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The Effects of Migration

Hubbard Broiler Chickens

Highlights

Ability to use Fertilizing

Heavy Metal Accumulation

Discovering Thoughts, Inventing Future

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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

By Bangu Bekele, Aberra Melesse, Mohamed Beyan & Kefyalew berihun
Hawassa University, Ethiopia

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.

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

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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

Bangu Bekele [α], Aberra Melesse [σ], Mohamed Beyan [ρ] & Kefyalew Berihun [ω]

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 -20ºC 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.

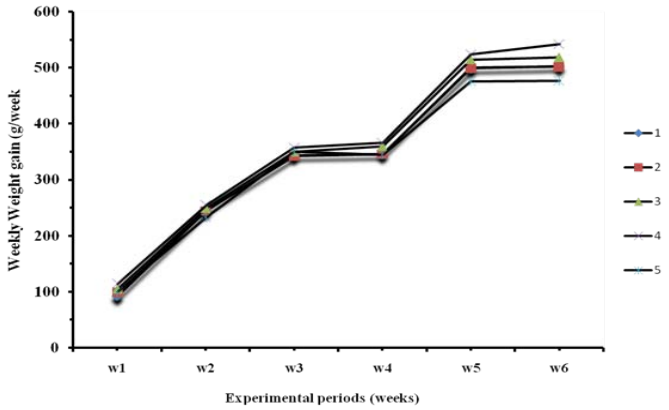

Figure 1 : Patterns of body weight gain of Hubbard broiler chicken breed fed diets containing different levels of stinging nettle leaf meal over a period of 6 weeks

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.

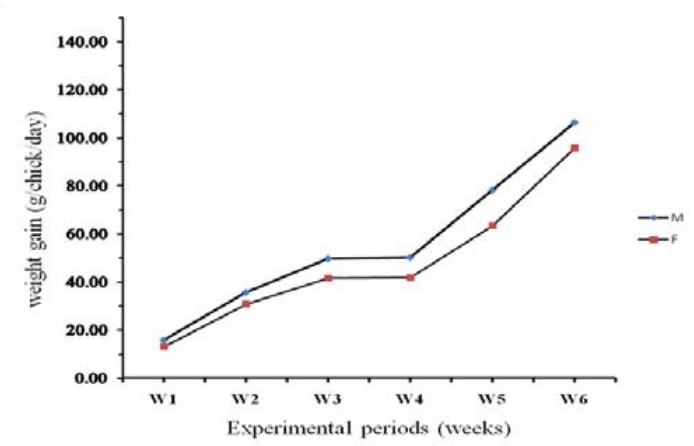

Figure 2 : Effect of sex on weekly body weight gain of Hubbard broiler breed fed diets with different levels of stinging nettle leaf meal over a period of 6 weeks

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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The Effects of Migration by Nomadic Farmers in the Livelihoods of Rural Crop Farmers in Enugu State, Nigeria

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Abstract- The study focused on the effects of migration by nomadic farmers on livelihoods of the rural crop famers in Enugu State of Nigeria. The study had the following specific objectives; determine the socio-economic attributes of the rural crop and nomadic farmers; identify the sources of nomadic farmers conflicts in the rural crop farmers farm fields; assess the socio-economic effects of migration by nomadic farmer on rural development and describe the methods adopted to resolve nomadic farmers conflicts with rural crop famers in the area. In the sampling procedure, purposive and random sampling techniques were used. A purposive multi stage sampling technique was used to obtain a sample size of 60 nomadic farmers and 80 rural farmers, information was elicited using questionnaires.

Keywords: *nomadic farmers, migration, rural community famers.*

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Keywords: *nomadic farmers, migration, rural community famers.*

I. Background Information

In recent years, Nigeria has witnessed series of violent communal clashes arising from the activities of the nomads who move about on a daily basis with their cattle in search of water and green pastures. They are on the streets in most of our cities and could also be found operating in the remotest villages in various state of the country. These nomads who are essentially Fulani tribesmen were originally found in small make-shift communities scattered across the northern fringes of Nigeria and other countries in West Africa.

