

ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE
DEPARTMENT OF MICROBIOLOGY, PARASITOLOGY AND POULTRY
HEALTH



EFFECTS OF WATER MELON (*Citrullus lanatus*) AND PUMPKIN (*Cucurbita maxima*)
SEEDS AND THEIR MIXTURE AS FEED ADDITIVES ON GROWTH PERFORMANCE,
CARCASS CHARACTERISTICS AND HEMATOLOGICAL CONSTITUENTS OF
BROILER CHICKENS

MSc Thesis

BY
BETELEHEM MENGISTU MULU

ADVISOR: EWONETU KEBEDE (MSc. Associate Professor)

JUNE, 2026
BISHOFTU, ETHIOPIA

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**A Thesis Submitted to the College of Veterinary Medicine and Agriculture,
Addis Ababa University in partial fulfillment of the requirements for the Degree of
Master of Veterinary Science in Poultry Health and Management**

**By
BETELEHEM MENGISTU**

**JUNE, 2026
BISHOFTU, ETHIOPIA**

APPROVAL SHEET

Addis Ababa University
College of Veterinary Medicine and Agriculture
Department of Microbiology, Parasitology and Poultry Health

Effects of Water Melon (*Citrullus lanatus*) and Pumpkin (*Cucurbita maxima*) Seeds and Their Mixture as Feed Additives on Growth Performance, Carcass Characteristics and Hematological Constituents of Broiler Chickens

This Thesis has been submitted for examination with our approval as:

Main Advisor

Ewonetu Kebede (MSc., Assoc. Prof.)

Signature

Date

Submitted by: Betelehem Mengistu Mulu:

Signature

Date

Department Head

Dr Olana Merera

Date

Addis Ababa University

College of Veterinary Medicine and Agriculture

Department of Microbiology, Parasitology and Poultry Health

As members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the thesis prepared by: Betelehem Mengistu entitled “Effects of Water Melon (*Citrullus lanatus*) and Pumpkin (*Cucurbita maxima*) Seeds and Their Mixture as Feed Additives on Growth Performance, Carcass Characteristics and Hematological Constituents of Broiler Chickens” and recommend that it be accepted as fulfilling the thesis requirement for the degree of Masters of Veterinary Science in Poultry Health and Management.

Final approval and acceptance of the contingent up on the submission of its final copy to the ADPG

I hereby certify that I have read the revised version of this thesis prepared under my direction and recommended that it is accepted as fulfilling the thesis/dissertation requirement.

Ewonetu kebede (MSc., Assoc. Prof.)

Advisor

Signature-----Date ----

DEDICATION

This Thesis document is dedicated to my kids: Yididya, Surafel and Emanuel for their daily activity of inspiring me to strive for the betterment, in all facets of my life.

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STATEMENT OF AUTHOR

I certify that this thesis is my own work and that all references used were properly cited. This thesis has been submitted to Addis Ababa University College of Veterinary Medicine and Agriculture in partial completion of the requirements for an MSc degree. It has been placed at the university/college library, where it will be made available to borrowers in accordance with library policies. I really certify that this thesis has not been submitted to any other university for consideration for a degree, diploma, or certificate. Short quotes from this thesis may be used without permission as long as the source is properly cited. The head of the major department or the college dean may approve requests for extensive quotations from or reproductions of this document in whole or in part if they believe the intended use of the material is in the interest of research. However, authorization from the author is required in all other cases.

Name: Betelehem Mengistu Mulu

Signature: _____

Place: Addis Abeba University, College of Veterinary Medicine and Agriculture, Bishoftu

Date of submission: _____

BIOGRAPHICAL SKETCH

Betelehem Mengistu, the author, was born in Karat, in the Konso Zone of South Ethiopia, in September 1988 E.C. She went to Karat Primary and Secondary School for her primary and junior schooling before attending Karat High School. In 2010 E, C, she enrolled at Haramaya University to pursue a BSc in Dairy and Meat Technology. She began working as a manager at the Poultry Enterprise of the South Ethiopian Region shortly after graduating, and she later joined Addis Ababa University to pursue a Master of Veterinary Science in Poultry Health and Management.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BWG	Body weight gain
CRD	Completely Randomized Design
DMI	Dry matter intake
FCR	Feed conversion ratio
GLM	General Linear Model
LBW	Live body weight
MP	Mortality percentage
MR	Mortality rate
MRR	Marginal rate of return
PSO	Pumpkin seeds oil

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ABSTRACT

This study evaluated the effects of feeding diets, containing seeds of water-melon, pumpkin and their combination on the growth performance, carcass characteristics, hematological indices, mortality and economic returns of broiler chicken production. 180 day-old Hubbard broiler chicks were divided into four treatment groups at random: T1 (control, 0% seeds), T2 (1% watermelon seeds), T3 (1% pumpkin seeds), and T4 (0.5% watermelon plus 0.5% pumpkin seeds). The trial lasted for forty-two days. The results demonstrated that although phase-dependent variations were observed, feed intake and growth performance were not significantly affected by dietary manipulations ($P > 0.05$). Birds of which fed on T4 gained less weight during the growth phase, but their feed conversion ratio improved during the finisher phase. While other carcass components were unaltered, supplementing with pumpkin seeds (T3) significantly enhanced live weight, dressed carcass weight, and breast muscle yield ($P < 0.05$). Packed cell volume, hemoglobin concentration, total erythrocyte count, and total leukocyte count were among the hematological parameters that were considerably higher in the supplemented groups ($P < 0.01$), indicating better immunological and oxygen transport. Treatments had little effect on the low mortality rate (3.47%). Due to increased feed efficiency and marketable weight, T3 produced the best net income per bird, according to economic research. In conclusion, adding 1% of pumpkin seeds and the seeds mixture to feed can be a safe, natural, and economical way to enhance the physiological health, carcass quality, and profitability of broiler production.

Keywords: *Broiler chickens; Watermelon seeds; Pumpkin seeds; Growth performance; Carcass characteristics; Hematological indices.*

1. INTRODUCTION

The use of feed additives, which have been widely accessible in chicken diets for many years, has increased due to the poultry industry's rapid development and improved production efficiency (Hameed, 2021). Antibiotics are used in avian rations to promote growth, which is beneficial for increasing productivity and preventing infections. However, overuse of these antibiotics resulted in an increase in bacterial resistance to diseases, as well as the accumulation of drug leftovers in animal products, which led to their dispensing (Nisha, 2008).

Pathogens causing financial losses in chicken farms emerged as a result of the removal of antibiotics used as evolutionary stimulants in chicken rations (Hameed, 2021). As a result, the search for plant extracts with therapeutic qualities was focused on adding them to the diet of birds as growth stimulants (Alloui *et al.*, 2013). The plant section (leaves, roots, seeds, flowers, and buds), the geographic origin, and the harvest season all have a significant impact on the active material component of these chemicals (Windisch *et al.*, 2008). Numerous bioactive compounds, including alkaloids, flavonoids, soaps, phenolic compounds, and polypeptides, are found in plants (Kiczorowska, 2016). Due to their variety, these chemicals have distinct mechanisms of action, including growth stimuli, immunological stimuli, antioxidants, and antibacterial properties (Alagawany *et al.*, 2015).

Numerous medicinal plants have a variety of effects on the digestive system, such as laxative and anticolic properties. For example, it was shown that adding mint to broiler rations improved the digestion of proteins (Emami *et al.*, 2012). Numerous studies showed that various concentrations of thyme, cinnamon, black pepper, ginger, red pepper, and oregano improved the morphology of the gastrointestinal tract in broilers and improved the digestion and absorption of numerous elements (Upadhaya *et al.*, 2016). Similarly, when utilized in animal production, pumpkin seeds (PS) has comparable potential to synthetic growth-promoting hormones and antibiotics, according to Brooker and Acamovic (2005). In contrast, Hajati *et al.* (2014) found that supplementing broiler diets with 50 g kg⁻¹ of PS oil had no discernible impact on growth performance; however, adding 100 g kg⁻¹ of PS oil had a detrimental effect.

Similarly, Suleiman and Uko (2010) found that while weight gain and feed utilization were unaffected, broilers fed diets supplemented with 225 g kg⁻¹ of raw or autoclaved PS dramatically reduced feed consumption when compared to broilers fed a diet without PS. But according to Tabari *et al.* (2015), broiler growth performance can be enhanced by using dietary PS in conjunction with other herbal compounds. According to Pham *et al.* (2017), pumpkin seeds are the primary metabolites that support life, and their functional components are important for both human and animal health promotion and illness prevention.

Staphylococcus aureus, *Bacillus subtilis*, *Staphylococcus wernerii*, *Pseudomonas putida*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Escherichia coli* are all effectively inhibited by the pumpkin seeds extract (Chonoko and Rufai, 2011). Furthermore, because pumpkin seeds include a variety of physiologically active compounds, such as polysaccharides, p-aminobenzoic acid, fixed oils, sterols, proteins, and peptides, they are believed to be healthful (Yadav *et al.*, 2010). Numerous studies have also reported significant antibacterial and antifungal properties of pumpkin seeds oil (Xiong *et al.*, 2000). Pumpkin seeds is one of the alternatives that could be employed as a protein source in the poultry industry because of its high crude protein content (Wafar *et al.*, 2017). Pumpkin seeds are also utilized as a hypoglycemic drug to treat parasites and hypercholesterolemia (Kerise *et al.*, 2008). Pumpkin seeds contain a substance called cucurbitin, which is used to treat worms and parasites (Bauri *et al.*, 2015; Acorda *et al.*, 2019).

Although it has a lot of bioactive substances, watermelon seeds are another plant seeds that is produced by different fruit juice production companies. Despite being edible, these byproducts are carelessly thrown into the environment, creating environmental. A cheap raw material might be watermelon seeds (Hasanin and Hashem, 2020). According to Braide *et al.* (2012), watermelon seeds (WMSs) are rich in protein, vitamin B, minerals (including magnesium, potassium, phosphorus, salt, iron, zinc, manganese, and copper), fat, and phytochemicals. Crude protein (17–50%), crude fiber (4%–46%), and total fat content (24–58%) are all abundant in WMSs (Falade *et al.*, 2020; Rico *et al.*, 2020). Alkaloids, flavonoids, and phenols are among the phytochemicals found in watermelon seeds (Sola *et al.*, 2019). According to Godwin *et al.* (2015), these phytochemicals have antibacterial properties.

