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The Effect of Feeding Stinging Nettle (Urtica Simensis S.) Leaf Meal on Feed Intake, Growth Performance and Carcass Characteristics of Hubbard Broiler Chickens

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Abstract- The effect of dietary inclusion of stinging nettle leaf meal(SNLM) on growth and carcass parameters of growing Hubbard broiler chickens was investigated. The leaves were collected from KofoleWoreda and dried under shade to produce the leaf meal. Five iso-nitrogenous and iso-caloric grower diets, T1 (the control), T2, T3, T4 and T5 were formulated to contain 0, 3, 6, 9 and 12% of SNLM, respectively as a substitution for roasted soybean meal of T1. After 2 weeks of brooding period, 200 unsexed Hubbard chicks were weighed and randomly allocated to the dietary treatments with four replicates of 10 chickens each .At the beginning of the experiment, 10 chicks were selected and killed and put in plastic bags and kept in a deep freezer at -20°C until they were processed for whole body chemical analysis. Feeding and water supply were ad-libitum. The experiment lasted for 6 weeks, during which feed intake and body weight were measured on daily and weekly basis, respectively. Daily body weight gain (DBWG) and feed conversion ratio (FCR) were calculated. At the end of the experiment, two chickens (cockerel and pullet) per replicate of each treatment were randomly selected, fastened overnight, weighed and slaughtered for measurement of carcass parameters. Dry matter, crude protein, and calcium intakes were higher for T4 but crude fiber intake relatively higher for T5 ($p<0.01$). T3 was comparable to T5 for crude protein and calcium intakes but lower intake of T1 ($p<0.01$) for the same parameter. No significant difference was detected on ether extract, phosphorous and metabolizable energy intakes across treatment groups. Higher ($p<0.01$) DBWG and final body weight values were observed in chickens fed on T4 diet than the rest. Chicks reared in T1, T2 and T5 diets were similar in these parameters. Moreover, body weight difference was not observed between T1 and T5 or T2 and T3. Significantly ($p<0.001$) higher dressing percentage was obtained from chickens fed with T2, T3 and T4 diets. The values for liver and gizzard were not affected by the inclusion rates of SNLM. Chickens fed with SNLM had higher ($p<0.01$) crude protein retention than those fed on control diet. However, no significance ($p>0.05$) difference was observed in ether extract retention in all treatments. The results of the present study revealed that inclusion of stinging nettle leaf meal up to 9% inbroilerdiet could be an alternative feeding strategy by substituting soybean meal.

Keywords: stinging nettle leaf meal, hubbard broiler chicken, feed intake, growth, carcass.

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I. Introduction

Animal production in general and chicken production in particular plays an important socio-economic roles in developing countries (Alders, 2005). Nearly all rural and per-urban families in developing countries keep a small flock of free ranging chicken and approximately 80% of the chicken populations in Africa are reared in free scavenging systems (Branckaert and Gueye 1999; Riise *et al.*, 2005). According to Robert *et al.* (1992) and Sonaiya (2004), smallholder farming families, landless laborers and people with incomes below the poverty line are able to raise chicken with low inputs and harvest the benefits of eggs and meat via scavenging feed resources. In most African countries, the rural chicken population accounts for more than 60% of the total national chicken population (Sonaiya, 1990). The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world (Delgado *et al.,* 1999). However, most communities lack the required husbandry skills, training and opportunity to effectively improve their household chicken production (Mlozi *et al.,* 2003).

In Ethiopia, chicken are widespread and almost every rural family own indigenous chicken, which provide a valuable source of family protein and income (Halima, 2007; Aberra and Tegene, 2011). The total chicken population in the country is estimated at50.38 million (CSA, 2013). The majority (97%) of these chickens are maintained under a traditional system with little or no inputs for housing, feeding or health care. The most dominant chicken types reared in this system are local ecotypes, which show a large variation in body position, color, comb type and productivity (Halima, 2007; Negussie *et al.*, 2010; Aberra and Tegene, 2011). Despite their low productivity, the indigenous chickens are known to possess desirable characters such as thermo tolerant, resistant to some disease, good egg and meat flavor, hard eggshells high fertility and hatchability (Aberra *et al.*, 2005, 2013a).

The greater part of the feed for village chicken is obtained through scavenging, which includes the household cooking waste, cereal and cereal by-products, pulses, roots and tubers, oilseeds, shrubs, fruits and animal proteins (Tadelle, 1996; Zemene *et al.*, 2012). Poultry production plays a major role in bridging the protein gap in developing countries where average daily consumption is far below than recommended standards (Onyimonyi *et al.*, 2009).However, the productivity of poultry in the tropics has been limited by scarcity and consequent high prices of the conventional protein and energy sources.

Protein sources are especially limiting factors in poultry feed production in the tropics (Atawodi *et al.*, 2008; Sandip *et al.*, 2013). Hence, there is a need to search for locally available alternative sources of protein for use as feed supplement to poultry. One possible source of cheap protein to poultry is the leaf meal of some tropical legume plants and multipurpose trees (Iheukwumere *et al.*, 2008; Aberra *et al.*, 2013b). Leaf meals of various plants have been incorporated in the diets of poultry as a means of reducing the high cost of conventional protein sources (Demir *et al*, 2003; Aberra et al., 2013b). According to Fasuyi *et al.* (2005) leaf meals do not only serve as protein source but also provide some necessary vitamins, minerals and oxycaretenoids which cause yellow color of broiler skin, shank and egg yolk.

Among those locally available unconventional protein feed resources one of the most prominent member of feed resource is the stinging nettle (*Urticasimensis*) leaves, which is endemic to Ethiopia. Stinging nettle, also known as Samma in Amharic, is a perennial plant that is widely known for its unpleasant stinging hairs located under the stems and lower leaf surface. It is an erect non-branched, wild-growing nettle plant that grows in the highlands of Ethiopia especially found in the highlands of North & South Gondar, North & South Welo, North Shewa, and Wag Hamra. Leaves are oval and coarsely toothed. The whole plant is covered with stinging hairs. It can be distinguished from other species by smaller stipules and simply serrate leaf margins, and it is less robust. The plant grows all year round and therefore can be harvested whenever there is a need. The herb usually used as emergency famine food in northern Ethiopia specially around Gonder, Gojam and Oromia region around Kofole area of Arsi zone and in most highlands of Sidama Zone in southern region (Tsegaye, 2008).

Stinging nettle leaves are reported to be excellent and easily available source of protein as well as vitamins. The leaves contain on the average about 22% protein on DM basis (Cross, 2007). The CP content of *Urticasimensis* S. (Samma) endemic to Ethiopia ranged from 25.1 to 26.3% (Eskedar *et al.*, 2013). Amino acids in nettle leaf meal are nutritionally superior to those of alfalfa meal. It is rich in vitamins A, C, Fe, K, Mn and Ca (Radford *et al.*, 1988). This makes the leaves suitable for feeding monogastric animals such as chickens. In Ethiopia, few research works are available on stinging nettle and are limited to medicinal uses. There are only few literatures regarding the utilization of nettle leaves meal in chickens' diet and almost no information available in Ethiopian. This study was thus developed to bridge the gap with the following objectives.

- To assess the feed and nutrient intake of Hubbard broiler chicken in response to diets containing varying levels of stinging nettle leaf meal;
- To evaluate the feed utilization and growth performances of stinging nettle leaf meal in Hubbard broiler chickens.
- To assess the effect of feeding dried stinging nettle leaf meal on carcass characteristics of Hubbard broiler chickens.

