EFFECTS OF FEEDING DRIED CAFETERIA FOOD LEFTOVER AS A PARTIAL REPLACEMENT OF MAIZE ON FEED INTAKE, GROWTH PERFORMANCE, AND CARCASS CHARACTERISTICS OF COBB-500 BROILER CHICKENS

MSc THESIS

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HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

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ADVISORS' APPROVAL SHEET

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This is to certify that the thesis entitled **"Effects of feeding dried cafeteria food leftover as a partial replacement of maize on feed intake, growth performance, and carcass characteristics of Cobb-500 broiler Chickens**" submitted in partial fulfillment of the requirements for the degree of Master of science with specialization in **Animal production** to the Graduate Program of the School of **Animal and Range Sciences**, and has been carried out by **Oliyad Gelan Buta** Id. No SGSK/224/09, under our supervision. Therefore we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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APROVAL SHEET 2

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DEDICATION

This thesis is dedicated to my beloved mother W/ro Beshentu Ijara who passed away when I joined Jimma University for my BSc study and my brother Mr. Taye Gelan for his proper guidance and financial support in the success of my life.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principle of scholarship in the preparation, data collection, data analysis and completion of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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LIST OF ABBREVIATION

AATVETC	Agarfa Agricultural Technical, Vocational and Education Training College
AOAC	Association of Official Analytical Chemists
CF	Crude Fiber
CFL	Cafeteria Food Leftover
CP	Crude Protein
CRD	Completely Randomized Design
CSA	Central Statistics Agency
DCFL	Dried Cafeteria Food Leftover
DM	Dry Mater
EE	Ether Extract
FAO	Food and Agricultural Organization of the United Nation
FCR	Feed Conversion Ratio
GDP	Gross Domestic Product
GLM	General Linear Model
HACCP	Hazard Analysis and Critical Control Points
ME	Metabolizable Energy
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
NRC	National Research Council
SAS	Statistical Analysis Systems
SBM	Soya bean Meal

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Effects of feeding dried cafeteria food leftover as a partial replacement of maize on feed intake, growth performance, and carcass characteristics of Cobb-500 broiler chickens

By

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Abstract

The current study was conducted to evaluate the effect of feeding dried cafeteria food leftover (DCFL) as a partial replacement of maize on feed intake, growth performance and carcass characteristics of Cobb-500 broiler chickens. The DCFL was mixed with other feed ingredients as a partial replacement of maize at 0% (Control diet, T1), 5% (T2), 10% (T3), and 15% (T4). After two weeks of brooding, one hundred sixty unsexed Cobb-500 broiler chickens were weighted and randomly allocated into four treatment diets in a completely randomized design with four replicates of 10 chickens each. The experiment lasted for 49 days exclusive of brooding period, during which feed intake and body weight were measured on daily and weekly basis, respectively. At the end of the feeding trial, two birds (one male and female) that had closely similar live weights to the rest of the birds were selected from each replicate and slaughtered to evaluate the carcass characteristics. The results indicated that the average daily feed intake (g/chicken) was 108, 109, 110, and 110 for those chickens fed on T1, T2, T3, and T4 diets, respectively. Chickens reared on control diet had the lowest final body weight (1790g) when compared to those of T2 (1834g), T3 (1867g) and T4 (1914g). Comparatively the better feed conversion ratio (kg feed/kg weight gain) was recorded with chickens fed on T4 (2.77) as compared to those chickens fed on T1 (2.93), T2 (2.89), and T3 diets (2.85) and differed ($p<0.05$) from each other. Male chickens had ($p<0.05$) higher values for all carcass components than females except for wings. Chickens fed with T4 had higher breast meat, thighs, drumsticks and keel bone meat values than those of T1. The highest values for thighs, and drumsticks were observed in chickens fed with T4 diet and differed ($p<0.05$) from those of T1, T2 and T3. The highest dressing percentage was observed in chickens reared in T4 (68.1%) followed by T3 (66.8%) and differed ($p<0.05$) from those fed with T2 (64.2%) and T1 (63.7%). From the present result, it can be concluded that DCFL can be included up to 15% in the broiler diets by replacing maize provided it is available in a continuous supply with large quantity.

Keywords: *cafeteria food leftover; carcass characteristics; Cobb-500 broiler chickens; feed intake; growth performance traits*

1. INTRODUCTION

Agriculture in Ethiopia is the foundation of the country's economy, where the sector contributes about 42% of GDP and between 80–85% of employment (MoFED, 2013). Livestock sector is an important and integral part of agriculture which contributes about 19% of the GDP, and 16–19% of the foreign exchange earnings of the country (MoA, 2012). In terms of number, Ethiopia has the largest livestock population in Africa. However, unlike crop production, there is considerable scope to improve production and productivity. Ethiopia's livestock population estimated as 60.39, 31.30, 32.74, 2.01, 8.86, 0.46, and 56.06 million heads of cattle, sheep, goats, horses, donkeys, mules, and chicken, respectively (CSA, 2018).

The rapid population growth, income rise and standard of living have increased the demand for animal proteins which are good sources of essential nutrients for human (FAO, 2010). The needed animal protein by the world's human population cannot be met from ruminant animals because of their high requirement for grazing land, high energy, cost of production and low reproductive efficiency. In order to meet the animal protein needs of the ever-growing human population in the short-term, efforts should be directed to the production of animals with short generation interval, high reproductive efficiency and early maturity such as poultry (Mahmood *et al*., 2005; FAO, 2012).

Poultry production has an important role in rural livelihoods due to quick turnover on investment, and a source of high biological protein value (Thomas *et al*., 2009). It also plays a major role in bridging the protein gap in developing countries where average daily consumption is far below recommended standards (Onyimonyi *et al*., 2009). Especially, broiler chicken production has an integral part to achieving sustainable and rapid production of high-quality protein to meet the increasing demand of the developing countries (Raji *et al*., 2014). It has been a common experience that with increased production of animal proteins, there is also increased demands for feeds, particularly for ingredients which have high protein and energy values. However, the world population is ever increasing, particularly in developing countries and increased the need for production of food crops leaving no hope of ever having surplus grains to compound economically viable poultry feeds. According to FAO, (2013) the production of cereals has been stepped up, but the prices are still high and not profitable for the poultry industry. A dynamic increment in cost of cereal grains and human competition impose a great challenge on economic viability and overall sustainability of the present poultry production system as well as limited accessibility of land to produce maize for poultry feed (Shapiro *et al*., 2015).

The high price and competition with human means there is a continuous demand for an alternative and locally available energy sources, which are cheap and nutritionally adequate to substitute conventional feeds used in poultry production. Therefore, non-conventional feeds could partly fill the gap in the feed supply, decrease competition for food between humans and animals, reduce feed cost, and contribute to self-sufficiency in nutrients from locally available feed sources (Umesh *et al.,* 2014).

The preliminary studies by (Negasa, 2015) have shown that for a good economic return in layer production is to take full advantages of local feed resources instead of using cereal grains. According to Farhat *et al*. (2001) and Enas (2018) ducks fed on partial food wastes had higher growth performance than those fed on the control diet. Therefore the use of by-products from food processing industrial and food waste such as cafeteria food leftover is an available opportunity to improve producers' economic returns.

Currently, the expansion of higher learning institutions and hotel services in Ethiopia could create a great opportunities to get a large volume of cafeteria food leftover for small scale poultry producers situated in those areas. It is also not common to buy or sell such by products as poultry feeds. However, if it is utilized effectively, cafeteria leftover could play a significant role as source of nutrients in the diets of broilers chickens. Dietary substitution of cafeteria food leftover at 10, 20 and 30% significantly improved the growth performance (body weight gain and feed conversion ratio) of broiler chickens and the best level was obtained at 10% (Saki et al., 2006). However, there is no adequate information on the feeding values of cafeteria food leftover as a partial replacement of cereal grains in the diets of broilers chickens in Ethiopia. Thus, this study was thus designed and carried out to fill the existing research gap with the following objectives:

General objective

To investigate the effects of feeding dried cafeteria food leftover as a partial replacement of maize on the performance of Cobb-500 Broiler Chickens.

Specific objectives

- to evaluate the effect of feeding different substitution levels of dried cafeteria food leftover on feed intake and growth performance of Cobb-500 Broiler chickens;
- to assess carcass characteristics of Cobb-500 Broiler chickens fed on different substitution levels of dried cafeteria food leftover for maize and
- to analyze partial cost-benefit analysis of dried cafeteria food leftover as a source of energy.

2. LITERATURE REVIEW

2.1. Poultry production systems in Ethiopia

The poultry sector in Ethiopia can be characterized into three major production systems depend on some selected parameters such as breed, flock size, housing, feeding, health, technology, and biosecurity. These are a large-scale commercial poultry production system, small-scale commercial poultry production system and, backyard poultry production system (Bush, 2006).

2.1.1. Large -scale commercial production system

According to FAO (2009) it is a highly intensive production system that involves, an average, greater or equal to 10,000 birds kept under indoor conditions and with a medium to high bio-security level. The existence of somehow better bio-security practices has reduced chicken mortality rates to merely 5% (Bush, 2006). This system heavily depends on imported exotic breeds that require intensive inputs such as feed, housing, health, and modern management system. This system is characterized by higher level of productivity where poultry production is entirely market-oriented to meet the large poultry demand in major cities with the main objective of production is to get better profit. In Ethiopia, Elfora, Ethio-chicks, Alema, and Genesis farms are the major large-scale poultry enterprises found in Debrezeit. Large-scale commercial poultry production systems are also characterized by large vertically integrated production units and use high-producing modern strains of birds. In these systems, feed is the most important variable cost component, accounts for 65 to 70% of production costs (FAO, 2013).

2.1.2. Small-scale commercial production system

Small scale commercial poultry production is the system between the two extremes of traditional and commercial production systems, which is characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security with small to medium-sized flocks (50 to 500 birds) meat and egg type breeds. The producers keep improved exotic breeds of chicken or their crosses with indigenous breeds. They usually provide housing structures made of local materials, purchase part of their feed, use vaccines and veterinary services whenever available and may even have minimal biosecurity systems in a place. Such systems are more prevalent in urban and peri-urban areas with output from these systems usually sold to nearby urban centers with varying degrees of marketing systems in a place (Nebiyu, 2016).

