level of poultry diet is 0.012% to 0.018%.Zinc supplementation in poultry increase immunity and resistance to disease. Dietary organic zinc supplementation at 80 mg/kg in old broilers and 40 mg /kg in young broilers improves immunity (Jagzap, 2018). For the poor growth and abnormal bone development in chicks zinc deficiency was responsible (O'Dell et al., 1958).

2.4.1. Effect of Zn supplement on growth Performance of poultry

Increasing levels of dietary zinc up to 10 mg /kg feed cause increase in feed intake quad-radically (Ao. et al., 2006). Zinc sulfate ($ZnSO_4$) at 40mg/kg chicks increased feed intake linearly (Batal et al., 2001.) Supplementation of zinc up to20 mg/kg responded quad-radically to weight gain, feed intake, and feed efficiency. (Huang et al., 2001). On the other hand, zinc supplemented diets from zinc-amino acid complexes (ZnAA) improved feed efficiency in poultry (Hess et al., 2001 and Rossi et al., 2007) showed that increasing level of dietary organic zinc in diets have no influence on body weight gain and carcass yield. With inorganic zinc (Mehring et al., 1956; Wang et al., 2002) and with organic zinc (Hudson et al., 2004a) indicated that growth performance, leg abnormalities, and meat yields were unaffected when dietary zinc were provided in excess of the NRC (1994) recommendations of 40 mg/kg. By contrast, many investigators have added zinc in inorganic form of zinc (Mehring et al., 1956; Edwards and Baker, 2000), or in organic form of zinc (Johnson and Fakler, 1998; Burrell et al., 2004; Yu et al., 2005), to diets of poultry and observed improvement in growth performance. As a result, Zn is commonly added to the diets of commercial broiler chickens to ensure optimal growth and health,

particularly during the early stages of development (Sandoval et al., 1997; Smith, 2003). Organic sources of trace minerals have become increasingly popular in animal nutrition in recent years due to their higher bioavailability and potential to reduce environmental emissions as compared to inorganic sources (Pierce et al., 2005).

2.4.2. Effect of Zn supplement on meat quality of poultry

The intestine microbial population, carcass properties, and oxidative stability of chicken meat were all improved by Zn supplement (Khajeh Bami et. al.2020). Chickens fed Zn-NPs and 70ZAAC had a lower pH value in their breast flesh. The current findings revealed that 30BZMO type of Zinc monooxide, as a recommended Zn-NPs treatment, aided growth, enhanced humoral immunity, breast meat Zn content, and meat quality, while lowering MDA levels in breast meat (Eskandani et. al., 2021). Different Zinc treatments had no effect on the yellowness index of the breast meat or drip loss ($P>0.05$). The control group's breast meat pH (24 hours after slaughter) was substantially higher than the other Zn treatment groups ($P<0.05$) (Eskandani et. al., 2021). Furthermore, part of the Zn effect on immunological function could be mediated by the chicken's ability to protect itself from oxidative damage and/or improve its antioxidative status (Osaretin and Gabriel, 2009; Akhavan-Salamat and Ghasemi, 2019). According to the current findings, broiler chickens' immune systems were improved by 70 mg Zn amino acid complex (70ZAAC) and all Zn-NPs levels (except for 50BZMO treatment), which was presumably due to higher Zn bioavailability of these sources of Zn (Ao. et al., 2009). Supplemental zinc enhanced the redness of the breast muscle and the pH of the thigh muscle in broilers, lowered shear force in the thigh muscle, and reduced drip loss in the breast and thigh muscle (Liu et al., 2011). Zn supplementation reduced cooking loss in the breast and thigh in this study, indicating that Zn, like other Zn sources, can improve broiler meat quality. Improved meat quality can be explained in part by meat's increased antioxidant capacity at the same time. MDA is the principal end product of reactive oxygen species' lipid peroxidation, and a rise in MDA concentration is a key indicator of lipid peroxidation (Sumida et al., 1989).

Chapter III: Methodology and Materials

3.1. Study area and duration

This experiment was performed from July, 2020 to September 2020. This time of year, is chosen because Kadakhnath breed originated from a hot humid country. Birds were observed in Department of Animal Science and Nutrition poultry research shed. It was reared in cage to see growth effect of rearing of free-range bird. July to September month considered as summer season In Bangladesh. In that season average temperature was 30°C to 38°C, humidity is around (74-79) %. The laboratory test was done in postgraduate (PG) lab of the Department of Animal Science & Nutrition of Chattogram Veterinary and Animal Sciences University (CVASU). The experimental trail was running for 75 days to see the growth performance of bird.

3.2. Preparation of turmeric powder

About 10 kg turmeric was collected from local market. After collection it was washed through tap water & finally washed using filtrate water. Washed turmeric was dried in Sun for 7 days. During drying Period Precaution was followed to avoid contamination. Dried turmeric was grinded through electrical grinder. Grinded turmeric was filtrated through 0.2mm sieve. Finally store in airtight zipper bag and keep in drum to avoid getting wet.

3.3. Preparation of 0.5 % zinc supplement

Vita zinc is a product contain 5 % zinc were collected from central store of Techno Drugs ltd. located in Segunbaghicha, Dhaka.

Image 3.1: Dried Turmeric

Image 3.2: Turmeric powder

Image 3.3: Chick on Chick career box

Image 3.4: Brooding of Chicks

3.4. Design of the experiment:

Seventy five Kadakhnath day old chicks of both sex (female and male) were purchased from Kamrul Poultry Hatchery, Shibpur, Narsingdi. Chick was transported to Chittagong in chick box maintaining proper temperature and other precaution through a car. Immediately after arrival on poultry shed, chicks were checked for any kind of abnormalities and weight was taken for maintain uniform flock size. Chicks were divided into five dietary treatment groups and each group were further divided into three replication in a completely randomized design. Treatment group were as: T0 = control (basal diet), T1 = basal diet+ 1% dried turmeric powder, T2 = basal diet+ 1.5% dried

turmeric Powder, T3 = basal diet+ 1% dried turmeric powder+ 0.5% zinc supplement and T4 = basal diet + 1% dried turmeric powder + 0.5% zinc supplement. Each group replication group was marking as R1, R2 and R3 with 5 birds per each replication.

Table 3.1. Layout of the experiment

Treatments	Birds per Replication		Total Birds / Treatment
T0=BD	R1	5	
	R2	5	15
	R3	5	
T1=BD+ 1% DTP	R1	5	
	R2	5	15
	R3	5	
T2=BD+ 1.5% DTP	R1	5	
	R2	5	15
	R3	5	
T3= BD+ 1% DTP+ 0.5% ZS	R1	5	
	R2	5	15
	R3	5	
T4= BD+ 1.5% DTP+ 0.5% ZS	R1	5	
	R2	5	15
	R3	5	
Total			=75

[Note: BD= Basal diet, DTP= dried turmeric powder, ZS=Zinc supplement]

3.5. Preparation of the Shed

3.5.1 Housing and cleaning

At first, Poultry Research Sheds floor of Animal Nutrition Department and all rearing cages of shed were thoroughly washed with running tap water and finally through bleaching powder mixed water. Then shed were left for dry for 2 to 3 days. During drying all windows were kept open for proper ventilation. By 40% formaldehyde and potash fumigation process was done. Kadakhnath chicks are free range bird but for study purpose Birds were kept in wire cages. Cages are arranged in treatment wise without any bias. Each cage had separate drinker and feeder. Cages area was (3.5 Ft. *1.63 ft. for 5 Birds). At starter period paper sheet was provided and feed were given into round feeder up to two weeks.

Image 3.5: Weighing of bird

Image 3.6. Housing of Birds

3.5.2. Sanitation

Potassium per manganate containing footbath was kept on shed entrance to avoid any kind of biosecurity hazard. Feeder and drinker were washed regularly before providing feed and water. Unauthorized person was strictly prohibited in shed during study period.

Bird's fecal wastage was cleaned once daily and in last two weeks of study twice daily. Proper ventilation was maintained to avoid ammonia storage from fecal wastage.

3.6. Bird's management

During study period, standard guideline of birds rearing was maintained thoroughly. Points are described below

3.6.1. Brooding period

Brooder cage floor was occupied by dry and clean newspaper to avoid any kind of injury from wire cages. Newspaper sheet was changed in every three day up to21 days. During study period two cages were separated through hardboard. During brooding it was done for proper lighting, after brooding it was done to avoid cannibalism. Lighting was done by 60-watt lamp in each rearing cage. Brooding temperature was 95°F, 90° F, and 85°F respectively. Room temperature was monitored by room thermometer.

3.6.2. Feeding

As per experiment layout, basal diet was provided to Control (T0) group. In 1% and 1.5% dried turmeric powder was added to the T1 and T2 experimental group with basal diet on DM basis respectively. In, T3 and T4 experimental group 0.5% zinc supplement with 1% and 1.5% dried turmeric powder respectively added to basal diet on DM Basis. Commercial broiler starter feed from Nahar Feed Ltd., Bangladesh was provided to chicks up to 21 days. Then commercial broiler grower feed was given until 74 days. Feed was in broken pellet form. Ad libitum fresh water was provided to birds.

3.6.3. Vaccination

Birds were vaccinated against New Castle disease and Infectious Bursal disease. On 5^{th} day of experiment each bird was vaccinated with New Castle Disease (ND) vaccine

named BCRDV through eye drop and booster dose were provided on 24th day. On 11thday of experiment infectious bursal disease vaccine were provided as eye drop and booster dose was provided on 20th day. BCRDV vaccine were purchased from DLS (Department of livestock services), Chattogram and infectious bursal disease vaccine were purchased from Incepta Drugs ltd., Bangladesh.