II. Materials and Methods

a) The study site

The experiment was carried out at poultry farm of School of Animal and Range Sciences, Hawassa University College of agriculture, which is situated between 7^0 4' N latitude and 38^0 29' E longitudes and an altitude of 1694 m above sea level. Rainfall is bi-modal and ranges between 700 and 1200 mm annually. The mean minimum and maximum temperatures in the area are 13.5°C and 27.6°C, respectively (NMA-Hawassa Branch Directorate, 2012).

b) Stinging nettle (UrticaSimensis S.) leaf meal preparation

The leaf part of stinging nettle was used in the experiment as protein source. Nettle leaves were collected from Kofole area in Arsi Zone, which is located 23 km from the Shashemene (main town of the zone) and situated between 6^0 4' N latitude and $37^0$34' E longitude and at an altitude of 1220 m above sea level. After removing the twigs, the leaves were dried under the shade to prevent the loss of vitamins and other volatile nutrients. The leaves were covered with mosquito netting to help keep them clean and put on the plastic sheet while drying. Regular turning of leaves was done to prevent growth of molds. The dried leaves were then grounded using locally available materials (mortar and pestle) to produce stinging nettle leaf meal (SNLM). Then SNLM was then included in graded levels in other feed ingredients by substituting soybean meal to prepare the experimental diets fed to the chickens for an experimental period of 42 days.

c) Formulating experimental diets

The dietary ingredients used in this experiment were maize (white), soybean seed (roasted), wheat bran, nougcake (*Guizotiaabyssinica*), SNLM, lime stone and salt. The control diet (T1) contained roasted and grounded soybean meal as the main protein source without SNLM and rests of the diets contained SNLM at the levels of 3% (Treatment, T2), 6% (Treatment, T3), 9% (Treatment, T4) and 12% (Treatment, T5) to substitute the protein level from roasted soybean seed in the control diet (Table 1). All ingredients except the lime stone and SNLM were purchased from Hawassa town. White maize, raw soybean and Nougcake were purchased from the commercial market while wheat bran from Hawassa Flour Mill Industry. The soybean seed was roasted for 5 minutes (to deactivate trypsin inhibitor) prior to inclusion. All the feed ingredients were grounded at the feed processing machine of Hawassa University.

Table 1 : The proportion of feed ingredients (on % DM basis) of the experimental diets

Ingredients	T1	T2	T3	T4	T5
Maize	45	45	45	45	45
Soybean seed	30	27	24	21	18
Nougcake*	10	10	10	10	10
Wheat bran	13	13	13	13	13
Premix	0.5	0.5	0.5	0.5	0.5
Limestone	1.0	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5
SNLM	0	3.0	6.0	9.0	12
Total	100	100	100	100	100
Calculated values					
Crude protein	19.94	19.80	19.66	19.51	19.37
Crude fiber	7.95	8.1	8.25	8.4	8.55
ME (kcal/kg DM)	3202	3198	3192	3174	3165

*SNLM = Stinging nettle leaf meal; ME = metabolizable energy a) Limestone contains 35% Ca (Boushy& Van der Poel, 2000) b) Rear premix contents per kg: ash 655 g, crude protein 135 g, crude fat 2 g, crude fiber 9 g, lysine 90 g, methionine 20 g, threonine 5 g, Ca 100 g, Na 135 g, Chloride 230 g, Cu 3000 mg, Fe 4000 mg Mn 6000 mg, Zn 5000 mg, Co 20 mg, I 80 mg, Se 15 mg, vitamin A 1,000,000 if, vitamin D3 200,000 if, vitamin E 1500 mg (Pre-Mervo, Utrecht. Expvalk) *Guizotiaabyssinica.*

d) *Experimental design*

The feeding trial was a completely randomized design (CRD) consisting of five dietary treatments with four replications (Table 3). Ten unsexed chicks of Hubbard broiler chickens were randomly assigned to each of the four replicates of the five treatment diets.

Table 2 : Experimental design of the feeding trial with Hubbard broiler chicken breed

Treatment Diets	Inclusion rate of SNLM (%)	Replicates	Chickens per replicate	Total chickens per treatment
T1	0	4	10	40
T2	3	4	10	40
T3	6	4	10	40
T4	9	4	10	40
T5	12	4	10	40
Total (N)				200

SNLM = Stinging nettle leaf meal; T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal; T5 = diets containing 12% of stinging nettle leaf meal

e) *Chickens and their management*

Three hundred day-old Hubbard broiler chickens were purchased from Debre-Zeit Agricultural Research Institute and served as a foundation stock for the experimental chickens. The chicks were reared under the brooder for two weeks at the experimental site and during which they were provided with the starter rations. After end of the adaptation period, two hundred chickens were randomly selected, weighed individually and transferred into their experimental pens in a manner that ten chickens were assigned to each of the four replicates of the five dietary treatments. The chicks were reared in a deep litter housing system whose floor was covered with wood shavings at a depth of 5 cm. The experimental house including watering and feeding troughs was cleaned, disinfected with formalin and aerated. Iso-management conditions like floor space, light, temperature, ventilation and relative humidity were provided to each of the groups.

Birds in each replicate were fed as a group. Chickens were fed ad libitum and each day a measured amount of feed was offered to birds. The feed refusal was collected and reweighed at the end of each day. If the birds were able to consume the whole feed they were provided with extra feed and the amount provided was recorded. Clean water was provided ad libitum throughout the experimental period. The chickens were vaccinated against, Newcastle disease; infectious bursal disease (Gumboro) and fowl typhoid as per the recommended vaccination schedule (Table 4).

Table 3 : Vaccination schedule of the experimental Broiler chickens

Age (days)	Name and type of vaccination	Route of administration
3	NCDV(HB1 strain)	Ocular (Eye droplet)
7	Gumboro (IBDV)	Drinking water
21	Gumboro (IBDV)	Drinking water
27	NCDV (Lasota strain)	Drinking water
45	Fowl typhoid	Subcutaneous

NCDV = Newcastle disease vaccine; IBDV = infectious bruits disease vaccine

f) Measurement of growth performance traits

Body weight of the chicks was taken at the beginning of the experiment and subsequently on a weekly basis, in the morning between 6:30 am and 8:00 a.m. prior to feed was offered. Daily body weight gain and feed conversion ratio values were calculated. Mortality and any abnormality were recorded throughout the entire experimental period.

i. *Measurement of carcass characteristics*

At the end of the experimental period, two chicks (1 male and 1 female) per replicate whose body weight was closest to the mean body weight of their respective groups were selected. The chicks were starved for 12 hrs to allow empting of the guts to minimize influence of the digesta on live body weight at slaughter. Each chick was weighed and immediately slaughtered by severing the jugular veins. The body was allowed to bleed and thereafter feathers were manually removed. Edible offal such as gizzard and liver and non-edible offal such as shank + claws, head, lungs, heart, spleen, kidney, pancreas, bile, cloacae, esophagus, crop and digestive organs were weighed using digital balance and recorded.

The carcass was further apportioned into commercially important parts (skins, neck, drumsticks, thighs, wings, back (thorax + abdomen), abdominal fat and breast muscle) and weighed. The dressing percentage was calculated as commercial carcass body weight/ slaughter weight × 100. Gizzard and liver are edible offal in Ethiopia, and these were added to the commercial carcass to calculate another version (to assess the value in Ethiopian context) of dressing percentage.

g) Whole body analysis for nutrient retention

At the beginning of the experiment, 10 chicks, whose average body weight was about the same as the average weight of the experimental chicks in the five treatments were selected and killed by dislocating the neck. The killed chicks were put in plastic bags and kept in a deep freezer at -20°C until they were processed for whole body chemical analysis. At the end of the experiment, from randomly selected 4 replicates, 1 male and 1 female chickens were selected (totally 40 chickens) and weighed. They were then fasted for 12 hours prior to and slaughtered manually. The carcass cuts were weighed and transferred to labeled plastic bags and put in a deep freezer until further analysis.

