Journal of Animal Husbandry and Dairy Science
Volume 4, Issue 3, 2020, PP 21-30
ISSN 2637-5354

Significance of Cafeteria Food Leftover as Alternative Cheap Feed Resource in Poultry Nutrition by Alleviating its Pollution Effect on the Environment

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ABSTRACT

To combat undernutrtion in Sub-Sahara Africa, it is essential to maximize animal products by replacing expensive conventional feeds with those of cheap unconventional. The current study was conducted to evaluate the impact of feeding dried cafeteria food leftover (DCFL) as a partial replacement of the expensive maize on growth performances and carcass characteristics of broiler chickens. The DCFL was mixed with other feed ingredients as a replacement of maize at 0% (control diet, T1), 5% (T2), 10% (T3), and 15% (T4). After two weeks of brooding, one hundred sixty unsexed broiler chickens were randomly allocated into four treatment diets with four replicates of 10 chicks each. Feed consumption and body weight were measured on daily and weekly basis, respectively. At the end of the feeding trial, two birds (one male and female) were used to evaluate the carcass components. The daily feed consumption (g/chicken) was 108, 109, 110, and 110 for T1, T2, T3, and T4 diets, respectively. Chickens reared on control diet had the lower ($p<0.05$) final body weight (1790g) than those of T2 (1834g), T3 (1867g) and T4 (1914g) and differed ($p<0.05$) from each other. The lowest feed conversion ratio (kg feed/kg weight gain) was recorded with chickens fed on T4 (2.77) as compared to those reared 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 ($p<0.05$) breast meat, thighs, drumsticks, and keel bone meat values than those of T1. Chickens fed on T4 had higher ($p<0.05$) thighs, and drumsticks than those of T1, T2 and T3 diets. 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 of T2 (64.2%) and T1 (63.7%). In conclusion, the DCFL can be safely included up to 15% in the broiler diets by replacing maize grain in smallholder poultry settings for improved and sustainable food security of the poor community.

Keywords: *broiler chickens; cafeteria food leftover; carcass components; consumption; growth performances*

INTRODUCTION

Maternal and child undernutrition is a major challenge in Sub-Saharan Africa due to consumption of diets that are inadequate in nutrient quality and quantity. Recent studies conducted in Southern Ethiopia indicated that above 94% of the mothers did not fulfill the minimum diet diversity score year round resulting in birth of malnourished children (Tafese *et al.*, 2019). The same study reported that animal source food consumption was very low in dry season and almost absent in wet season due to limited supply of these products. In Southern Ethiopia, the national food consumption survey reported little contribution of meat (0.4%) and eggs (0.2%) to the women's diet as well as their share was reported to be low in children's diet (meat 1%, and eggs 1.1%) (EPHI, 2013).

The major staple foods in Ethiopia are maize, barely, sorghum, teff (*Eragrostis tef*), enset (*Ensete ventricosum*) or false banana, wheat and millet. These staple foods contain small quantities of low-quality protein due to lack of some essential amino acids like lysine, threonine, the sulphur containing amino acids (methionine and cysteine) and tryptophan. As a result, most of the people particularly mother and children in Ethiopia have been recurrently exposed to undernutrition. On the other hand, chicken meat and eggs are rich in these essential amino acids along with important vitamins and minerals (Aberra *et al.*, 2014). Consequently, these products can bridge the gap in providing high quality protein and other essential nutrients to the rural and urban communities.

Nearly all rural and peri-urban families in developing countries keep a small flock of free-range poultry. They can be raised in a wide range of environments with little investment. Nevertheless, the productivity of poultry in most tropical regions has been limited due to inaccessibility and White leghorn chickens. In another study conducted by Tesfaye *et al.* (2015) reported on suitability of dried cafeteria leftover feed on nutrient digestibility in growing castrated male pigs. However, there is no adequate information on the feeding values of cafeteria food leftover in the diets of broilers chickens in the country. Thus, the aim of this study was to investigate the significance of feeding dried cafeteria food leftover as a partial replacement of maize grain on growth performances and carcass components of broiler chickens.