3.7. Diet of the Experiment

Two different Rations respectively Broiler Starter and Broiler grower feed were purchased from Nourish feed company, Bangladesh. The experimental herbal growth promoter (Turmeric powder) and zinc supplement were added according to experiment layout. The ingredients and nutrient compositions are shown in table 3.2

Table 3.2 Ingredients of basal diet per 100 kg feed

Ingredients	Starter (0-21) days	Grower (22- 74) days
Maize	51	55
Rice polish	4	4
Vegetable oil	2.5	1
Soyabean meal	27.12	26
Groundnut Cake	12	10
Oyster shell Grit	3.38	4.0
DCP		
Salt		
Methionine		
l- lysine		
Vitamin - mineral premix		
Toxin binder		
Coccidiostat		
Enzyme		

Nutrient composition of basal diet		
Ingredients	**Starter (0-21) days**	**Grower (22- 74) days**
ME(Kcal/Kg)	2900	3050
Crude Protein%	22	20
Crude Fiber %	3	2.7
Ether Extract%	4.7	5.5

*****Vitamin- mineral premix composed of Vitamin A, Vitamin D3, Vitamin E, Vitamin K3, Vitamin B12, Niacin, Thiamin, Folic acid, Riboflavin, Choline Chloride, Manganese, Selenium, Iron and Cobalt.

3.8. Data collection

Amount of feed intake and weight gain were recorded at every week throughout the whole study period. Weight gain was calculated through deducting previous week weight gain. Feed intake also calculated through deducting previous week feed supplied and residue. Finally, FCR value calculated through dividing feed intake amount by weight gain. FCR value calculated for every 2 weeks. At 74th day 3 birds from each treatment (bird per replication) group were sacrifice for meat quality study purpose. Blood sample were collected using vacutainer tube and meat sample was collected in air tight zipper bag separately for different laboratory test.

3.9. Laboratory Analysis

3.9.1. Carcass Characteristics

At, 74th day one bird randomly selected from each replication group for slaughter purpose. Bird were slaughtered by severing jugular vein through sharp knife. When a bird bled adequately, it was scaled and feather was removed. After removing feather birds were eviscerated. Dressed bird's weight is taken. Weight of head, shank, breast meat, thigh meat, drumstick, liver, abdominal fat, heart, spleen, gizzard was taken separately.

3.9.2 Meat pH Measurement

By using a portable pH meter (ORION STAR A211 Thermo Scientific, Indonesia) the thigh muscle's pH was measured. One gram meat sample weighed and taken into falcon tube. 10 ml cold deionized water added to the falcon tube and homogenized by using a homogenizer (VELPR Scientificia OV5) for 30 seconds. According to American meat science Association (AMSA) each sample pH was measured three time and make average reading for each replication (Hunt et al., 2012).

3.9.3. Drip loss percentage of meat

After processing of sample, meat sample from breast muscle was weighed and recorded as initial weight (W1). Then meat sample was preserved in airtight zipper bag at 4°C in a refrigerator. After 48 hours of preservation, meat sample were taken from Zipper bag and kept 20 minutes in room temperature for thawing. After thawing, meat sample was gently pressed with tissue paper to suck the water in sample and 2nd weight (W2) was measured. Then weighed sample again preserved at 4°C for further 48 hours. After preservation period the process of taking sample

Image 3.7. Sample collection

Image 3.8. Weighing of sample

Image 3.9. Sample in Airtight Zipper Bag

weight was repeated and final weight measured as (W3). According to Honikel (1998), the drip loss percentage was calculated by the following formula:

Drip loss % = [(W1-W2)/W1] *100

2nd Drip loss Percentage was measured by following formula;

Drip loss % = [(W2-W3)/W2] *100

3.9.4. Cooking loss percentage of meat

The initial weight of a sample of thigh meat was obtained and recorded (W1). The samples were then stored at -20°C in an airtight zipper bag until laboratory analysis was completed. Meat samples were left at room temperature for 30 minutes on the day of lab examination to allow for thawing. After thawing, the complete sample was immersed in an 80°C water bath (WB-22, Witeg, Germany) for 20 minutes with a labeled zipper bag. After cooking with the Zipper Bag, the meat sample was removed from the Water bath and allowed to cool at room temperature. Then the meat sample was carefully wiped with tissue paper to remove any excess water from the zipper bag. Meat sample weight was taken and recorded as W2. According to (Khatun et al., 2018) cooking loss measurement formula is

Cooking loss% = [(W1- W2)/W1] *100

3.9.5. Proximate analysis of meat

Preserved sample at -20°C were taken out from refrigerator and kept at room temperature for thawing. After 30 minutes, meat sample weighed and approximate analyses (Crude protein (CP), Dry matter (DM), Ether extract (EE), Total ash (TA) was carried out at Animal Nutrition Laboratory of CVASU as described by (AOAC, 2005).

3.9.6. Oxidative Stability of meat

After dressing meat sample were preserved at -20°C. At the day of analysis preserved sample was kept in room temperature about one hour for thawing. Thawed meat was used to measure thiobarbituric acid reactive substances (TBARS) values. TBARS procedure was done at 1^{st} , 3^{rd}, 5^{th} and 7^{th} day respectively according to the modified method of (Du and Ahn, 2002). TBARS values are expressed as micromoles of malondialdehyde (MDA) per 100 gm of meat sample.

Stock solution 1- For 500 ml of stock-1 solution need 402 ml distilled water, 98 ml phosphoric acid and 100 mg trichloracetic acid

Stock solution 2 -for 250 ml stock-2 solution need 250 ml distilled water and 0.18 gm dihydroxi-2-mercaptopyridine.

Procedure TBARS test are described below:

4 g of meat sample in falcon tube

↓

10 ml of distilled water were added

↓

10 ml stock solution-1 was added

↓

Homogenize with a homogenizer (VELPR Scientificia OV5)

↓

Filtrated through Whatman No. 1 filter paper

↓

2 ml filtrate solution was taken to another falcon tube

↓

2 ml stock solution-2 was added

↓

Kept on water bath (WB-22, Witeg, Germany) at 80°C for 30 minutes

↓

After withdrawn from water bath kept on room temperature for cooling

↓

The absorbance was than measured by Spectrophotometer

(UV-2600, UV-VILS Spectrophotometer, Shimadzu) at 530 nm

3.9.7. Amino acid analysis

Briefly, 1 gm sample were dissolved in 50 ml 6N HCl solution and kept at 110°C for 22 hours. Prepared sample was taken to HPLC vial and put into HPLC machine as described Shimadzu technologies notebook.

3.9.8. Fatty acid analysis

Fatty acid was measured through direct fatty acid methyl ester method by the GC system (standard Agilent technologies 7890A, USA). Briefly, in a 15 ml falcon tube 1 gm sample was taken. Then 0.7 ml of 10 N KOH and 6.3 ml of methanol was added into tube. In a water bath all the tubes were incubated at 55°C for 1.5 hours. Vigorous hand shaking during incubation need in every 30minutes for 10 seconds. After 1.5 hours, cooled the tubes in cold water. Then 0.58 ml 24N H_2SO_4 was added into falcon tube. Again incubated at water bath for 1.5 hours at 55°C. Here also need vigorous hand shaking 3 times in 1.5 hours. Again, cooled in cold water and 3 ml hexane was added and centrifuged at 3000 rpm for 5 minutes. Hexane layer was separated through pasteur pipette into GC vials. GC vials with sample placed in sample chamber of gas chromatography machine. After analyzation of sample GC machine show graph. Data from this graph were further analyzed through statistical analyzer software.

3.10. Cost- benefit analysis

Expense of feed, chicks, labor, vaccine and miscellaneous cost was included as cost of cost of experiment, money got from bird selling considered as benefit from experiment. Finally, total cost was deducted from total income and calculate the profit amount.

Total cost= Feed cost+ Chick Cost+ Vaccine cost+ Miscellaneous cost

Total Income = Total Weight of bird * Price per 1 kg wt.

Total Profit= Income-Total cost

3.11. Statistical analysis

All data were put into Microsoft Excel sheet (MS Excel, 2009, USA) and analyzed by GLM (General Linear Model) procedure at SAS Institute Inc. (2007). Duncan's multiple range test were used to examine significant differences among the treatment means (Duncan, 1955). All data was expressed as mean with standard error (SE). The level of statistical significance was presented at $p<0.05$.

Image 3.10: Hexane layer collection for fatty acid test

Image 3.11: Titration for CP analysis

Chapter IV: Results

This chapter describes findings of the effect of feed additives (turmeric powder a herbal growth promoter and zinc supplement) on the growth performance, carcass characteristics, meat quality of Kadakhnath chicken such as proximate composition, cooking loss, drip loss, meat pH, oxidative stability, fatty acid profile and amino acid composition.

4.1. Composition of experimental diet with or without additives

The chemical composition of experimental diets shown in table 4.1. From the Result it has been observed that crude protein percentage of feed increase about 1% after adding turmeric powder in feed. Further adding of zinc supplement in feed does not increase crude protein percentage. Crude fiber percentage increase significantly after adding turmeric powder but after adding zinc supplement crude fiber percentage decrease slightly. At 1% turmeric powder in feed showed lowest ash percentage. EE% of feed increase significantly in adding more percentage of turmeric powder and zinc supplement.