The whole body of each chickens were chopped while still frozen and retransferred to the freezer until it was minced using a commercial mincer, then it was put again back to the deep freezer. After thawing, representative samples were taken from each of the homogenized samples for dry matter analysis. The second portion of the minced carcass was dried in an air forced oven for whole body nutrient analysis. After drying, it was grounded using Thomas Willey mill to pass through 1mm sieve size.

The dry matter, lipids/fat, nitrogen and protein were analyzed in Animal Nutrition Laboratory of Hawassa University, College of Agriculture. These values were multiplied by their respective total DM in the carcass to get the amount of nutrients deposited in the whole body. The amount of each nutrients retained during the experimental period were calculated as a difference between initial and final concentration of nutrients in the body. The amount of each nutrient retained daily was also estimated by dividing the total amount of nutrient retained by the duration of the experimental period.

h) Chemical analysis

The stinging nettle leaf meal and feeds offered were analyzed for dry matter, ether extract (EE), crude fiber (CF) and total mineral (ash) by proximate analysis procedures (AOAC, 1995) and nitrogen free extract (NFE) was calculated by difference. Protein in the feed was assessed using Kjeldahl procedure, and the nitrogen in the feed was multiplied by 6.25 to obtain the crude protein value. Calcium and phosphorus were analyzed by atomic absorption spectrophotometer as described by AOAC (1995). The metabolizable energy (ME) was estimated by the formula: ME (Kcal kg-1 DM) = 3951 + 54.4EE - 88.7CF - 40.8Ash (Wiseman, 1987).

i) Statistical analysis

Data obtained on DM intake, body weight gain, DM conversion ratio, measurement of carcass traits and nutrient retention were subjected to ANOVA using the General Linear Model (GLM) procedure of SAS version 2006. Means were separated using Duncan's Multiple Range Tests. Treatment differences were considered significant at the $P<0.05$ level unless noted otherwise.

The following statistical models summarize the statistics employed to analyze the data.

Model .1

$$Yijk = \mu + Ai + eik;$$

Where, Yik=individual values of the dependent variables;

μ = overall mean of the response variable;

Ai= the effect of the *i*th SNLM level (*i*= 3, 6, 9, 12,) on the dependent variable

eik=error associated with the experimental study.

Model 2

$$Y_{ij} = \mu + \alpha_i + b_j + ab_{ij} + e_{ij}$$

μ= overall mean

i= effect of sex, 1 and 2

j= effect of Stinging nettle leaf meal levels on dietary treatments, 1, 2, 3, 4 and 5

αb_{ij}= effect of i^{th} sex on j^{th} level of stinging nettle leaf meal supplementation

e_{ij} = error associated with the experimental study.

III. Results

a) Nutrient and energy contents of stinging nettle and treatment diets

The determined nutrients composition and calculated metabolizable energy values of STNL and the experimental diets are presented in Table 5. The levels of dry matter (DM), crude protein (CP), nitrogen free extract (NFE) and phosphorous (P) did not show variation between treatment diets. However, ash levels showed a slight increase as the inclusion rate of SNLM increased. But the level of calcium (Ca) and crude fiber (CF) showed a slight increase as inclusion rate of SNLM increased.

Table 4 : Nutrient (% DM) and metabolizable energy (kcal/kg DM) contents of stinging nettle leaf meal and experimental diets fed to Hubbard broiler chicken breed

Treatment diets	DM	CP	EE	CF	Ash	NFE	Ca	P	ME
T1	91.4	19.8	9.80	8.32	9.17	52.91	0.63	0.40	3372
T2	91.4	19.7	9.59	8.47	9.20	53.04	0.66	0.41	3346
T3	91.3	19.6	9.48	8.61	9.80	52.51	0.67	0.43	3303
T4	91.3	19.5	9.27	8.76	10.1	52.37	0.68	0.44	3266
T5	91.3	19.4	9.19	9.01	10.3	52.1	0.74	0.45	3231
SNLM	94.8	26.1	5.8	9.60	8.27	34.0	1.31	0.68	3078

NFE = 100-(CP+EE+CF+Ash);DM = dry matter; CP = crude protein; EE = crude fat; CF = crude fiber; NFE = nitrogen free extract; Ca = calcium; P = phosphorus; ME = metabolizable energy; SNLM = stinging nettle leaf meal; T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal; T5 = diets containing 12% of stinging nettle leaf meal.

b) Feed intake of chickens

Feed intake of broiler chickens fed different levels of stinging nettle leaf meal up to six weeks of experimental period is shown in Table 6. As the results indicated, there was non-significant ($p>0.05$) difference during the experimental period of week 1 and week 2 across treatment diets. However, the feed intake varied with significant ($P < 0.01$, $p<0.001$) difference across the dietary treatments in the rest of experimental periods. During the week 3, week 4, week 5 and week 6 of experimental periods, chickens fed on T1 and T2 diets showed comparable intake as well as those fed on the T3 and T4 indicated comparable intake during the week 3 and week 4. After second week, chickens fed on T5 of experimental diet showed low feed intake. However, starting from the Week 3 up to the Week 6 chickens fed on the T4 dietary treatment showed relatively higher intake than the rest of the group.

Table 5 : Weekly mean daily feed intake (g/chick/day) of Hubbard broiler breed raised on diets containing different levels of stinging nettle leaf meal

Experimental period (weeks)	T1	T2	T3	T4	T5	SEM	P
W1	68	70	71	71	68	1.93	NS
W2	77	78	79	80	77	1.9	NS
W3	84^{b}	85^{b}	88^{a}	90^{a}	84^{b}	1.78	***
W4	90^{b}	90^{b}	94^{ab}	96^{a}	88^{c}	1.34	***
W5	96^{b}	97^{b}	98^{b}	109^{a}	90^{c}	2.00	***
W6	100^{b}	101^{b}	102^{b}	117^{a}	95^{c}	1.78	***

a, b, c Means within the same columns with different superscript letters are significantly different (p<0.05); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal; T5 = diets containing 12% of stinging nettle leaf meal; SEM = standard error of the mean.

c) *Nutrient and energy intakes of chickens*

The effects of various levels of SNLM on mean daily nutrient and energy intakes of growing broiler chickens during experimental period are presented in Table 7. The results indicated that significant differences intake values on DM (p<0.001), CF (p<0.01), CP (p<0.05) and Ca (p<0.01) were observed between the treatment groups. Accordingly, T4 had the higher intake for these nutrients than the other treatments except CF intake for that T5 had the higher intake. In all treatment groups, T1 consumed relatively lower amount of nutrients during the experimental period.