2.1.3. Traditional chicken production system

Traditional chicken production system is characterized by little or no inputs for housing, feeding (scavenging is the only source of diet) and health care with minimal level of biosecurity, high off-take rates and high mortality rate (FAO, 2008). The system does not involve investment beyond the cost of the foundation stock and handfuls of local grains. Mostly, indigenous chicken and some hybrids and exotic breeds may be kept under this production system (Dawit *et al*., 2008). Village chicken production is very cheap, but nutritional needs of the birds are difficult to meet. Flock productivity of this production system is low, compared to other production systems. This is due to sub-optimal management, lack of supplementary feeds, low genetic and disease (FAO, 2009).

2.2. Feed resources for chicken

The available feed resources in Ethiopia can be divided into two main categories as conventional and non-conventional feed resources. Conventional feed sources are those feeds which are commonly and traditionally used for chicken feed. Whereas, those non-conventional once are not commonly and traditionally used as chicken feeds (Younas and Yaqoob, 2005).

However, conventional feed resources in Ethiopia are facing a problem of competition with human foods. Anxiety on the alternative feed source's use is very likely to improve the price's increments of poultry feeds. While replacing alternative ingredients, equivalency of nutritional values, costs, and side effects on birds should be assessed and considered. Gradual replacement or substitution of one type of feed or ingredients with the other is always advised to the producers to adapting birds with such new feeds. The target of the replacement of ingredients is always not to affect the performances of birds (Mammo, 2012).

2.2.1. Conventional feed resources

2.2.1.1. Cereal grains

From cereal grains, maize is used in livestock diets worldwide. Maize is the most common cereal used in broiler diets as the main source of energy (Panda *et al*., 2010), and constitutes about 50-60% in most poultry diets (Ibitoye, 2012). There is a huge competition for it among humans, livestock, and industries because of its high energy contents (TMEn value of 3, 448 kcal/kg) (FAO, 2008), low fiber (22 g/kg) (Mehri *et al*., 2010), better palatability, presence of pigments and essential fatty acids (Panda *et al*., 2010). To identify the ideal alternative for maize, the main thing is about the environment as well as to secure a depth understanding about the chemical characteristics of alternative feeds available locally including their consequent effects on the performance of broiler chickens. This may result in a more sensible utilization of these ingredients which may reduce the demand for maize and eventually lower the prices of poultry feed ingredients.

2.2.2. Non-Conventional feed resources

Non-conventional feed resources are (NCFR) are feeds which are not usually common in markets and not traditional ingredients. NCFRs are recognized for being noncompetitive in terms of human consumption, very cheap to purchase/ collect, by- product or west product from Agriculture, farm made feeds and processing industries and are able to serve as farm waste management in enhancing good sanitation (Kedir, 2016).

2.2.2.1. Agro-industrial product and by-products

Wheat bran (WB) is one of the industrial by-products which are obtained by dry milling wheat (*Triticum aestivum* L.) into flour. It may be an economical and nutritional alternative for poultry feeding in many tropical countries (Mateos *et al.,* 2012). This feedstuff consists of the hard outer layer of the grains. It is mainly fiber and low in carbohydrates. Protein, minerals, oil, and fiber are mainly found in the outer layers of the grain, which is richer in these nutrients than the whole grain (Nelson *et al*., 2007). On a dry matter basis, wheat bran is made up of (14-19%) protein, (4-7%) minerals, (0.07- 0.2%) calcium and (0.9-1.3%) phosphorus. Its oil content (3-5%) is higher than that of the whole grain and has a CF between 7-14% DM.

Soybean meal is an important source of dietary protein and energy for poultry throughout the world. Gyamera (2010) reported that soybean meal substitution in poultry feed is low due to its high cost. The substitution level ranges from as low as 10 percent to 18 percent of the total ration for layers and 15 to 35 percent of feed formulation for broilers (Flake and Ashitey, 2008). The raw soybean seeds contain many natural anti-nutritional factors when fed to poultry, the most problematic being trypsin (protease) inhibitors. Trypsin inhibitors disrupt protein digestion, which results in decreased release of free amino acids. Their presence is characterized by compensatory hypertrophy of the pancreas due to stimulation of pancreatic secretions. However, the heat treatment done during processing for oil is usually enough to destroy trypsin inhibitors and other toxins such as lectins (Göhl, 2005). However, it should be noted that higher processing temperatures may lead to the loss of amino acids especially lysine through mallard reaction (Sundu *et al*., 2009).

2.2.2.2. Dried cafeteria food leftover as feed of Chickens

Food-waste in food service institutions can be broadly categorized as: Kitchen waste and Plate waste. Kitchen-wastes are referred-to as pre-consumer-waste whereas, plate waste is post-consumer food-waste or ‘table-scraps’ (Path, 2012). Depending on the product and the relevant local-regulation, food-waste can be fed directly to animals, either slightly (sterilized), or heavily (dehydrated) processed (FAO, 2013). Feeding food waste to animals has been an important aspect of livestock production and provides a competitive and beneficial alternative to the usual feed grain and protein sources. Not only do the livestock benefit from the nutrients received from the recycled food, but society benefits from the environmental advantages (Tesfaye, 2013). The use of kitchen wastes from institutions such as hospitals, schools or hotels, for livestock, would help to reduce feed cost and the increasingly important problematic question of environmental pollution. Using food-waste as livestock feed also has the potential to create revenue and jobs. Food-waste feeding to animals have been practiced, in the university (to a limited extent), where nearby farmers (mainly pig producers, and to a lesser degree, chicken and dog owners) use their transport, time, and their containers, to buy/collect, the food waste from the university cafeterias, on a daily basis. The protein, fat, carbohydrate, and mineral contents of food leftovers are adequate to use as feed resources for poultry and although its salinity content is relatively high. According to Asmamaw and Dinberu (2015) dried cafeteria leftover was found to be an alternative feed resource for small scale poultry farming in and around towns where the resource is abundantly available. Dried cafeteria food leftover has high metabolizable energy values and could be used as a supplemental feed or a feed ingredient for poultry (Negasa, 2015). The higher metabolizable value shows that the diet can be used as an energy source in the ration of chickens. Research conducted by different researcher demonstrated that a dehydrated cafeteria food leftover has variable nutrient contents.

The typical analyses (on dry matter basis) previously reported shows that, crude protein contents of 9 to 17.5%, fat of 2.35 to 13%, crude fiber of 1.33 to 3.6 %, and ash of 3.76 to 9.1%, (Tesfaye, 2013; Negasa, 2015; Asmamaw and Dinberu, 2015).

2.3. Nutrient requirements of broiler chickens

Broiler chickens are mainly bred for fast growth and slaughtered when they weight about 1.8 to 2.2 kg live mass, usually between 6 and 8 weeks of age (Musa *et al*., 2006). The overall objective for broiler chicken producers is to produce meat with leaner tissue and acceptable lipid content to meet modern consumer demands as per the Hazard Analysis and Critical Control Points (HACCP) approach (Weltzien, 2009). Therefore, to ensure fast growth rate and efficient feed conversion in broiler chickens, good management practices that involves effective disease prevention and control, flock maintenance under continuous illumination as well as provision of high quality feeds and water (fed ad libitum) are all necessary (Amakari and Owen, 2011). Amino acids, energy, water, vitamins, and minerals are the basic nutrients required by broiler chickens to ensure correct skeletal growth and muscle deposition. Nutrient intake of fast-growing broilers needs to be carefully controlled to prevent metabolic diseases such as ascites and leg weakness (Choct, 2012).

2.3.1. Energy

The term used for the assessment of energy for poultry is Metabolisable energy (ME). It refers to that portion of the feed which is available to the bird for the production of meat and the maintenance of vital functions and body temperature. Metabolizable energy (ME) concentration of 3,200 kcal/kg has been recommended for broiler chickens (NRC, 1994; Klasing, 2015). An absolute requirement for energy in terms of kilocalories per kilogram of diet cannot be stated because poultry adjust their feed intake to obtain their necessary daily requirement (NRC, 1994).

2.3.2. Protein

Proteins are polymers that are composed of an amino acid, which are linked together by peptide bonds. Proteins are broken down and hydrolyzed in the digestion into amino acids. Then, after absorption, the amino acids will be assembled and metabolized to form proteins that are used in the building of different body tissues (Aviagen, 2009). Dietary requirements of Sulfur AA (amino acid), methionine and cysteine, for broilers are higher than for any other meat-producing animal, due to their rapid growth, tissue deposition and their plumage being rich in these AA (Eriksson, 2010). The most important Sulfur AA is methionine, which cannot be synthesized by the chickens and is generally the first limiting AA. The level of the first limiting AA in the diet normally determines the utilization of the other essential AA (Blair, 2008). Achieving the correct levels of AA in the broiler diet is commonly accomplished by using high-quality protein sources such as solvent-extracted protein-rich meals from oilseeds, e.g. soya protein meal, and thereafter balancing the AA levels in the diet with synthetic AA like lysine, methionine and threonine. In this way, the diet can be optimized to include specific CP and AA levels.

2.3.3. Minerals and vitamins

The actual levels of macro minerals to be used in broiler diets will vary with the feed ingredients. Calcium in the broiler diets influences growth, feed efficiency, bone development, led health, nerve function, and the immune system. Therefore, calcium must be inadequate quantities and consistently to achieve optimum performance (Weltzien, 2009). Just like calcium, phosphorus is required in the correct form and quantity to optimize broiler performance. Thus, calcium: available phosphorus (2:1) is appropriate for broiler diets (Choct, 2012). Limestone is one source of minerals, which is rich in calcium (Dateh, 2013). Bone meal is also considered as a very good source of both calcium and phosphorus amongst others. Common salt can satisfy the birds' sodium and chloride requirements. However, trace mineral requirements are usually met by supplementation via the vitamin/mineral premix.

Vitamins are essential organic nutrients which are required in small amounts and it cannot be synthesized by the body. They are generally classified into fat-soluble vitamins (A, D, E, and K) and water-soluble vitamins (B-complex and vitamin C). Vitamin D for poultry is provided in the form of vitamin D3 and is essential for Ca and P metabolism. There is no Ca to P ratio that will promote optimal bone formation if vitamin D is deficient in the diet. It is a common practice to provide supplementary vit. D in poultry diets (Xiuhua Li *et al*., 2013).