By their culture, tradition and occupation, they have not remained an itinerant race who owned lands nor had any permanent abode. In fact, they cared less about land ownership because they are always on the move. They simply lived with their cattle wherever there was abundance of fodder and absence of tse-tse-fly, the blood sucking insect that once threatened the existence of their flocks. The nomads used to embark on seasonal migrations from the North to the South but this movement has become an all season's affair. The reason has been that over-grazing in the far north has given way to desertification and the normal alternating wet and dry seasons have metamorphosed into some unusual weather conditions now known as climate change. Initially, a symbiotic relationship existed between the nomads and the farmers in every new community they stopped over to take a rest. The host communities usually peopled by farmers derived organic manure from cow dungs and protein from the beef and diary products while the nomads relied on the farm produce for food Ofem and Inyang (2014).

However, over the years, the presence of the nomads and their cattle has provoked violent clashes in several communities in Nigeria even in the rural communities of Enugu State. Apart from the language and cultural barriers which usually spots out the nomads as strangers, the audacity with which they shepherd their flocks to graze on every available vegetation on their route has often attracted protests from communities. This scenario has given rise to an unhealthy rivalry between farmers and herdsmen leading to violence, loss of lives and property. In some cases, a whole community is wiped out and those fortunate to escape have become refugees in other places.

These clashes have occurred several times in Plateau, Benue, Nassarawa, Kogi, Kwara, Edo, Delta, Enugu, Abia, Ebonyi, Ondo, Oyo Osun and many other states as reported by Okoli and Atelhe (2014). Whenever these clashes occur, the ripples wriggle through the immediate flash points down to the foundations of Nigeria. When herdsmen attack and kill scores of villagers in the course of a contest for grazing fields and

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water, there are usually reprisal attacks. There are also claims and counter claims as to who were the aggressors and the underlying motives for the violence. It often brings to the fore, the indigene/settler question, land ownership and citizenship rights in Nigeria. This scenario has times without number thrown up tribal, ethnic, regional, religious and political sentiments that threaten the corporate existence of Nigeria.

Researches in recent time have shown that by its population and capacity for animal production, with 25% of livestock herds in the sub-region, Nigeria is by far the leading livestock producer in Central and West Africa. The country's cattle herds are estimated at over 16 million head, far ahead of Niger (8.7 million), Mali (8.2 million) and Chad (7 million). The share of Sahel countries is significant, however, representing over 50% of total cattle herds. Cattle raising in Nigeria is largely supplemented by short-cycle livestock operations, estimated at 33.8 million head of sheep and 175 million poultry birds.

Between 85% and 90% of domestic cattle herds are tended by 8 million migratory shepherds and farmer herders, the majority of whom are of Peul ethnicity although other groups are also herders (Shuwa Arabs, Koyam, Kanuri, Kanembou, Touareg, etc.). It is very difficult to assess import flows of live animals from Niger, Chad or Mali, as many animals are "naturalized" when they cross the border, some of which are fattened and finished on their way to the final market outlets. Large parts of the livestock sold on these markets come from the Sahel countries. Cross-border movement of herds during seasonal migration also involves a significant number of animals. Demand for beef is largely driven by the Federation of Nigeria, as Nigerians make up 50% of beef consumers in ECOWAS. Nigeria is experiencing a historic demographic expansion and a spectacular change in food habits. With a population growth nearing 2.8% per year, according to NPC 2006, the country's own domestic production is far from being able to meet demand. Nigeria is therefore forced to import more than 25% of the beef consumed, and is therefore a major outlet for Sahel livestock, via direct sales or the moving of herds for commercial purposes. At the federal level, livestock operations contribute only about 5% of GDP, whereas agriculture as a whole contributes 35% of GDP as reported by CBN 2013.

Following the foregoing discussion, one can see why it is difficult for both the nomadic and rural communities to co-exist without problems. This is because, as the nomadic are busy trying to protect their herds and make livelihood from their sales, the rural farm communities need to protect their farms which these animals upon migration use as grazing land.

The objectives this paper are to:- determine the socio-economic attributes of the rural and nomadic farmers; identify the sources of nomadic farmers conflicts in the rural farmers farm fields; assess the socio-economic effects of migration by nomadic farmer on rural development and describe the methods adopted to resolve nomadic farmers conflicts with rural famers in the area.