Table 4.1. Proximate composition of experimental diet with or without zinc supplement and turmeric powder.

Parameter	Treatment					
	T0 (Mean±SE)	T1 (Mean±SE)	T2 (Mean±SE)	T3 (Mean±SE)	T4 (Mean±SE)	P
DM%	84.5±0.22	84.61±0.07	85.15±0.08	85.00±0.14	85.83±0.60	0.08
CP%	18.08±0.01	19.54±0.61	19.89±0.21	19.48±0.74	19.72±0.82	0.33
CF%	3.25^{ab}±0.14	3.47^{a}±0.03	3.50^{a}±0.00	3.00^{b} ±0.00	3.25^{ab}±0.14	0.02
Ash%	4.72^{a} ±0.59	3.74^{b}±0.52	4.96^{a}±0.17	4.999^{a}±0.16	4.59^{a} ±0.05	0.04
EE%	5.84^{b} ±0.01	5.97^{b}±0.29	6.02^{b}±0.01	6.69^{a} ±0.19	6.89^{a} ±0.19	0.01
NFE%	68.11	67.28	65.63	65.84	65.55	

^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three replicate groups of five birds each. (n=15).* T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.SE=Standard error. CP=Crude protein; DM=Dry matter; CF=Crude fiber; EE= Ether extract. NFE=Nitrogen free extract.

4.2. Growth performance of kadkhnath chicken

The impact of turmeric powder and zinc supplement on weekly growth performance of kadakhnath bird was shown in table 4.2.

Table. 4.2. Kadakhnath growth performance in weekly basis

Parameter	Treatment					P value
	T0 (Mean±SE)	T1 (Mean±SE)	T2 (Mean±SE)	T3 (Mean±SE)	T4 (Mean±SE)	
Average weekly weight gain/bird						
2nd week	73.92±6.50	76.25±4.38	80.62±6.26	75.00±1.33	79.53±3.54	0.83
4th week	141.33 ^{b} ±4.07	155.25 ^{b} ±8.66	197.60 ^{a} ±17.33	161.73 ^{b} ±4.12	169.20 ^{ab} ±2.44	0.02
6th week	222.83± 15.38	244.17± 14.91	248.15± 16.09	233.00± 20.74	227.27± 3.43	0.73
8th week	183.17±2.1	216.83±5.6	227.70±25.6	216.13±15.6	215.60±11.3	0.32
10th week	285.67± 17.05	270.67± 13.80	264.82±2.31	252.11±8.37	230.80±15.19	0.09
Average weekly feed intake/bird						
2nd week	168.08± 2.53	173.50±1.00	174.97±6.28	175.87±1.27	177.67± 0.996	0.32
4th week	277.08 ^{a}± 1.82	274.00 ^{ab}± 2.31	250.90 ^{bc}± 16.32	234.87 ^{c} ±2.47	237.93 ^{c} ±2.18	0.01
6th week	428.50± 11.09	416.00±5.88	381.77 ±29.47	387.87± 29.27	378.80± 21.90	0.43
8th week	459.33± 30.40	463.33± 33.65	381.10± 30.78	440.50± 57.66	396.13 ±30.65	0.47
10th week	796.00 ^{a}±8.25	675.17 ^{b} ±7.07	585.17^{bc}± 50.91	630.50 ^{b}± 16.69	511.47 ^{c} ±28.37	0.0003
FCR						
2nd week	2.31±0.22	2.29±0.15	2.19±0.11	2.35±0.03	2.24±0.09	0.92
4th week	1.96 ^{a} ±0.04	1.77 ^{b} ±0.09	1.27 ^{d} ±0.03	1.46 ^{c} ±0.05	1.41 ^{cd} ±0.03	0.0001
6th week	1.93±0.11	1.71±0.08	1.54±0.12	1.67±0.03	1.66±0.07	0.09
8th week	2.51 ^{a} ±0.20	2.15 ^{ab} ±0.21	1.69 ^{b} ±0.06	2.02 ^{ab} ±0.12	1.85 ^{b} ±0.17	0.04
10th week	2.81±0.19	2.51±0.11	2.21±0.18	2.50±0.04	2.25±0.25	0.17

^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three replicate groups of five birds each. (n=15). T0 = control group, T1 = 1% turmeric powder, T2 = 1.5% turmeric powder and T3=1% turmeric powder 0.5% zinc and T4 = 1.5% turmeric powder+0.5% zinc. FCR = feed conversion ratio, SE = Standard error.

The average daily gain (ADG) of the birds grew significantly in the T2 fed birds throughout the third and fourth weeks of age, while it increased numerically in the T1, T3, and T4 fed birds compared to control group over the same time period. Feed intake decreased significantly in the T3 and T4 treatment groups throughout the third and fourth weeks of experiment, while it decreased marginally in the T1 and T2 treatment groups. Feed intake decreases more significantly in T2 and T4 diet groups than in T1 diet group during the finisher phase of 9th and 10th week of age. At the 9th and 10th week of experiment, the T1 and T3 diet groups exhibit a less substantial drop in feed intake.

FCR considerably improved in the T2 diet group during the third and fourth weeks of experiment. T4, T3, and T1 treatment groups all demonstrate improved feed conversion ratios. The feed conversion ratio in the T2 and T4 diet groups improved significantly between the 7th and 8th week of experiment. T1 and T3 diet groups, on the other hand, have marginally better FCR.

Table 4.3. Overall growth performance of kadakhnath chicken on turmeric powder and zinc supplement diet.

Parameter	Treatment					P Value
	T0(Mean± SE)	T1 (Mean±SE)	T2 (Mean±SE)	T3 (Mean±SE)	T4 (Mean±SE)	
Inwt/b (g)	27.25±0.52	26.00±0.80	26.20±0.53	26.93±0.55	7.13±0.48	0.48
Fwt/b (g)	944.17± 18.05	985.83± 10.83	1045.08± 23.14	964.92± 43.17	946.20± 9.04	0.07
wtgain/ b(g)	916.92± 17.92	959.83± 11.18	1018.88± 23.05	937.98± 43.54	919.07± 9.48	0.07
TFI/b (g)	2129.0^{a}± 16.87	2002.00^{ab}± 42.25	1773.90^{bc}± 92.01	1869.60^{bc}± 93.28	1702.00^{c} ±83.12	0.01
FCR	2.32^{a}±0.04	2.09^{b}±0.03	1.74^{d}±0.07	1.992^{bc}± 0.007	1.85^{c}±0.11	0.0004

*

* ^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three replicate groups of five birds each. (n=15).* T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc. FCR=feed conversion ratio, SE=standard Error, Inwt= Initial Weight, Fwt= Final weight, Wt. gain= Weight gain, TFI= Total feed intake, b= Bird, g= gram.

Table 4.3 shows the effect of turmeric powder on the overall growth performance of Kadakhnath poultry from day 0 to day 74 of the trial. The results revealed that the diets group had no significant differences in initial weight, final weight and weight gain ($p<0.05$). On the other hand, total feed intake and feed conversion ratio differ significantly ($p<0.05$) among diet groups. The T4 diet group has the greatest decrease in feed intake ($p<0.05$), while the other diet groups have only a minor decrease and no significance difference among T1, T2 and T3 groups.

However, all the treatment group show improved FCR than control birds but within treatments there is no significant difference. In this study, the T2 group's FCR improved the most with a 1.5 percent turmeric powder diet. Dietary groups T1, T3, and T4 exhibit substantial differences ($p<0.05$) of FCR improvement.

4.3. Carcass Characteristics of kadakhnath chicken

In table 4.4 summarizes the differences in carcass characteristics across the experimental birds

Table. 4.4. Effect of turmeric powder on carcass characteristics of Kadakhnath chicken

Parameter	Treatment					
	T0 (Mean±SE)	T1 (Mean±SE)	T2 (Mean±SE)	T3 (Mean±SE)	T4 (Mean±SE)	P Value
DW	57.73^{c}±0.2	59.79^{b}±0.5	62.10^{a}±0.3	61.22^{ab}±0.35	62.83^{a}±1.2	0.001
BMW	26.39±1.10	26.15±0.34	26.69±0.96	27.37±0.48	27.16±0.86	0.80
TMW	24.84±0.39	24.74±0.38	24.60±0.28	25.91±0.31	25.01±1.20	0.61
HW	2.93±0.14	2.95±0.19	3.16±0.18	2.94±0.03	2.87±0.24	0.79
DruW	20.29±0.70	20.86±0.34	20.24±0.17	21.39±0.12	20.09±0.75	0.36
Heart	0.81±0.04	0.80±0.05	0.82±0.004	0.88±0.01	0.90±0.07	0.39
liver	3.24^{ab}±0.07	3.04^{b}±0.09	3.07^{b}±0.02	3.41^{ab}±0.08	3.60^{a}±0.22	0.03
Gizzard	3.71±0.22	3.97±0.11	3.96±0.02	4.16±0.10	4.14±0.15	0.23
Spleen	0.10±0.01	0.09±0.01	0.10±0.004	0.10±0.001	0.10±0.01	0.68
Bursa	0.26±0.02	0.28±0.01	0.27±0.003	0.29±.001	0.28±0.013	0.63
AFW	1.07±0.01	0.99±0.01	1.07±0.04	1.08±0.02	0.996±0.04	0.08

* ^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three replicate groups of five birds each. (n=15).* T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc. FCR=feed conversion ratio, SE=standard Error.BMW= Breast meat weight, DW=Dressed weight, HW= head weight, DruW= Drumstick weight, AFW= Abdominal fat weight.