Materials and Methods

Preparation of Feed Ingredients

The study was conducted at Agarfa Agricultural Technical Vocational and Education Training (AATVET) College's Poultry Farm, which is situated at an altitude of 2330 m above sea level. The feed ingredients used in the formulation of the experimental rations contain dried cafeteria food leftover, maize grains, wheat bran, soybean meal, lysine, methionine, salt, vitamin premix and limestone. The cafeteria food leftover was collected from students' cafeteria of AATVET College from January 1/2019 to February 30/2019. It was then spread on plastic sheet and sun-dried for about 3 days to reduce the moisture content. During the drying process, it was hand-stirred about five times a day to facilitate the drying process while every evening it was kept indoors. After completing the drying process, any hard materials and indigestible wastes such as bones were collected by hand and discarded. The dried leftover was then milled to produce the final leftover, which is hereafter referred as dried cafeteria leftover (DCFL). Maize grain was purchased from local market and milled. Wheat bran, soybean meal and limestone were purchased from a local Flour Milling Factory while vitamin premix, lysine, and methionine were obtained from local Feed Processing Plants. Finally, the experimental diets were formulated in a mash form by mixing all milled feed ingredients to meet the minimum nutrient requirements broiler chickens (NRC, 1994).

Experimental Design and Treatment Diets

A completely randomized design consisting of four treatment diets with four replicates was applied (Table 1). The control diet (T1) contained maize as the main energy source without DCFL and the remaining treatments were formulated to contain DCFL at 5, 10, and 15% representing treatment 2 (T2), treatment 3 (T3) and treatment four (T4, Table 1). Three hundred day-old unsexed Cobb-500 broiler chicks were purchased from Alema Private Limited Company (D/Zeit, Ethiopia). The chicks were initially kept in a brooder house during which they were provided with a commercial starter ration *ad libitum*. 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 weight. This blocking was essential to have a uniform bodyweight distribution across treatment diets. The individual chick from each block was then randomly allocated to four treatment diets in a completely randomized design. Each treatment diet was further replicated 4 times with 10 birds each.

Management of Experimental Birds

Before the arrival of the experimental animals, each pen of the deep litter housing was cleaned and fumigated using formaldehyde solution. The concrete floor was covered with wood shavings at a depth of 5 cm. Each pen had a dimension of 1.5 × 2 m, which was designed to accommodate a minimum of ten chickens along with feeders and drinkers. 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).

Table1. 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

Data Collection Procedures

Feed Intake and Body Weight

A measured amount of feed was offered twice a day at 8:30 am and late afternoon at 5:30 pm throughout the entire period. Feed refusal was collected the next day every morning before feed was offered. Feed intake was then calculated by difference between the feed offered and refused. Finally, the total feed intake per chicken was determined by adding the daily feed consumption.

The chicks were weighed individually at the beginning of the experiment 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 (kg feed/ kg gain) was calculated by dividing the total feed consumed (kg) with the total body weight gain (kg) during the experimental period. The experiment lasted 42 days exclusive of the brooding period.

Carcass Components

At the end of the feeding trial, two birds (one male and female) were randomly selected from each replicate and deprived food over night. In the next morning, the birds were weighted (taken as pre-slaughter weight) on digital balance and slaughtered by cutting the jugular vein and eviscerated manually. The weight of the dressed carcass was taken after removing all visceral organs and non-edible cuts. The dressed carcass was dissected to the different parts of the carcasses (skin, thighs and drumsticks, wings, breast region, neck, keel bone meat and thorax and backbone) and giblets (gizzard, heart and, liver). All carcass components were weighed inclusive of bones. The dressing percentage was calculated from dressed carcass weight as a percentage of the slaughter weight.

Nutrient Composition Analysis

Analyses of proximate nutrients were performed as outlined by AOAC (2005). Samples of feed ingredients were analyzed for dry matter (DM, method 950.46), ether extract (EE, method 920.39), crude fibre (CF, method 962.09) and ash (method 942.05). Nitrogen was determined according to the procedure of Kjeldahl and crude protein (CP) was calculated as N x 6.25. Nitrogen free extract (NFE) was determined by using the following equation: NFE = 100 – (%moisture + %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+54.4*EE-88.7*CF- 40.8*Ash.

Chemical analyses of experimental feed samples for determination of DM, EE, CF and ash were conducted at the Nutrition Laboratory of School of Animal and Range Sciences at Hawassa University, while the CP content was analyzed at the laboratory of Southern Agricultural Research Institute, Ethiopia. All samples were analyzed in duplicates and repeated when results from one of the duplicates is largely deviated from the other.