II. Methodology

The study was carried out in Enugu State of Nigeria which was created out of the former Anambra State during 1991 creation of States in the Country. The state is located between latitudes 5o561 and 7o061N and longitudes 6o531 and 7o551E (Ezike, 1988). Enugu State is bounded on the East by Ebonyi State, on the North by Benue and Kogi States, on the south by Abia State and on the west by Anambra State (Ezike, 1988). The State occupies an area of about 8,022.95km2 (Ezike, 1988) and has a population of 3,257,298 with average growth rate of 3% according to NPC, 2006. Enugu State with seventeen local government areas is divided into three agricultural zones namely: Awgu, Enugu and Nsukka Zone.

In the sampling procedure, both purposive and random sampling techniques were used to select those vulnerable areas where there are effects of nomadic farmers' activities on the livelihoods of the rural crop famers. In the study area made of three agricultural zones two (2) local government areas was purposively selected given total of six (6) local government areas. From the selected local government areas, two (2) rural communities were selected given total of twelve (12). Finally, from the selected rural communities seven (7) household's heads were selected as respondents given total of eighty-four (84). But during the analysis for the rural crops farmers, only eighty (80) respondents were used, as four of the data collection instruments were discarded because the respondents did not give satisfactory information as required. In the case of nomadic farmers, 62 of them were interviewed. At analysis, 60 of the respondents gave adequate information whereas 2 were rejected due to incomplete information. Therefore, a total of 140 questionnaires were used for the study. Primary data were collected through the use of well-structured questionnaires. The questionnaire focuses on demographic, socio-economic characteristics as well as data on conflict management and rural development. Data were analyzed using descriptive.

III. The Oretical Framework

Over the years researchers have studied the conflict theory in order to understand what the root causes of conflicts, are their effects on rural development and how they can be managed for effective and sustainable development. According to Hornby (1995), conflict is a serious disagreement, argument, struggle and serious difference of opinions, wishes or a clash. The threat is directed towards limiting

or eliminating the access of one party to some resource or goal (Robinson, and Clifford 2010). This could be seen in cases of land disputes between crop farmers and grazers in the grass-fields where they share the same environment for farming and grazing.

The conflict theory attributes to a society the characteristics of coercion, division, hostility, dissension conflict, mal-integration and change. Klein and Ritti (1980) stated that conflict has various components which include; differences in tasks, values, attitudes and goals priorities as groups try to gain control over scarce resources. According to Ekong (2003), conflict may arise where there is difference of opinion between group leaders or in situations where one group tends to be exploiting the other. Conflict between personalities may lead to group quarrel and division of the community into several factions. Challenge to the security of the community may engender conflict. Conflict has both positive and negative effects on the society. Its negative effects include the disruption of social unity, generation of bitterness which may lead to destruction of property and bloodshed, generation of inter-group tension, disruption of normal channels of cooperation and diversion of members' attention from group's goals. Conflicts have been perceived to begin with the basic premise that there should be a different distribution of some scarce resources in society and that one group or individual should have more equitable opportunity to maximize their potential than others. Conflict emanates from the insatiable nature of human wants; competition for scarce resources is the foremost cause of community or inter-group conflicts. This is most common with crop farmers and grazers who need the land for their activities. Another cause of conflict is associated with inter-dependence. If two groups depend on one another there tend to be more conflicts among them (Walton, Dolton and Caffety, 1991) Also economic relations have led to conflicts which in turn have led to change.

Pelican (2000) identified ethnic conflict and integration as problems of inter-ethnic relation facing the Fulbe grazers and their neighbouring crop farmers. Since their migration into the Grass-fields of the North-West, the relationship between the pastoral Fulbe and crop farmers has been both advantageous and problematic. Haman (2002), in his study in Mezam division, suggested that the future of pastoralists is tied to pastoralism itself. It was therefore clear that pastoralism in a very high population density and growth, where the pastoralists have no control over the grazing lands which they occupy, is an issue of major concern. In loosely structured group, conflict helps to stabilize and integrate its members by eliminating sources of dissatisfaction. Internal conflict serves as a means for asserting and ascertaining the relative strength of antagonistic interests in the situation of interaction. Conflict helps to bring to light the areas of discontent and suggested solutions to reach consensus and achieve equilibrium (Charles, 2005). This seems to be the situation in the North-West area in which the farmers and grazers tied together in the rural areas.