In all of the dietary treatment groups, dressed weight and liver weight increased significantly ($p<0.05$). The diet including 1.5 percent turmeric powder plus or minus a zinc supplement resulted in the highest dressed weight. In contrast, a diet containing 1% turmeric powder resulted in a little increase in dressed weight.

In the meantime, liver weight increased more in the T3 and T4 dietary groups with zinc supplementation than in the T1 and T2 dietary groups without zinc supplement. In comparison to the control group T0, all of the dietary groups have a significant ($p<0.05$) variation in liver weight.

4.4. Determination of meat quality

4.4.1. Proximate composition of kadakhnath chicken meat

The dietary effect of turmeric powder and zinc supplement on Kadakhnath meat composition was shown in Table 4.5. Dry matter and ether extract percentage of Kadakhnath meat show significant ($p<0.05$) difference on dietary treatment with turmeric powder and zinc supplement than control group. All dietary groups' dry matter increased significantly ($p<0.05$) than control group T0 but among dietary groups there is no significant difference.

On the other hand, ether extract percentage show more significant ($p<0.05$) difference in diet with both turmeric powder and zinc supplement.

Table 4. 5 . Effects of turmeric powder and zinc supplement on kadakhnath meat composition

Parameter	Treatment					
	T0 (Mean±SE)	T1 (Mean±SE)	T2 (Mean±SE)	T3 (Mean±SE)	T4 (Mean±SE)	P value
DM%	24.67^{b}± 1.12	26.87^{a}± 0.18	29.53^{a}± 1.70	28.63^{a}± 0.75	29.43^{a}± 0.70	0.03
CP%	22.34± 0.21	24.03± 0.41	24.21± 0.88	22.40 ±1.23	23.92±0.00	0.39
EE%	0.72^{b}± 0.03	0.62^{c}± 0.02	0.78^{b}± 0.03	0.97^{a}± 0.03	0.96^{a}± 0.02	0.0001
Ash%	0.17±0.14	0.19± 0.12	0.20± 0.11	0.21± 0.13	0.21± 0.14	0.69

* ^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three replicate groups of five birds each. (n = 15).* T0 = control group, T1 = 1% turmeric powder, T2 = 1.5% turmeric powder and T3 = 1% turmeric powder+ 0.5% zinc and T4 = 1.5% turmeric powder+0.5% zinc. FCR = feed conversion ratio, SE= Standard error CP = Crude protein; DM = Dry matter; EE= Ether extract.

4.4.2. Drip loss percentage of meat

Figure 4.1 shows the drip loss % of all experimental kadakhnath birds. There was no significant ($p<0.05$) difference in drip loss percentage across the dietary feeding groups. However, drip loss percentage in day 3 increased than drip loss percentage of day 1.

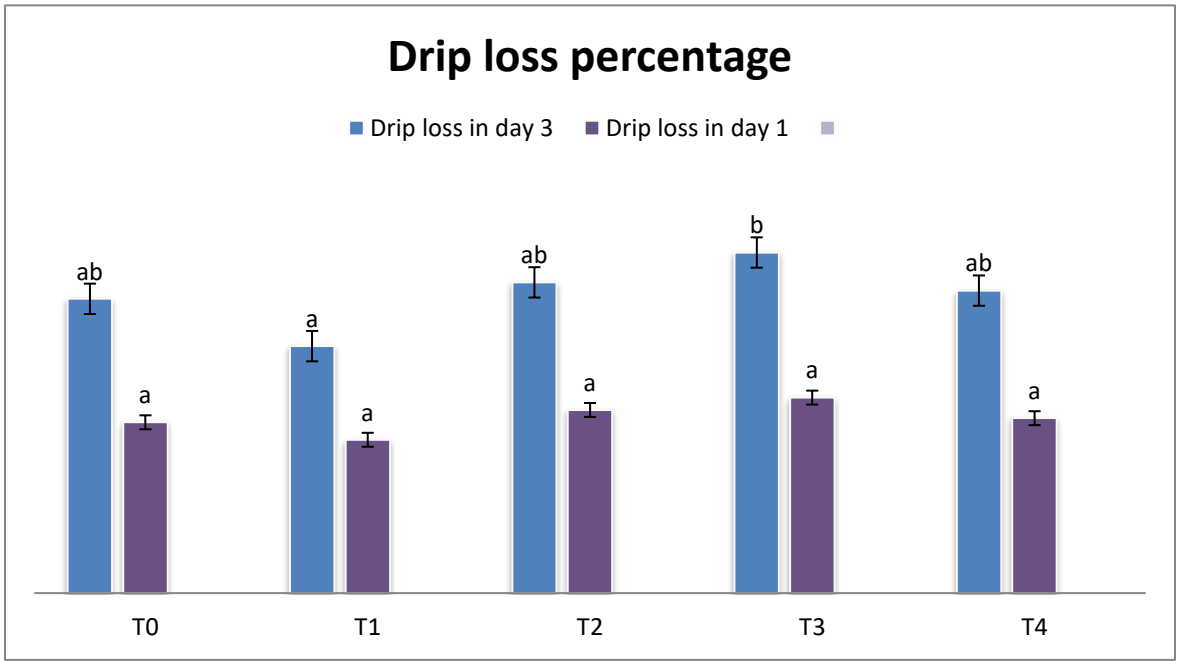

Fig.4.1. Effect of turmeric powder and zinc supplementation on Kadakhnath meat drip loss percentage

The data is presented as the average of three replicate groups of five birds each. (n= 15). T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc. .

4.4.3. Cooking loss percentage of kadakhnath chicken meat

Figure 4.2 shows the effects of probiotics on cooking loss percentage of kadakhnath meat. It was observed that the percentage of cooking loss differed significantly between the experimental diet groups. All of the dietary groups have a lower percentage of cook loss than the control group T0, while the T1 dietary group with 1% turmeric powder has a great significant difference from the control group T0.

Fig.4.2. Dietary turmeric powder and zinc supplement effect on cook loss percentage of Kadakhnath meat

*The data is presented as the average of three replicate groups of five birds each. (n=15).*T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.

4.4.4. Meat P^H measurement

The P^H of kadakhnath meat was significantly influenced by the addition of turmeric powder and zinc. T4 group has the lowest P^H of 5.009. In comparison to the control group T0, the other dietary groups show very little variation.

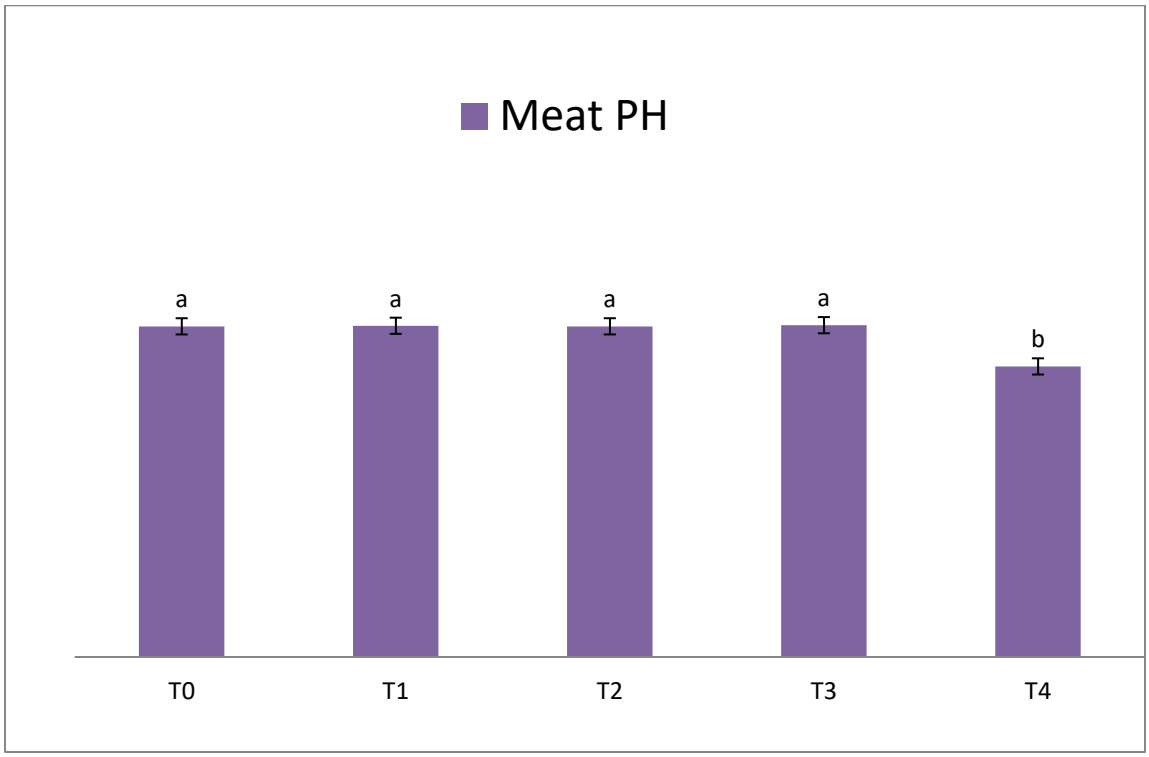

Fig.4.3. Dietary turmeric powder and zinc supplement effect on P^H of Kadakhnath meat

The data is presented as the average of three replicate groups of five birds each. (n=15). T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.