Statistical Analysis

For growth performances (final body weight, weight gain, feed intake, and feed conversion ratio), the replicate was the average of all broiler chickens in each pen. The data were then subjected to one-way ANOVA (SAS, 2012, ver. 9.4) by fitting the effect of treatment diets as independent variables. For carcass evaluation, the replicate was the average of two birds (female and male) per pen. Data on carcass components were then subjected to two-way ANOVA by fitting treatment diets, sex, and their interactions as main effects. Since the interaction effect for all variables was insignificant, it was dropped from the statistical model. When ANOVA declared significant, the mean differences among fixed effects was compared by using Tukey's Studentized Range (HSD) Test. Moreover, linear and quadratic regression analysis was conducted to graphically plot the trend of body weight gain and feed conversion ratio, respectively.

RESULTS

Nutrient Compositions of Experimental Diets

The analyzed nutrient compositions, calculated ME and NFE values of feed ingredients in formulated ration and treatment diets are presented in Table 2. The NFE represents the non-structural carbohydrates such as starches and sugars in a given feed ingredient. The content of NFE in DCFL was comparable to that of maize. The results indicated that DCFL 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.

Nutrient Intakes

The results of feeding different levels of DCFL on average daily feed and nutrient consumption are presented in Table 3. Significance difference was observed in intakes of daily feed, CP, CF, EE and ash 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 of T4 and T3 consumed lower ($p<0.05$) CF than those of T2 and T1. Similarly, the EE intake was lowest in T4 and T3 and differed ($p<0.05$) from those of T2 and T1. The highest ash intake was observed in chickens raised in T4, followed by T3, T2 and T1 and differed significantly from each (Table 3).

Table2. *Nutrient compositions 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

Table3. *Feed and nutrient intakes of chickens fed with experimental diets*

Intakes	T1	T2	T3	T4	SEM	P- value
Feed (g/chicken/day)	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 treatment diets with different superscript letters are significant at $p<0.05$ SEM = standard error of the mean*

Growth Performance and Feed Conversion Efficiency

The effect of feeding different levels of DCFL on growth performances and feed conversion ratio is presented in Table 4. The results showed that the final body weight and total body weight gain increased with increasing levels DCFL resulting in a significant difference among treatment diets. As indicated in Fig. 1, the daily weight gain of chickens linearly increased with increased substitution levels of maize with cafeteria food leftover. The lowest FCR was observed in chickens fed with T4 followed by T3, T2 and T1 diets and differed significantly from each other (Table 4). In addition, the FCR consistently reduced as more the maize grain was substituted with cafeteria food leftover (Fig. 2). The result further indicated that various substitution levels of DCFL did not show significance difference in mortality rate although the highest was observed in T2.

Table4. *Effects of substituting maize with different levels of dried cafeteria food leftover on body weight, feed intake, feed conversion ratio and mortality rate*

Parameters (kg/chicken)	T1	T2	T3	T4	SEM	P-value
Initial body weight	0.244	0.244	0.245	0.244	0.10	0.6257
Final body weight	1.790[d]	1.834[c]	1.867[b]	1.914[a]	11.7	<.0001
Weight gain	1.547[d]	1.591[c]	1.623[b]	1.670[a]	11.6	<.0001
Feed intake	4.532[b]	4.596[a]	4.616[a]	4.627[a]	10.7	0.0002
FCR (kg feed/ kg weight gain)	2.93[a]	2.89[b]	2.85[c]	2.77[d]	0.02	<.0001

[a-d]Means between treatment diets with different superscript letters are significant at $p<0.05$ FCR = feed conversion ratio; SEM = standard error of the mean