The grazing lands are considered as national lands which could be taken over at any time for any other development purposes by the government or some individuals. In former times, the pastoral Fulbe roamed with their cattle from one place to another as nomads and only settle temporarily where there was abundant pasture. Nowadays they are more sedentary practicing transhumance due to population pressure; which has reduced the grazing land. The settlement of grazers raises a number of conflicts, first of all within themselves since they find it difficult to give up their extensive grazing habits and secondly with local communities, who claim to be first settlers thus imposing a superiority complex and rights over land. Most farmers and grazers tend to resolve their problems by themselves, despite the setting up of a legislative procedure by the government to solve such disputes.

Despite efforts by the government at the liberalization of political space, the struggle for land natural resources remains one of the key factors fuelling instability in Africa. In the former settler colonies such as Kenya, Zimbabwe and South Africa, the failure to resolve historical claims arising from colonial expropriations and compounded by unequal re-distribution of land after independence, remains a primary source of conflict. Apart from dealing with issues relating to the redress of historical injustices and the attainment of social equity, land policy development and reform must address the problem of conflict prevention and restoration of peace and security in Africa (African Union, 2009).

IV. Consequences of Crop and Nomadic Farmers Conflicts

The nomadic farmers or grazers suffer from material damages when the crop farmers inflict physical injuries on the cattle by using cutlasses, spears or guns or by poisoning the cattle. In Santa Sub division in Pinyin in 1994 a grazer lost his entire herd as a result of attack on the cattle by crop farmers (Haman, 2002).

Open confrontation results in rural insecurity and out migration (Ngoufo, 1992). In the event of a conflict, properties and lives are destroyed leading to misery and hardship. The socio-economic consequences of agro-pastoral conflicts are felt at three levels. At the social level, misunderstanding between the crop farmers and nomadic famers or grazers creates some mistrust, tension and open confrontations between the opposing groups. Crop and nomadic farmer conflicts, have increased in the last decade because many of those who have been retrenched or retired from service can no longer afford to live in the urban areas. They return to the rural areas and embark

on agriculture thus increasing the demand for farm land. This is very visible in the grass-field areas of different parts of Nigeria especially in Enugu State where some rural areas have greater population per square kilometer. The nomadic farmers in Nigeria and even the study area practice transhumance to avoid over grazing the available limited land or reduce the herd size during the dry season when there is scarcity of pasture and water on the highlands. The animals are taken to the low lands and farmer-grazer conflicts become intensified during this period because as the farmers cultivate vegetables in the river valleys with little or no land for grazing. Therefore, farmer-grazer conflicts pose a serious problem to the people and affect rural development negatively as project is executed during chaos or conflict.

V. Results and Discussions

Results of the socio-economic characteristics of the respondents are presented in Table 1. Most of the rural crop farmers (56%) as well as the nomadic farmers (75%) fall in the age range 21-40 years while only a few of the respondents were above forty-one years of age. Also it can be seen that majority of the respondents (both crop farmers and nomadic farmers) were males. This explains the fact that most of those who practice crop farming or are engaged in grazing of animals are mostly matured males. However, in reality it is the women who are engaged in crop farming but when there is a conflict it is the men who carry out the attack or go to courts. The table also shows that 56% of crop farmers have a family size of ≤10 persons. It further shows that 53% of nomadic famers have a family size of ≥ 11persons. These are peculiar situations in rural areas as most of these families lack the basic resources for development and consider land or cattle their only source of livelihood. Also most of these farmers and nomadic famers believed that it is better to have more children who will work on the farm or help in grazing the herd than hiring external labour.

Most of the crop farmers had at least a primary school education (44%) while 38% had no formal education. On the contrary, majority of the nomadic farmers (58%) had no formal education. This goes to show that education amongst the nomadic farmers is not considered a priority because they are known for their nomadic life style which makes them to constantly keep migrating from place to place. Also the low level of education amongst the nomadic famers is a product of several factors in the society. Many of them live in remote and enclave areas where schools are not available. This confirms the reason why the present government of Nigeria established so many nomadic educational institutions in the country especially in the northern parts of the country. Furthermore, 62% of farmers had a farm size of less than or equal to one hectare while only 4% of the rural crop farmers have a farm size of equal to or above six hectares. This goes to confirm that land holdings in the rural areas are usually small and is obtained mostly through inheritance. On the other hand 58% of nomadic farmers have cattle herds of 30 and below while 3% had herd size of equal to 151 and above cattle. The number of cattle a man has is considered as a sign of wealth therefore those with 50 or below herd are considered poor amongst the nomadic famers.