Statement of the problem

Feed additives are substances that are added to animal feed in order to improve digestibility, nutrient absorption, and the removal of pathogens that live in the animal's gut (Athanasiadou *et al.*, 2007). Based on studies made since 1946, antimicrobial chemicals are frequently added to chicken feeds for growth promotion and illness prevention at lower therapeutic dosages (Demir *et al.*, 2005; Elagib *et al.*, 2015). However, the use of antibiotics as feed additives in animal agriculture is prohibited in many nations. Therefore, search for antibiotic alternatives is encouraged by the World Health Organization (Humphrey *et al.*, 2002) because the indiscriminate use of antimicrobial drugs has created very dangerous drug resistance to microbial strains; many bacterial strains have developed resistance against antibiotics, such as *ampenicillin* resistant *Streptococcus pneumoniae*, *methicillin* resistant *Staphylococcus aureus* (Sola *et al.*, 2019).

In order to find new biologically active molecules with improved action against multidrug resistant bacteria and less side effects associated with antibiotics, researchers are encouraged to focus on plant products, which is the most promising area (Teoh *et al.*, 2012). Therefore, using fruit seeds, which are thrown away while the fruit is consumed, as feed additives can reduce the likelihood of environmental problems by replacing antibiotics. In order to maximize poultry profit and minimize seeds losses, waste, and environmental impact, it is crucial for sustainability to properly handle, process, and convert watermelon and pumpkin seeds in order to design and develop innovative alternative feed additives with added value. Additionally, there is little research on the combined effects of adding pumpkin and watermelon seeds to chicken rations. Thus, this study assessed the effects of a natural feed supplement consisting of watermelon and pumpkin seeds on the growth performance, carcass features, and hematological and blood biochemical components of broiler chicks.

Objectives

General objective:

The general objective of the current study is to assess the effects of water melon, pumpkin seeds, and their combination as a natural feed addition on the hematological components, carcass features, and growth performance of broiler chicks.

Specific objectives

- To assess how watermelon seeds, a natural feed supplement, affects the growth performance, hematological components, and carcass features of broiler chickens;
- To assess how broiler chicken performance, hematological components, and carcass traits are affected by pumpkin seeds as a natural feed additive;
- To assess how a natural feed supplement made of pumpkin and watermelon seeds affects the growth performance, hematological components, and carcass features of broiler chickens
- To evaluate the financial advantages of adding watermelon and pumpkin seed combinations to broiler chicken rations as feed additives.

2. LITERATURE REVIEW

2.1. Feed Additives in Poultry Diets and its Inclusion Level

Poultry diets frequently contain antimicrobial substances to encourage growth and prevent illness. Due to the possibility of drug resistance in human harmful bacteria, the European Union has outlawed feed-grade antibiotic growth promoters; only two antimicrobial growth promoters will continue to be used (Shane, 2001). The use of chemical-free feeds in poultry nutrition is growing. All forms of antibiotic growth promoters are being banned in various nations. Herbs and natural feed additives are therefore being studied as natural sources of physiologically significant chemicals. Herbs and herbal preparations have been shown to improve broiler growth performance (Gou *et al.*, 2020).

In order to improve the performance and immune response of birds, probiotics and medicinal herbs have lately been added to chicken diets as natural feed additives. Numerous efforts have been made to lower the cost of diets by increasing the growth rate and feed conversion ratio with the use of dietary supplements such probiotics and antibiotics (Abdel, 2002). In chicken production, the use of natural feed additives in place of antibiotics has drawn a lot of attention (Kumar *et al.*, 2003).

The goal of feed formulation is to create a balanced diet that will supply the bird with the right amounts of nutrients that are biologically available. Formulations include supplements to supply minerals, vitamins, and certain amino acids in addition to energy and protein. Since these supplements offer vital nutrients required for performance and health, they must be included in all diets (Krishna *et al.*, 2017). A wide variety of non-nutritive additives that may not be necessary but have a significant impact on performance and health are also included in modern feed formulas. In many instances, the necessity of their inclusion is well known: The effectiveness of these additives is a key consideration when choosing them. Only modest amounts of feed supplements and additives are employed, and it's crucial that they be well combined with the primary ingredients to ensure equitable distribution (Balakrishnan, 2004).

2.2. Botany of Water Melon (*Citrullus lanatus*)

In the warmest regions of the world, watermelons (*Citrullus Schrad*) are one of the most popular vegetable crops (Wehner and Naegele, 2019). Every year, more than 3400,000 hectares are planted, and more than 102,000,000 are produced. On hot summer days, few foods are more loved and refreshing than cold watermelon slices. In addition to the well-known sweet dessert watermelon, other cultivated members of the xerophytic genus *Citrullus* ($2n=2x=22$) include the colocynth, citron, and egusi watermelons (Jeffrey, 2001).

However, compared to the others, the sweet dessert watermelon has far less DNA sequence polymorphism, suggesting that it came from a single founder population (Maggs-Kölling *et al.*, 2000; Nimmakayala *et al.*, 2014a). The colocynth or citron watermelon has long been thought to be the ancestor of the sweet dessert watermelon, but more recently, genome sequencing has supported the idea that the egusi watermelon is the ancestor (Guo *et al.*, 2013). Another popular theory is that, thanks to Islamic conquests, sweet watermelons initially made their way from the Indian subcontinent to Europe via Moorish Spain sometime around 961 CE (Wehner and Naegelle, 2019).

2.3. Botany of Pumpkin (*Cucurbita maxima*)

Pumpkins belong to the family *Cucurbitaceae*. The majority of the species in this family are used as food and are found in five genera: *Citrullus* (water melons and wild colocynths), *Cucumis* (cucumbers, gherkins and melons), *Lagenaria* (gourds), *Sechium* (chayotte) and *Cucurbita*. The genus *Cucurbita*, which is economically the most important one, includes five species: *C. maxima*, *C. pepo*, *C. moschata*, *C. ficifolia*, and *C. turbaniformis* in which *C. pepo* exhibits the widest variation, especially with respect to fruit characteristics. *C. pepo* is a native species of North America and has been cultivated there for several thousand years (Paris, 1989). It is claimed that *C. pepo* is more persistent and less liable to deterioration, which certainly is reflected in the quality of the extracted oil. Phytochemical Composition of Water Melon (*Citrullus lanatus*) (Gemrot *et al.*, 2006).

Citron watermelon produces a variety of phytochemicals and bioactive metabolites that build up in distinct plant sections. These include medicinally valuable flavonoids, cucurbitacin, and

cucurbitacin glycosides (Davidovich-Rikanati *et al.*, 2015). Other cucurbit crops have reportedly expressed phytochemicals like terpenoids, phenolics, spingolipids, and tetranortriterpenoids, which are also bioactive compounds with significant pharmacological and pharmaceutical applications (Enneb *et al.*, 2020).

Phytochemicals in different cucurbit species are linked to a variety of pharmacological activities, including anti-oxidant, anti-hyperglycemic, anti-cancer, analgesic, anti-diabetic, anti-hepatotoxic, anti-inflammatory, anti-helminthics, anti-virus, anti-bacterial, anti-microbial cardioprotective, cytotoxic, and anti-oxidant properties. Additionally, a number of illnesses, such as epilepsy, liver problems, ulcers, cancer, rhinosinusitis, and other skin infections, can be treated using bioactive substances (Alsayari *et al.*, 2018).

2.4. Phytochemical Composition of Pumpkin (*Cucurbita maxima*)

Compounds including lipids, proteins, phytosterol, vitamins, and minerals can be found in pumpkin seeds. Furthermore, they are a good source of β -carotene, K, P, and Fe (Seo *et al.*, 2005). Due to its antibacterial, hypoglycemic, anticancer, anti-inflammatory, and long-standing vermifuge action, they have recently drawn attention for possible advantages to human health (Matthews *et al.*, 2016). Because of its application in the food and pharmaceutical industries, its antioxidant function is significant. It can also prevent many pathological diseases, including cancer, atherosclerosis, and inflammatory problems brought on by oxidative stress, as well as diseases associated with aging (Yin *et al.*, 2011).

2.5. Effect of Pumpkin Inclusion on Chicken Performance and Blood Parameters

The use of traditional antibiotics in animal diets is currently being gradually reduced or completely eliminated. When employed in animal production, pumpkin seeds meals have been shown to have comparable potential to synthetic growth-promoting antibiotics and hormones. Researchers are looking for alternatives to antibiotics as performance enhancers in the poultry sector due to cross-resistance against infections and instances of chemical residues in animal products; phytogenics are a relatively new class of feed additives (Cederroth *et al.*, 2012).

According to Hajati and Hassanabadi (2011), broiler growth performance was not significantly impacted by PS oil supplementation up to 50 g kg⁻¹ diet; however, growth performance was adversely affected when 100 g kg⁻¹ food was introduced. In a study by Suleiman and Uko (2010), broilers fed diets supplemented with 225 g kg⁻¹ of raw or autoclaved PS significantly reduced ($P<0.05$) feed consumption when compared to broilers fed a diet without PS, but this supplementation had no effect on weight gain or feed utilization. According to Tabari *et al.* (2015), broiler growth performance can be enhanced by using dietary PS in conjunction with other herbal ingredients.

2.6. Effects of Different Fruit Seeds Mixture on Poultry Performance

The addition of the plant supplements (amaranth seeds, sea buckthorn pomace, chokeberry pomace) to grower feed combinations led to variations in the n-3 PUFA levels, particularly ALA, between the feed mixtures used to feed the various chicken groups. The ALA content varied between 23.5 and 25.1% in the experimental groups and 19.5% in the control group I. The overall concentration of unsaturated and saturated fatty acids did not change.

The feed mixes including sea buckthorn fruit pomace showed the highest concentration of α -tocopherol with the strongest antioxidant effect, with n-6/n-3 PUFA ratios of 1.4, 1.2, 1.1, and 1.2, respectively. Furthermore, compared to the control group, the experimental group's feed combinations including chokeberry fruit pomace and amaranth seeds had greater levels of this type of tocopherol (36.62 and 42.46 vs. 30.03 mg/kg). In comparison to the control (12.01 mg/kg), the feed's δ -tocopherol content increased by 31%, 170%, and 209% when amaranth seeds, dried sea buckthorn, and chokeberry pomace were added. All experimental groups had greater levels of d-tocopherol (2.7, 3.48, 3.92 vs. 1.8 mg/kg) (Orczewska *et al.*, 2018).

4.1.2.7. The Uses of Water Melon (*Citrullus lanatus*) and Pumpkin (*Cucurbita maxima*) Seeds in Poultry

Watermelon (*Citrullus lanatus*) is a red-fleshed, juicy, sweet fruit that can be eaten as a dessert or as a way to relieve thirst on hot days. It is actually much more than that. In certain regions of the world, watermelon varieties with more solid, white to cream, and orange flesh are grown.