Table 6 : Nutrient (g/chick/day) and energy (kcal/chick/day) intakes of Hubbard broiler breed fed diets with various levels of stinging nettle leaf meal

Nutrients	T1	T2	T3	T4	T5	SEM	P
Dry matter	50.8^{c}	50.9^{c}	53.1^{b}	57^{a}	50.9^{c}	2.49	***
Crude protein	7.4^{d}	7.7^{c}	8^{b}	8.4^{a}	7.5^{c}	0.39	*
Crude fat	3.1	3.2	3.2	3	3.1	0.077	NS
Crude fiber	2.5^{c}	2.5^{c}	3.2^{b}	3.2^{b}	3.3^{a}	0.38	***
Calcium	0.16^{d}	0.18^{c}	0.19^{b}	0.20^{a}	0.18^{c}	0.0176	*
Phosphorous	0.12	0.127	0.127	0.132	0.12	0.0051	NS
Metabolizable energy	133	135	139	142	135	3.19	NS

a, b, c ,d Means within the same row bearing different superscript letters are significantly different (p<005); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal; SEM = Standard error of the mean.

d) *Effect of stinging nettle on growth performance traits*

Table 8 shows the average initial body weight, final body weight (FBW), total body weight gain (TBWG), daily body weight gain (DBWG), feed conversion ratio (FCR) and mortality rate of broiler chickens fed diets containing different levels of SNLM. The average FBW, TBWG, DBWG and FCR of chickens were significantly (p<0.001) influenced by the inclusion of SNLM in all treatment diets.

Chickens fed on the control (0% SNLM) and T5 (12% SNLM) diets had lower FBWG, TBWG and DBWG than those fed diets containing SNLM of 3%, 6% and 9% (T2,T3 and T4, respectively). However, chickens fed on T2 were comparable with T1, T3 and T5 in these parameters. The highest values in FBW, DBWG and TBWG were obtained from those chickens fed with T4. Mortality of chickens kept under T4 was lower (p<0.001) than those reared in other treatment diets.

Table 7 : Average body weight gain (g/chick/d), feed conversion ratio (g feed/g gain) and mortality rate (%) of Hubbard broiler breed fed diets with different levels of stinging nettle leaf meal

Parameters	T1	T2	T3	T4	T5	SEM	P
IBW	172	171	172	172	173	7.32	NS
FBW	2131^{c}	2142^{bc}	2187^{b}	2463^{a}	2125^{c}	39.10	***
TBWG	1959^{c}	1972^{bc}	2015^{b}	2291^{a}	1952^{c}	41.2	***
DBWG	45^{c}	47^{bc}	48^{b}	55^{a}	46^{c}	0.98	***
FCR	3.4	3.5	3.5	3.7	3.5	0.07	NS
EFU	0.28^{b}	0.28^{b}	0.30^{ab}	0.32^{a}	0.28^{b}	0.007	***
MR	18^{a}	13^{b}	20^{a}	7^{c}	13^{b}	1.62	***

[a,b,c]Means within the same row bearing different superscript letters are significantly different (p<0.05); IBW = initial body weight; FBW = final body weight; TBWG = total body weight gain; DBWG = daily body weight gain; FCR = feed conversion ratio; MR = morality ratio; SEM = standard error of the mean; T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal.

e) Growth performance of broiler chickens

The results pertaining to the mean body weight gain (on a weekly basis) across treatments are presented in Figure 1. The body weight gain was non-significant (p>0.05) across the treatment diets up to the third week of experimental periods. However, starting from the fourth week, chickens fed on T3 and T4 diets had mostly higher body weight gain as compared with those fed on the other dietary treatments. However, those fed on the T1 and T2 diets were showed comparable weight gain throughout experimental periods. Chickens fed with T5 (12% SNLM) showed relatively lower weekly weight gain than the rest of the group after third week of experimental period. In general, the mean weekly body weight gain across all treatment groups increased from 1st week of experimental period up to 5th week while it decreased in increasing manner in the 6th week of experimental period.

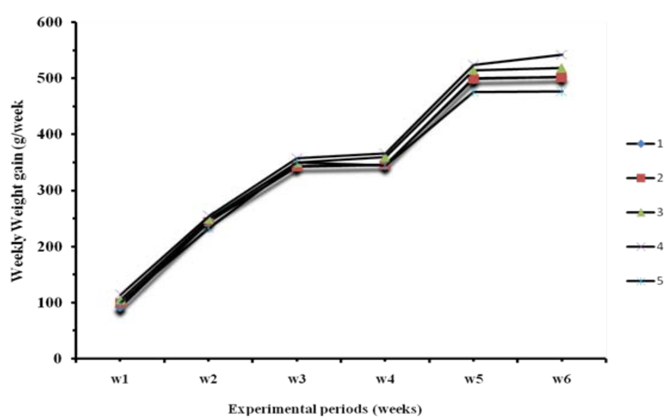

Figure 1 : Patterns of body weight gain of Hubbard broiler chicken breed fed diets containing different levels of stinging nettle leaf meal over a period of 6 weeks

f) Effect of sex on growth performance of chickens

Sex had significant (p<0.001) effect on daily body weight gain of chickens. As presented in Figures 2, both male and female birds showed a significant (p<0.05) increase in body weight up to 6 weeks of age during which the body weight was increased at a higher rate. However, the males showed better body weight development as compared to females. Male chickens obtained more gain than the females during the experimental period and consequently achieved a higher body weight at the end.

As indicated in the figure, starting from the first week of experimental period there was a significant difference in DBWG between both sexes. So the difference was statistically significant and an increase in DBWG over time was greater in males than in females.

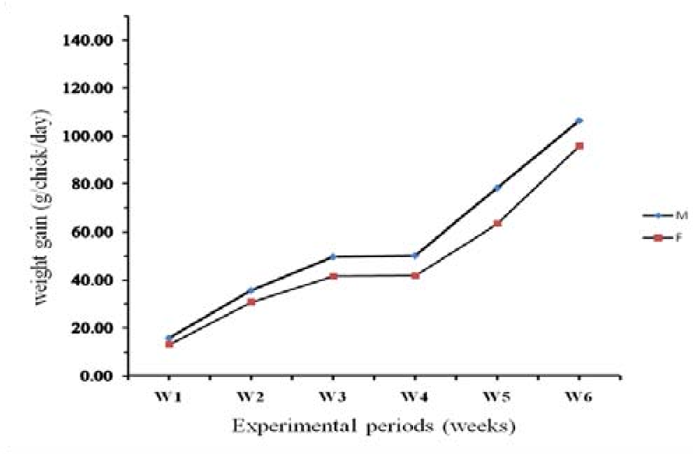

Figure 2 : Effect of sex on weekly body weight gain of Hubbard broiler breed fed diets with different levels of stinging nettle leaf meal over a period of 6 weeks

g) Effect of stinging nettle on commercial carcass traits

The effect of feeding various levels of SNLM on slaughter weight, dressed carcass, dressing percentage and weights of different body parts and organs of experimental birds is shown in Table 9. Except for abdominal fat, gizzard and liver weights, inclusion of SNLM produced significant effects on carcass traits of the chickens. As a result, chickens fed with T3 and T4 had significantly higher slaughter weight ($p<0.001$) than those fed with T1, T2 and T5 diets; while chickens fed with T4 diet had significantly higher slaughter weight than those fed T3. In general, chickens fed with T4 diets had significantly higher values for drumstick, breast muscle, breast bone, neck, skin and total carcass than those fed the rest of the diets. On the other hand, chickens fed with T1, T2, T3 and T5 diets had comparable dressing percentage and drumstick values. Chickens fed with T5 diet had significantly ($p<0.001$) lower values in breast muscle and total carcass as compared with those fed those fed with other diets.