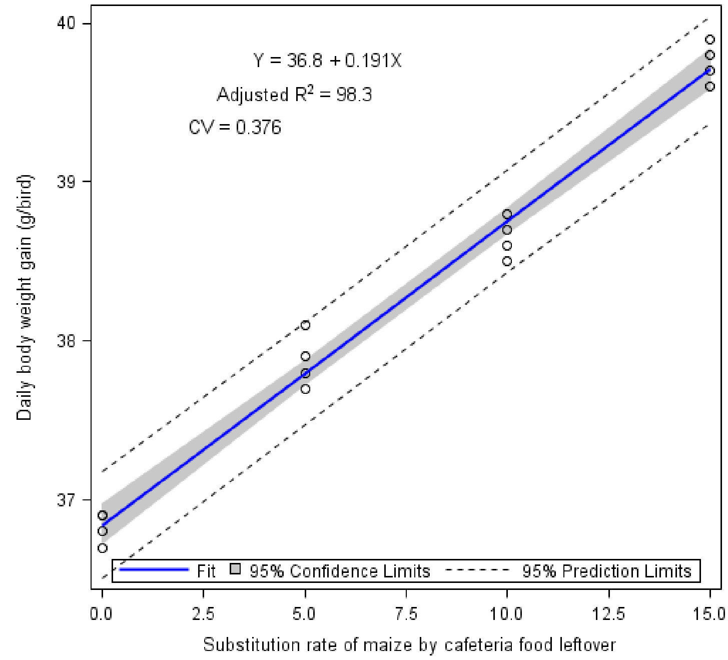

Figure1. *Response of daily body weight gain with increased substitution of maize with cafeteria food leftover*

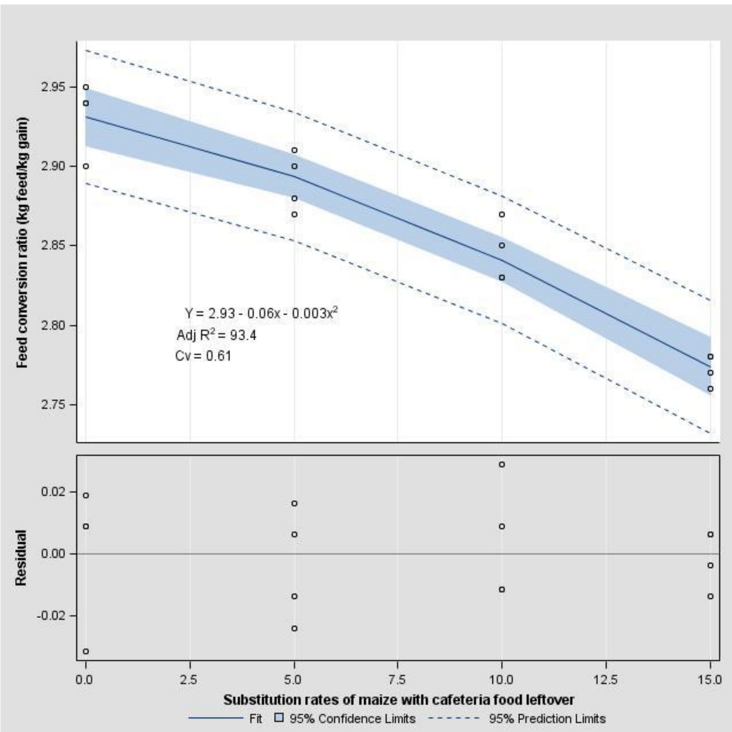

Figure2. *Trend of feed conversion ratio when maize is substituted with increased levels of cafeteria food leftover*

Carcass Components

The results showed that there was a significant difference in slaughter and dressed carcass weights among treatment diets (Table 5). 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, dressed carcass weight was insignificant between T1 and T2 diets. 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. Chickens fed with T4 diet had higher ($p<0.05$) breast meat, thighs, drumsticks and keel bone meat values than those of the control diet. 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.

Table5. *Effects of substituting maize with different levels of dried cafeteria food leftover on carcass components*

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}	41.9	<.0001	<.0001
Dressed carcass	1260	1353	1140^{c}	1177^{c}	1227^{b}	1308^{a}	28.3	<.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}	12.5	<.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	14.1	13.9	14.6	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 = treatments