These varieties' flesh is usually used as a vegetable in cooking, or the seeds, for example, are ground into flour and used to make sauces or snacks. In this sense, the seeds provide both fat and protein to the diet (van *et al.*, 2004).

The three primary components of watermelon biomass are the flesh, seeds, and rind. Compared to other similar fruit peels like melon (40%), pumpkin (45%), bitter apple (30%), musk melon (35%), and papaya (47%), the rind and seeds make up about 60% of the total weight of watermelon fruits, which is a significant amount of agro-waste (Hasanin and Hashem, 2020; Chakrabarty *et al.*, 2020). Only half of the watermelon fruit is edible; the other half is thrown away. Approximately 42 million tons of watermelon by-products (rind and seeds) were produced during the production, preparation, and consumption of watermelon in 2017–18 by various fruit juice processing industries, cottage fruit juice manufacturers, and restaurants. Despite being edible, these byproducts are carelessly thrown into the environment, creating environmental problems (Esparza *et al.*, 2021).

However, a number of factors, including the world's population growth, the depletion of renewable resources, the loss of agricultural land, and the over-accumulation of waste, make it necessary to value these byproducts in order to use them as a substitute ingredient and create useful products for the food, pharmaceutical, and nutraceutical industries. Large amounts of these waste byproducts are rich in vitamins, minerals, fibers, lipids, and bioactive substances with specific medicinal qualities (Rico *et al.*, 2020).

High-nutrient watermelon byproducts have attracted a lot of attention since they are highly prized and have a lot of potential for inclusion in the human diet. Watermelon seeds (WMSs) and watermelon rind (WMR) can be inexpensive raw materials (Hasanin *et al.*, 2020). rich in components that could be used to other sectors. According to research, pumpkin seeds are an excellent source of lipids and proteins (Nawirska *et al.*, 2013). Palmitic (C16:0), stearic (C18:0), oleic (C18:1), and linoleic (C18:2) fatty acids, vitamins E and A, zinc, magnesium, phosphorus, copper, potassium, niacin, folic acid, riboflavin, thiamine, and high-quality proteins are all present in the seeds oil (Kulaitienė *et al.*, 2007).

According to Brooker and Acamovic (2005), the seeds' complexity and level of bioactivity

may provide sustainable natural options for the management of parasitic and pathogenic organisms, nutrition stimulation, or increased resistance to disease infections. Additionally, the bioactivity of pumpkin seeds increases serum levels of good lipids while lowering belly fat and dangerous lipid levels. According to a paper (Umesiobi, 2012), the growth and reproductive performance of cattle and poultry fed rations suitably enriched with organic compounds, including pumpkin seeds meal (PSM), are improved by the carcass quality and haematological parameters.

2.8.Nutritional Composition of Water Melon (*Citrullus lanatus*) Seeds

Protein, vitamin B, minerals (including magnesium, potassium, phosphorous, salt, iron, zinc, manganese, and copper), fat, and phytochemicals are all abundant in watermelon seeds, which are recognized for their excellent nutritional value (Braide *et al.*, 2012). Watermelon seeds are recognized to provide economic advantages, particularly in nations where farming is expanding. For example, the seeds are ground into flour, used to make sauces, and used to make snacks. The oil extracted from the seeds is utilized in both culinary and cosmetic manufacturing (Jensen *et al.*, 2011). Despite the many possible uses, watermelon seeds are frequently thrown away as the fruit is consumed.

In the tropics, watermelon (*Citrullus lanatus*) is a popular fruit. About 6% of its weight is sugar, and 91% is water. The pulp, which is edible to humans, makes up about 68% of the entire weight, while the rind and seeds make up about 32%, of which 2% are seeds (Yamaguchi, 2006). It is a good source of polyphenols, vitamin C, and a substantial amount of *citrulline*, just like many other fruits. According to Perkins *et al.* (2004), the rind of *Citrullus lanatus* contains substantial amounts of moisture (10.61%), ash (13.09%), crude protein (11.17%), fat (2.44%), and carbohydrates (56%). Watermelon rinds are rich and tasty. Although watermelon skin includes numerous hidden nutrients, most people avoid eating it due to its unattractive flavor. As a result, it is now a viable option for feeding poultry and has positive health effects.

Table 1: Proximate composition of WMSs.

Parameters	References			
	Sajjad <i>et al.</i> (2020)	Kausar <i>et al.</i> (2020)	Milala <i>et al.</i> (2018)	Tabiri <i>et al.</i> (2016)
Moisture	8.26	5.06 ± 0.12	3.39 ± 0.09	7.87 ±
Crude fat	46.78	32.90 ± 0.18	32.04 ± 0.52	26.83 ± 4.24
Crude protein	26.37	49.70 ± 0.61	34.73 ± 0.015	17.75 ± 0.95
Ash	3.73	2.98 ± 0.18	3.67 ± 0.13	3.00 ± 0.00
Carbohydrates	10.77	6.06 ± 0.12	21.20 ± 0.97	11.67 ± 6.62
Crude fiber	4.10	2.10 ± 0.21	4.97 ± 0.46	40.75 ± 6.12

2.8.1. Use of water melon (*Citrullus lanatus*) seeds in traditional way

Since precolonial times, watermelon has been grown in Southern Africa alongside other crops like sorghum and maize. Fruit flesh is boiled with maize meal to make porridge, and the leaves and young fruits are utilized as green vegetables. The empty fruit can be used as a container for both cooking and storing berries. Different cuisines are prepared using pulp and seeds (Gill, 2016). Compared to the meat, the flat brown seeds are more nutritious and have a higher nutritional value. They are a great source of fat, minerals, and vitamin C. They can be used in flour mixes and consumed raw or roasted. According to a study, the pulp from the seeds is utilized to thicken soups. The fermented seeds are either used to make a sweetener known locally as "ogiri" or cooked with leaves to make another sweetener known as "igbãlo." *Citrullus lanatus* seeds are utilized for their oil, and their application in the pharmaceutical and cosmetic industries is growing. Seeds are also utilized to promote baby feeding due to their high fat and protein content (Maynard, 2001).



Figure 1: Water melon fruits and seeds.

2.8.2. Antimicrobial effects

Maceration, infusion, decoction, percolation, hot continuous extraction (Soxhlet extraction), thermal desorption, surfactant mediated extraction, counter-current extraction, accelerated solvent extraction, pressurized liquid extraction, and other techniques are used to extract medicinal plants. Supercritical fluid extraction, ultrasonication assisted extraction, microwave assisted extraction, and extraction are examples of advanced extraction techniques (Gupta *et al.*, 2012). The majority of research on the antibacterial properties of *C. lanatus* seeds has demonstrated that the most common method for extracting *C. lanatus* plant parts is cold maceration (Oseni and Okoye, 2013); Soxhlet extraction is also occasionally used (Oyeleke *et al.*, 2012). As a result, it is now necessary to assess extraction techniques to ascertain which will have the most antibacterial impact on the organisms.

4.2.2.9. Nutritional Composition of Pumpkin (*Cucurbita maxima*) Seeds

Pumpkin seeds are a great source of useful nutrients. Although pumpkin seeds' nutrients are the main metabolites that support life, their functional components are crucial for preventing disease and promoting human health. More than 95% of the total fatty acids in pumpkin seeds oil (PSO) include linoleic, oleic, stearic, and palmitic; around 75% of these are unsaturated fatty acids (UFAs). Due to their ability to prevent cardiovascular illnesses, unsaturated fatty acids have been well researched. They are crucial for the normal development of the brain and nervous system, respectively, and have been shown to improve arthritis, hypertension, and coronary heart disease (Meru *et al.*, 2018).

Figure 2: Pumpkin seeds.

2.9.1. Anthelmintic effect



In both humans and animals, intestinal parasites are dangerous infections. More than 3.5 billion people worldwide are infected with intestinal helminths, in particular, which are known to be quite widespread (Acorda *et al.*, 2019). Infections with helminths are common in China, sub-Saharan Africa, East Asia, and the Americas. In fact, high-risk locations with a prevalence of more than 50% were found in roughly 32 African countries. The community may face severe health and socioeconomic consequences as a result of the helminth problem. Studies show that helminths in both humans and animals are becoming more resistant to synthetic anthelmintics, despite the poor and selective deworming coverage used in developing nations to prevent geohelminthes (Gadisa and Jote, 2016).

To address this fatal pandemic health issue, effective anthelmintics are therefore required. Considerable effort is being made to take advantage of the naturally existing substances that

plants create in the metabolic pathways of helminths in order to address the issue (Abdel *et al.*, 2018). According to Makkar *et al.* (2009), treating helminths solely with synthetic medicines is not a long-term viable strategy for controlling the parasites. Livestock producers are moving toward less hazardous, sustainable, and alternative methods of production in order to overcome this obstacle.

Accordingly, records indicate that plants with anthelmintic compounds, such as *Ananas comosus* (pineapple), *Momordica charantia* (bitter melon), and *Azadirachta indica* (neem), are used to control internal parasites. Eucalyptus, on the other hand, directly affects gastrointestinal nematodes because of its tannin content. When used correctly, many species of *Cucurbita* genus seeds are known to be herbal dewormers that can eradicate all intestinal helminths and parasites (Li *et al.*, 2009). According to scientific studies, the high concentration of phenolic glycosides in *C. moschata* seeds may be responsible for the anthelmintic and antiparasitic properties (Lyttle *et al.*, 2008).

2.9.2. Antimicrobial effects

The major cause of deaths of many people is the bacteria, parasites, viruses and fungi that develop many diseases and lead to death despite of the hygienic environment and foods. The pumpkin seeds oil contains the components that are antimicrobial components and have been isolated from oil of pumpkin seeds. *Aeromonas veronii*, *Candida albicans*, *Enterococcus faecalis*, *Escherichia coli*, *Salmonella enterica*, *Typhimurium*, and *Staphylococcus aureus* are all inhibited from growing by pumpkin seeds oil at a concentration of 2% (Hammer *et al.*, 1999).

3. MATERIAL AND METHODS

3.1. Description of the Study Area

The Wolayita Sodo broiler farm of the South Ethiopian region Poultry Enterprise was the site of the study. The Wolaita Zone is situated in southern Ethiopia and is bounded by latitudes 6.4° and 7.1° N and longitudes 37.4° and 38.2° E. Its overall size is 3,982 square kilometers. It is between 1,200 and 2,950 meters above sea level. It is divided into three agro-ecological zones based on elevation: Dega or highland (9%, > 2,400 masl), Woina Dega or intermediate highland (56%, 1,500 to 2,400 masl), and Kolla or lowland (35%, <1,500 masl). The mean daily temperature is 19.5 °C, and the average annual rainfall is 1,014 mm (WZFEED, 2005).