Table 8 : Commercial carcass traits of Hubbard broiler chickens reared on different levels of stinging nettle leaf meal

Carcass traits	T1	T2	T3	T4	T5	SEM	P
Slaughter weight	1255^{c}	1258^{c}	1321^{b}	1431^{a}	1242^{c}	16.8	***
Dressing, %	65.4^{b}	67.0^{ab}	67.1^{ab}	68.0^{a}	64.5^{b}	1.43	**
Drumstick	112^{b}	115^{b}	121^{b}	143^{a}	115^{b}	7.38	***
Thigh	110^{b}	117^{ab}	123^{a}	123^{a}	106^{b}	7.4	*
Wing	65^{b}	71^{b}	73^{ab}	81^{a}	82^{a}	6.13	**
Breast muscle	134^{c}	141^{b}	144^{b}	151^{a}	116^{d}	3.96	***
Breast bone	93^{bc}	97^{b}	97^{b}	108^{a}	87^{c}	6.53	**
Neck	49^{c}	51^{c}	59^{b}	70^{a}	47^{c}	3.08	***
Skin	63^{c}	67^{b}	71^{ab}	76^{a}	65^{c}	4.02	**
Liver	24	24	27	25	21	4.1	NS
Gizzard	33	35	35	39	35	3.24	NS
Abdominal fat	17	19	18	20	17	1.68	NS
Back	114^{b}	115^{b}	122^{a}	125^{a}	109^{b}	4.06	***
Total carcass	764^{cb}	784^{c}	825^{b}	907^{a}	745^{d}	17.15	***
Edible offal	57	59	62	64	56	6.29	NS
Total edible	821^{cd}	842^{c}	887^{b}	974^{a}	801^{d}	19.76	***

[a, b ,c ,d] Row means within the same category with different superscripts letters are significantly different ($p<0.05$); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal; SEM = Standard error of the mean.

h) Effect of stinging nettle on non-edible offal traits

As shown in the Table 10, most of the non edible offal (head, blood, feather, shank, kidney, lung, pancreases, gonads, proventrculus, esophagus, heart and cloacae) weights shows non-significant (p>0.05) values across the dietary treatments. Values for crop and spleen were comparable among T1, T2, T3 and T5 diets. Similarly, values for small intestine weight and length were similar among chickens fed with T1, T2 and T5 diets. Chickens fed on T4 showed higher values in most parameters than those fed on the rest of dietary treatment.

Table 9 : Non-edible offal values of Hubbard broiler chickens reared on different levels of stinging nettle leaf meal

Carcass traits	T1	T2	T3	T4	T5	SEM	P
Head	33	32	36	38	33	3.16	NS
Blood	47	44	43	45	44	4.1	NS
Feather	45	46	46	48	45	3.1	NS
Shank	49	51	51	54	49	3.3	NS
Kidney	8	8	9	9	8	1.67	NS
Lung	5	6	6	7	5	1.1	NS
Crop	8^{b}	10^{b}	10^{b}	13^{a}	9^{b}	1.78	*
Spleen	1.4^{b}	1.7^{ab}	1.7^{ab}	1.9^{a}	1.4^{b}	0.20	*
Pancreases	4	4	5	5	4	1.09	NS
Gonads	4	4	5	5	4	1.03	Ns
Proventriculus	7	8	8	7	7	0.96	NS
SI (gm)	27^{b}	27^{b}	31^{a}	33^{a}	26^{b}	1.34	***
LI (gm)	8^{b}	10^{a}	10^{a}	11^{a}	11^{a}	1.28	*
Inte. length	155^{b}	156^{b}	164^{a}	166^{a}	155^{b}	2.85	***
Esophagus	6	6	7	7	6	1.15	NS
Heart	7	7	7	8	6	0.82	NS
Bile	1.75^{b}	2.5^{a}	2.5^{a}	2.5^{a}	2^{b}	0.32	*
Cloacae	6	6	7	7	5	0.59	NS
TNEO	421^{c}	430^{c}	449^{b}	467^{a}	421^{c}	9.50	**

[a,b,c]Means within the same columns with different superscript letters are significantly different (P<0.05); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal; SEM = standard error: SI = small intestine; LI = large intestine; TNEO = total non edible offal

i) The effects of sex on carcass characteristics

The edible carcass traits and TNEO yields of slaughtered broiler chickens reared on different levels of stinging nettle leaf mealare presented in Table (11). The results indicated that non-significant (P>0.05) differences on the weight of abdominal fat and total edible offal weights were observed between the male and female chickens receiving experimental diets in all treatments. However, in females non- significance (p>0.05) difference across dietary treatments were showed on the weights of total edible offal, gizzard and thigh. The interaction between sex and diet showed significant effect on the weights of drumsticks, thighs, breast muscle and breast bone, neck, wing, skin, back, total edible carcass and total non edible offal of chickens reared on all diet dietary treatments. The weights of most parameters on the T1,T2,T3 and T5 diets comparable as well as T3 and T4 on both male and female. But the chickens both male and female that fed on the T4 diets showed higher values than the rest of dietary treatments.

Table 10 : The effects of sex on carcass characteristics of broiler chickens

Parameters(g)	Sex	T1	T2	T3	T4	T5	SEM	SL
Neck	M	55^{b}	55^{b}	65^{a}	70^{a}	53^{b}	4.98	***
	F	47^{bc}	47^{bc}	53^{b}	68^{a}	41^{c}	6.11	***
Wing	M	69^{b}	75^{b}	78^{ab}	86^{a}	86^{a}	7.34	*

	F	61^{b}	63^{b}	69^{ab}	76^{a}	77^{a}	6.01	**
Skin	M	68^{c}	71^{bc}	75^{ab}	80^{a}	69^{bc}	4.34	**
	F	60^{bc}	63^{bc}	67^{ab}	72^{a}	59^{c}	4.79	**
Back	M	121^{ab}	119^{b}	127^{ab}	130^{a}	109^{c}	6.46	**
	F	109^{b}	109^{b}	117^{a}	119^{a}	109^{b}	4.18	**
Drumstick	M	116^{b}	120^{b}	126^{b}	148^{a}	114^{b}	9.9	**
	F	109^{b}	107^{b}	115^{ab}	125^{a}	107^{b}	8.07	*
Breast muscle	M	117^{b}	127^{ab}	130^{a}	136^{a}	103^{c}	6.9	***
	F	110^{c}	115^{bc}	119^{ab}	125^{a}	89^{d}	5.27	***
	M	76^{b}	78^{b}	84^{ab}	92^{a}	73b	7.03	*
Breast bone	F	71^{bc}	76^{ab}	70^{bc}	84^{a}	61^{c}	7.4	**
Thigh	M	122^{abc}	120^{bc}	129^{ab}	132^{a}	112^{c}	7.2	*
	F	113	104	117	115	101	8.57	NS
Abdominal fat	M	20	20	19	21	18	1.7	NS
	F	16	18	17	19	17	1.97	NS
TEC+TEO	M	825^{cd}	850^{c}	897^{b}	964^{a}	795^{d}	23.95	***
	F	744^{cd}	753^{c}	802^{b}	864^{a}	715^{d}	20.5	***
TEO	M	62	64	63	68	59	7.36	NS
	F	52	53	60	60	55	7.41	NS
TEC	M	764^{cd}	786^{c}	834^{b}	897^{a}	737^{d}	18.79	***
	F	692^{c}	700^{c}	742^{b}	803^{a}	659^{d}	18.36	***
TNEO	M	421^{c}	430^{c}	449^{b}	466^{a}	421^{c}	9.5	***
	F	404^{bc}	409^{bc}	423^{b}	448^{a}	402^{c}	13.04	***

$^{a-d}$Means within the same columns with different superscript letters are significantly different (P<0.05); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal; SEM = standard error: TEC = total edible carcass; TEO = total edible offal; TNEO = total non edible offa.

j) Effects of stinging nettle leaf meal on the nutrient retention

As indicated in Table 12, the chickens reared on T1 diet had significantly (P<0.05) lower protein retention than those reared on the T2, T3, T4 and T5 dietary treatments. However, chickens fed on the T1, T2 and T5 diets showed comparable (p<0.01) retentions of DM while those chickens fed on the T3 and T4 dietary treatments retained intermediate (p<0.01) values of DM. However, chickens fed on T4 diet retained (p<0.01) both DM and CP than those fed other treatment diet. However, retention of EE showed non-significant (p>0.05) difference across all dietary treatments.