4.4.5. Oxidative stability of meat

TBARS value of kadakhnath meat of control group and four treatment groups are showed below in figure 4.4. The entire treatment group showed significant reduction ($p< 0.05$) in TBARS values than control bird's meat.T2 treatment group showed the most significant reduction on TBARS value at the 7th day of storage at 4°c whereas all the treatment groups and control group did not show any significant variation in TBARS Value at day one. All the treatment groups show significant reduction ($p< 0.05$) in TBARS values at day 3, day 5 and day 7.

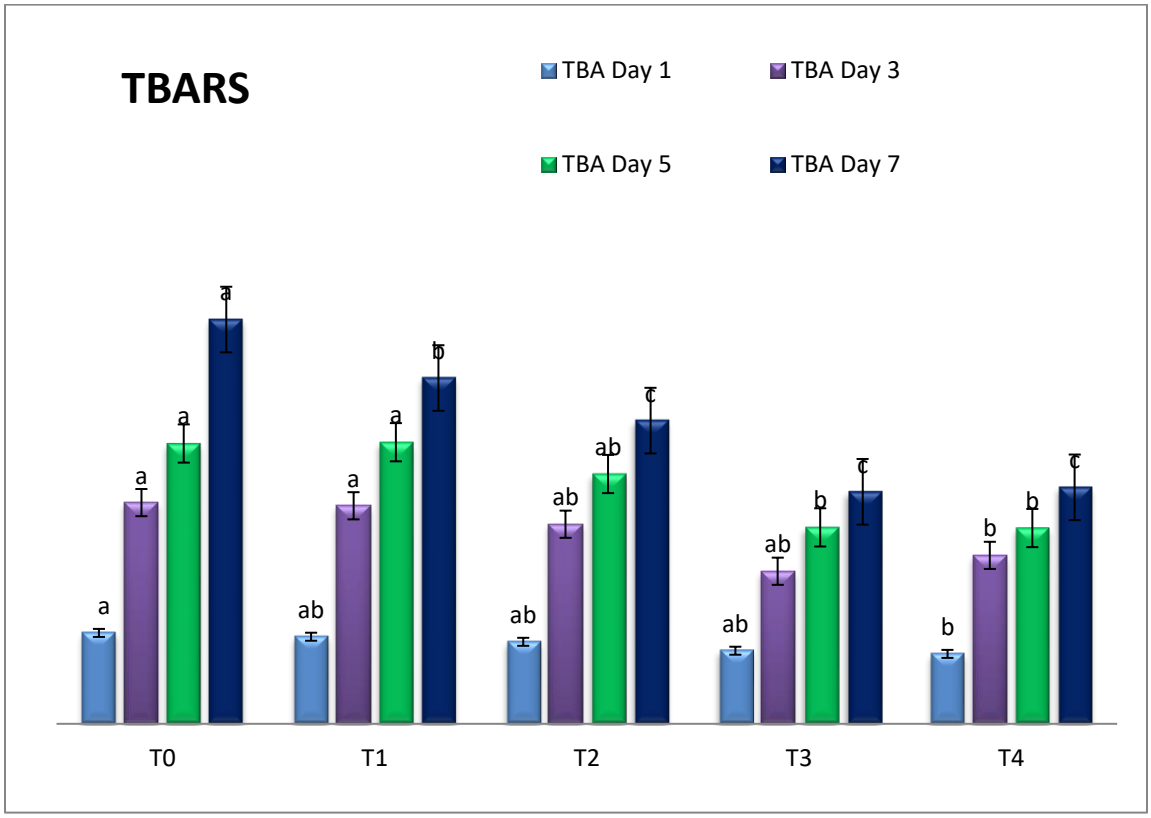

Figure .4.4. Dietary turmeric powder and zinc supplement effect on oxidative stability of Kadakhnath meat.

The data is presented as the average of three replicate groups of five birds each. (n=15). T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.TBA day 1= TBARS value in day 1; TBA day 3= TBARS value in day 3; TBA day 5= TBARS value in day 5; TBA day 7= TBARS value in day 7.

4.4.6. Fatty acid analysis of kadakhnath poultry

Docosahexaenoate, Cis-5,8,11,14,17 Eicsapentenoate, Tridecanoate, Cis-9 oleic acid, Linoleate, Linolenate groups of fatty acid show slight significant($p<0.005$) difference. Other types of fatty acid do not show any significant difference at dietary treatment with turmeric powder and zinc supplement. However palmitate reduced numerically with supplement turmeric powder and zincin diet.

In combined diet with turmeric and zinc saturated fatty acid decrease. Unsaturated fatty acid (UFA) decrease in turmeric powder diet and increase significantly ($p<0.005$) in combined diet of turmeric and zinc. Combined supplement of turmeric powder and zinc increased mono unsaturated fatty acid significantly.

Table 4.6. Effects of turmeric powder and zinc supplement on kadakhnath meat fatty acid composition.

Fatty Acid/ Treatment	T0 Mean±SE	T1 Mean±SE	T2 Mean±SE	T3 Mean±SE	T4 Mean±SE	P value
Butyrate	0.38±0.11	1.23±0.21	0.54±0.51	1.33±0.21	1.21±0.21	0.55
Laurate	0.21±0.07	0.22±0.06	0.06±0.01	0.44±0.06	0.36±0.06	0.17
Tridecanoate	0.20^{cd}±0.0	0.99^{a}±0.14	0.05^{d}±0.10	0.79^{ab}±0.1	0.42^{b}±0.1	0.0
Myrisate	0.90±0.40	0.59±0.13	0.77±0.09	0.36±0.13	0.31±0.13	0.75
Pentadecanoate	1.84±1.60	0.11±0.69	0.11±0.04	0.76±0.69	4.47±0.69	0.44
Palmitate	41.09±18.	26.12±5.5	29.27±2.1	17.66±5.5	18.01±5.5	0.81
Palmetoliate	0.67±0.31	0.48±0.11	0.22±0.19	0.58±0.11	0.23±0.11	0.74
Heptadecanoate	1.07±0.64	4.12±0.50	1.97±0.63	0.61±0.50	0.64±0.50	0.28
Cis-10 Heptadecanic acid	0.64±0.05	0.35±0.11	0.21±0.13	0.96±0.11	0.72±0.11	0.14
Stearate	5.62±1.93	4.49±1.26	4.99±4.85	7.20±1.26	8.48±1.26	0.97
Elaidate	0.27±0.09	8.23±1.43	4.03±3.95	1.1±1.43	0.25±1.43	0.60
Cis-9 oleic acid	0.55^{c}±0.2	0.25^{c}±3.39	0.20^{c}±0.2	16.7^{b}±3.4	20.5^{a}±3.4	0.006

Linolaidiate	13.01±3.8	4.16±2.32	1.92±1.89	0.51±2.32	0.24±2.32	0.29
Linoleate	0.36^{b}±0.1	0.11^{b}±0.2	0.06^{b}±0.0	1.43^{a}±0.2	0.41^{b}±0.2	0.04
Arachidate	14.8±14.5	39.93±6.5	49.17±1.2	23.14±6.5	24.84±6.5	0.42
Cis-11 Eicosenoate	0.70±0.23	0.25±0.12	0.18±0.01	0.89±0.12	0.44±0.12	0.31
Linolenate	0.61^{b}±0.4	0.43^{b}±0.71	0.36^{b}±0.0	5.40^{a}±0.7	0.40^{b}±0.7	0.02
Heneiicoseno ate	3.72±1.86	3.05±0.63	3.84±0.57	0.93±0.63	1.39±0.63	0.70
Cis-11,14 Eicosadioeni cc acid	0.37±0.17	0.39±0.11	0.06±0.03	0.89±0.11	0.50±0.11	0.21
Cis-8,11,14 Eicosatrienoi c acid	0.30±0.08	0.07±0.08	0.22±0.19	0.63±0.08	0.45±0.08	0.51
Erucate	0.53±0.14	0.28±0.10	0.19±0.02	0.86±0.10	0.70±0.10	0.17
Cis-5,8,11,14 Eicosatrienoi c acid	9.25±1.77	3.10±1.75	1.02±0.98	10.82±1.8	10.41±1.8	0.12
Cis-5,8,11,14,17 Eicsapenteno ate	0.23^{b}±0.07	0.08^{b}±0.12	0.07^{b}±0.03	0.93^{a}±0.12	0.34^{b}±0.12	0.0435
Nervonate	0.92±0.24	0.59±0.33	0.22±0.19	2.40±0.33	2.00±0.33	0.083
Docosahexano ate	1.71^{c}±0.1	0.40^{d}±0.38	0.26^{d}±0.1	2.7^{a}±0.38	2.30^{b}±0.4	0.001
SFA	66.8^{c}±0.8	78.28^{b}±5.1	87.15^{a}±0.9	52.9^{d}±5.1	59.0^{d}±5.1	0.005
UFA	33.2^{b}±0.8	21.72^{c}±5.1	12.85^{d}±0.8	47.1^{a}±5.1	41.0^{a}±5.1	0.005
PUFA	19.7±1.83	16.38±2.17	10.48±2.55	12.05±2.1	4.98±2.17	0.19
MUFA	13.51^{b}±1.0	5.34^{bc}±5.50	2.37^{c}±1.74	35.07^{a}±5.5	36.03^{a}±5.5	0.0126

* ^{a,b,c} in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three duplicate groups of five birds each. (n=3).*T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.SFA= Saturated fatty

acid, UFA= Unsaturated fatty acid; Pufa= Polyunsaturated fatty acid; Mufa= Monounsaturated fatty acid.