3.2. Sources and Preparation of Feed Additives

The experimental ration's feed additions were pumpkin seeds and watermelon. The watermelon fruit seeds were gathered from fruit stores and juice houses in Arabaminch and Wolayita Sodo. Additionally, dried pumpkin seeds were bought at a local commercial market in the South Ethiopian region's Konso zone. In order to extract the seeds, Watermelon fruits were gathered and longitudinally cut into two equal sections using a homemade knife after fruit juice dealers and watermelon fruit growers collected the broken and discarded watermelon fruits. After that, the seeds were carefully extracted from the pulp and cleaned in water. The seeds were then sun-dried. Then, 0 kg, 1.0kg of pumpkin seed powder, 1.0kg of watermelon seed powder, a combined (0.5kg of pumpkin and 0.5kg of water-melon seeds) powder were added on each of 100 kg of broiler diets and finally created /developed/ experimental diets of T1, T2, T3 and T4, respectively to conduct the trial.

3.3. Experimental Chickens and their Management

Modjo Poultry Farm provided 180-day-old unsexed Hubbard broiler chicks, which were then divided into four groups at random, each with three replications. A total of 45 chickens were utilized in each treatment, with each replication consisting of 15 day-old chicks that were assigned at random. Wire mesh was used to prepare and divide the experimental pens. All of

the chicks in each treatment were given vitamins through drinking water upon arrival to help them recuperate from the stress of traveling. To guarantee that the chicks in each pen received enough heat, a 250-watt infrared heat bulb was hung at the ideal height for the chicks. For a period of twenty-three hours, the lightning program was modified.

Each experimental pen has been cleaned and disinfected with hydrogen peroxide using the deep litter housing system, which is bedded with Teff straw. Each experimental pen's feeding and watering troughs were appropriately positioned and thoroughly cleaned. Two weeks before to the chicks' arrival, the experimental housing were thoroughly cleaned and sanitized. After being cleaned with water, the pens were disinfected using hydrogen peroxide (1L/330L water). Water and food were always available during the trial. The National Veterinary Institute supplied vaccines, including HB1, Gumboro, Thermo stable, Gumboro booster dose, and Newcastle Thermo stable, to the chicks in accordance with the breeder company Modjo Poultry Farm's recommendations.

3.4. Diets and Feeding Management

The starter, grower, and finisher mash commercial broiler diets were purchased from Modjo Poultry farm feed processing plant, which is located in Modjo town. The proportion of experimental diet used in ration formulation and the chemical composition of the diet were obtained from the feed processing plant (Table 2). The diet is fed to experimental chickens based on the recommendation of feed manufacturers. The experimental feed additives were added on the top of broiler ration (Table 3) and fed twice daily at 8:30 AM and 5:00 PM.

Table 2: Diet formulation for experimental broiler chickens at different growth phase (%)

Ingredients	Starter Phase (0-14 days)				Grower Phase (15-28 days)				Finisher Phase (29-42 days)			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
Maize	54.0	54.0	54.0	54.0	61.0	61.0	61.0	61.0	61.4	61.4	61.0	61.0
Soybean meal	39.0	39.0	39.0	39.0	32.0	31.5	32.0	32.0	32.00	30.80	31.2	31.2
Wheat bran	3.0	2.0	2.4	2.4	2.5	2.5	2.5	2.4	2.5	2.5	2.5	2.5
DL-Methionine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
L-Lysine HCl	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Broiler Concentrate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Salt	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Limestone	2.5	3.5	2.5	1.25	2.3	3.5	2.5	1.25	2.0	3.2	2.2	2.2

Table 3: Nutrient composition of formulated basal diets (% on DM basis)

Nutrients	Starter Phase (0-14 days)				Grower Phase (15-28 days)				Finisher Phase (29-42 days)			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
DM (%)	89.00	90.60	90.51	90.22	90.83	89.07	92.75	93.13	89.82	93.79	89.69	92.59
ME(Kcal/kg)	3000.10	2980.00	3031.80	2979.11	2951.10	2975.70	2912.70	2918.30	3012.10	3073.00	2994.80	3019.90
CP (%)	21.82	22.31	21.74	22.30	20.33	22.87	21.94	19.46	20.07	21.62	19.54	19.02
Ash (%)	6.35	5.93	7.03	6.10	5.01	6.21	6.23	6.61	7.61	6.13	7.30	7.90
CF (%)	5.05	6.68	5.47	7.43	5.29	4.78	4.98	4.98	4.88	4.31	5.31	5.52
EE (%)	6.30	7.54	6.95	7.28	5.61	5.34	5.37	5.49	6.42	6.17	6.87	6.01

DM-Dry Matter, ME-Metabolizable Energy, CP-Crude protein, CF-Crude fiber, EE- Ether extract, ADF-Acid Detergent fiber, NDF- Neutral Detergent Fiber.

4.3. 3.5. Experimental Design and Treatments

Three replications and four treatments were employed in a completely randomized design (CRD). The treatments involved adding additives to commercial broiler diets. T1 (control) is a commercial broiler diet that does not contain watermelon or pumpkin seeds powder; T2 is a commercial broiler diet that contains 1 kg of watermelon seeds powder; T3 is a commercial broiler diet that contains 1 kg of pumpkin seeds powder; and T4 is a commercial broiler diet that contains a combination of watermelon and pumpkin seeds powder in an equal amount (0.5 kg) (Table 4).

Table 4: Experimental treatment arrangements and level of feed additives

Treatments	Levels and amount of additives		Number of replication	Chickens/ replication	Total chickens/treatment
	Watermelon seeds powder (kg*)	Pumpkin seeds powder (kg*)			
T ₁	0	0	3	15	45
T ₂	1	0	3	15	45
T ₃	0	1	3	15	45
T ₄	0.5	0.5	3	15	45

*=Kg/100kg of commercial broiler diet

4.4. Measurements and Observations

3.6.1. Chemical analysis

At Jije Laboratory in Addis Ababa, representative samples of each stage's experimental diet were collected and examined for ash content, dry matter (DM), crude protein (CP), ether

extract (EE), and crude fiber (CF). To measure dry matter, 60 g of samples were dried for 24 hours at 105°C in a draft oven. The Kjeldahl method was used to quantify nitrogen (N), and the sample's crude protein content was computed as N*6.25 (AOAC, 1995). The usual technique was followed to determine the total lipid (ether extract) content (AOAC, 1995). The total mineral content was measured for three hours at 550°C in a muffle furnace. Using Wiseman's (1987) formula, the total metabolizable energy content was calculated as follows:

$$\text{ME (Kcal/kg DM)} = 3951 + 54.4 \text{ EE} - 88.7\text{CF} - 40.8 \text{ Ash}$$

3.6.2. Feed intake

The amount of feed consumed was calculated as the difference between the amount of feed offered and denied on a dry matter basis. The amount of feed offered and refused per replication and/or treatment was recorded every day.

$$\text{Average daily feed intake (g)} = \frac{\text{Daily feed offered} - \text{Daily feed refusal}}{\text{Number of chickens in pen or replication}}$$

3.6.3. Chick mortality

At the conclusion of the experiment, daily mortality was recorded as it happened and calculated as a percentage of the overall mortality for each treatment.:

$$\text{Mortality percentage (MP)} = \frac{\text{Number of dead chicks}}{\text{Number of total chicks}} \times 100$$

3.6.4. Body weight gain (BWG)

At the start and thereafter once a week, the body weight of the chickens was assessed in groups using sensitive balance. As shown in the formula below, the average body weight gain or loss for each replicate is calculated by deducting the initial weight from the end weight and dividing the result by the number of experimental days among consecutive measurements:

$$\text{Average Daily weight gain (ADG)} = \frac{\text{Body weight gain}}{\text{Number of experimental days}}$$

3.6.5. Feed conversion ratio (FCR)

Using the method of Essien (1989), the feed conversion ratio was calculated as the ratio of feed consumption per unit increase in weight gain.

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Average daily feed intake (g)}}{\text{Average daily body weight gain(g)}}$$

3.6.6. Carcass characteristics

At the conclusion of the experiment, twenty-four chickens (six for each treatment or two for each replication) were chosen at random and killed in order to examine the carcass and internal organs. Before the birds were killed, their live body weight was measured after they had been fasted for 12 hours. After the jugular vein was sliced to allow for full bleeding, the birds were defeathered and disemboweled. In addition to the pre-slaughter live weight and weight following bleeding, the weight of the back, neck, breast, drumstick, thigh, wing, gizzard, and all visceral organs (including the heart, kidneys, spleen, and lungs) as well as the shank, head, and belly fat were noted. A computerized balance was used to weigh each component and organ, and the results were recorded. Finally, the dressed carcass yield was evaluated for each treatment as follows:

$$\text{Dressing percentage} = \frac{\text{Carcass Weight}}{\text{Live body weight}} * 100$$

3.6.7. Hematological profiles

At the conclusion of the experiment, five milliliters of blood were drawn from the bronchial wing veins of six (6) randomly chosen chickens from each treatment. The Addis Ababa University College of Veterinary Medicine and Agriculture Technical Pathology Laboratory performed hematological blood analyses. To avoid coagulation, 2.5 milliliters of blood were drawn into an EDTA (ethylene diamine tetra acetic acid) tube; the remaining 2.5 milliliters were drawn into a plain tube and allowed to coagulate. Total erythrocyte count (TEC),

hemoglobin (Hb), packed cell volume (PCV), and total leucocyte count (TLC) were measured in the blood samples. Acid hematin or Sahli's procedures were used to measure hemoglobin concentration. The packed cell volume (PCV) was measured using microhematocrit capillary tubes and centrifuged for five minutes at 3000 revolutions per minute (rpm).

3.6.8. Statistical analysis

The General Linear Model (GLM) technique of SAS version 9.2 was used to perform analysis of variance (ANOVA) on the experimental data. The least significant difference (LSD) test was used to compare treatment mean differences when the analysis of variance indicated the presence of significant differences.