Table 11: The daily nutrient retention (g/chick/day) of Hubbard broiler breed fed different levels of stinging nettle leaf meal

Nutrients	T1	T2	T3	T4	T5	SEM	P
Dry matter	4.81^{c}	4.85^{bc}	5.09^{ab}	5.34^{a}	5.04^{bc}	0.27	**
Organic matter	5.003^{c}	5.26^{bc}	4.42^{ab}	5.56^{a}	5.16^{bc}	0.27	**
Crude protein	2.65^{c}	2.83^{abc}	2.9^{ab}	3.03^{a}	2.72^{b}	0.009	**
Ether extract	0.94	1.209	1.008	1.24	0.93	0.362	NS

a-c Means within the same columns with different superscript letters are significantly different (P<0.05); T1 = diets without stinging nettle leaf meal; T2 = diets containing 3% of stinging nettle leaf meal; T3 = diets containing 6% of stinging nettle leaf meal; T4 = diets containing 9% of stinging nettle leaf meal and T5 = diets containing 12% of stinging nettle leaf meal; SEM = standard error:

IV. Discussion

a) *Nutrient and energy contents of the experimental diets*

Treatment diets in this experiment were very close in their DM (91.3-91.8%), CP (19.4-19.8%), EE (9.19-9.80%), CF (8.27-8.91%) and P (0.40-0.450) contents. In addition to this, the Cp contents in Table 1 and Table 5 for all dietary treatments were comparable and within the recommended levels suggested by Scanes *et al*. (2004), 20% and 18.5% CP for grower and finisher broilers, respectively. These values were also above 16% dietary CP level recommended by Shewangizaw *et al*. (2011). However, the level of ether extract slightly decreased as the level of SNLM increases in diets. This might be explained by the increased level of oil in soybean due to the use of full fat soybean seed. This together with crude fiber and ash values resulted to differences in metabolizable energy content of diet.

Among the dietary treatments that contained of SNLM, T3, T4 and T5 contained slightly more percentage of crude fiber than T1 and T2 diets. However, the chickens fed on these experimental diets (except T5) showed increased feed intake which suggests that it is still under the upper critical fiber level that can adversely affect the feed intake of birds resulting poor performances of experimental birds. The composition of calcium linearly increased as the level of stinging nettle leaf meal in the diet increases. This might be explained due to the fact that stinging nettle leaf meal contains relatively high calcium content. The phosphorous content was comparable in all treatment diets. However, all the treatment diets were in accordance with the recommended levels of calcium and phosphorous in terms of quantity and proportion (2:1 ratio) in practical grower chicken diets under tropical conditions (Smith, 1990).

The nutrient contents of SNLM indicated that it is rich in crude protein (26.13%), phosphorous (0.68%) and Ca (1.31%) contents. The CP content of SNLM found in the current study was comparable with values reported by Cross (2007) and Tozer (2007) respectively for dried stinging nettle leaves and Samma (*UrticaSimensis)* leaf samples collected from Debreberhan, Fitche and Ambo areas had more or less similar protein contents with a mean value of around 26% (Eskedar *et al*., 2013). However, the CP values found in the current study were lower than the values reported by Liu (2007) for the nettle hay (29.40%). The CP values found in stinging nettle in the current study were comparable to those reported for *Moringasetnopetala* and *Moringaoliefera* leaves (Aberra et al., 2009; 2012a). The protein content of *raw Samma* (*UrticaSimensis*) was also found to be higher compared to commonly consumed vegetables in Ethiopia such as Lettuce (*Lactuca sativa*) (15.5 %), Swiss chard (Beta vulgaris) (12.2 %), Kale (*Brassica carinata*) (8.0 %) and Spinach *(Spinaceaoleracea*) (18.6 %) (EHNRI, 1997). This indicates that the leaves of Samma *(UrticaSimensis*) might be another cheap source of plant protein for marginal resource communities of Ethiopia.

The crude fat composition of SNLM (5.8%) obtained from this study was comparable with the values reported by Odeyinkaet al. (2008) and Asaoluet al. (2010) respectively for M. oleifera leaves (5.5-6.68%) and within the ranges reported by Aberraet al.(2009, 2011, 2012a) for the *Moringaoleifera* and *Moringastenopetala* leaves (4.73-8.4%). Also, fat contents of *Sammaleaves (UrticaSimensis*) like that of the protein content, were also found to be higher than spinach (*Spinaceaoleracea*) (0.8%), lettuce (Lactuca sativa) (0.2%), Swiss chard (Beta vulgaris) (0.4%) and Kale (*Brassica carinata*) (0.80 %) (EHNRI, 1997). Similarly, the fat content was found to be higher than that of Malabar Spinach (*Basellarubra*) (0.86%), Bonongwe, mowa (*Amaranthushybridus*) (0.4%) (Bhardwaj, R., et al. 2009).

The crude fiber content of SNLM (9.6%) obtained from the current study was within the values reported by Cross et al. (2007) for the same species. However, the deviation of crude fiber as reviewed from some of the literatures may be attributed to non genetic factories such as location, maturity of the leaves and as well as the herb as a whole, besides the methods of processing the leaf meals. However, the crude fiber content of raw *Samma (UrticaSimensis*) leaves was higher than those cultivated green leafy vegetables consumed in Ethiopia such as spinach *(Spinaceaoleracea*) (4.60 %), lettuce *(Lactuca sativa)* (3.7%), Swiss chard *(Beta vulgaris)* (6.10%) and Kale (*Brassica carinata*) (7.50 %) Muchuweti M., et al., 2009.

b) *Feed and nutrient intakes of chickens*

One of the most important factors that play crucial roles on the performance of animals is voluntary feed intake and it can be defined as the amount of feed consumed by an animal or group of animals in a given period of time during which they have free access to it. It is a decisive parameter to evaluate the nutritive value of animal's feed. In the current study, the feed intake result showed that substitution of roasted soybean seed with various levels of Samma *(Urticasimensis*) demonstrated an improvement trend in the feed intake of broiler chickens.

The DM intake of broiler chickens improved in all Samma (*UrticaSimensis*) leaf fed treatments with the exception of T5, which showed a decreasing trend of feed intake. This finding is in accordance with that of Allardic, (1993) who reported that nettles are a very nutritious food that is easily digested and is high in minerals (especially iron), vitamin C and pro-vitamin A.

There is also evidence to suggest that herbs, spices and various plant extracts have appetizing and digestion-stimulating properties and antimicrobial effects (Gill 1999; Langhout 2000; Madrid et al. 2003; Alçiçeket al 2004; Zhang et al., 2005), which stimulate the growth of beneficial bacteria and minimize pathogenic bacterial activity in the gastrointestinal tract of poultry (Wenk, 2000). Apart from this, there is also evidence which suggest that herbs and their derivatives have digestion-stimulating properties via stimulating the production of endogenous secretions in the small intestinal mucosa, liver and pancreas, and thus help digestion (Windisch *et* al., 2008).Consistent with the current findings, an increased DM intake with inclusion of *M.oleiferaleaf* meal in cassava based diets was reported by Olugbemiet al. (2010a) when broilers were fed up to 5-10%.