4.4.7. Amino acid analysis of Kadakhnath chicken

Dietary effect of turmeric and zinc supplement on amino acid profile of kadakhnath meat is showed below in figure 4.5.There is no significant difference among different dietary group of turmeric powder and zinc supplement. All essential amino acid is present in kadakhnath meat. Different dietary treatment does not change its amino acid profile significantly. Percentage of different amino acid may vary numerically in different diets but it do not vary significantly.

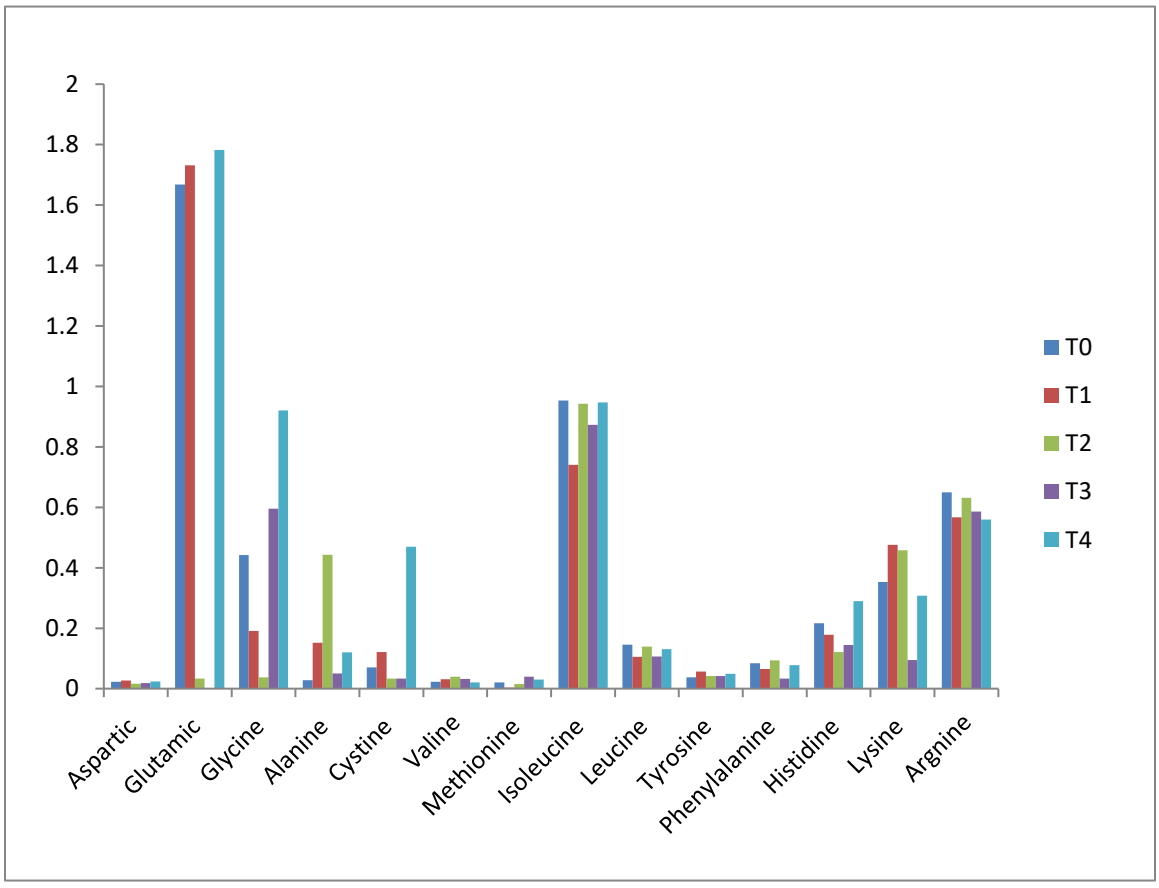

Figure 4.5. Dietary turmeric powder and zinc supplement effect on amino acid profile of Kadakhnath meat.

The data is presented as the average of three duplicate groups of five birds each. (n=3). T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc

4.4.8. Cost Benefit analysis of Kadakhnath chicken

Table 4.7 represents the cost benefit analysis of 10 weeks trails of Kadakhnath poultry. Dietary treatment of T2 group show the significance ($p<0.05$) highest in live weight (in Kg) gain and T4 group show the lowest feed intake per bird. T2 group show lowest cost per bird and highest profit in both term of income per bird and net profit per Kg live weight.

Table 4.7. Effects of turmeric powder and zinc supplement on cost benefit of kadakhnath meat

Parameter	Treatment					
	T0	T1	T2	T3	T4	P value
LWt/ b(Kg)	1.0065^{c}± 0.0015	1.06^{bc}± 0.03	1.105^{ab}± 0.015	0.99^{c}± 0.03	1.08^{a}± 0.03	0.03
FI/b (Kg)	2.129^{a}±0	2.002^{b}± 0.07	1.7739^{d}± 0	1.97^{c}± 0.07	1.702^{e}± 0.07	0.001
Feed cost/kg feed (TK)	37^{e}± 0	39^{d}± 1.0	41^{c}± 0	42^{b}± 1.0	44^{a} ±0.10	0.000 1
Total feed cost/b (TK)	78.773^{b}± 0	78.078^{c}±1. 4	72.7299^{e}± 0	82.74^{a}± 1.4	74.888^{d}± 1.39	0.000 1
CVLcost/bird(TK)	251± 0	251± 0	251± 0	251± 0	251± 0	
total cost/ b (TK)	329.773^{b}± 0	329.078^{c}± 1.4	323.7299^{e} ±0	333.74^{a}± 1.4	325.888^{d}±1 .39	0.000 1
Income/bird (TK)	349.18± 3.11	368.2± 2.61	382.08± 5.56	343.94± 2.6	363.06± 3.08	0.33
Net profit/kg live weight(TK)	19.41^{b}± 3.11	39.12^{b}± 2.61	58.35^{a}± 5.56	10.19^{b}± 2.57	32.07^{b} ±3.08	0.044

$*^{a,b,c}$ in a row with no shared superscripts deviate significantly ($p<0.05$). The data is presented as the average of three duplicate groups of five birds each. (n=15).*T0 =control group, T1 = 1% turmeric powder, T2= 1.5% turmeric powder and T3=1% turmeric powder+ 0.5% zinc and T4 =1.5% turmeric powder+0.5% zinc.LWt= Live weight; Kg= kilogram;FI= feed intake; b= bird;TK= taka; CVL= cost of vaccine and labor.

Chapter V: Discussion

This chapter explains and contrasts the results of the current study with those of earlier research on the dietary effects of turmeric powder (an herbal growth promoter) and zinc supplements (a trace mineral) on growth performance, carcass characteristics, proximate composition, cooking loss, drip loss, meat ph, oxidative stability, amino acid profile, and fatty acid profile of kadakhnath (black meat) meat.

5.1. Growth performance

The findings of the current study showed that improved average daily gains were observed at the third and fourth weeks and that overall weight gains were also boosted in the birds at Kadakhnath when turmeric powder was added. Arslan et. al., 2017 supported the current study with the outcomes demonstrated that adding turmeric to a diet improved growth efficiency. Adding supplements at 1 and 1.5 percent boosted body weight increase. All levels increased the efficiency of feed conversion; however supplementation at a rate of 1.5% produced the best outcomes. Despite the lower consumption compared to other groups, this herb plant may have certain chemicals that improve nutrient digestion and absorption. That could also be because turmeric contains active ingredients (curcuminoids and curcumin), which increase feed consumption efficiency and promote growth. It has been noted that turmeric possesses antibacterial capabilities, and an ethanol turmeric extract showed a high ability to suppress several pathogenic microorganisms in hens (Miquel et al., 2002; Ong-ard et al., 2010). Thus, instead of using antibiotics, turmeric may be able to restrain the growth and colonization of a variety of pathogenic and non-pathogenic species of bacteria in the chicken's gut, creating balanced gut microbial ecosystems that enhance feed utilization as measured by a higher feed conversion ratio. The results of some previous studies (Durrani et al., 2006; Raghdad and Al-Jaleel, 2012; Osawa et al., 1995; Samarasinghe et al., 2003; Wuthi-Udomler et al., 2000) were in agreement with the findings of the effect of turmeric powder on body weight gain. They discovered that adding turmeric increased broiler body weight by a significant amount

(5g/kg). However, these results are at odds with Namagirilakshmi's (2005) claim that broiler fed turmeric at levels of 0.25, 0.50, 0.75, or 1 percent did not significantly alter body weight gain.