The model used for data analysis is;

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

Y_{ij} = represents the j^{th} observation taken under treatment

μ = Over all mean

T_i = Treatments effects of feed additives

e_{ij} = Random error

3.6.9. Partial Budget analysis

The cost of feeds for each therapy was taken into account when evaluating the partial budget analysis. the analysis used to determine the experimental diet's variable costs and profits. The amount of money left over after deducting total variable costs (TVC) from total returns (TR) is the experimental group's net return (NR):

$$NR = TR - TVC$$

The difference between the change in total return (ΔTR) and the change in total variable costs (ΔTVC) was used to compute the change in net income (ΔNR) or net return (ΔNR).

$$\Delta NR = (\Delta TR - \Delta TVC),$$

Where: NR: net return,

TR: total return and

TVC: total variable costs

The marginal rate of return (MRR) measures increases in net income (ΔNI) associated with each additional unit of expenditure (ΔTVC) and it is calculated as:

$$MRR = (\Delta NI / \Delta TVC)$$

$$\text{Marginal rate of return} = \frac{\text{Net Return}}{\text{Total variable cost}} * 100$$

3. RESULTS

4.5. Growth Performance

The growth performance of the experimental chicken is shown in Table 5. The findings demonstrated that neither daily feed intake (DFI) nor total feed intake (TFI) throughout the starter, grower, finisher, or full experimental period were significantly impacted by dietary interventions ($P > 0.05$). Uniform feed intake across treatments during the starting phase suggests that the experimental diets were equally appealing and had no effect on early feeding behavior. Pumpkin seeds and watermelon both exhibited similar effects on feed intake, indicating that they can be substituted or used interchangeably. Although birds in T3 and T4 showed numerically lower DFI and TFI throughout the growth phase than birds in T1 and T2, these changes were not statistically significant, indicating that feed intake was constant across treatments. During the finisher phase, a similar pattern was seen, with feed intake progressively declining numerically from T1 to T4 without reaching statistical significance. The decreased feed intake in T4 is associated with the two feed additives' synergistic impact.

Final body weight (FBW), were not substantially impacted by feed treatments at any point during the trial, according to the examination of growth performance criteria ($P > 0.05$). Average body weight increase (ABWG) and daily weight gain (DWG) were statistically the same across treatments throughout the starter phase, indicating comparable early growth responses. ABWG and DWG, on the other hand, showed a significant treatment effect ($P = 0.0476$) during the grower phase, with birds in T1 showing noticeably greater gains than those in T4, while T2 and T3 showed intermediate performance. Average birds' feed intake, in T4 was considerably lower at the grower stage, which could be attributed to the synergistic impact of both feed additives that blended by an identical ratio. This showed that using pumpkin seeds and watermelon combined in chicken feed reduced feed consumption more successfully than using them individually. With the exception of feed conversion ratio, no significant difference was found in any of the variables throughout the finisher phase; however, birds in T3 and T4 showed statistically greater increases in body weight.

The findings demonstrated a phase-dependent relationship between dietary interventions and feed conversion ratio (FCR). FCR values were statistically similar across all treatment groups during the starter and grower phases ($P > 0.05$), suggesting that feed additives had no effect on early and mid-growth feed utilization and that observed variations in weight gain were probably caused by nutrient partitioning rather than feed efficiency. The finisher stage was the most receptive to nutritional intervention, as seen by the considerable treatment effect on FCR ($P = 0.04$) that birds receiving the T4 diet showed when compared to chicken in other treatment groups. A higher FCR in T4 may be associated with the synergistic action of those feed additives, which include bioactive compounds including phenolic acids, flavonoids, and carotenoids. Although numerical improvements in T3 and T4 indicate possible biological and economic benefits, the FCR did not substantially differ ($P > 0.05$) for the entire stage (0-42 days).

Over the course of the entire experiment (0–42 days), the nutritional addition of watermelon seeds, pumpkin seeds, or both did not substantially affect the mortality rate among broiler chicks ($P = 0.876$). The death rates for the birds in treatments T1 and T2 were 4.44% and 2 dead birds out of 45, respectively. Treatments T3 and T4, on the other hand, showed reduced mortality rates of 2.22%, or one dead bird out of forty-five. The statistical analysis showed that the treatments had no discernible effect on the broiler chickens' capacity to survive despite these numerical differences.

This study's overall mortality rate was 3.33%, or six deaths out of 180 experimental birds. This comparatively low mortality rate implies that the birds were maintained under ideal management, dietary, and environmental circumstances during the experiment. The findings also suggest that adding pumpkin seeds, watermelon seeds, and their combination to broiler diets had no negative physiological impacts on the birds.

The beginning phase had the highest amount of mortality, according to a phase-wise examination of mortality. Four birds perished during the starting phase (weeks 1-2), making up 2.22% of the entire experimental population and 66.7% of all recorded deaths. By contrast, only one bird perished in the grower phase (0.56%) and another in the finisher phase (0.56%).

As the birds grew older and adjusted to the experimental environment, this pattern shows a notable decline in mortality.

According to the weekly distribution of mortality, three birds perished during the first week, which had the largest number of fatalities. One bird perished in the second week, one more in the fourth, and one more in the sixth. No deaths were noted in the third or fifth weeks. The increased mortality during the early growing period suggests that younger chicks were more vulnerable to physiological and environmental stressors during the brooding stage.

Table 5: Effects of watermelon and pumpkin seeds and their mixture on growth performance

Phase	Parameters	T1	T2	T3	T4	p-value	sig.
Starter (1-14 days)	IBW(g/bird)	43.99	44.12	44.37	43.38	0.4521	ns
	FBW(g/bird)	415.79	430.82	434.2	437.41	0.9068	ns
	ABWG (g/bird)	371.79	386.7	389.83	394.03	0.9067	ns
	DWG(g/bird/day	26.55	27.62	27.84	28.14	0.9067	ns
	DFI	32.74	32.74	33.62	32.96	0.6032	ns
	TFI(g/bird)	458.38	458.38	470.7	461.46	0.6032	ns
	FCR(gfeed/gBWG)	1.24	1.20	1.21	1.18	0.95	ns
Grower (15-28 days)	IBW(g/bird)	415.79	430.82	434.2	437.41	0.9068	ns
	FBW(g/bird)	1118.1	1043.7	1098.3	1034.3	0.48	ns
		7	4		4		
	ABWG(g/bird)	702.38 ^a	612.92	664.1 ^{ab}	596.93	0.0476	*
					^b		
	DWG(g/bird/day)	50.17 ^a	43.78 ^{ab}	47.435 ^a	42.638	0.0476	*
				^b	^b		
	DFI	83.529	83.529	79.566	75.138	0.2623	ns
	TFI(g/bird)	1169.4	1169.4	1113.9	1051.9	0.2623	ns
		1	1	2	3		

	FCR(gfeed/gBWG)	1.68	1.91	1.68	1.76	0.27	ns
Finisher	IBW(g/bird)	1118.1	1043.7	1098.3	1034.3	0.48	ns
(29-42 day)		7	4		4		
	FBW(g/bird)	1883.3	1980	2033.3	1976.6	0.3675	ns
		3		3	7		
	ABWG(g/bird)	765.16	936.26	935.03	942.33	0.1198	ns
	DWG(g/bird/day)	54.655	66.876	66.788	67.309	0.1198	ns
	DFI	186.89	186.89	181.31	174.59	0.3872	ns
		6	6	4	2		
	TFI(g/bird)	2616.5	2616.5	2538.4	2444.3	0.3872	ns
	FCR(gfeed/gBG)	3.42 ^a	2.82 ^{ab}	2.75 ^{ab}	2.61 ^b	0.04	*
Entire	Average						
(1-42 days)	BW(g/bird)						
	ABWG(g/bird)	1839.3	1935.8	1988.9	1933.2	0.3717	ns
		4	8	6	9		
	TFI (g/bird)	4244.3	4244.3	4123	3957.7	0.1704	ns
	FCR (gfeed/gBWG)	2.3084	2.1983	2.0817	2.0473	0.187	ns
	Mortality rate (%)	4.44	4.44	2.22	2.22	0.876	ns

P < 0.05 * = significant; ^{ab} Means within a row with different superscripts differ significantly (*P* < 0.05); T1 = 0% inclusion; T2 = 1% watermelon seeds inclusion; T3 = 1% pumpkin seeds inclusion; T4 = 0.5% watermelon seeds and pumpkin seeds inclusion; IBW = initial body weight; FBW = final body weight; ABWG = average body weight gain; DWG = daily body weight gain, FI = Feed intake; FCR = Feed conversion ratio.

4.6. Carcass Characteristics

Table 6 shows how broiler chicken carcass properties are affected by nutritional interventions. The results showed that dietary treatments had a significant impact on slaughter and dressed carcass weight (*P* < 0.05), with birds in T3 achieving the maximum slaughter and dressed carcass weight, indicating the beneficial effects of pumpkin seeds. Nevertheless, neither the dressing % nor the carcass yield varied significantly (*P* > 0.05) between treatment groups,

indicating that the addition of pumpkin seeds powder and/or watermelon as feed additives had a significant impact on overall carcass output in relation to slaughter weight. This implies that using either watermelon or pumpkin and their combination at equal amounts has no effect on the carcass output and dressing % of Hubbard broiler chickens.

The groups of chickens fed the control diet showed the least dressed carcass as compared to the control diet, suggesting that the feed additives used enhanced carcass yield. Breast muscle weight showed a similar pattern, with T1 exhibiting an intermediate response and T3 considerably higher ($P < 0.05$) than T2 and T4. This implies that the food intervention in T3 increased the amount of breast muscle, a crucial cut from an economic standpoint. However, there was no significant difference ($P > 0.05$) in the weights of the thigh muscles, legs, wings, and back (spinal cord) between treatments, suggesting that food changes had little effect on these carcass components. The weights of internal organs and non-carcass parts, such as the gizzard, liver, neck, head, and shank, were also statistically equal among treatments, indicating that the feed additives had no negative effects on physiological balance or organ development.