Discussion

Nutrient Compositions

The present findings indicated that the analyzed CP content (16.1%) of DCFL was slightly lower than reported by Asmamaw and Dinberu (2015) and Enasa *et al.* (2018) (17.4-17.5%) while the EE content was higher than the findings of the same authors. Saki *et al.* (2006) reported 12.7% CP content in kitchen waste, which is lower than observed in the present study. Similarly, Tesfaye *et al.* (2015) reported much lower CP values (9.0%) for cafeteria food leftover. On the other hand, Tesfaye *et al.* (2015) and Enasa *et al.* (2018) reported higher EE and ash values in cafeteria and restaurant leftover foods, respectively than found in the current study. Such variations might be due to the type of leftover (kitchens, hotels/restaurants, or cafeteria) and the proportion of food components used to prepare the food by different catering services. The CP content of DCFL in the current study was lower than the recommended CP requirement (19-21%) of broiler chickens (NRC, 1994). It is therefore necessary that energy rich feed ingredients such as maize or DCFL must be mixed with the feed ingredients that have high protein contents to increase the average daily CP consumption of the birds. The ME content of DCFL in the present study is relatively higher than observed in the maize grain indicating its potential to be used as energy source feed by substituting the much expensive maize grain. Saki *et al.* (2006) and NRC (1994) respectively reported 3530 and 3380 kcal/kg ME for kitchen waste and waste leftover, which is lower than of DCFL in the present study. Such differences might be due to the composition of the original feed materials presented in both waste products.

Feed Intake and Growth Performances

Birds reared in treatments diets consumed significantly higher feed than those reared on the control diet, which is consistent with the results of Saki *et al.* (2006) who reported a significant increase of feed consumption in broiler chickens fed with 10% kitchen waste as compared with the other treatments. Moreover, consistent with current findings, Cho *et al.* (2004) reported significantly higher daily feed consumption at 20% level of dried leftover food than broilers fed with the control diet. Likewise, Kim *et al.* (2001) reported that higher levels of swine manure and food leftover mixture in layer hen's diet increased the feed consumption, which is in good agreement with the current observations. On the other hand, Tesfaye *et al.* (2015) and Enasa *et al.* (2018) found that the inclusion of different levels of cafeteria food leftover in pigs' diet and restaurant leftover food in duck's diet did not affect feed consumption. In another study, by Aberra (2020) reported that feeding grain milling by-products significantly reduced feed intake of White leghorn chickens. Such variations are expected because of using different animal species as well as chicken breeds that could respond differently to such leftover feed materials.

Chickens reared on T4 diet had higher CP consumption as compared to those of T1 and T2 diets, which justify that the consumption was improved with increasing substitution levels of DCFL.

This can be explained by the fact that the CP content in DCFL is much higher than that of maize grain, which would apparently result in increased consumption of CP. The current results also indicated that broiler chickens fed with T1 and T2 diets had a similar EE and CF intakes while the lowest CF consumption was observed in those fed on T4 diet. The result further showed that chickens fed on T4 diet had higher ash consumption than those of the control diet (T1).

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 weight gain than those reared on control diet. These results are consistent with those of Chen *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. The current findings further showed that chickens reared on diet containing a high level of DCFL (15%) as a substitution of maize grain had the highest body weight gain when compared to those chickens reared on T1, T2 and T3 diets. Farhat *et al.* (2001) and Enasa (2018) revealed that ducks fed on partial food wastes had higher growth performance than those fed on the control diet, which is in line with the current results. The findings also indicated that there is an increasing trend in body weight gain with an increased substitution level of cafeteria food leftover over the experimental period (Fig. 1). 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% improved the growth performance (body weight, weight gain and feed conversion ratio) of broiler chickens and the best level was obtained at 10% substitution level. Similarly, Tesfaye *et al.* (2015) reported an increasing trend in total body weight gain of pigs as the proportion of DCFL increased in a conventional concentrate mixture diet. On the other hand, Westendorf *et al.* (1998) reported that the inclusion of kitchen wastes in broiler diets resulted in decreased body weight. Such variations might be associated with the constituents of the food leftover, type of chicken breed and maize varieties used in the study.

Hascik *et al.* (2010) reported that a low FCR (kg feed/kg gain) is a good indication of high quality feed with least cost benefit for poultry producers. The finding of this study showed that chickens fed on T2, T3 and T4 diets had comparatively a reduced feed conversion ratio than those of the control diet. The best feed conversion ratio was recorded by the birds fed on diet containing 15% DCFL (T4) as compared with those fed on the diet. This observation is consistent with that of Enasa *et al.* (2018) who reported a reduced feed conversion ratio as the dried food leftover increased. This trend has been demonstrated in (Fig. 2) in which feed conversion ratio linearly reduced as the substitution level of maize grain with cafeteria food leftover increased. In contrary, Cho *et al.* (2004) and Chen *et al.* (2007) reported a significant increase of feed conversion ratio in layer and broiler chickens fed with diets containing dried leftover food as compared with the control group. On the other hand, Saki *et al.* (2006) and Tamasgen (2015) reported no significant effect of substitution of maize with leftover food on feed conversion ratio in the performance of White leghorn chickens. This could be explained by the fact that White leghorn chickens are layer type breeds with small body size, which could respond less to high levels of such unconventional feed materials. Moreover, it may be due to the difference in nutrient contents of feed ingredients used in the experimental ration, management, environmental and climate variations.