Except those of ether extract, metabolizable energy and phosphorous intake values of all nutrients were linearly improved with increasing level of SNLM. The increased trend of feed intake by the chickens in this experiment can be explained in terms of the combined effects of increasing CF and decreasing ME contents of diets with SNLM.This is because birds eat primarily to satisfy their energy requirements (Vieira et al., 1992) and hence, feeds of lower energy levels will provide higher intakes. This was confirmed with results reported by Nuhu (2010) in a study of feeding M. *oleiferaleaves* meal to rabbits and the author suggested that, an increase in the total fiber content of the diets resulted from the relatively high fiber content of leaf meals tends to dilute other nutrients, animals must eat to meet their nutrient requirement to sustain rapid growth and development, hence they increased feed intake.

Enhanced feed intake of broilers in diets even with similar energy contents was also reported by Mushtaq *et al*. (2009) to the high dietary crude fiber contents and was argued that the laxative nature of fiber in simple stomach animals might have impaired nutrient digestion due to high passage rate in the digestive tract. Improved feed intake, probably due to increased bulk and lower metabolizable concentration in leaves meal was also reported by Olugbemi *et al*. (2010). Throughout the dietary treatments enhanced feed intake observed in the current study might be further attributed to better palatability and preference of SNLM based diets. Except those EE, phosphorus and ME, all nutrient intake values had improved positively with increasing level of SNLM in the same manner with dry matter intake which might be the attributing factor to those results. These higher nutrient intake values observed in the present study suggests that SNLM could be a good alternative source of feed ingredient which improves DM intakes and consequently nutrient consumption of chickens if it included up to 9% in grower rations.

c) Growth performance of broiler chickens

The body weight gain did not vary across the experimental diets up to the fourth week of experimental periods. These results were consistent with the works of Nassir et al. (2010) that using different levels of nettle in starter and growing feeds did not show any significant effects on feed intake, weight gain and feed conversion of broilers. However, after the fourth week, chickens receiving T3 and T4 diets had higher body weight gain as compared to those fed with T1, T2, and T5 diets. The findings are in good agreement with those of Windisch *et al*. (2008) who reported that spices influence the gastrointestinal ecosystem mostly through growth inhibition of pathogenic microorganism's growth. So, it might be possible that the increase of digestion and absorption of essential nutrients due to increasing the enzyme activity and/or inhibition of pathogenic microorganism's growth could be the main reason of pennyroyal medicine plant to accelerate the performance. This is also supported by experiments done by Kwiecien and Miec-zan, (2009) that the addition of 2% nettle to broiler diet led to increase their body weight.

The broiler chickens reached the highest growth rate at the 6th week of experimental period. Even if there was non-significant difference in most dietary treatments, chickens fed with diets containing SNLM showed relatively higher weight gain than those fed on control diet. However, chickens fed experimental diets on T5 showed relatively lower weekly weight gain than the rest of dietary treatments after fourth week of experimental period. This is in line with the findings of Ekenyem and Madubuike (2006) who reported on supplementation of broiler rations at 0, 5, 10 and 15% Ipomoea *asarifolia* leaves meal in which significant reduction in final weight and daily weight gains were observed when the feed was included at higher levels. In agreement to these observations, Esonu *et al*. (2006) also reported that higher dietary inclusion levels of *Azadirachtaindica* leaf meal resulted in decreased weight gain of egg laying hens. This might be attributed to the effects of nutrient imbalance and poor metabolism by monogastric animals when fed high levels of unconventional feed ingredients (Esonu *et al*., 2009). In general, the improved weight gain observed in the current study on those chickens fed diets containing SNLM than those received the control diet might be due to the increased feed intake.

d) Effect of sex on performance of chickens

Regardless of diet, male chickens scored more weight gain than the females and achieved a higher body weight at the end of experimental period. These was consistent with the work of Pattel *et al*. (2010) who reported high body weight and gain for growing male birds than females. Fassil et al. (2010) had similarly reported that more gain and higher body weight for growing male birds than females. This is in fact associated with higher feed intake (Ng'ambi *et al*., 2009) and conversion efficiency of male birds (Tegene and Asrat, 2010) compared to female chickens.

The effect of sex on daily body weight gain of growing broiler chickens indicated that although males showed higher growth rate than the females during the experimental period, the difference became statistically significant starting from beginning up to the latter ages of chicken.

e) Effect of Stinging nettle on weight gain and feed utilization parameters of chickens

Feeding of different levels of SNLM to broiler chickens showed significant improvements in final body weight, total body weight gain and daily body weight gain. These findings are in agreement with those reported by Kwiecien and Miec-zan (2009). Nettles are a very nutritious food that can be easily digested and contain minerals (especially iron), vitamin C and pro-vitamin A (Allardice, 1993). It is hypothesized that it may also affect protein and lipid metabolism and improve the performance of animals. Moreover, amino acids in dehydrated nettle meal are nutritionally superior to those of alfalfa meal (Hojnik *et al*., 2007) and this could be also a possible explanation for increased performances of broiler chickens fed with diets containing stinging nettle leaf meal.

In this study, the inclusion of SNLM in the chickens' diet up to the level 9% had a positive effect than the control diet. On the other hand, lower values in final body weight, total body weight gain and daily body weight gainwere observed in chickens fed with T5 diet. This was in agreement with the suggestion made by Esonu *et al*. (2006) that the effects of nutrient imbalance and poor metabolism on mono-gastric animals fed higher levels of unconventional feed ingredients. This could probably occur due to the presence of anti-nutritional factories like tannins and formic acids (Viegiet al. 2003; Gulcin *et al.* 2004), which could impair bioavailability of nutrients. This is because, the anti nutritional factors are the major factors limiting the wide use of many plants as they are present in the plants naturally and capable of eliciting deleterious effects in man and animals (Marshal *et al*., 1997). However, as the result reported by (Addis *et al*., 2005) that the tannin content of raw Sammaleaves collected from Debrebrehan, Fitche and Ambo areas were 25.3, 28.2 and 27.0 mg/100gm, respectively on dry weight basis. These values were very low compared to other indigenous wild vegetables. In fact this low concentration of condensed tannin is an advantage for not lowering the bioavailability of other nutrients. The feed conversion ratio was not significant throughout the experimental diets. However, chickens fed with T4 diets showed slightly more fed conversion than the rest of the treatment groups. However, efficiency of feed utilization of chickens fed diets containing different levels of SNLM showed significant ($p<0.001$) differences. This was in agreement with results reported by Bedford (2000) that inclusion of nettle leaf meal lead to a greater efficiency in the utilization of feed, resulting in enhanced growth and improved feed efficiency. Generally, chickens fed diets containing 9% levels (T4) showed better weight gain and efficiency of feed utilization than those fed on other treatment diets.

f) Conditions of the experimental birds

Mortality cases of birds recorded in chickens fed with T1, T2, T3, T4 and T5 diets were 18, 13, 20, 7 and 13% respectively. The coccidiosis disease was the cause of these all mortalities at the first week and paralysis on some body parts while chickens starts to grow more since, broilers have being fast grower than the others. In addition to this, stresses induced from transfer of birds from brooding house to their experimental pens and delay of providing the preventive vaccines and drugs before the outbreak of the disease were the attending factors for relatively higher mortality rates recorded in the current study. In agreement to the current observation, none of any adverse effects on chickens' health and mortality due to incorporation of M. oleifera leaves to diets of growing chickens up to 24% was observed by Ayssiwede *et al*. (2011).