Table 6: Effect of pumpkin and watermelon seeds on broiler carcass characteristics (LSMean)

Carcass parameters	Treatment group				P-value	sig.
	T1	T2	T3	T4		
Slaughter weight (g/bird)	2.10 ^{ab}	1.95 ^b	2.38 ^a	1.95 ^b	0.01	*
Dressed carcass (g/bird)	1.18 ^b	1.26 ^{ab}	1.59 ^a	1.30 ^{ab}	0.02	*
Dressing percentage (%)	56.98	64.74	66.90	66.67	0.46	ns
Breast weight (g/bird)	0.49 ^{ab}	0.43 ^b	0.56 ^a	0.45 ^b	0.04	*
Thigh weight (g/bird)	0.27	0.26	0.3	0.233	0.40	ns
Leg (g/bird)	0.24	0.22	0.24	0.22	0.62	ns
Wing weight (g/bird)	0.18	0.167	0.19	0.17	0.40	ns
Gizzared weight (g/bird)	0.05	0.05	0.05	0.04	0.44	ns
Liver weight (g/bird)	0.05	0.05	0.05	0.05	0.00	ns
Neck weight (g/bird)	0.05	0.06	0.05	0.05	0.44	ns
Back weight (g/bird)	0.18	0.18	0.23	0.19	0.35	ns
Head weight (g/bird)	0.05	0.05	0.05	0.05	0.00	ns
Shank weight (g/bird)	0.083	0.075	0.10	0.083	0.30	ns

$P < 0.05$; * = significant; ^{ab} means within a row with different superscripts differ significantly ($P < 0.05$); T1=0% inclusion; T2=1% watermelon seeds inclusion; T3=1% pumpkin seeds inclusion; T4=0.5% water melon seeds and pumpkin seeds inclusion;

4.7.Hematology

Table 7 shows how the dietary interventions affected hematological parameters. The findings demonstrated that the therapies had a substantial impact on all assessed blood parameters ($P < 0.01$). Packed cell volume (PCV), which indicates increased erythropoietic activity in chicken receiving the natural additions, was lowest in the control group (T1) and significantly higher in T2 and T4, with T3 displaying an intermediate value. Hemoglobin concentration (Hb) revealed a similar pattern, with T2 and T4 having the greatest levels, T3 having an intermediate level, and T1 having the lowest, indicating that the blood's ability to carry oxygen was improved in groups of chickens fed a meal containing additives. A group of chickens fed a meal containing watermelon and pumpkin seeds had a considerably higher total erythrocyte count (TEC) than T1, which further supports the birds fed the additive-containing diets' better red blood cell production and general physiological state. Similarly, there were substantial differences in the total leukocyte count (TLC) between treatments, with T2 and T4 having much higher counts, followed by T3, and T1 having the lowest number. A potential improvement in immunological response is suggested by the higher TLC in groups of chickens fed a meal containing natural additives. The increased levels of PCV, Hb, TEC, and TLC in the blood of chicken fed a diet containing watermelon and pumpkin seeds and their combination may be due to the oil content of these seeds, which have antioxidant properties that strengthen immunity and protect cells from oxidative stress. Additionally, the seeds of both natural additions had a considerable nutritional benefit because to their high mineral concentration, which led to greater amounts of PCV, Hb, TEC, and TLC in the chickens' blood.

Table 7: Effect of dietary feed additives on broiler blood parameters (LSMean)

Parameters	Treatments				p-value	sig.
	T1	T2	T3	T4		
PCV (%)	31.60 ^c	47.27 ^a	41.65 ^b	46.30 ^a	0.0001	**
Hb (g/dl)	10.50 ^b	15.17 ^a	13.38 ^a	15.30 ^a	0.0001	**
Total Erythrocyte count ($10^6/\mu\text{L}$)	2.74 ^b	3.48 ^a	3.36 ^a	3.70 ^a	0.0006	**
Total Leucocyte count ($10^3/\mu\text{L}$)	2.41 ^c	19.75 ^a	14.41 ^b	21.54 ^a	0.0001	**

ns = non-significant, * = significant at $P < 0.05$; ^{ab} Means within a row with different superscripts differ significantly ($P < 0.05$); T1=0% inclusion; T2=1% watermelon seeds inclusion; T3=1% pumpkin seeds inclusion; T4=0.5% water melon seeds and pumpkin seeds inclusion; PCV= Packed cell volume; HB= hemoglobin,.

4.8.4.4. Partial budget

The current study's economic findings show that dietary interventions significantly impacted profitability, mostly on feed costs throughout growth performance (Table 8). In comparison to the control group, the variable cost decreased in the groups of chickens fed a diet containing natural additives, especially in T3 and T4, indicating increased feed efficiency. T3 recorded the highest average final body weight, which translated into the highest total return and net revenue per bird. This improvement in growth performance coincided with the decrease in variable cost. In comparison to the control, all treatment groups that employed dietary supplements saw increases in net income, with T3 producing the greatest financial gain. In certain treatments, the reported negative marginal rate of return values were linked to lower variable costs rather than lower profitability.

Table 8: Effect of watermelon and pumpkin seeds and their mixture on economic benefit

Description	Treatment			
	T1	T2	T3	T4
DOC Purchase (birr/bird)	110	110	110	110
Vaccine and vitamin cost	10	10	10	10
Labor cost (birr/bird)	35	35	35	35
Feed intake (g/bird)	4244.3	4244.3	4123	3957.7
TFC (birr/bird)	254.67	254.66	247.38	237.46
Total Expense (birr/bird)	409.67	409.66	402.38	392.46
Carcass sale (birr/kg)	400	400	400	400
FBW (kg/bird)	1.88	1.98	2.033	1.97
Total return (TR)	752.00	792	813.33	788.00
Net income	342.33	382.33	410.95	395.54
cNI	0	40.00	68.62	53.21
cTVC	0	0	-7.29	-17.21
MRR (cNI/cTvc)	0	0	9.41	3.09

$P < 0.05$; * = significant; ^{ab} Means within a row with different superscripts differ significantly ($P < 0.05$); T1=0% no additives; T2= 1% watermelon seeds; T3= 1% punpkin seeds; T4=1% mixture; NI= net income; cTFC = change in total feed cost; cTVC=total variable cost; cNI =

*change in net income; ΔTVC = change in variable cost; FBW = final body weight;
MRR=Marginal rate of return; DOC = Day old chicks, TFC = Total Feed cost*

5. DISCUSSION

5.1. Growth Performance

This study showed that the development performance characteristics of broiler chickens were affected in different, phase-dependent ways by the dietary addition of watermelon seeds, pumpkin seeds, and their combination at a 1% level (Table 5). Throughout the production stage, feed intake was consistent across all treatments, suggesting that these natural additions were easily taken without causing problems with palatability or feed rejection. This result is comparable with Vlaicu *et al.* (2021), who found that adding up to 100 g/kg of pumpkin seeds meal improved nutrient utilization efficiency while maintaining regular feed intake patterns. Similarly, Siudak *et al.* (2025) found that adding pumpkin seeds to broiler diets does not impact performance. The investigation's findings confirmed a previous study's conclusion that adding up to 20% watermelon seeds had no effect on feed consumption (NRC, 1994). On the other hand, secondary metabolites found in many plant-based additives lower palatability at greater inclusion levels, according to Obianwuna *et al.* (2024). The bioactive components of the feed additives are equivalent if there is no discernible impact on feed intake over the course of the experiment. In a similar vein, Wafar *et al.* (2017) discovered that broiler chickens' feed intake was not significantly affected by pumpkin seeds; however, they differed with Martínez *et al.* (2010), who discovered that feed intake increased significantly when broiler chicks were fed diets mixed with 1% and 10% pumpkin seeds.

The experimental additions did not negatively impact early feeding behavior or nutrient utilization in young chicks, as evidenced by the lack of significant variations in body weight increase or feed conversion ratio (FCR) across treatment groups throughout the starter period. This result is consistent with observations by Abaza *et al.* (2008), who observed that when added at modest amounts, natural feed additives typically do not hinder initial growth. During the grower phase, a noteworthy finding was that birds fed the control diet (T1) showed significantly greater daily weight gain and average body weight gain than birds getting the mixed seeds additions ($P = 0.0776$). Certain antinutritional factors, such as cucurbitacins in Cucurbitaceae seeds, can temporarily impair nutrient digestibility during this crucial growth

phase when metabolic demands are rapidly increasing, which may be the cause of this brief decrease in growth rate with seeds supplementation at the grower stage (Bauri *et al.*, 2015; Falade *et al.*, 2020). Nevertheless, the combination treatment (T4) showed a better feed conversion ratio than the control during the finisher phase, which made up for this growth depression. As shown by Oni *et al.* (2024) in phytogetic-supplemented broilers undergoing metabolic adaptation, this phase-dependent response suggests that broilers gradually adapted to the seeds-based additives, possibly through modification of gut flora and increased enzymatic activity.

In comparison to the control group, birds that received the mixed seeds additions (T4) showed statistically superior body weight growth and a significantly improved feed conversion ratio during the finisher phase ($P = 0.0372$). This phase-dependent response implies that the phytochemical components of watermelon and pumpkin seeds, such as akaooids, flavonoids, phenolics, and cucurbitacins, have more noticeable positive effects on nutrient utilization in later growth stages when metabolic demands are at their highest. Pumpkin seeds offer 34.56% ether extract rich in polyunsaturated fatty acids that improve energy metabolism and nutrient absorption efficiency (Vinayashree *et al.*, 2021), while watermelon seeds have a rich unsaturated fatty acid profile with 24-58% crude fat primarily composed of linoleic and oleic acids (Rico *et al.*, 2020). Similarly, in broilers treated with pumpkin seeds oil, Tabari *et al.* (2016) found phase-dependent increases in FCR with herbal additions.

Despite the lack of statistical significance, the numerical improvements in FCR for T3 and T4 compared to T1 suggest potential economic benefits from seeds inclusion. The results showed that final body weights and total feed intake did not differ significantly among treatments ($P > 0.05$) for the entire stage of growth. This observation is in line with research by Girma *et al.* (2019), who found that supplementing broilers with pumpkin seeds at a 1% level increased feed efficiency without appreciably changing final body weight. On the other hand, Wafar *et al.* (2017) discovered that growth performance metrics like as final body weight, total body weight gain, and average daily weight gain increased significantly when broiler diets included more pumpkin seeds. The FCR for the entire broiler production stage was non-significant and varied from 2.04 to 2.31, which is within the range of 2.1 to 5.1 that Oluyemi and Roberts

(2000) recorded for broiler chickens in a tropical environment. This lack of significance is consistent with the results of Wafar *et al.* (2017), who found no appreciable effect when broiler chickens were fed pumpkin seeds. Adequate nutrition absorption, digestion, and utilization were indicated by the reported FCR range falling within the recommended ranges. Overall, the study's findings are in line with previous research showing that: Pumpkin seeds increase carcass yield and muscle growth (Meru *et al.*, 2018); phytogenic feed additives improve feed efficiency and health status (Hashemi and Davoodi, 2011).

The high lipid and amino acid contents of watermelon seeds found in the proximate composition analysis of the current study may be responsible for the numerical improvement in feed conversion ratio and final body weight observed in birds supplemented with watermelon seeds. Unsaturated fatty acids, especially linoleic acid, which is a vital source of energy for broilers that grow quickly, are abundant in watermelon seeds. Watermelon seeds meal has substantial levels of digestible proteins and essential fatty acids, which can enhance nutrition metabolism and energy use in animal feeding systems, according to Adegunwa *et al.* (2014). Increased energy availability from components of watermelon seeds oil may be responsible for the better nutritional efficiency seen in this study.