Table 1 : Socio-economic characteristics of respondents

Variable	Crop farmers (frequency)	Percentage	Nomadic farmers (frequency)	Percentage
Gender				
Male	65	81	55	92
Female	15	19	5	8
Ages				
≤ 10	3	4	2	3
11-20	12	15	5	8
21-40	45	56	45	75
≥ 41	20	25	8	14
Educational level				
No formal education	30	38	35	58
Primary school	35	44	15	25
Secondary school	10	13	10	17
Tertiary education	5	6	NA	NA
Experience				
≤ 5	10	13	5	8
6-10	25	31	20	33
11-20	30	38	35	58
≥ 21	15	19	5	8
Household size				
≤ 5	5	6	3	5
6-10	40	50	25	42
≥ 11	35	44	32	53
Marital status				
Single	10	13	12	20
Married	50	62	45	75
Widowed	15	18	1	2
Widower	3	4	NA	NA
Separated	2	3	2	3
Land size (hectares)			**Herds (number of animals)**	
≤ 1	50	62	NA	NA
2-3	20	25	NA	NA
4-5	7	9	NA	NA
≥ 6	3	4	NA	NA
≤ 30	NA		35	58
31-60	NA		10	17
61-90	NA		5	8
91-120	NA		5	8
121-150	NA		3	5
≥ 151	NA		2	3

Source: Field survey 2014; NA=Not applicable

Conflicts over the years have brought long sufferings and hardship on both the nomadic farmers and the crop farmers in Nigeria and Enugu State in particular. Table 2 below shows the various sources of conflict between these two groups and the various methods employed in trying to resolve these conflicts.

VI. Sources of Farmer-Grazer Conflicts

Data on sources of crop and nomadic famers' conflicts and possible methods of resolution are presented in Table 2 below. Results show that 37% of crop farmers and 8% of nomadic farmers consider competition over land as the major source of conflict between them. This indicates that land is a limiting factor for both and is declining as the population increases. On the other hand, 13% of crop farmers and 42% of nomadic farmers attribute the cause of conflict between them as being conflict of culture. This conflict of culture is a serious obstacle between crop farmers and nomadic famers who are heterogeneous in race, occupation and religion. Other causes of crop and nomadic farmers' conflict include encroachment into grazing land, cattle trespass, as well as leadership struggle between the communities.

According to Baye (2002) the demarcation of grazing and cropping land in the grass field that took place since the colonial period in different parts of Africa is highly contested now because of the rapidly growing population, need of more land for agriculture and rural development. In the study area, many farmers are not

generally satisfied with the manner in which crop and nomadic cases are handled by some local (traditional) and government officials. The general belief by the crop farmers is that the nomadic farmers sell their cattle to bribe the government officials, some traditional chiefs in other to twist judgments in their favour. The conflicts have contributed in depleting the primary assets of crop farmers and the nomadic farmers since they use their scarce resources to hire the services of solicitors. These are resources which could be used to educate their children who are almost always remaining in a state of poverty and underdevelopment. The nomadic farmers even blame the crop farmers for the increasing encroachment into grazing land over the years and placement of crop farms along access routes to watering points and transhumance tracks across the country and the study area.

Table 2 : Sources of nomadic/rural farmers' conflicts and possible methods of resolving them

Sources of conflicts	As seen by rural farmers (frequency)	Percentage	As seen by Nomadic farmers (frequency)	Percentage
Competition over land	30	37	5	8
Cattle trespass	25	31	10	17
Leadership struggle	8	10	15	25
Conflict of culture	10	13	25	42
Corruption	5	6	NA	NA
Encroachment into grassing land	2	3	5	8
Methods of conflict resolution				
Traditional councils	30	37	20	33
Magistrate courts	10	12	10	17
Peaceful settlement (ADR)	20	25	10	17
Deliberate escape	3	4	2	3
Law enforcement	5	6	7	12
Agricultural agents	2	3	1	2
Land commissions	2	3	2	3
Open confrontations	8	10	8	13

Source: Field survey 2014
NA=Not applicable

VII. Summary, Conclusion and Recommendations

From the discussion on this paper, it is obvious that farmer-grazers conflicts in any parts of Nigeria and that of Enugu State are centered mainly on cattle owners and crop farmers. The population of both crop and nomadic farmers is rapidly increasing but land remains fixed. The research have found that majority of the causes are seen in terms of competition on land, cattle trespass, struggle for leadership, conflict of culture and corruption by some officials. Based on the above premise, and other relevant issues raised in this research, it is therefore, considered very necessary that to meet with the demand of the society, the government and other interested policy makers may find the following under listed recommendations useful.