The increase in body growth gain in broiler chickens could be the result of a number of variables, such as the influence of turmeric on gastric digestion (William and Losa, 2001), increased villus length and width in the duodenum, jejunum, and caeca of hens (Rajput et al., 2013); increased bile production, which promotes the digestion of lipids (Al-Sultan and Gameel, 2004); Pancreatic lipase activity, amylase, trypsin, and chemotrypsin thresholds were accelerated (Chattopadhyay et al., 2004); digestive sucrose and maltase activities were stimulated (Platel and Srinivasan, 1996); a more stable intestinal flora was formed as a result to their antimicrobial effects (Erhan et al., 2012); the number of intestinal microbes was decreased; as well as selectively increased Lactobacillus count ((Sieo et al., 2005 and Namagirilakshmi et al., 2010). According to Faghani et al. (2014), the antibacterial effect of turmeric on intestinal microbial may be responsible for the reduction in microbial load in broiler chicks, which was primarily caused by increased feed intake and digestion. According to the current study, adding herbal phenolic acids, such as turmeric, which act as antimicrobials and induce mixing and gastrointestinal tract sterilizing, improved feed utilization and led to an increase in weight. These results were consistent with those of (Murray et al.,1991 and Hernandez et al., 2004) who suggested that the increase in body weight may have been caused by the presence of fatty acids or by the boosting impact of the broilers' digestive systems.

But according to the study, a diet that includes both zinc supplements and turmeric powder improves growth performance when compared to the control group. The FCR value and feed intake significantly decrease when zinc and turmeric powder are consumed together. A study of Kumar et al. (2021) agreed that When compared to the Zn-deficient diet (control), weight gain was increased with dietary supplements of Zinc supplement. In comparison to controls, broiler chicks given the zinc-supplemented food had a greater FCR ($P < 0.05$). Feed intake did not differ across the treatments. According to evidence in the literature, nano-Zn enhances feed efficiency, boosts growth performance, and lessens costs

of production in livestock and poultry (Swain et al., 2016; Kim et al., 2017) that also support the presentstudy. In summarize, broiler chickens' growth performance can be improved by supplementing their diets with Zn ; Kumar et al. (2021). In the current investigation, dietary Zn treatments had no discernible impact on average daily weight gain (ADG), average daily feed intake (ADFI), or FCR during the rearing period, Eskandani et al. (2021) which is contradicted to our study.

According to this experiment, dietary supplements containing turmeric powder lower feed intake, improved FCR, and increased weight growth compared with control group. In addition to significantly reducing feed intake, the combined dietary effects of turmeric powder and zinc supplements also increase FCR, but not as much as a solitary turmeric diet. The study's growth performance summary indicates that turmeric powder at a concentration of 1.5 percent exhibits the best growth performance and FCR and lower feed intake.

5.2. Carcass characteristics

The study showed that the liver weight of kadakhnath birds was affected by dietary supplements of zinc and turmeric powder, whereas other carcass parameters remained largely unchanged throughout treatment. Diet using turmeric powder lower liver weight but slightly increase liver weight when paired with a zinc and turmeric powder diet. Potential liver protection properties of turmeric and its constituents were known in Indian traditional medicine hundreds of years ago, according to Wei et al., 2019, Rivera-Espinoza et al. 2009, and Kim et al., 2013. Curcumin's effectiveness in improving liver function has also been shown in recent studies, which in some ways supports the findings of our study. Furthermore, the research we had suggested that taking supplements of curcumin might help treat liver conditions (Panahi et. al, 2017). According to Antiga et al. (2015), the pharmacologic effects of Curcuma longa L. appear to span a remarkably broad range, including anti-carcinogenic, anti-inflammatory, antioxidant, and immunomodulatory activity. The favorable effects of curcumin on liver function, however, have not been demonstrated in all trials (Navekar et al.,2017). The AST and ALP enzymes can both be

decreased by turmeric (Chukwu et al., 2015). In the study by Emadi and Kermanshahi (2007a), the level of 5 g/kg turmeric powder demonstrated the highest activity of lactate dehydrogenase (LDH) at 21 days of age and significantly decreased serum alkaline phosphatase (ALP) of the chickens, suggesting that turmeric may have some beneficial effects on liver enzymes that either directly or indirectly reflect a healthier liver status in broiler chickens.

Mehala and Moorthy (2008) also found no significant effects of turmeric powder (up to 10 g/kg of feed) on the carcass % of broiler chickens raised to six weeks of age, which is similar to our findings on carcass yield. On the other hand, broilers fed diets with 5 g/kg turmeric powder showed increased dressing percentage, breast, thigh, and giblet weight, according to Durrani et al. (2006). Other investigations found that adding turmeric to the diet had no appreciable impact on the weight of the carcass, heart, pancreas, intestine or gall bladder. (Nouzarian et. al.2011; Al-Sultan et. al. 2003)

Supplementation with zinc and turmeric had no discernible impact on carcass yield, with the exception of liver weight, which increased noticeably. IQudsieh et. al., 2018 statement of Dietary Zn had no impact on carcass weight and part yield, but it did raise the absolute weight of male, but not female, whole breast and tenders by 240 mg Zn/kg in comparison to 0 mg Zn/kg with 120 mg Zn/kg as an intermediary. Furthermore, according to Rossi et al.2007, feeding broilers increased amounts of dietary organic Zn had no effect on carcass yields. The prior study by Collins and Moran, which found that broiler fed inorganic Zn at levels above those recommended by the NRC had no effect on carcass weight, provided support for the current findings. Supplemental zinc may enhance Pekin duck breast muscle antioxidant enzyme activity and mRNA levels while also enhancing meat quality and carcass characteristics (Wen, 2019).

5.3. Meat quality

Current study showed a improved oxidative stability after dietary treatment of turmeric powder with or without Zinc .The results of the Wan et. al.(2015) also showed that dietary turmeric supplementation might boost broilers' ability to fight free radicals by raising their SOD and GSH-Px activities and lowering their serum MDA levels. These findings are in line with other reports of conventional broilers (Daneshyar, 2012; Daneshyar et al., 2012).In our study 1.5% turmeric powder show most significant result in case of kadakhnath meat oxidative stability. Whereas combined diet of turmeric powder and zinc supplement show low TBARS value from first day of experiment. Previous research showed that the antioxidant activity increased with the amount of added turmeric(Bojorges et. al, 2020). Similar to our findings, Kanani et al. (2016) shown that supplementing with turmeric lowered oxidative stress in broilers by lowering levels of plasma and serum MDA and TBARS. The primary component of turmeric is curcumin, which improves the body's natural defenses against free radicals and has positive impacts on a variety of biological processes (Chattopadhyay et al., 2004). Supplemental Zn markedly improved the pH and redness values in thigh muscle, reduced shear force in thigh muscle, and reduced drip loss in thigh and breast muscle (Liu et. al., 2011). This statement somewhat support our experimental result. Zn treatments considerably reduced the shear force and TBARS value less than that of the control group (Eskandani et. al., 2019).

Similar to our work, Hussain (2013) found that broilers treated with turmeric powder cause decrease in ether extract. In our study single diet of turmeric powder decrease ether extract but combined diet with turmeric powder and zinc increase ether extract. Al-Sultan (2003) also looked fat percentage decreased in bird meat treated with 1.0% turmeric which also supports our study. But In crude protein percentage there is no significant difference among the treatment groups. Dry matter of kadakhnath meat after using turmeric powder with or without zinc supplement increase than control group.

Current study show that Kadakhnath meat ph range is 5.009 to 5.72. Combination of 0.05 % zinc and 1.5 % turmeric powder show lower pH 5.009 at kadakhnath meat. The findings of Sundari et al., 2015 show that the meat's pH value is good; meat with a low pH (5.1-6.2) will be bright red, have a pleasant flavor, resist rot, and have an open structure. This study's findings outperformed those of the study that claimed the average pH varies from 5.96 to 6.58 (Wala , 2013). Broiler meat has an ideal pH range of 5.4 - 5.8 (Masni et. al.2013). According to Daneshyar et al. (2011), dietary supplementation with powdered turmeric rhizome had no discernible impact on the pH of thigh muscle, which is not identical to our results. Combined diet with zinc and 1.5 % turmeric powder. The control group's breast meat pH (24 hours after slaughter) was substantially higher than those of the other Zn treatment groups (P 0.05) (Eskandani et. al., 2019).

Meat's ability to hold water is measured using a characteristic called drip loss. Muscles with a low capacity to store water may leak more fluid, which could result in the loss of flavor and soluble nutrients (Otto et al., 2004). According to the findings of the current investigation, dietary turmeric supplementation with or without zinc has no significant on the drip loss of kadakhnath meat. The quantity of cooking losses is indicated by the weakening of protein linkages, which makes it difficult to bind meat liquids and increases the amount of meat juices that are released due to a diminished ability to hold water (Dewi et al., 2003). According to Meng et al. (2020), adding antioxidant supplements turmeric to the diet decreased the shear force levels of pork as the cellular antioxidant capability improved and enhanced meat quality. In our study combined diet of turmeric powder and zinc show lowest TBARS value with great oxidative stability. Drip loss is a criterion used to assess the sample's water-holding capacity. Consumers are hesitant to accept meat that has a high drip loss and cooking percentage. Different Zn treatments had no effect on drip loss (P>0.05) (Eskandani et. al.2019) that support our study. In the current investigation, dietary turmeric with or without zinc markedly reduced the amount of Kadakhnath meat lost after cooking. In broiler chicken breast muscle, cooking and drip losses were shown to be reduced by dietary curcumin, according to Zhang et al., (2015). The ability of Kadakhnath breast muscle to absorb antioxidants increased along with reductions in cooking losses. Similar research shown that adding curcumin to the meal dramatically

reduced drip loss and improved the redness of the pigs' meat. Zinc and turmeric powder work together to improve the broiler's weight, performance, carcass features, digestive enzymes, meat quality traits, blood indices, cecal microbial load, and antioxidant capacity. To improve performance and health while also giving financial benefits, it is proposed that broiler feeding regimens include Zn, turmeric, and their combinations (El-Hack et. al., 2021).