Additionally, a number of physiologically active substances found in watermelon seeds, including citrulline, flavonoids, and phenolics, have been demonstrated to increase physiological and metabolic processes. Citrulline increases the production of nitric oxide, which enhances blood flow and the movement of nutrients throughout tissues (Rimando and Perkins-Veazie, 2005). The numerical increases in growth performance indicators may be attributed to improved circulation, which may enhance the supply of nutrients to digestive organs and muscle tissues. Additionally, watermelon seeds' phytogenic compounds may boost gut microbial balance and digestive enzyme release, improving nutritional digestibility and feed efficiency (Abd El-Moneim *et al.*, 2020).

5.2. Mortality

According to the current study, the experiment's overall death rate was 3.33%, indicating that the birds found the experimental diets to be generally safe and acceptable. T1 and T2 had mortality rates of 4.44%, while T3 and T4 had reduced mortality rates of 2.22%. Over the course of the experiment, the addition of watermelon seeds, pumpkin seeds, or both did not significantly affect the mortality rate of broiler chickens ($P = 0.876$). The inclusion of watermelon and pumpkin seeds supplements did not adversely affect the health and survival of broiler chickens, as evidenced by the lack of significant differences across treatments.

This overall mortality rate shows strong flock health and management techniques and is within the permitted range for commercial broiler production. Under intensive poultry production systems, mortality rates below 5% are often regarded as acceptable. Similarly, Wafar *et al.* (2017) discovered that adding pumpkin seeds meal to broiler diets did not negatively impact the survival or health of the birds. Their research showed acceptable survival rates and normal physiological performance in birds fed diets based on pumpkin seeds meal, indicating that pumpkin seeds can be safely integrated into poultry feed as an alternative ingredient as long as nutritional and environmental factors are well managed (FAO, 2013).

The current results are also consistent with the research conducted by Digarse *et al.* (2025), who investigated the addition of pumpkin seeds powder to broiler chicks and observed enhanced growth performance without appreciable variations in mortality across the treatment groups. According to the study, pumpkin seeds are full of beneficial nutrients and antioxidants that can improve bird health and reduce physiological stress. Furthermore, the low mortality rate seen in this study is consistent with the results of Adegbenro *et al.* (2020), who evaluated the effects of adding fluted pumpkin to broiler diets and came to the conclusion that plant-based dietary supplements had no negative effects on broiler survival. The scientists attributed the favorable survival results to the naturally occurring bioactive chemicals, vitamins, and antioxidants included in diet ingredients obtained from plants.

Four out of every six deaths (66.7%) in this study occurred during the beginning phase, which accounted for the majority of mortality events. There was only one recorded fatality in each of

the grower and finisher periods (0.56%), indicating much decreased mortality rates. This pattern is in line with typical studies in chicken production, which show that early in life, immature chicks are more vulnerable to environmental stress, problems with brooding management, temperature fluctuations, and immunological instability. (Niranjan and others, 2018). Studies looking at phytogetic and non-traditional feed sources in broiler chickens have shown similar results, with mortality mostly focused in the starting period rather than in later growth stages.

Birds successfully adapted after the first stage, as seen by the dramatic drop in mortality during the grower and finisher phases. As the birds grew older, their immune systems and physiological stability may have improved. increase mortality, suggesting that when used at the tested levels, these feed additives are safe for broiler chickens. This result is consistent with earlier research demonstrating that, when appropriately added to poultry diets, phytogetic feed additives do not negatively impact survivorship (Hashemi and Davoodi, 2011).

Additionally, the lack of statistically significant variations in mortality across treatment groups raises the possibility that these additions' positive benefits would be more noticeable in situations with increased disease challenge or environmental stress. In ideal experimental settings, managerial issues frequently have a greater impact on mortality than nutritional interventions alone (FAO, 2013). Consequently, The study's low and consistent fatality rates across treatments highlight the significance of appropriate husbandry procedures, especially in the crucial early stages of production.

The significantly lower death rates observed in groups supplemented with watermelon seeds may be due to the antibacterial and antioxidant properties of watermelon seeds phytochemicals. Watermelon seeds include compounds with antibacterial qualities, including alkaloids, flavonoids, tannins, and saponins (Braide *et al.*, 2012). These compounds may improve overall avian health and reduce intestinal microbial issues, which would lower mortality rates. Watermelon seeds are also known to contain citrulline, an amino acid associated with improved physiological tolerance to stress. Citrulline aids in the production of nitric oxide under stressful conditions, which raises blood flow and tissue oxygenation (Tarazona-Díaz *et*

al., 2013). Because of their enhanced physiological adaptation, grill chickens may be more resilient to environmental and metabolic stressors, reducing their chance of dying during the production period. The improved health of birds fed watermelon seeds supplements may also be associated with enhanced antioxidant defense mechanisms. Antioxidants help maintain physiological and immunological stability under high production settings and reduce the harm that free radicals cause to cells (Surai, 2016). This protective impact may help to explain the lower mortality and improved health observed in the supplemented groups.

In conclusion, the current study's mortality results confirm that adding watermelon seeds, pumpkin seeds, or both to broiler chicken diets is safe and won't negatively impact flock survival. These non-traditional feed sources may serve as safe substitute nutritional supplements in broiler production systems, as evidenced by the low mortality rate and the lack of notable changes between treatments.

5.3. Carcass Characteristics

Certain carcass characteristics were strongly impacted by dietary treatments; the most notable favorable impacts on slaughter live weight, dressed carcass weight, and breast weight were seen by pumpkin seeds supplementation (T3). This outcome is consistent with the results of Aguilar *et al.* (2011), who discovered that the addition of pumpkin-seeds flour increased the yield of breast muscle and live body weight. Similarly, Wafar *et al.* (2017) discovered that there were significant differences between dietary groups in the live weight and dressed weight of broiler chicks supplemented with pumpkin seeds. However, Martínez-Aguilar *et al.* (2010) discovered that the dressing percentage and carcass properties of broiler chickens did not change considerably when 10% whole pumpkin seeds were added. Pumpkin seeds has been shown to improve nutrition partitioning toward muscle deposition, which may be mediated by its rich amount of unsaturated fatty acids and bioactive peptides that affect protein metabolism (Meineri *et al.*, 2018). This is consistent with the increase in carcass production.

Since breast meat is the most important carcass component in broiler production, the considerable increase in breast muscle weight in T3 relative to T2 and T4 ($P = 0.0409$) is very relevant from a commercial standpoint. This result supports the findings of Alagbe *et al.* (2024), who showed that by upregulating muscle protein synthesis pathways, phytogenic supplements high in essential amino acids and bioactive peptides greatly increase protein accretion in broiler breast muscle. According to Rezig *et al.* (2013), pumpkin seeds have a favorable amino acid profile and contain about 28.37% crude protein. These amino acids include significant amounts of arginine, glutamic acid, and aspartic acid, which are precursors for the synthesis of muscle proteins and nitric oxide, which improves blood flow to developing muscle tissues. The dressed carcass and breast weight were generally better when pumpkin seeds was added to broiler feed than when watermelon seeds was. This could be because watermelon seeds has a moderate amount of phenolics and phytosterols, whereas pumpkin seeds has a greater protein content (30–40%) compared to watermelon seeds (18–35%) (Xie and Nie, 2021; Gade *et al.*, 2022; Matthauss and Ozcan, 2022; Polyzos *et al.*, 2024).

Although the dressing percentage was not significant, treatment groups had higher dressing percentage (DP) values than the control. This may be related to the bioactive or phytochemical components of both feed additives. The percentage of other edible meat in relation to live weight was not negatively impacted by seeds supplementation, as indicated by the statistical similarity of the DP values across all treatments ($P = 0.4622$). On the other hand, Wafar *et al.* (2017) discovered that there were notable differences in the dressed percentage of broiler chicks supplemented with pumpkin seeds among dietary groups. Yakubu and Alfred (2014) and Ogbu *et al.* (2015) found values of 73.15–89.49% for tropical broiler chicken, which are higher than the dressing percent (56.98–66.90) obtained in this study. This could be due to the experimental ration's usage of mash feed. The 1% inclusion level represented a safe threshold that avoided potential toxic effects associated with higher concentrations of cucurbitacin compounds present in Cucurbitaceae seeds, as evidenced by the lack of significant differences in dressing percentage and normal organ weights observed for gizzard, liver, and other viscera (Grzybek *et al.*, 2016). The fact that there were no appreciable variations in the weights of the thighs, legs, wings, and backs indicates that the growth-promoting effects of pumpkin seeds were more focused on the development of breast muscles than on the growth of the entire

carcass. The safety of these natural additives at the investigated inclusion levels is further supported by comparable weights of non-carcass components (neck, head, and shank) across treatments, which show that seeds supplementation at 1% level did not interfere with normal organ development or physiological homeostasis.

The favorable fatty acid profile and protein quality of watermelon seeds may be connected to the notable increase in dressed carcass yield and breast muscle weight observed in the groups fed with watermelon seeds. Watermelon seeds are rich in arginine and glutamic acid, which are necessary for the synthesis of muscle proteins and the development of tissue, according to Tabiri *et al.* (2016). Because it encourages muscle growth, immune response, and protein accumulation, arginine is particularly advantageous for chicken diet. Furthermore, watermelon seeds oil contains a high concentration of polyunsaturated fatty acids, which may improve lipid metabolism and carcass composition. Polyunsaturated fatty acids are known to promote lean tissue growth while lowering excessive fat deposition (FAO, 2010). Without noticeable changes in the quantity of fat deposited in the belly, this could explain the improved carcass traits observed in the supplemented groups. Similar results were reported by Oluba *et al.* (2008), who discovered that watermelon seeds oil improved test animals' physiological function and lipid metabolism. Another factor for improved carcass characteristics is the antioxidant activity of watermelon seeds. Proteins and cellular structures are harmed by oxidative stress, which may impede the development of muscle and the quality of the carcass. Antioxidant compounds found in watermelon seeds may reduce oxidative damage and support muscle integrity throughout growth (Tlili *et al.*, 2011). Therefore, the improved carcass metrics seen in this study may be partly due to the protective effects of watermelon seeds antioxidants on muscle tissues.

5.4. Hematological Parameters

In comparison to the control group, the hematological results showed significant and statistically significant improvements ($P < 0.01$) in all evaluated blood parameters when watermelon and pumpkin seeds and their mixture were supplemented. A group of chickens fed

a meal comprising watermelon seeds and its blend with pumpkin seeds at an equal amount shown a substantial increase in packed cell volume and hemoglobin content as compared to feeding only pumpkin seeds. This suggests that the bioactive compounds in watermelon seeds increase PCV, a gauge of the blood's capacity to carry oxygen and a sign of the presence of red blood cell-filled blood. These improvements in PCV and Hb values show that birds fed diets supplemented with seeds have better oxygen-carrying capacity and erythropoietic activity.