2.4. Feed consumption and weight change in Broilers

Since feed represents the highest cost of producing poultry meat and eggs, data on feed consumption together with information on body weight and feed conversion ratio of individual flocks are important (Devi, 2016). Many factors have been reported to affect feed intake and performance of poultry. Smith (2001) reported that birds of broiler strains consume more feed than birds of egg laying strain. Dietary effects on feed intake have also been reported by Smith (2001) that, an increase in dietary energy concentration results in a decrease in feed intake. If the diet is deficient in one or more essential nutrients, appetite is depressed and this is associated with a decline in growth and reproductive performance (Smith, 2001; Cobb Management Guide, 2010). The intake of pelleted feed is greater than that of the same feed in the form of meal. NRC (1994) conveyed that feed intake decreases by about 1.5% for each rise of 1 °C above the thermo-neutral zone in poultry. Feeding diets containing low ME and increased concentrations of protein and amino acids has been reported to minimize the deleterious effect of heat on feed intake. The feed consumption and body weight are higher in the male than the female chicken (NRC, 1994; Devi, 2016). Light management program has also been reported to affect broiler performance (Cobb Management Guide, 2010).

2.5. Factors affecting nutrient utilization

Some factors that affect the nutrient utilization of broiler chickens are genetics, age, sex, gut microflora, and nutritional factors (mainly due to nutrient imbalance) (Tsigab, 2016). However, under the circumstance of this study, anti-nutritional factors and crude fiber are picked up and appraised as follows.

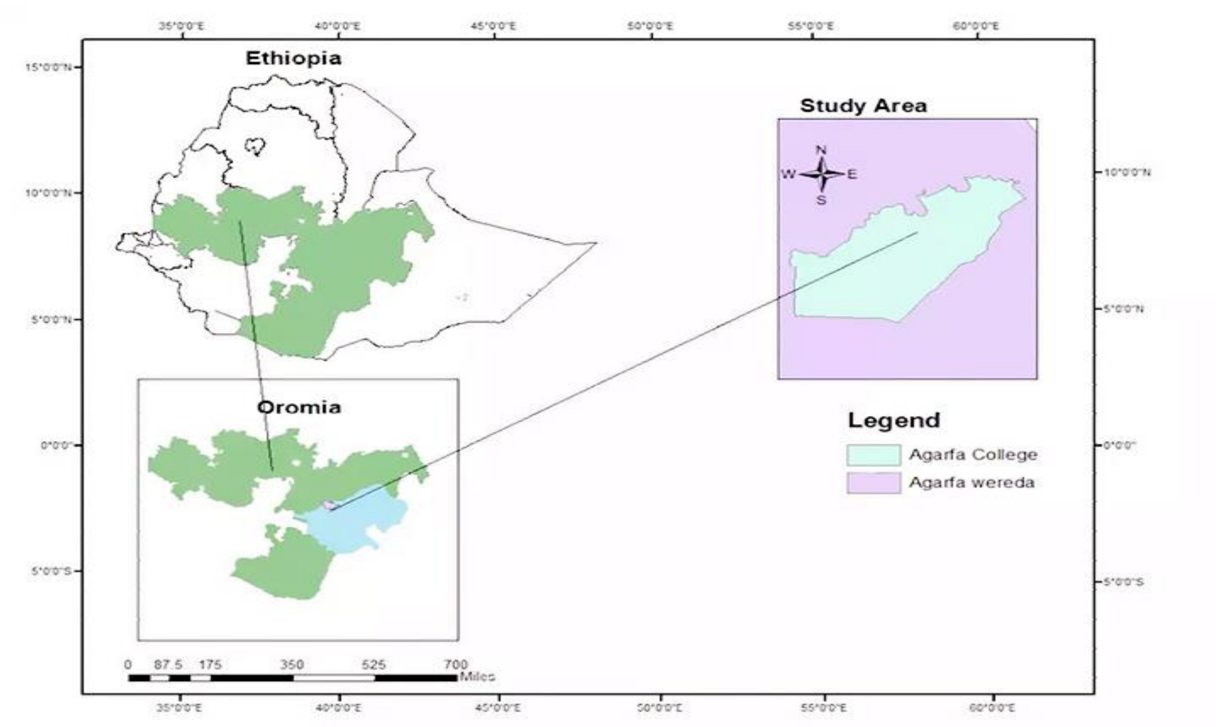
Anti-nutritional factors are naturally occurring compounds such as protease inhibitors, alkaloids, oxalates, and phytate that innate natural components of feed ingredients that can impair the availability of nutrients, depress feed intake, and reduce the growth of animals; predominantly monogastric animals (Shahidi, 1997; Ferket, 2006). They significantly depress the digestion of protein, energy, minerals, and vitamins in poultry and may reduce their absorption up to 20%. Other anti-nutritional factors in foods are produced as a result of fungal or microbial metabolism or by the plants themselves as defensive mechanisms against injury or infection (Ferket, 2006).

Crude fiber (CF) refers to the structural carbohydrates made of cellulose, hemicelluloses, and lignin in the plant cell wall while the composition of crude fiber in each single plant varies from other kinds of plants. Feeds containing high levels of CF are nutritionally poor in compounding poultry ration. In poultry diets, CF could be in a range of 3 to 4% for a greater period while it could be applied up to 7% for layers (Varastegani and Dahlan, 2014).

3. MATERIALS AND METHODS

3.1. Location and description of study area

The study was conducted at Agarfa Agricultural Technical and Vocational Educational Training (AATVET) College poultry farm, which is located in the Bale Zone of Oromia regional state, southeastern Ethiopia. Agarfa ATVET College is found at 458 km away from Addis Ababa in Agarfa district and situated at an altitude of 2330 meter above sea level at 39^{o} 49'E longitude and 7^{o} 17' N latitude. Its mean annual maximum and minimum temperatures of the area are 24.75 ^{o}C and 7.1 ^{o}C, respectively (Bale Robe Meteorological Station unpublished). The average annual rainfall in the study area is about 829.4 mm, based on meteorological data. The area has a short rainy and main rainy season. The farming systems around the study area are mainly mixed crop-livestock production systems. The common food crops grown are cereals such as; wheat, maize, and barley and cash crops like linseed and noug. The livestock raised in the study area are cattle, sheep, goats, equines, and poultry.



3.2. Dried cafeteria food leftover preparation

The cafeteria food leftover was collected from students' cafeteria of Agarfa ATVET College from January 1/2019 to February 30/2019 G.C. The major component of collected cafeteria food leftovers which encompasses Ejera, bread, stew (meat and shiro), rice, and past were sun-dried on plastic sheet for 2-3 days for reducing moisture and avoiding molding and the indigestible wastes such as bones were discarded. It was hand-stirred greater than five times a day to facilitate better drying and every evening it was put indoors to minimize the reabsorption of moisture. After drying of the amount required for the entire experiments, the dried leftover was milled using locally available materials (mortar and pestle), which is hereafter referred as dried cafeteria leftover (DCFL). The DCFL was mixed with other experimental feed ingredients and used as partial replacement of maize at different substitution levels.

3.3. Experimental rations formulation

The feed ingredients used in the formulation of the experimental rations contain DCFL, maize grains, wheat bran, soybean meal, lysine, methionine, salt, vitamin premix and limestone. Maize grain and salt were purchased from Robe local market and the maize grain was milled into a small size of around 5mm separately. Wheat bran was purchased from Robe Flour Mill Factory, soybean meal and limestone from Bishoftu Flour Mill Factory and vitamin premix, lysine, and methionine from Akaki Feed Processing plants in Addis Ababa. Finally, 4 treatment rations (as shown in Table 1) were formulated based on the result of the laboratory analytical data. The experimental rations were formulated by using Feed Win software. The control diet (T1) was containing maize as the main energy source DCFL and the remaining treatments contained DCFL at 5, 10, and 15% as shown in Table 1.

Table 1: The proportion of feed ingredients used in formulating the experimental rations

Ingredients (%)	T1	T2	T3	T4
Maize	54.0	49.0	44.0	39.0
Wheat bran	6.0	6.0	6.0	6.0
Soybean meal	35.0	35.0	35.0	35.0
Dried cafeteria food leftover	0.0	5.0	10.0	15.0
Limestone	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5
Methionine	1.5	1.5	1.5	1.5
Lysine	1.0	1.0	1.0	1.0
Total	100	100	100	100
Metabolizable energy (kcal/kg DM)*	3085	3120	3154	318
Crude protein (%)*	20.5	20.5	20.6	20.7

*Calculate values; According to NRC (1994) the standard daily requirements of energy in a ration of broilers chickens is 3,200 kcal ME/kg and that of crude protein 21% at starter and 20% for finisher phases.

3.4. Experimental design and treatment diets

The experiment was conducted using completely randomized design. After the purchased chickens were reared under brooder for two weeks, one hundred sixty (160) unsexed Cobb-500 broiler's chickens were divided into four treatment groups consisting of 40 birds per group. Each treatment group was further replicated 4 times with 10 birds per replicate as shown in Table 2.

Table 2: Levels of dried cafeteria food leftover as partial replacement for maize grain

Treatments	Proportions of DCFL	Replication	Chickens per replication	Total chickens per treatment
T1	0%DCFL	4	10	40
T2	5%DCFL	4	10	40
T3	10%DCFL	4	10	40
T4	15%DCFL	4	10	40

T= treatment; DCFL= dried cafeteria food leftover

3.5. Management of experimental Birds

Fourteen days, before the chickens arrived and actual experiment commenced, the pen were prepared by using a local available construction materials and standard wire mesh, cleaned and disinfected by using disinfectants and fumigated by using formaldehyde solution. The deep litter brooder house was covered with wood shavings at a depth of 4-5 cm. Each pen had a dimension of 1.5 × 2 m, which was designed to accommodate a minimum of ten chickens along with feeder and drinker. The watering and feeding troughs were cleaned and disinfected with appropriate disinfectants. A total of three hundred day-old unsexed Cobb-500 broiler chicks were purchased from Alema Private Limited Company, Debrezeit. All chickens were brooded using 200-watt infrared electric bulbs as sources of heat and the temperature was monitored with a thermometer. The temperature of the brooder pen was gradually reduced until the chicks have developed their feather to protect them from cold weather. The chicks were vaccinated against Newcastle (HB1 as day 7 through eye drop, Lasota at day 21 with drinking water) and Infectious Bursal Disease (Gumboro) at 14 and 28 days with drinking water. All vaccines were bought from National Veterinary Institute (Debrezeit, Ethiopia). The purchased chickens were reared under brooder for two weeks at an experimental site and placed on commercial starter rations and clean water was provided *ad libitum* during those two weeks for adaptation purpose.