5.4. Fatty acid and amino acid

The level of fatty acids in kadakhnath meat is well recognized. The level of fatty acids in kadakhnath meat is unaffected greatly by the addition of turmeric powder to the diet, with or without zinc. Similar to our finding, Daneshyar et al. (2011) did a study and found that high doses of turmeric (0.75%) added to broiler feeds significantly reduced plasma triglyceride levels and total SFA levels. The total MUFA rate was significantly reduced ($P< 0.05$) by the addition of 6 g/kg of turmeric to the diet. it was found that the addition of turmeric had no appreciable impact on the overall PUFA rate(Ürüşan et. al., 2020) and zinc in bird diet have no effect on fatty acid composition of birds meat (Cerovi, 2005);this statement support our study.

Adding of singly turmeric powder increase saturated fatty acid but combination diet of turmeric powder and zinc decrease the saturated fatty acid of kadakhnath meat. On the other hand unsaturated fatty acid decrease4d by single diet of turmeric powder whereas combined diet of turmeric and zinc increase unsaturated fatty acid.

Kadakhnath meat amino acid profile does not affected by dietary treatment of different percentage of turmeric powder with or without zinc supplement. All the essential amino acid found in black meat. The concentration of turmeric extracts in germinated korean brown rice led to an increase in the amount of essential, non-essential, and total amino acids, including GABA (Dhungana et. al., 2021) which do not supported our study.

Chapter VI: Conclusion

In this experiment, the dietary effects of turmeric powder and zinc supplementation were examined for their effects on growth performance, carcass characteristics, proximate composition, cooking loss, drip loss, meat pH, oxidative stability, fatty acid profile, and cost-benefit analysis of Kadakhnath (black meat) meat.

Birds fed T2 diet containing 1.5% turmeric powder exhibits the superior feed consumption, highest weight gain and lowest FCR. In a diet that included both zinc supplements and turmeric powder, the weight of the liver increased while it reduced when only turmeric powder was used in diet. Other aspects of the carcass did not alter much compared with control birds. Compared to the control group, the treatment group's proportion of dry matter and ether extract (EE %) increased.

The drip loss % did not differ from the control group. The dietary treatment group saw a reduction in cooking loss, with the T1 group having the lowest cooking loss when using turmeric powder at 1%. Oxidative stability of black meat is great. The value of meat TBARS significantly decreased gradually 3, 5 and 7 days of storage at 4°c.T4 diet groups with 1.5% turmeric and 0.5 % zinc supplement show highest reduction on TBARS value. Black meat's amino acid composition was unaffected by different dietary supplements. When zinc was combined with turmeric powder, saturated fatty acids were reduced and unsaturated fatty acids were raised.

With regard to dietary supplements, it can be concluded that the T2 groups with 1.5% turmeric powder supplements are most beneficial. These dietary groups fulfill all 4 objectives of experiment with most cost effective diet group. Thus, supplementation of 1.5% turmeric powder could be used to improve growth, meat quality and shelf life of kadakhnath chicken (black meat) meat.

Chapter VII: Recommendation

Other herbal growth promoter like ginger, peppermint, curry powder, zinger e.t.c can be used in different forms to see the growth performance, meat quality and other meat composition. Study can perform to determine effects of turmeric powder and zinc supplement on intestinal microbial population and intestine morphology. Cholesterol level of both blood and meat should be examined. Nutrient digestibility of black meat can be examined. In this study we used turmeric powder; other form of turmeric like leaves, fresh turmeric, prebiotic from turmeric can also be used in diet to find out most stable growth promoter for commercial farming. Black meat shelf life should test.

Other micro minerals like ca, mg e.t.c. can also be used in diet of kadakhnath birds to see the effect on growth performance and meat quality. A series of marketing trails can be performed to commercialize the black meat.

Chapter VIII: Limitation and future perspectives

These limitations of the current study allow for future experimentation by researchers.

Limited funding sources, lab space, and time appear to be obstacles that can be reduced and addressed in great detail. Only 70 kadakhnath birds received feeding trails. Although the Kadakhnath is a scavenger bird, it was raised in a cage for better research. This fact might slightly slow growth. This route has to be run in more population centers and in climates with a variety of conditions to evaluate its true effectiveness. Both male and female birds can be raised separately to see grow performance.

Liver weight rose following therapy with zinc and turmeric. To determine the true immunological response of kadakhnaths following turmeric feeding, we did not conduct any biological tests. Meat from the Kadakhnath birds should be tested for cholesterol level. In the future, various immunological testing can be carried out to fully comprehend the mechanism. Turmeric has a favorable impact on some types of meat quality; its impact on other types of meat quality should be investigated. Checking nutritional digestibility is important.

Following zinc supplementation, the total nitrogen lost through feces may be measured; blood parameters should be examined. To determine the most stable growth promoter, many kinds of trace minerals and herbal growth promoters can be utilized in the diet. To create a more accurate biochemical profile of kadakhnath meat, more amino acid and fatty acid sample tests should be conducted.

The color of the flesh is a significant marketing barrier for kadakhnath or black meat. There should be some research done on marketing strategies for black meat. Kadakhnath farming is profitable, according to studies, but a commercial batch can be examined for more accurate analysis.

Chapter IX: References

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Appendix

Cost benefit:

Control group (T0)-

Live weight of each bird-1.0065 kg

Feed intake per bird-2.129 kg

Feed cost per kg-37 taka

Total feed cost per bird=2.129*37= 78.773 taka

Cost of vaccine and labor per bird= 251 taka

Total cost per bird= Total feed cost per bird+ Cost of vaccine and labor per bird

= (78.773 +251) taka =329.773 taka

Total net income per bird=live weight*price per kg bird

= (1.0065* 350 taka)=349.18 taka

Net profit= Total net income per bird - Total cost per bird

= (349.18-329.773) taka= 19.41 taka

Dietary group of 1 % turmeric powder (T1)-

Live weight of each bird-1.06 kg

Feed intake per bird-2.002 kg

Feed cost per kg-39 taka

Total feed cost per bird=2.002*39= 78.078 taka

Cost of vaccine and labor per bird= 251 taka

Total cost per bird= Total feed cost per bird+ Cost of vaccine and labor per bird

= (78.078+251) taka =329.078 taka

Total net income per bird=live weight*price per kg bird

= (1.06 * 350 taka)=368.2 taka

Net profit= Total net income per bird - Total cost per bird

= (368.2-329.078) taka= 39.12 taka

Dietary group of 1.5 % turmeric powder (T2)-

Live weight of each bird-1.105 kg

Feed intake per bird-1.7739 kg

Feed cost per kg-41 taka

Total feed cost per bird=1.7739*41= 72.7299 taka

Cost of vaccine and labor per bird= 251 taka

Total cost per bird= Total feed cost per bird+ Cost of vaccine and labor per bird

= (72.7299 +251) taka =323.7299 taka

Total net income per bird=live weight*price per kg bird

= (1.105 * 350 taka) =382.08 taka

Net profit= Total net income per bird - Total cost per bird

= (382.08.2-323.7299) taka= 58.35 taka

Dietary group of 1 % turmeric powder with 0.5% Zinc (T3)-

Live weight of each bird-0.99 kg

Feed intake per bird-1.97 kg

Feed cost per kg-42 taka

Total feed cost per bird=(0.99 *42)= 82.74 taka

Cost of vaccine and labor per bird= 251 taka

Total cost per bird= Total feed cost per bird+ Cost of vaccine and labor per bird

= (82.74 +251) taka =333.74 taka

Total net income per bird=live weight*price per kg bird

= (0.99 * 350 taka) =343.94taka

Net profit= Total net income per bird - Total cost per bird

= (343.942-333.74) taka= 10.19 taka

Dietary group of 1.5% % turmeric powder with 0.5% Zinc (T4)-

Live weight of each bird-1.08kg

Feed intake per bird-1.702 kg

Feed cost per kg-44 taka

Total feed cost per bird=1.702 *44= 74.88 8taka

Cost of vaccine and labor per bird= 251 taka

Total cost per bird= Total feed cost per bird+ Cost of vaccine and labor per bird

= (74.88 +251) taka =325.888 taka

Total net income per bird=live weight*price per kg bird

= (1.08 * 350 taka) =363.06 taka

Net profit= Total net income per bird - Total cost per bird

= (363.06 -325.888) taka= 32.07 taka

Brief Biography

This is Dr. Kazi Asmany, daughter of Kazi Ashaduzzaman and Bilkis Begum from Belabo upazila under Narsingdi district of Bangladesh. Kazi Asmany passed the Secondary School Certificate Examination in 2010 from Harisangan high school,Belabo,Narsingdi and then Higher Secondary Certificate Examination in 2012 from Gazipur Govt. Women College, Gazipur. She obtained her B.Sc. (Hons.) in Veterinary medicinefrom the Faculty of Veterinary medicine at ChattogramVeterinary and Animal Sciences University, Chattogram, Bangladesh. Now, she is acandidate for the degree of Master of Science in Animal and poultry nutrition under the Department of Animal science and poultry nutrition, Chattogram Veterinary and Animal Sciences University (CVASU). She has an immense interest to work in improving the health status of people through proper guidance and suggestions and to create awareness among people about food safety and nutrition as well as animal welfare. With her best knowledge and expertise, she hopes to deliver competent veterinary medical treatment and sustains the norms of professionalism in the future.