Then there were no adverse effects of SNLM observed on the chickens' health during the experimental period. In agreement with current observation, Kwiecien and Mieczan (2009) reported that supplementing the diet with plant material that is rich in active substances might have beneficial effects on the immune system and can be used as an alternative to antibiotic growth promoters. In an experiment conducted by (Hojnik *et al*., 2007) indicated that the addition of 2% in broilers diet showed that using nettle in mixture with other medicinal plants had positive effects on performance, carcass traits, and blood biochemical and immunity parameters.

g) Effect on the carcass characteristics

Under Ethiopian context total edible offal includes gizzard and liver. The effect of different levels of stinging nettle (Samma) leaf meal on total edible offal was non-significant ($P > 0.05$) across treatment groups and is in agreement with findings by Toldy *et al*. (2005). The non-significant improvement in liver and gizzard weights observed with inclusion level of SNLM can be explained by increasing the live body weight of chickens rather than due to physiological response of birds to SNLM since organs development in chicken is proportional to their live body weight (Ayssiwede *et al*., 2011). Increased liver weight of birds as related to increase liver activities can be caused by the effect of anti-nutrients and bulkiness feeds which might have resulted in liver over load that brought about possible hypertrophy of the organ (Togun *et al*., 2006). Hence, the result of the current study implies that SNLM up to 12% of inclusion level did not produce any significant effect to the normal function of liver in broiler chickens. However, this finding was in contrary with the reports of Debersac *et al.* (2001) who indicated that a plant extract from rosemary enhanced hepatic metabolism and hence, increased relative liver weights in rats.

Although, as observed by Born et al., 2006 that the increase in gizzard size is related to the volume of feed, increased time spent on grinding the feed and increased frequency of gizzard contraction which is needed the large particles for further digestion in the distal parts of the intestine, and small increases in the level of dietary fiber are needed to stimulate gizzard development. The absence of changes in gizzard weight with increasing level of SNLM in the current study thus suggests SNLM did not exhibit any effect to delay the retention time of ingesta in the gizzard and to increase frequency of gizzard contraction. This could probably be due to the high digestibility of the leaf meal. This was in line with observations suggested by Platel and Srinivasan (2005) and Suresh and Srinivasan (2007) that extracts from herbs and spices accelerated the digestion and shorten the time of feed passage through the digestive tract.

On the other hand, chickens fed diets containing different levels of stinging nettle leaf meal were significantly superior in many other carcass traits as compared to the control diet. Chickens fed diets with SNLM showed yellow coloration of shank, beak and skin than those fed control diet. This is in line with the reports of several researches on leaf meal feeding (indicating that leaf meals do not only serve as protein source but also provide some necessary vitamins, minerals and oxycaretenoids which cause yellow color of broiler skin, shank and egg yolk (Fasuyi *et al.*, 2005; Aberra *et al.*, 2013).

High carcass yield suggests more nutrient bioavailability for anabolic processes; perhaps more so, protein synthesis than other diets (Tegene and Asrat, 2010) since the true muscle development is an accumulation of protein. Thus, the relatively lower weight of these carcass parts of control group compared to those of chickens fed diets with SNLM might be due to less deposition of protein in the former group. This might be attributed to the possible amino acid imbalance in maize, wheat bran and noug cake which demands supplementation of cereal based diets with animal protein (Agbede and Aletor, 1997). Apart from this, methionin is in particular the primary limiting amino acid in soybean meal based poultry diets (Cavins *et al.*, 1972). Amino acids in dehydrated nettle meal are nutritionally superior to those of alfalfa meal (Hojnik *et al.*, 2007). Thus, the availability of this limiting amino acid along with other essential amino acids might have contributed to the observed higher values for carcass components in chickens fed diets containing SNLM. As shown in Table 2, the value of essential amino acid lysine is comparatively high in soybean seed. However, roasting of raw soybean to inactivate the proteolytic inhibitor in the current study might have resulted in a partial loss of lysine which would affect it's availability in chickens diet. Furthermore, since weight of body parts are proportional to their live body weight, this can also additionally be explained by general terms of relatively higher weight gain of SNLM fed groups and in turn greater slaughter weight of these birds achieved at the end of the experiment.

In the Ethiopian context, total non edible offal includes feather, blood, head, shank and claw, esophagus, crop, proventriculus, spleen, pancreas, kidney, heart, lung and intestines while the total edible offal includes skin, gizzard and liver. The non-edible offal was non-significant (P>0.05) across treatment diets except for crop, spleen, intestine and bile. Most of the non-edible offal's are comparable across all treatment diets. This is in agreement with findings observed by Basmaciolu *et al.* (2004) and Sarica *et al.* (2005). Relative weights of most organs were not affected by inclusion of nettle leaf meal to the diet in this experiment, which is in agreement with findings by Nobakht (2011). Chickens fed with T4 diet showed higher weights than the rest followed by T3 and T2. However, chickens fed on T5 diet showed impaired digestion and utilization of nutrients resulting in lower performance compared with other groups.

h) Effect of sex on carcass traits

Non-significant (P>0.05) differences on the weight of total edible offal and abdominal fat weights was observed between the male and female chickens across treatment diets. However, the male chickens raised on all dietary treatments had significantly (P<0.05) higher values of neck, drumstick, thighs, wing, breast muscle, skin, back, TEC and TNEO weights when compared to female chickens. This is in line with results observed by Marchi *et al.* (2005) for Padovana breed chickens in which male birds had significantly larger breast and thigh weights than female chicks. Studies by Rondelli et al. (2003) and Mendes *et al.* (2004)indicated that male chickens had larger yields of breasts, thighs and drumsticks than female chickens. This effect of sex on carcass weight was pronounced with higher value for males and is consistent with the findings of Aberra *et al.* (2013) for Koekeok chickens fed with different levels of M. stenopetala leaf meals. This difference related to sex of chickens might be attributed to the presence of sex hormone (androgen) in males that enhanced muscle development than the sex hormone (estrogen) in females which is mostly responsible for fat deposition rather than muscle tissue development. This is a physiological fact that the weight of adipose tissue is lighter than that of muscle tissue (Scanes, 2003) from the latter being denser than the former (Tegene and Asrat, 2010).

i) Effects of stinging nettle leaf meal on the nutrient retention of boiler chickens

The chickens reared on T1 diet had significantly (P<0.05) lower protein retention than those on T2, T3, T4 and T5 diets. However, chickens fed on T1, T2 and T5 diets showed comparable retentions of DM while those fed on the T3 and T4 diets retained intermediate values. Nevertheless, chickens fed with T4 diet retained higher (p<0.01) DM and CP than the other treatment diets. This in agreement with the results observed by Shawangizaw *et al.* (2011) that the RIR chickens receiving lowest dietary crude protein resulted in significantly lower protein retention as compared to those receiving high crude protein supplemented diets. In agreement with the current results, Frankic *et al.* (2009 reported that herbs stimulate the secretion of pancreatic enzymes, important factors in nutrient digestion and retention .Generally, inclusion different levels of stinging nettle leaf on the broiler diets showed positive effects on their performance as evidenced by enhanced retention of nutrients as compared with those chickens fed on the control diet.

V. Conclusion

The substitution of roasted and grounded soybean seed with stinging nettle (Urticasimensis S.) leaf meal up to 12% in the diet of growing broiler chickens had no negative impacts on performance and best results were obtained up to the inclusion rate of 9% as evidenced by improved feed intake, live body weight, daily weight gain, slaughter weight and nutrient retention. The general improvement in the performance of chickens especially those kept under 6 and 9% levels together with their physical appearance provide sights to conclude that SNLM have supplied better health and nutritional benefits. Thus, the inclusion of stinging nettle leaf meal up to 9% in broilers grower diet could be an alternative feeding strategy for substituting other expensive protein sources such as soybean seed in urban and per-urban chicken production practices which assists to enhance their income through increased productivity and improved nutritional status of birds.

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