At the end of the brooding period, one hundred sixty unsexed broiler chicks were individually weighted and blocked into four categories based on similarities in their body. Each chick from each block was then randomly allocated to each treatment diet to have uniform bodyweight distributions across treatment diets. Each pen was equipped with one feeder and one waterer to be used for every 10 chicks. The experimental feed was offered twice a day at 8:30 am and 5:30 pm throughout the entire period. The experimental period lasted 42 days exclusive of the brooding period.

3.6. Measurement for feed intake and growth performance

Feed was offered on daily basis twice a day in the morning and late afternoon. Feed refusal was collected the next day every morning before feed was offered. Feed intake was then calculated by the difference between the feed offered to the chickens and the refused feed. Finally, the total feed intake per chicken was determined by adding the daily feed intake. The chicks were weighed individually at the beginning of feeding trials and then on weekly basis up to the end of the experimental period. Total bodyweight gain was then calculated as the difference between the final and initial weight, while the average daily weight gains were computed by dividing the total weight gain by the number of the experimental days. Feed conversion ratio was calculated as the ratio between total feed inke (kg) and total body weight gain (kg) during the experimental period.

3.7. Carcass yield evaluation

At the end of the feeding trial, two birds (one male and female) that had closely similar live weight to the rest of the chicken were selected from each replicate. The birds were starved of feed for 12 hours, to make empty guts for minimizing the influence of digesta on live body weight at slaughter. The selected birds were weighted (taken as pre-slaughter weight) on digital balance and slaughtered manually to evaluate the carcass characteristics. The birds were slaughtered by severing jugular vein, allowed to bleed, de-feathered, and eviscerated manually. The dressed carcass weight was taken after defeathering and removal of feet, head and all the visceral organs (including giblets) while the skin is included. The eviscerated birds were dissected to the different parts of the carcass (skin, thighs and drumsticks, wings, breast region, neck, keel bone meat and thorax and backbone) and giblets (gizzard, heart and, liver). The dressed carcass, breast, thighs and drumsticks were weighed inclusive of bones. The dressing percentage was calculated from dressed carcass weight as a percentage of the slaughter weight.

3.8. Partial budget-analysis

Partial budget analysis was undertaken to estimate the economic profits of dried cafeteria food leftover as a partial replacement for maize at different substitution levels by using the Upton (1979) method. For the determination of the potential profits by Partial budget analysis, the only variable cost was the cost of experimental rations among the treatments. The cost of cafeteria food leftover which determined by the institute and other expense for preparing dried cafeteria food leftover were included in total variable cost of formulated rations by their substitution levels. The price of a day old broiler chickens were determined by the company. Variable cost does not consider costs that are common for all treatments, such as labor, housing, and veterinary service. The purchase prices of the experimental feeds and broilers chickens were recorded. In the analysis, the difference in purchase price and selling prices of broilers chicks in each treatment was considered as total return (TR). The net income (NI) was calculated by subtracting total variable cost (TVC) from total return. NI = TR-TVC

The change in net income (ΔNI) was calculated as the difference between the change in total return (ΔTR) and the change in total variable cost (ΔTVC):

$\Delta NI = \Delta TR - TVC$

The marginal rate of return (MRR) was estimated as the increase in net income (ΔNI) associated with each additional unit of expenditure (ΔTVC) and expressed in percentage.

$$MRR = \frac{\Delta NI}{\Delta TVC}$$

3.9. Chemical analysis of the experimental feed

The representative offered feed samples for all treatments were collected once per week and assembled by treatment type for the entire experimental period. After thorough mixing of the ground samples, per treatment, sub-samples were collected and dried in an oven at 60 ^{o}C for 48 hours. Both air-dried and oven-dried feed samples were finely ground to pass through 1 mm mesh size and stored in an airtight plastic bag. Then, the feed samples were taken to a laboratory for determination of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash contents using the method of AOAC, (2005). Nitrogen was determined according to the procedure of Kjeldahl and crude protein (CP) was calculated as N x 6.25. Nitrogen-Free Extract (NFE) represents the non-structural carbohydrates such as starches and sugars, and was determined using the following equation: %NFE = 100 – (%water + %CP + %CF + %Ash + %EE). Metabolizable energy (ME) of feed ingredients and experimental diets were calculated by indirect method according to Wiseman (1987) as follows: ME (kcal/kg DM) = 3951+54.4EE-88.7CF- 40.8Ash.

Chemical analyses of experimental feed samples for determination of DM, EE, CF and ash were done in nutrition laboratory of Hawassa University, while that the CP content was analyzed at SARI laboratory.

3.10. Statistical data analysis

The collected data of an experiment on daily feed intake, body weight gain and calculated feed conversion ratio were subjected to one-way ANOVA (SAS, 2012, ver. 9.4) by fitting the effect of treatment diets as independent variables However, data on carcass components were subjected to two-way ANOVA by fitting the effect of treatment diets and sex as independent variables. The difference among treatment means were compared by using Tukey's Studentized Range (HSD) Test. The following statistical models were used to analyze the data:

ANOVA Model 1 $Yij = \mu + Ti + Eij$, Where:

Yij = the observed j^{th} variables in the i^{th} treatment

μ = overall mean of the response variable

Ti = effect due to i^{th} treatment levels ($i = 1, 2, 3, 4$)

Eij = random residual error

ANOVA Model 2

$Y_{ijk} = \mu + Ti + Sj + E_{ijk}$, where:

Y_{ijk} = the observed k^{th} variables in the i^{th} treatment and j^{th} sex

μ = overall mean of the observed variable

Ti = effect due to i^{th} treatment levels ($i = 1, 2, 3, 4$)

Sj = effect due to j^{th} sex of chickens (j = male and female)

E_{ijk} = random residual error.

Since, the interaction effect of sex by treatment was insignificant, it was omitted from the statistical model.

4. RESULTS

4.1. Chemical composition of feed ingredients and experimental diets

The analyzed chemical composition, calculated ME and NFE values of feed ingredients in formulated ration and treatment diets are indicated in Table 3. The results indicated that dried cafeteria food leftover had higher CP and ME contents than the replaced maize. The T3 and T4 diets had higher CP content than the control diet while control diet has slightly higher ME than other treatment diets.

Table 3: Chemical composition of feed ingredients and experimental diets (% in DM basis)

Ingredients and treatment diets	DM	CP	EE	CF	Ash	NFE	ME (kcal/kg DM)
Feed ingredients							
Maize	91.5	8.93	5.65	4.97	1.58	70.3	3753
DCFL	92.3	16.1	3.02	2.16	2.55	68.4	3812
Soybean meal	94.2	40.6	7.01	8.82	5.62	32.2	3321
Wheat bran	89.7	15.0	2.51	7.26	3.89	61.1	3285
Starter ration	92.3	21.8	5.02	7.88	9.42	48.1	3141
Treatment diets							
T1	93.4	19.9	4.54	5.84	6.33	56.8	3422
T2	93.7	19.9	4.46	5.74	6.45	56.7	3405
T3	93.9	20.2	4.35	5.65	6.51	56.8	3404
T4	94.0	20.3	4.11	5.59	6.58	57.4	3401

DM = dry matter; CP = crude protein; EE = ether extract; CF = crude fiber; NFE = nitrogen-free extract; ME = metabolizable energy; DCFL = dried cafeteria food leftover

4.2. Average daily feed and nutrients intakes of experimental Chickens

The results of feeding different levels of DCFL on average daily feed, and nutrient intake of experimental chickens are presented in Table 4. Significance difference was observed in daily feed intake, crude protein intake (CPI), crude fiber intake (CFI), fat intake (EEI) and ash intake among treatment diets. Accordingly, chickens fed with treatments diets had a higher ($p<0.05$) daily feed intake than those of the control diet. The CP intake was higher ($p<0.05$) in chickens reared in T4 and T3 than those of T2 and T3. Chickens reared in T4 and T3 consumed lower ($p<0.05$) CF than those fed on T2 and T1. Similarly, the EEI was lowest in T4 and T3 and differed ($p<0.05$) from those of T2 and T1 diets. The highest ash intake was observed in chickens raised in T4, followed by T3, T2 and T1 & differed significantly from each (Table 4).

Table 4: Feed and nutrient (g/chicken/day) intakes of experimental birds

Nutrients	T1	T2	T3	T4	SEM	P- value
Feed intake	108^{b}	109^{a}	110^{a}	110^{a}	0.25	0.0001
Crude protein	21.2^{c}	21.8^{b}	22.2^{a}	22.4^{a}	0.11	<0.0001
Crude fiber	6.30^{a}	6.28^{a}	6.21^{b}	6.16^{b}	0.02	0.0001
Ether extract	4.90^{a}	4.88^{a}	4.78^{b}	4.53^{c}	0.03	<.0001
Ash	6.83^{d}	7.06^{c}	7.16^{b}	7.25^{a}	0.04	<.0001

$^{a-d}$ Means between treatments with different superscript letters are significant at $p<0.05$

SEM = standard error of the mean

4.3. Growth performance and feed conversion ratio of experimental chickens

The influence of feeding different levels of DCFL on growth performances and feed conversion ratio are presented in Table 5. The results showed that the final body weight and total body weight gain increased with increasing levels DCFL resulting in significant difference among treatment diets. The lowest FCR was observed in chickens fed with T4 followed by T3, T2 and T1 diets and differed significantly from each other (Table 5). The result also indicated that different substitution levels of DCFL did not show significance difference in mortality rate although the highest was observed in T2.

Table 5: Effects of substituting maize with various levels of dried cafeteria food leftover on body weight gain, feed conversion ratio and mortality rate in broiler chickens

Performance parameters	T1	T2	T3	T4	SEM	P-value
Initial body weight (g/bird)	244	244	245	244	0.10	0.6257
Final body weight (g/bird)	1790^{d}	1834^{c}	1867^{b}	1914^{a}	11.7	<.0001
Total weight gain (g/bird)	1547^{d}	1591^{c}	1623^{b}	1670^{a}	11.6	<.0001
Daily weight gain(g/bird)	36.8^{d}	37.9^{c}	38.7^{b}	39.8^{a}	0.28	<.0001
Total feed intake (g/bird)	4532^{b}	4596^{a}	4616^{a}	4627^{a}	10.7	0.0002
Feed conversion ratio (kg feed /kg gain)	2.93^{a}	2.89^{b}	2.85^{c}	2.77^{d}	0.02	<.0001
Mortality rate (%)	5.0	7.5	2.0	2.0	1.28	0.8427

$^{a-d}$ Means between treatments with different superscript letters are significant at $p<0.05$

SEM = standard error of the mean

4.4. Carcass characteristics of Cobb-500 Broiler Chickens

The results showed that there was a significant difference in slaughter and dressed carcass weights among treatments (Table 6). Accordingly, chickens reared in T4 had higher ($p<0.05$) slaughter and dressed carcass weights than those fed on the other treatment diets. However, no significance difference was observed in slaughter weight among chickens fed with T1, T2 and T3 diets. Similarly, the observed dressed carcass weight was insignificant between T1 and T2.