The study's Hb levels (10.50–15.30g/dl) were higher than the typical ranges (7–13g/dl) for chicken reported by Bounous and Stedman (2000). A group of chickens fed diets including watermelon and pumpkin seeds as natural additives had significantly more leucocytes, or white blood cells, than the chicks in a control group. The rich mineral content of both seeds, especially their high iron, copper, and zinc content, which are crucial cofactors in hemoglobin synthesis and erythrocyte maturation, is probably the reason for the experimental group's significantly higher total erythrocyte count when compared to the control group (Braide *et al.*, 2012; Eke *et al.*, 2021). Pumpkin seeds supply zinc, which is necessary for erythrocyte membrane stability and maturation, while watermelon seeds include significant amounts of iron (13.68 ppm) and copper that promote heme production (Lin *et al.*, 2024). This result is in line with Jimoh *et al.* (2018), who found that adding watermelon juice to heat-stressed broilers improved their hematological indices. They attributed this improvement to the fruit's high mineral and antioxidant content.

The most notable finding was perhaps the significant rise in total leukocyte count in supplemented groups, especially T4 and T2, when compared to controls ($P = 0.0001$). It strongly implies that birds fed diets enriched with seeds have better immunocompetence and illness resistance. Cucurbitacins, flavonoids, and phenolic compounds that increase leukocyte generation and activity are among the several phytochemical components of Cucurbitaceae seeds that have been linked to their immunomodulatory qualities (Godwin *et al.*, 2015; Alka *et al.*, 2018). In particular, the cucurbitacins and glycosides found in watermelon seeds have been shown to have immunostimulatory properties that stimulate lymphocyte proliferation and macrophage activity (Sola *et al.*, 2019), which explains the significant leukocytosis seen in birds that were supplemented. According to recent studies, phytochemical substances that contain

phenolic acids and flavonoids improve poultry immune cell proliferation and phagocytic activity (Aminullah *et al.*, 2025). Together, these hematological improvements show that supplementing with watermelon and pumpkin seeds and their mixture improved immune function and oxygen transport capacity without causing pathological changes, as shown by the lack of aberrant clinical signs during the trial. The increased feed efficiency shown during the finisher phase, when metabolic and immunological demands are at their maximum, was probably caused by these physiological improvements. According to Khan *et al.* (2012), plant bioactive chemicals also improve hematological indices and immunity.

Higher packed cell volume (PCV), hemoglobin (Hb), total erythrocyte count (TEC), and total leukocyte count (TLC) are among the improved hematological markers seen in the supplemented groups (T2, T3, and T4), which point to improved immunological and physiological health. Specifically, higher leukocyte counts are linked to better immunological reactivity, which can lessen vulnerability to infectious diseases and, as a result, lower death rates (Windisch *et al.*, 2008). Rich in bioactive components, antioxidants, and vital minerals, plant-based feed additions like watermelon and pumpkin seeds can improve poultry health and immunity (Hashemi and Davoodi, 2011).

The improved haematological profile observed in birds fed with watermelon seeds may be directly related to the rich mineral content of watermelon seeds, particularly iron, magnesium, phosphorus, and zinc. The production of erythrocytes, the synthesis of hemoglobin, and the maintenance of normal physiological functions all depend on these minerals. According to Mabalaha *et al.* (2007), watermelon seeds are nutrient-dense oilseeds with notable mineral concentrations that support animals' metabolic and hematological functions.

Watermelon seeds' inherent antioxidants may also protect blood cells from oxidative stress and membrane damage. Reduced blood quality and erythrocyte breakdown in chicken production systems are mostly caused by oxidative stress. Perkins-Veazie *et al.* (2019) state that the antioxidant activity of watermelon seeds may therefore aid in maintaining red blood cell integrity and increasing hemoglobin concentration. The increased white blood cell counts in the supplemented groups may indicate a better immune response related to the phytochemicals in watermelon seeds. Watermelon seeds include antimicrobial and anti-inflammatory

compounds that may strengthen immunity and promote resistance to disease (Braide *et al.*, 2012). Improved immunological competency is especially important in intensive grill production systems where birds are exposed to various environmental and pathogenic challenges.

5.5. Economic Evaluation

Pumpkin seeds supplementation (T3) had the highest economic returns, according to partial budget analysis, with a net income of 410.95 birr/bird as opposed to 342.33 birr/bird for the control group, a difference of 68.62 birr/bird, or a 16.7% gain. The combination of lower feed costs and higher marketable weight led to this higher profitability. Additionally, the combination treatment (T4) showed positive economic returns (553.21 birr/bird), with its numerically enhanced FCR during the finisher phase accounting for the largest feed cost decrease. The MRRs for T3 and T4 were 9.41 and 3.09, respectively, indicating that each additional Birr invested resulted in a benefit of 9.41 and 3.09 Birr. As a result, treatments T3 and T4 are financially feasible and should be recommended for use.

These financial advantages are consistent with the idea of functional feeding, in which natural additives enhance production efficiency through bioactive effects on metabolism, digestion, and health status in addition to their nutritional contribution (Hayajneh, 2019). T3's economic viability for commercial broiler production is confirmed by its positive marginal rate of return (9.41), which shows that every additional birr invested in pumpkin seeds supplementation produced 9.41 birr in greater net income. These results corroborate the suggestions made by Thirumalaisamy *et al.* (2016) and Phillips *et al.* (2023) regarding economical feeding techniques that make use of locally accessible plant materials to increase poultry profitability while lowering reliance on synthetic growth promoters, especially in areas where these seeds are agricultural byproducts with low acquisition costs. It is important to exercise caution when interpreting the negative marginal rates of return that were seen for some treatments because they were caused by lower variable costs rather than decreased profitability. This is because using locally available seeds resources that would otherwise be waste streams from fruit processing industries can save money.

The study's findings show that watermelon and pumpkin seeds, especially pumpkin seeds alone, can be utilized as safe, economical, and natural feed additives in the production of broilers. Improvements in feed efficiency, carcass characteristics, hematological parameters, and economic returns demonstrate their potential advantages even though growth performance was not much impacted. These results are especially significant given the growing limitations on the use of antibiotics in animal husbandry because of worries about antimicrobial resistance (World Health Organization, 2017). This study confirms that using watermelon and pumpkin seeds as phytogetic feed additions offers a viable substitute that improves animal production and health without sacrificing food safety.

The increased economic return observed in treatments supplemented with watermelon seeds may be due to the extremely low cost and local availability of watermelon seeds compared to commercial feed additives. Watermelon seeds are often discarded as agricultural waste in many poor countries, despite their high nutritional value. As a result, incorporating these by-products into poultry diets can improve economic efficiency and reduce feed costs. According to Zia *et al.* (2021), watermelon processing by-products have substantial industrial and nutritional value and can be utilized as sustainable feed sources in livestock production systems. Additionally, using watermelon seeds in chicken feed encourages environmentally sustainable production by reducing the buildup of agro-industrial waste. Circular agricultural systems are increasingly encouraging the sustainable use of agricultural wastes in order to minimize environmental harm and maximize resource efficiency (Mirabella *et al.*, 2014). Therefore, incorporating watermelon seeds into the meals of chickens boosts production efficiency while also cutting waste and encouraging environmental sustainability.

6. CONCLUSION AND RECOMMENDATIONS

This study assessed how broiler chicken performance, carcass characteristics, hematological indices, mortality, and economic returns were affected by nutritional supplementation of watermelon seeds (*Citrullus lanatus*), pumpkin seeds (*Cucurbita maxima*), and their combination. The findings demonstrated that adding these seeds additions at a rate of 1% had no discernible impact on feed intake or overall growth performance, suggesting good

palatability and no negative impacts on nutrient utilization. Growth responses, however, differed depending on the stage of production; the mixed group saw a brief decrease in weight gain during the grower phase, which was followed by an increase in feed conversion ratio during the finisher phase. These results point to a phase-dependent response to the dietary interventions. Supplementing with pumpkin seeds greatly enhanced carcass attributes, especially slaughter weight, dressed carcass weight, and breast muscle yield, demonstrating its beneficial effect on improving muscle deposition. Additionally, the supplemented groups' hematological indicators showed a considerable improvement, indicating improved immunological state and oxygen-carrying capacity. The additives' safety was confirmed by the fact that mortality stayed low and was unaffected by dietary interventions. Due primarily to increased feed efficiency and ultimate body weight, economic analysis showed that supplementing with pumpkin seeds had the highest net return, followed by the combination diet. In conclusion, watermelon and pumpkin seeds—especially pumpkin seeds—can be used as natural, affordable feed additions in broiler production to enhance carcass quality, health status, and profitability without sacrificing growth performance.

Recommendations

- To increase carcass yield and financial returns, broiler diets should contain 1% pumpkin seeds (*Cucurbita maxima*).
- To increase feed efficiency, a combination of pumpkin and watermelon seeds (*Citrullus lanatus*) can be employed in the finisher stage.
- To find the ideal inclusion levels and long-term effects, more research is required.
- Local seeds resources should be used by farmers as affordable feed additives.

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8. APPENDICES

Annex 1: The procedures of blood hemoglobin determination.

1. Take 0.1N HCl (1%) into central graduated tube up to mark
2. Suck the blood exactly up to mark 20 (20 μ l) with the help of sahlis pipette
3. Transfer the blood from pipette to central graduated tube of the hemometer.
4. Mix it well with the help of stirrer or rod and allow it to react for two minutes.
5. Make up with distilled water by adding drop by drop until the color matches with the Standard comparator tube and mix well.
6. When the color matches take out and record the values on the side as gm/100ml and or in percentage.
7. Repeat 5 to 6 times and take the average value

Annex 2: [The procedures of blood PCV determination](#) (Bancroft and Gamble, 2002; Ibrahim, 2013).

1. The blood is filled in to a micro hematocrit tube to (3/4th) and seals it with sealer.
2. Centrifuge the filled hematocrit tube in a hematocrit centrifuge at 12000 rpm for 4-5 Minutes.
3. Read the value (the tube) with hematocrit reader and record the result.

Appendix 3: Rearing the Chickens



Annex 3: Pictures that shows Watermelon and Pumpkin Seeds



Pumpkin Seeds



Watermelon seed

Annex 4: Pictures that shows slaughtering process and measuring carcass parts



Annex 5: picture that shows blood collection for hematological parameters



Annex 6: picture that shows prepared hubbard feed.