Carcass Characteristics

Chicken meat is an important protein source for consumers particularly to those whose daily food consumption is based on cereal grains. The combined effect of the feed consumptions, feed conversion ratio, and weight gain has a direct impact on the live weight, carcass weight and dressing percentage (Martinez *et al.*, 2015). The mean values of slaughter, dressed carcass, breast, thigh, and drumsticks were recorded higher values in male chickens than female chickens. The observations are in good agreement with the findings of Bogosavljevic *et al.* (2006) and Aberra *et al.* (2013) who reported that cocks had significantly larger breast and drumstick yields than hens. The higher values of carcass traits observed in male chickens might be attributed to the presence of sex hormones mainly that of androgen, which might be responsible for enhanced muscle development as compared with estrogen (the major sex hormone) that is mostly responsible for fat deposition rather than muscle tissue development (Aberra *et al.*, 2013).

In the current study, breast meat was significantly higher in T3 and T4 groups than other treatment diets which is in line with the findings of Saki *et al.* (2006) who reported that chickens fed with kitchen waste had significantly higher breast meat value than those of the control diet. In the current study, DCFL had more CP and ME values than the substituted maize grain. In this regard, Marcu *et al.* (2013) and Infante-Rodríguez *et al.* (2016) reported that higher energy and protein contents in the diet increased the weight of carcass, thigh, and breast yields. On the other hand, Chen *et al.* (2007) reported no significant difference in dressing percentage, carcass weight, and weights of drumsticks, breast, and thigh between chickens fed with control diet and different levels of dehydrated food wastes. Similarly, Enasa *et al.* (2018) reported the absence of significant effect of leftover food on carcass weights and dressing percentages of Muscovy duck. Such contradictory findings might be explained by the type of poultry species used in both experiments, in which the duck gastrointestinal tract might have a better ability to digest the relatively high fiber content of the leftover food as suggested by Chen *et al.* (2007).

The weight of giblets (gizzard, liver, and heart) did not differ among treatment diets, which is in good agreement with the results of Enasa *et al.* (2018) who reported non-significant effect of leftover food on the diet of Muscovy ducks. This observation may suggest that DCFL did not have any negative effect on the normal function of these vital organs. This has been further reflected to the levels of DCFL in which the weights of heart, gizzard, and liver increased with increased levels of DCFL in the diets. Moreover, Cho *et al.* (2004) reported an increase in the weight of total edible offal (which included giblets) without significant differences among chickens fed with an increased level of DCFL.

Conclusion

Based on the current study, it is possible to conclude that substitution of dried cafeteria food leftover up to 15% in broilers diet had a positive effect on growth performances and carcass components. Therefore, levels of substitution from 5% to 15% can be used as an alternative energy sources in broilers diets by substituting the expensive maize grain. However, considering the advantage of reducing high costs of maize grain, a substitution rate of 15% and perhaps higher could be justifiable under smallholder production settings for optimum exploitation of the resource. It should be noted that such practices are only recommended if there is a reliable supply of cafeteria food leftover in a given location. Authors suggest future works focusing on the comprehensive laboratory analysis of mineral (both macro and micro) and amino acid compositions of cafeteria food leftover.

Acknowledgements

Authors acknowledge the Nutrition Laboratory of School of Animal and range Sciences at Hawassa University for allowing us to conduct the chemical analysis. Moreover, the cooperation provided by the Southern Agricultural Research Institute (SARI) for the nitrogen analysis is highly appreciated. The first author is grateful to the Agarfa Agricultural Technical and Vocational Educational Training College for grating full study leave with all benefits.

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Citation: *Oliyad Gelan et al, "Significance of Cafeteria Food Leftover as Alternative Cheap Feed Resource in Poultry Nutrition by Alleviating its Pollution Effect on the Environment", Journal of Animal Husbandry and Dairy Science,4(3), 2020, pp. 21-30.*