The dressing percentage was similar in chickens fed on T3 and T4 diets but was higher (p<0.05) than that of T1 and T2, which had similar values. Chickens fed with T4 diet had higher (p<0.05) breast meat, thighs, drumsticks and keel bone meat than those of T1. The highest values for thighs, and drumsticks were observed in chickens fed with T4 diet and differed (p<0.05) from those of T1, T2 and T3. No significant difference was observed in skin and giblets among treatment diets. Findings further indicated that male chickens recorded (p<0.05) higher values for all carcass components than females except for wings.

Table 6: Effects of substituting maize with different levels of dried cafeteria food leftover on carcass characteristics in broiler chickens

Carcass traits (g)	Female	Male	T1	T2	T3	T4	SEM	P-value	
								Sex	Trt
Slaughter weight	1801	1888	1790^{b}	1834^{b}	1836^{b}	1918^{a}	41.86	<.0001	<.0001
Dressed carcass	1260	1353	1140^{c}	1177^{c}	1227^{b}	1308^{a}	28.25	<.0001	<.0001
Dressing %*	66.1	67.6	63.7^{b}	64.2^{b}	66.8^{a}	68.1^{a}	1.26	0.0017	<.0001
Breast meat	364	395	357^{c}	372^{bc}	387^{ab}	403^{a}	12.52	<.0001	<.0001
Thighs	193	202	188^{c}	194^{c}	202^{b}	208^{a}	4.21	<.0001	<.0001
Drumsticks	158	175	146^{c}	155^{c}	166^{b}	200^{a}	7.62	<.0001	<.0001
Keel bone meat	155	164	155^{b}	157^{ab}	161^{ab}	166^{a}	6.58	0.0010	0.0187
Backbone	91.0	103	85.9^{c}	100^{ab}	94.4^{bc}	109^{a}	7.83	0.0002	<.0001
Skin	91.6	95.6	91.7	92.2	94.3	96.3	3.97	0.0083	0.1097
Wings	68.5	69.6	67.9^{b}	68.6^{ab}	69.6^{ab}	70.2^{a}	1.52	0.0541	0.0321
Neck	47.7	50.8	49.0^{c}	38.5^{d}	53.6^{b}	56.0^{a}	1.06	<.0001	<.0001
Gizzard	38.8	41.0	38.4	40.8	38.5	41.8	2.51	0.0175	0.0325
Heart	13.5	14.4	13.3^{b}	14.1^{ab}	13.9^{ab}	14.6^{a}	0.99	0.0172	0.0757
Liver	36.4	40.9	37.0	37.9	38.8	41.0	4.34	0.0074	0.3067

$^{a-d}$ Means between treatments with different superscript letters are significant at p<0.0

*Exclusive of giblets; SEM = standard error of the mean; Trt = treatment diets

4.5. Partial cost-benefit analysis

The obtained results of economic profit presented in Table 7 suggest that there was a variation in total variable costs, total return, net income and marginal rate of returns with increased substitution levels of dried cafeteria food leftover. The result also indicates that broiler chickens reared with T4 has the lowest feed cost/ kg of slaughter weight (ETB) as compared to those chickens fed with T1, T2, and T3 diets. Chickens reared with control diet had the highest total variable cost while the lowest was recorded with chickens fed with T4 diet. The highest total return was observed with chickens reared with T4 diet as compared to chickens fed with T3, T2 and T1 diets. The observation also further suggests that broiler chickens reared with T4 had the lowest feed cost/ kg of slaughter weight (ETB) as compared to those chickens fed on T1, T2, and T3 diets.

Table 7: Partial cost-benefit analysis of dried cafeteria food leftover as a source of energy

Variables	T1	T2	T3	T4
Total feed consumption /treatment (kg)	182.1	183.8	184.3	184.4
Cost of feed consumed ETB /kg	17.6	17.1	16.8	16.6
Total variable cost (ETB)	3196	3150	3104	3058
Cost of day-old chickens (ETB)	1120	1120	1120	1120
No chickens reach market	38.0	38.0	39.0	40.0
Selling price / bird (ETB)	140	140	140	140
Selling price of Birds (ETB)	5320	5320	5460	5600
Total return (ETB)	4200	4200	4340	4480
Net income (NI) (ETB)	1004	1050	1236	1422
Change in total variable costs (ETB)	-	-46.0	-45.9	-46.0
Change in net income (ΔNI)	-	46.0	186	186
Marginal rate of return (MRR %)	-	100	405	404
Feed cost/ kg of slaughter weight(ETB)	44.6	42.9	42.3	39.9

ETB = Ethiopian Birr; kg = kilogram; g = gram

5. DISCUSSION

5.1. Chemical composition of feed ingredients and experimental diets

The present findings indicated that the analyzed CP content (16.1%) of DCFL was lower than the previous findings (17.5%) reported by Asmamaw and Dinberu (2015). It may be due to the variations in different constituents of prepared DCFL, methods of preparation, environment, and climate variation. The crude protein content of a studied DCFL was also lower than a normal required CP for the best growth performance of the broiler chickens per day at finisher phases. NRC (1994) reported that broiler's chickens at starter and finisher phases require 21% and 20 % CP in their feed intake/day, respectively. Rouhani (2015) also suggested that the best feed that generates the highest daily weight gain, and feed conversion for broiler chickens is a feed that contains 19% - 22% protein levels. Therefore, in broilers ration DCFL must be mixed with the feed ingredients which have high protein contents to increase the average daily CP intake per chicken. The obtained CF content of DCFL was lower than the one reported by Negasa, (2015) and in a recommended range by Melkamu (2013) who reported that the level of crude fiber in poultry-feeds must be kept below 7%. A crude fiber level above 7% affects the normal feed consumption resulting in reduced production performance of chicken (Varastegani and Dahlan, 2014). The ether extract (EE) content of DCFL in the recent study was higher than that of reported by Asmamaw and Dinberu, (2015). The metabolizable energy content of DCFL in the current experiment was lower than the value reported by Tesfaye *et al*., (2015) (3812 vs. 4029 kca/kg). The variation in CF, EE and ME contents could be due to the presence of different constituents of the prepared DCFL, methods of preparation, environment, and climate variation.

The obtained NFE content of maize grain was lower than (70.3 vs. 75.1%) that of reported by Lidetewold *et al*., (2016). The findings of the current study also showed that the higher CP content of an experimental diet was observed with T4 (21.3%) as compared to control diet

(19.9%). The ash contents of experimental diets slightly increased from T1 –T4 diets with increased substitution levels of DCLF. It may be due to the reason of DCFL which had higher ash content than the substituted maize grain. However, EE and CF contents of experimental rations decreased with increased substitution levels of DCFL due to the reason that maize grain had higher ether extract and crude fiber than dried cafeteria food leftover. The results further indicate that, the calculated ME was slightly lower in T4 than the control diet. However, it was higher than the recommended energy level (3,200 kcal/kg DM) for broiler chickens per day (NRC, 1994).

5.2. Average daily feed and nutrients intakes

Feed intake is one of the most important factors which influence the performance of broiler chickens. In the current study, substitution of maize grains with different levels of DCFL has resulted in no significant difference in daily feed intake among those chickens fed with T2, T3 and T4 diets. The absence of a significant difference in daily feed intake among groups fed with different levels of DCFL suggests that it could be included in broiler's chickens feed up to 15% without resulting in any adverse effect on the feed intake of chickens. A similar result was also reported by Kim *et al*. (2001) that increasing the swine manure and food leftover mixture in broilers' diet increased the feed intake. In another study, Tesfaye (2013) also found that the different levels of DCFL inclusion in concentrate mix did not affect pig's feed intake.

Chickens reared on T4 diet had higher CP intake as compared to those reared on T1 and T2 diets which justify that the intake of CP was increased with increasing substitution levels of DCFL across the treatments. The current results also indicated that broiler chickens reared on T1 and T2 diets had a similar EE and CF intakes and the lowest CF intake was observed in those chickens fed on T4 diet. The result further showed that chickens reared on T4 diet had higher ash intake than those of the control diet (T1). It may be due to the reason of DCFL, which had higher ash content than the substituted maize grain.

5. 3. Growth performance traits and feed conversion ratio

Growth performance is one of the main factors for determining the productivity of broiler chickens. The observation of the current study indicated that chickens fed on increased DCFL levels (T2 T3, and T4 diets) had higher final weight and average daily weight gain than those chickens reared on control diet without affecting their liveability. These results are consistent with those of Kuo-Lung *et al*. (2007) who found that the addition of 5% dehydrated food waste products to broiler's diets increased body weight gains up to 8 weeks of their age. This finding further showed that, chickens reared on diet containing a high level of DCFL (15%) as a substitution of maize grains had the highest body weight gain when compared to those chickens reared on T1, T2 and T3 diets. A similar study conducted by Farhat *et al*. (2001) and Enas (2018) revealed that ducks fed on partial food wastes had higher growth performance than those fed on the control diet. The result of further showed that there was an increasing trend in body weight gain of broiler chickens with an increased substitution level of DCFL among the treatments over the experimental period. This observation is in good agreement with that of Saki *et al*. (2006) who reported that dietary inclusion of kitchen waste at 10, 20 and 30% significantly improved the growth performance (body weight gain and feed conversion ratio) of broiler chickens and the best level was obtained at 10%. Similarly, Tesfaye (2013) reported an increasing trend in total body weight gain of pigs as the proportion of DCFL was increasing as a mixture in a conventional concentrate diet. On the other hand, Westendorf *et al*. (1998) reported that the inclusion of kitchen wastes in broiler diets resulted in decreased body weight through four weeks of age. Such different observations might be associated with the difference between constituents of dried cafeteria food leftover, methods of preparation and maize varieties used in the study.

In the current study, the body weight gain of an experimental chicken was also influenced by the nutrient content of treatment diets which is in line with the findings of Ravindran and Tancharoenrat (2014) who observed that an increase in energy level of diet's improved weight gain and feed conversion ratio. A similar observation was also reported by Tang *et al*. (2007) in which increased live body weight was obtained with the increased energy content in the dietary ration. This result is in good agreement with the previous reports by Loar *et al*. (2010) who found that broiler chicks' body weight gain was reduced at higher levels of crude fiber in the chickens' ration. The highest final body weight of experimental broiler chickens (1914 g) in the present study was lower than (2100 g) reported by FAO, (2003) at the end of six weeks of an experimental period. It may be due to the difference in nutrient contents of feed ingredients used in experimental ration, management, environmental and climate variation.

Hascik *et al*. (2010) reported that a low FCR (g feed/g gain) is a good indication of high-quality feed with least cost benefit for poultry producers. The finding of this study showed that chickens reared on T4 had comparatively a better feed conversion ratio (2.76) than those reared in T1, T2 and T3 diets. This result is in good agreement with the reports of FAO (2006). This observation is also comparable with the findings reported by Cho *et al*. (2004) and Kuo-Lung *et al*. (2007) who reported that the feed intake and FCR were increased linearly with increasing substitution levels of DCFL. However, Negasa (2015) reported no significant effect of substitution of maize by DCFL at 15, 30, 45 and 60%, on FCR on the performance of white leghorn chickens. This could be explained by the fact that white leghorn chickens are layer type breeds which could respond positively to high levels of such unconventional feed materials. Moreover, it may be due to the difference in nutrient contents of feed ingredients used in experimental ration, management, environmental and climate variation.

5.4. Carcass characteristics

The combined effect of the feed consumptions, feed conversion efficiency, and weight gain has a direct impact on the live weight, carcass weight and dressing percentage (Martinez *et al*., 2015). The result of the current study indicated that male chickens had higher slaughter and dressed carcass weight than female chickens. Tegene and Asrat (2010) reported that the difference was associated with higher feed conversion efficiency of male birds than female birds. The mean values of breast, thigh, and drumsticks were also recorded higher values in male chickens than female chickens. The observations are in good agreement with the finding of Bogosavljevic *et al*. (2006) and Rondelli *et al*. (2003) who reported that cocks had statistically bigger breasts and drumsticks yield than hens. The higher values of carcass traits observed in male chickens might be attributed to the presence of sex hormones (androgen) that enhanced muscle development more than the sex hormone (estrogen) in females which are mostly responsible for fat deposition rather than muscle tissue development (Aberra *et al*., 2018). The present result is further in good agreement with that of Raji *et al*. (2010) and Muñoz *et al*. (2018) who reported that the sex of the animal is a factor that affects performance, carcass characteristics and economic viability.

The finding of this thesis work is contrary with that of Kuo-Lung *et al*. (2007) who found that no significant difference in the dressing percentage, carcass weight, and relative weights of drumsticks, breast, and thigh between chickens fed with control diet and different substitution levels of DCFL. It may be due to the difference between constituents of dried cafeteria food leftover, and methods of preparation. For example, in the current study, DCFL had more CP and ME than the substituted maize grain. Marcu *et al*. (2013) suggested that higher energy and protein contents in the diet increased the weight of carcass, thigh, and breast yields. In the current study, the highest breast meat, drumsticks and thigh values were observed with chickens fed with DCFL at 15%, which suggests that replacement of maize with DCFL up to 15% level had positive effects on carcass traits. The weight of giblets (gizzard, liver, and heart) did not differ among treatment diets indicating DCFL did not have any negative effect on the normal function of these organs. This has been reflected to the levels of DCFL in which the weight of heart, gizzard, and liver increased with increasing levels of DCFL in the diets. These observations are in line with those of Cho *et al*., (2004), who reported that there was a linear increment in the weight of total edible offal without significant differences among chickens fed with all treatment with an increased level of dried cafeteria food leftover.

5.5. Partial cost benefit analysis

The economic analysis of an experimental broiler's chickens fed with different substitution levels of dried cafeteria food leftover was determined from the difference between total return and total production costs. As indicated in Table 7, the highest feed consumption and low feed cost/Kg were recorded with chickens fed T4 when compared to (T1, T2, and T3 diets). A similar result was presented by Cho *et al*. (2004) who reported that Feed cost per unit kg was decreased with increasing levels of DCFL in poultry diets. Richert (2001) and Tesfaye *et al*. (2015) also reported that dried cafeteria food leftovers could be used for the formulation of the least cost swine ration without adverse effect on the pig performance. Alabi *et al*. (2014) reported that the cost of poultry production is related to the cost of the feed.

The control diet (T1) had the lowest net profit (1003.8 Birr) as compared to (T2, T3, and T4 diets) which had 1049.8, 1235.7 and 1421.7 Birr net profits respectively. From the economic point of view there was progressive increment profit as the substitution levels DCFL was increased up to 15%. It had a good agreement with Cho *et al*. (2004) who found that in the viewpoint of economics, dried leftover food could be included at least more than 10% in a broiler diet for the starter period and up to 30% in broiler chicks' diet for the finisher period.

Asmamaw and Dinberu (2015) conveyed that, 33% replacement of conventional rations by non-conventional cafeteria leftovers with small inclusion of soy meal was found to be an economically feasible feeding strategy of broiler's chickens. Chickens receiving T4 had the highest marginal rate of return as compared to those chickens fed on T1 and T2 diets which defined that, there was an increment in the marginal rate of return with increased substitution levels of dried cafeteria food leftover

6. SUMMARY AND CONCLUSION

6.1. Summary

The study was conducted to assess the effect of feeding dried cafeteria food leftover as a partial replacement of maize on feed intake, growth performance and carcass characteristics of broiler's chickens. The prepared DCFL was mixed with other feed ingredients as a partial replacement of maize at 0%, 5%, 10%, and 15% in the experimental diets. Chicks were first reared in a brooder house for about two weeks. Then, one hundred, sixty (160) unsexed Cobb-500 broiler's chickens were divided into four treatment groups and assigned to the four treatments diets randomly. At the end of the feeding trial, two birds (one male and female) were selected from each replicate to evaluate the carcass characteristics.

Chickens fed with treatments diets had a higher ($p<0.05$) daily feed intake than those of the control diet. The crude protein intake was higher ($p<0.05$) in chickens reared in T4 and T3 than those of T2 and T3. Chickens reared in T4 and T3 consumed lower ($p<0.05$) crude fiber than those fed with T2 and T1 diets. Similarly, the fat intake was lowest in chickens fed with T4 and T3 and differed ($p<0.05$) from those of T2 and T1 diets. The highest ash intake was observed in chickens raised in T4, followed by T3, T2 and T1 and differed significantly from each other. The final body weight and total body weight gain increased with increasing levels DCFL resulting in significant difference among treatment diets. The lowest FCR was observed in chickens fed with T4 followed by T3, T2 and T1 diets and differed significantly from each other. The result further indicated that different substitution levels of DCFL did not cause mortality rate ($p>0.05$) although the highest was observed in T2.

Chickens reared in T4 diet had higher ($p<0.05$) slaughter and dressed carcass weights than those fed on the other treatment diets. However, no significance difference was observed in slaughter weight among chickens fed with T1, T2 and T3 diets. Similarly, the observed dressed carcass weight was insignificant between T1 and T2. The dressing percentage was similar in chickens fed on T3 and T4 diets though it was higher ($p<0.05$) than that of T1 and T2, which had similar values. Chickens fed with T4 diet had higher ($p<0.05$) breast meat, thighs, drumsticks and keel bone meat than those of T1. The highest thighs and drumsticks values were observed in chickens fed with T4 diet and differed significantly from those of T1, T2 and T3. No significant difference was observed in skin and giblets among treatment diets. Findings further indicated that male chickens recorded ($p<0.05$) higher values for all carcass components than females except for wings.

6.2. Conclusion

Based on the current study, it's possible to conclude that, substitution of dried cafeteria food leftover up to 15% in broilers diet had a positive effects on feed intake, growth performances and carcass characteristics. Therefore, the levels of substitution from 5-15% can be used as an alternative energy sources in broilers diets by substituting maize. However, based on partial budget analysis, the 15% substitution level of dried cafeteria food leftover (T4) in the diets of broiler chickens appeared to more profitable than other treatments.

Based on the above findings, the following sets of recommendations were forwarded:

- Small scale poultry producers can use DCFL, a good source of energy to substitute expensive maize or other energy rich ingredients.
- Among all substitution levels of DCFL, 15% is the best-recommended one to obtain good profits from broiler chickens production.
- Further investigation is needed to investigate the effect of DCFL on the performance of broilers chickens at higher substitution levels of maize meal.

7. REFERENCES

Aberra Melesse, Mengistu Masebo & Aster Abebe. 2018. The substitution Effect of Noug Seed (*Guizotia abyssinica*) Cake with Cassava Leaf (Manihot Escutulata C.) Meal on Feed Intake, Growth Performance, and Carcass Traits in Broiler Chickens. *Journal of Animal Husbandry and Dairy Science*, 2(2), 1-9.

Alabi, O., J. Atteh, & P. Ogunniyi. 2014. Effect of Dietary Inclusion of Rice Husk Supplemented with Commercial Enzymes on Performance, Nutrient Retention and Gastro-intestinal Tract Characteristics of Arbor Acres Broilers. *American Journal of Experimental Agriculture*, 4(5), 575.

Amakari, A. & O. Owen. 2011. Broiler chicken's growth rate in three different nocturnal lighting regimes. *African Journal of Food, Agriculture, Nutrition and Development*, 11 (5), 1-8.

Association of Official Analytical Chemists (AOAC). 2005. Official Methods of Analysis of the Official Analytical Chemists, 18th Edn. (Horwitz, W., Eds.).Washington DC.

Asmamaw Yinnesu and Dinberu Mamuye. 2015. Effect of Replacing Conventional Ration by Cafeteria leftover on Performance of Ross 308 Broiler Chicken. *International Journal of Life Sciences*, 4(4), 270–276.

Aviagen. 2009. Ross 308 broiler management guide: www.aviagen. Com

Ayssiwede, S.B., A. Dieng, H. M. Bello, C.A. Chrysostome, M. B. Hane & A.N. Mankor. 2011. Effects of Moringa oleifera (Lam) leaves meal incorporation in diets on growth performances, carcass characteristics and economics results of growing indigenous Senegal chickens. *Pakistan Journal of Nutrition*, 10 (12), 1132-1145.

Banson, K. E., G. Muthusamy & E. Kondo. 2015. The import substituted poultry industry; evidence from Ghana. *International Journal of Agriculture and Forestry*, 5(2), 166–175.

Blair, R. 2008. Nutrition and Feeding of Organic Poultry , CAB International, Wallingford, UK and Cambridge, MA, USA (2008) ISBN 978-1-84593-406-4 Hardback, 314 pp.

Bogosavljevic-Boskovic, S., V. Kurčubić, M.D. Petkovic & V. Radovic. 2006. The effect of sex and rearing system on carcass composition and cut yields of broiler chickens. In Czech Journal of Animal Science, 51(1), 31-38.

Bush, J. 2006. The Threat of Avian Flu Predicted Impacts on Rural Livelihoods in Southern Nation, Nationalities and Peoples Region (SNNPR), Ethiopia. The Food Economy Group, May 2006.

Cho, Y. M., G. W. Lee, J. S. Jang, I. S. Shin, K. H. Myung, K. S. Choi, I. H. Bae & C. J. Yang. 2004. Effects of Feeding Dried Leftover Food on Growth and Body Composition of Broiler Chicks. *Asian-Aust Journal Animal. Science*, 17(3), 386-393.

Choct, M. 2012. Poultry Cooperative Research Centre. Retrieved on 12 June, 2012, from http://www.poultryhub.org.

Central Statistics Agency (CSA). 2018. Agricultural sample survey. Livestock and livestock characteristic report (Private Peasant Holdings). April, Addis Ababa, Ethiopia 2, 1-83.

Cobb Management Guide. 2010. Cobb-500 broiler performance-nutrition supplement, Cobb vantress.com.http://www.cobb-vantress.com/docs/defaultsource/cobb-500guides/Cobb500 Broiler _Performance _And Nutrition _Supplement .pdf. (Accessed 30th October, 2015)

Dawit Alemu, Tamrat Degefe, F. Stotaw, S. Nzietcheung & D. Roy. 2008. Overview and background paper on Ethiopia's poultry sector. Relevance for HPAI Research in Ethiopia. www.h pai-research net. Accessed 06 April 2011.

Dateh, A. 2013. Modeling the feed mix for poultry production: the case of Adama musa farms, dormaa-ahenkro in the Brong Ahafo region of Ghana. MSc thesis, Kwame Nkrumah University of science and technology, Kumasi.

Devi, A. 2016. Effect of diet composition on the utilization of copra meal by finishing broiler chickens

Enas, A. 2018. Using dried leftover food as nontraditional feed for Muscovy duck diet. https://www.researchgate.net/publication/328477020

Eriksson, M. 2010. Protein Supply in Organic Broiler Production Using Fast-Growing Hybrids Welfare and Performance Aspects.

Food and Agriculture Organization of United Nation (FAO). 200). Good practices in planning and management of integrated commercial poultry production in South Asia, Rome, 2003.

Food and Agriculture Organization of United Nation (FAO). 2006. Evidence based policy for controlling HPAI in poultry: Biosecurity revisited, by Otte, J., Pfeiffer, D., Tiensin, t., Price, L. and Silbegeld, E. Pro-poor livestock policy initiative research report. Rome.

Food and Agriculture Organization of United Nation (FAO). 2008. An Analysis of the Poultry Sector in Ethiopia. Poultry Sector Country.

Food and Agriculture Organization of United Nation (FAO). 2009. The State of Food and Agriculture Livestock in Balance Rome, 2009.

Food and Agriculture Organization of United Nation (FAO). 2010. Agribusiness Handbook. Poultry meat and eggs. Rome, Italy 2010.

Food and Agriculture Organization of United Nation (FAO). 2012. Feed Resources Information System, Animal Health and Production Division, Rome. http://www.fao.org/ag/AGA/AGAP/FRG/afris/default.htm

Food and Agriculture Organization of United Nation (FAO). 2013. The State of Food Insecurity in the World the multiple dimensions of food security Rome, 2013.

Farhat, A., L. Normand, E.R. Chavez, & S.P. Touch burn, 2001. Comparison of growth performance, carcass yield and composition, and fatty acid profiles of Pekin and Muscovy ducklings fed diets based on food wastes. *Can. J. Anim. Sci*, 81 (2), 107-114.

Ferket P. 2006. Factors That Affect Feed Intake of Meat Birds. A Review (October 2006). https://doi.org/10.3923/ijps.2006.905.911

Flake, L & E. Ashitey. 2008. Ghana Poultry and Products. Voluntary Report – Public distribution.GH8006, United States Department of Agriculture (USDA) Foreign Agricultural Service, USDA.

Göhl, B. 2005. Tropical feeds. FAO Software Developed by Speedy A. & Waltham N, Version 8.

Gura, S. 2008. Industrial livestock production and its impact on smallholders in developing countries. Consultancy Report to the League for Pastoral Peoples and Endogenous Livestock Development, Germany, and pp: 65. http://www.pastoralpeoples.org/docs/gura_ind_livestock_prod. Pdf.

Gyamera, E. 2010. Palm Kernel Oil Residue (PKOR) as livestock feed in Ghana: A case study of four (4) districts in the Central Region (Unpublished master's thesis). University of Cape Coast, Cape Coast, Ghana.

Hascik, P, M. Kacaniova, M. Mihok, J. Pochop & E. Benczova. 2010. Performance of various broiler chicken hybrids fed with commercially produced feed mixtures. *International Journal of Poultry Science*, 9 (11), 1076–1082.

Ibitoye, S. 2012. Influence of Farm size, Educational status and Farm income on the Adoption of Maize Varieties in Kogi State, Nigeria. *American-Eurasian Journal of Sustainable Agriculture*, 4(1), 20-25.

Kedir Abdurrahman. 2016. Studies on poultry management practices, marketing system and effect of feeding fish meal on growth performance and carcass characteristics of

Koekoek Chickens in bora district, east Shoa zone MSc. Thesis studies on poultry management practices.

Kim, C. H., Y. H. Song, B. J. Chae & Y. C. Rhee. 2001. Effects of feeding extruded swine manure and food waste mixture diets on growth performance, body composition and feeding behavior of broilers. *J. Anim. Sci. Technol. Kor*. 43(1), 91-100.

Klasing, K. 2015. The Merck Veterinary Manual. Veterinary Professionals Nutrition and Management: Poultry Merck Sharp and Dohme Corporation. Kenilworth, N. J. USA. http://www.merckvetmanual.com/mvm/poultry/nutrition_and_management_poultry/

Kuo-Lung Ch., Ch. Hwang-Jen, Y. Ching-Ke, Y. Shanq-Huei, J. Horng-Der, & Y. Bi. 2007. Effect of Dietary Inclusion of Dehydrated Food Waste Products on Taiwan Native Chicken (Taishi No. 13). Asian-Aust. J. Anim. Sci, 20 (5), 754 – 760.

Leeson, S., J. Summers & L. Caston. 1993. Growth response of immature brown-egg strain pullet to varying nutrient density and lysine. J. Poult. Sci, 72, 1349-1358.

Lidetewold Tsega, Ajebu Nurfeta and Aster Abebe. 2016. Cactus (Opuntia Ficus Indica) Fruit Meal as a Partial Replacement of Maize in Broiler Ration, 7(1), 34–43.

Loar II, R., J. Mortitz, J. Donaldson, & A. Corzo. 2010. Effects of feeding distillers dried grains with soluble to broilers from 0 to 28 days post hatch on broiler performance, feed manufacturing efficiency, and selected intestinal characteristics. *J. Poult. Sci*, 89 (4) 2242- 2250.

Mahmood. S., S. Hassan, M. Ahmed, M. Ashraf, F. Alam & A. Muzaffar. 2005. Influence of feed withdrawal for different durations on performance of broilers in summer. *International Journal of Agriculture and Biology* 7(1), 975-978.

Mammo Mengesha. 2012. The Issue of Feed-Food Competition & Chicken Production for the Demands of Foods of Animal Origin. https://doi.org/10.3923/ajpsaj.2012.31.43

Martinez, Y., Y. Carrión, R. Rodríguez, M. Valdivié, C. Olmo, C. Betancur, G. Liu, N.A. Dhabi, & V. Duraipandiyan. 2015. Growth Performance, Organ Weights and Some Blood Parameters of Replacement Laying Pullets Fed with Increasing Levels of Wheat Bran. Revista Brasileira de Ciência Avícola, 17(3), 347-354.

Mateos, G., E. Jiménez-Moreno, M.P. Serrano, & R. Lázaro. 2012. Poultry response to high levels of dietary fiber sources varying in physical and chemical characteristics. *Journal Applied Poultry Research*; 21(10), 156-174.

Mehri, M., J. Pourreza & S. Sadeghi. 2010. Replacing maize with PM in laying hens ‘diets. Tropical Animal Health Production 42, 439–444. Retrieved on 20 April, 2012 from http://birjand.academia.edu.

Melkamu Bezabih. 2013. Carcass Characteristics of Rhode Island Red (RIR) Grower Chicks Feed on Different Levels of Dried Tomato Pomace (DTP). *Asian Journal of Poultry Science*, 7 (1), 27-33

Ministry of Agriculture (MoA). 2012. Performance assessment report on the growth and transformation agenda in the spheres of agriculture

Ministry of Finance and Economic Development (MoFED). 2013. Development and poverty in Ethiopia: 1995/96–2010/11. Addis Ababa, Ethiopia.

Muñoz, C., D. Herrera, S. Hube, J. Morales & E. Ungerfeld. 2018. Effects of dietary concentrate supplementation on enteric methane emissions and performance of late lactation dairy cows, 78, 429–437. https://doi.org/10.4067/S0718-58392018000300429

Musa, H., G. Chen, J. Cheng, B. Li, & D. Mekki. 2006. Study on carcass characteristics of chickens breeds raised under the intensive condition. *International Journal of poultry Science*, 5(6), 530-533.

Nebiyu Yemane. 2016. Assessment of Urban Poultry Production Practices in Addis Ababa with Emphasis on Egg Production, Product Marketing, Feed Quality and Waste Management. PhD Dissertation, Agricultural University, Bishoftu, Ethiopia 174p.

Negasa Tessema. 2015. The Effect of Feeding Graded Level of Dried Cafeteria Food Leftover on Egg Production and Quality of White Leghorn Chickens, 5(7), 93–105.

Nelson, F., G. Ameleke, A. Donkoh, & V. Lamptey. 2007. Use of locally available agro-industrial by-products (AIBPs) for egg production in the western region of Ghana. The results of an on-farm trial. In Proceedings of the Ghana Society of Animal Production Symposium, 15, 103-107.

National Research Council (NRC). 1994. Nutrient Requirements of Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC, USA.

Onyimonyi, A., A. Olabode & G. Okeke, 2009. Performance and economic characteristics of broilers fed varying dietary levels of Neem leaf meal (Azadirachta indica). *International Journal of Poultry Science*, 8(3), 256-259.

Panda, A.K., M. V. Raju, S.V. Rama, G. Lavanya, E.P. Reddy & G. Sunder. 2010. Replacement of normal maize with quality protein maize on performance, immune response and carcass characteristics of broiler chickens. *Journal of Animal Science*, 23(12), 1626-1631.

Path, L. 2012. How to Conduct a Food Waste Audit. [Online] Available: https://www.LeanPath.com (19 August, 2018).

Raji, A., J. Igwebuike & I Kwari. 2010. Regression models for estimating breast, thigh and fat weight and yield of broilers from non-invasive body measurements.

Raji, A., S. Mbap & J. Aliyu. 2014. Comparison of different models to describe growth of the Japanese quail (Coturnix japonica). *Trakia Journal of Sciences*, 12(2), 182–188.

Ravindran, V. & P. Tancharoenrat. 2014. Influence of tallow and calcium concentrations on the performance and energy and nutrient utilization in broiler starters. *Poult Sci* 93,1453–1462.

Rohaeni, E. 2015. The effects of the protein level from soybean meal and poultry meat meal on the growth of broiler chickens. Livest. Res. Rural Dev. Available at: http://www.lrrd.org/lrrd27/5/roha27084.html

Rondelli, S., O. Martinez & P. Garcia. 2003. Sex effect on productive parameters, carcass and body fat composition of two commercial broilers lines. Bras. Cienc. Avic, 5(3), 169-173.

Sadao, K. 2005. Dehydrated Kitchen Waste as a Feedstuff for Laying Hens. International *Journal of Poultry Science*, 4 (9), 689-694.

Saki, A., M. tabatabie, A. Ahamadi, S. Hossenin, S. Mirzayi & A. Kianin. 2006. Nutritive value, metabolizable energy and viscosity of kitchen-waste on broiler chicken performance. *Pakistan Journal of Biological Sciences,* 9(10), 1970-1974.

Statistical Analysis Systems (SAS). 2009. SAS/STAT User's Guide. Release 9.0 ed. SAS Institute Inc., Cary, NC.

Shahidi, F. 1997. Beneficial health effects and draw backs of anti-nutrients photo chemicals in food. American Chemical Society: Washington, DC, 1997.

Shapiro, B.I., G. Gebru, S. Desta, A. Negassa, K. Nigussie, G. Aboset & H. Mechal. 2015. Ethiopia livestock master plan. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Scheideler, S. 2009. Trace mineral improvements in egg quality. All tech 25th International Animal Health and Nutrition Symposium, Lexington, KY.

Smith, A. 2001. Poultry. CTA Tropical Agriculturalist Series. Technical Centre for Agricultural and Rural Co-operation. Macmillan, London, UK and Wageningen. The Netherlands, 242 pp.

Sundu, B., A. Kumar & J. Dingle. 2009. Feeding value of copra meal for Broilers. *World Poultry Science Journal*, 65, 481-491.

Tang, M., Q. Ma, X. Chen & C. Ji. 2007. Effects of dietary metabolizable energy and lysine on carcass characteristics and meat quality in Arbor Acres broilers. *Asian Aust. J. Anim. Sci*. 20, 1865-1873.

Tegene Negesse & Asrat. T. 2010. Effect of feeding different level of cooked and sun dried fish of offal on carcass trait of growing Rhode Island Red chicken .Tropical .Animal .Health Production, 42, 45-54.

Tesfaye Amene. 2013. The effects of different proportion of dried cafeteria leftover inclusion in a concentrate mix on performance of weaned piglets. MSc Thesis, Agricultural University, Haramaya, Ethiopia. 76pp.

Tesfaye Amene, Mangistu Urge & Mitiku Eshetu. 2015. Effects of Different Levels of Dried Cafeteria Leftover Feed on Nutrient Digestibility in Growing Castrated Male Pigs : Implication for Efficient Alternative Feed Resources Utilization, 3(1), 1–8.

Thomas, M., X. Diao & D. Roy. 2009. Impact of a potential avian flu outbreak in Ethiopia: A multimarket model analysis. Controlling Avian Flu and Protecting People's Livelihoods in Africa and Indonesia, HPAI Research Brief No. 13. http://www.ifpri.org/sites/default/files/publications mpairbl3.pdf.

Tsigab Nirayo. 2016. Effect of cowpea (vigna unguiculata) grain on growth performance and carcass characteristics of Cobb 500 broiler chickens. MSc thesis effect of cowpea on growth performance broilers chickens, Haramaya University, Haramaya, 76pp.

Umesh, S., K. Vishnu, B. Bisitha & K. Muneendra. 2014. Non-Conventional Feeds and Agro Industrial by Products: Their Scope and Future Demand for Livestock Production.

Upton, M. 1979. Farm Management in Africa, the Principal of Production and Planning, Oxford University Press, 380p.

Varastegani, S. & G. Dahlan. 2014. Influence of Dietary Fiber Levels on Feed Utilization and Growth Performance in Poultry Influence of Dietary Fiber Levels on Feed Utilization and Growth Performance in Poultry, *4*(6), 422–429.

Weltzien, M. 2009. Nutrition and management of the broiler for superior carcass quality. Retrieved on 22 August, 2011 from http://www.poultryindustrycouncil.ca/pdfs/factsheets/fs 134.pdf

Westendorf, M., Z. Dong & P. Schoknecht. 1998. Recycled cafeteria food waste as a feed for swine: Nutrient content, digestibility, growth and meat quality. *Anim. Sci.*, 76, 2976-2983.

Westendorf M. L. 2000. Food waste as swine feed. In Food Waste to Animal Feed. M. L. Westendorf (Ed.). p69. Iowa State Univ., Ames, IA.

Wiseman, J. 1987. Feeding of non-ruminant livestock. Butterworth and C. Ltd. 370 p.

Xiuhua, L., Z. Dagong, H. H. Kim, & L. B. Wayne. 2013. Available Phosphorus Requirement of Meat Chickens, 17, 66pp.

Younas Muhammed. & Muhammed Yaqoob. 2005. Feed resources of livestock in the Punjab, Pakistan. Livestock Res. Rural Dev, 17(2), 30-36.

8. APPENDICES

Appendix Table 1: Summary of ANOVA table on nutrients intake

AV. daily intake	**DF**	**SS**	**MS**	**F Value**	**Pr > F**
Feed intake/bird	3	12.272718	4.09090625	10.08	0.0001
CP intake /bird	3	2.68922500	0.89640833	53.60	<0.0001
CF intake /bird	3	0.05146875	0.01715625	10.55	0.0001
EE intake /bird	3	0.27016875	0.09005625	109.98	<.0001
Ash intake /bird	3	0.41976875	0.13992292	89.06	<.0001

Appendix Table 2: Summary ANOVA table on growth performances

Parameters	DF	Anova SS	Mean Square	F Value	Pr > F
IBW	3	0.732	0.244	0.75	0.6257
FBW	3	32510.265	10836.755	327.08	<.0001
TBW	3	32228.063	10742.688	357.10	<.0001
ADWG	3	18.29961875	6.0998729	363.09	<.0001
FCR	3	0.05791875	0.01930625	31.06	0.0002
Mortality rate%	3	87.5000000	14.5833333	0.43	<.0001

Appendix Table 3. Summary ANOVA table on carcass traits

Carcass traits (g)	df	Anova SS	Mean Square	F-value	P. Values	
					Sex	Trt
Slaughter weight	4	129059.3750	32264.8438	16.63	<.0001	<.0001
Dressed carcass	4	203242.2228	50810.5557	55.61	<.0001	<.0001
Dressing %*	4	123.2546250	30.8136563	16.20	0.0017	<.0001
Dressing %**	4	104.3187500	26.0796875	15.98	<.0001	<.0001
Breast muscles	4	17150.26375	4287.56594	25.22	<.0001	<.0001
Thigh	4	2531.497500	632.874375	27.66	<.0001	<.0001
Drum sticks	4	15699.28625	3924.82156	60.24	0.0010	0.0187
Keen bone	4	1156.196250	289.049063	6.90	0.0002	<.0001
Back bone	4	3467.762500	866.940625	14.43	0.0083	0.1097
Skin	4	233.226265	53.306522	3.45	0.0541	0.0321
Wing	4	33.39250000	8.34812500	3.90	<.0001	<.0001
Neck	4	106.8212500	26.7053125	3.47	0.0175	0.0325
Gizzard	4	106.5112500	26.6278125	3.92	0.0172	0.0757
heart	4	13.99125000	3.49781250	3.44	0.0074	0.3067
liver	4	232.9250000	58.2312500	3.30	<.0001	<.0001

Appendix figures 1. Figure of milling dried cafeteria food leftover by mortar and pestle, chickens transportation, chickens reared under brooder, weight measurement, de feathering and components of carcass

BIOGRAPHICAL SKETCH

Oliyad Gelan was born in 1990 G.C, at Kuyu District, North Shewa Zone Oromia Regional State, Ethiopia. He attended his elementary and Junior Secondary education at Chere Mikael and G/ Guracha No 3 elementary and Junior Secondary School, respectively. He completed his Secondary and High School education at G/Guracha Secondary High School from 2006 to 2009 G.C.

Then, he joined College of Agriculture at Jimma University in 2010/11 and graduated with a BSc degree in Animal Science in 2012/13 G.C. After graduation, he worked for the Ministry of Agriculture in Oromia Regional State, North Shewa Zone at Wuchale District. After having worked for about a year, he was employed by the Agarfa Agricultural Technical, Vocational and Education Training College, as B level instructor. In 2017, he joined the Graduate Program of Animal and Range Sciences at Hawassa University to pursue his MSc study specializing in Animal Production.