In view of the rapid population pressure and declining farmlands there is the need to adopt improved farming techniques. The farmers should adopt intensive cultivation by using improved seeds and farm inputs. The pastoralists should adopt a viable and intensive system of grazing in order to cope with the rapid demographic pressure on the grass fields across the country.They should embark on greater fodder production to feed the cattle especially in times of scarcity during the dry season. The government at different levels should intervene and carryout periodic sensitization workshops for both crop and nomadic farmers.

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Impact of KVK in Transfering Knowledge to Tribal Farmers on Farm Activities

By Dr. Narayan Bar
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Abstract- Krishi Vigyan Kendras (KVKs) are organising training programmes with the felt needs of the tribal farmers as per the resources available. The study conducted with 240 tribal farmers and farm women undertaken training at KVK in the districts of Sundergarh, Keonjhar and Nuapada revealed that there was overall increase of 36.82% of the knowledge level of the respondents on various farm activities. However, 33.00% gaps indicated that the tribal farmers and farm women were still lacking adequate knowledge. More gaps were observed on farm forestry, fish farming, income generating activities, farm mechanisation, animal production and horticulture in comparison to crop production. Socio-economic attributes of the respondents had not much influence in increasing their knowledge level. Hence, KVKs have to organise more need based training programmes to enrich knowledge and skill competency of the tribal farmers to adopt the changed practices for more production and income for their sustainable livelihood.

Keywords: *Training, KVK, tribal, knowledge.*

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Keywords: training, KVK, tribal, knowledge.

I. Introduction

Krishi Vigyan Kendra (KVK) is an innovative science based institution which functions on the collaborative participation of scientist, subject matter experts, extension functionaries and farmers. The main purpose of KVK is to impart learning through work experience to those who are engaged in farming. The syllabus and programmes of each KVK are tailored to the felt needs of the farmers, their resources and potential for agricultural development of a particular area. Teaching by doing and learning by doing are the main approach of imparting skill training by KVKs.

The constitution of India has provided adequate safeguards for the socio-economic development of the weaker communities and more particularly to tribal people. KVKs are also giving emphasis for the development of tribal farming community. When the tribal farmers learn the skill with interactive approach, they will equip with adequate knowledge and skill over the changed practice and motivated to adopt the changed practices. Follow-up actions were also made through field visits, ex-trainees meet etc. to assist the tribal farmers in adoption of changed practices learned through training. It is therefore apprehended that the tribal farmers undergone training at KVK have develop knowledge and skill competency on farm activities.

An attempt was therefore made to assess the impact of KVK in transferring knowledge to tribal farmers on farm activities.

II. Materials and Methods

The study was conducted in tribal districts of Sundergarh,Keonjhar and Nuapada under North Western Plateau, North Central Plateau and Western Undulating Agro-climatic Zones of Odisha. A list of tribal farmers and farm women undertaken training were collected from KVKs functioning in these districts. Two blocks from each district and two gram panchayats from each block was selected randomly with the more coverage of KVK activities. Twenty tribal farmers and twenty farm women were selected randomly from each block covering total sample size of 240. The data was collected personally through a semi-structured scheduled pre-tested earlier. The information recorded on scale point of fully know, considerable know, least know and not know were analysed with score value of 3, 2, 1 and0 respectively. Statistical tools of mean score, gap percentage and correlation co-efficient were employed to reveal the results.

III. Results and Discussions

Rice, maize, oilseeds and pulses are the major crops by the tribal farmers in the study districts. KVKs are also organising training programmes regularly for updating their knowledge. It is observed from table-1 that there was significant increase (41.35%) in knowledge level of the respondents on various aspects of crop production. At the same time, average gap of 21.00% indicated that there is still scope to enhance the knowledge level of the respondents particularly on green manuring and composting.

Crop production and mixed farming, bio-fertilizer and bio-pesticide use, nursery management, line sowing and transplanting, water management, harvesting and post harvesting for which KVKs have to organise more training programmes on these aspects.

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Table 1 : Knowledge gained on crop production (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Land preparation	1.63	2.67	38.95	11.00
2	Variety	1.42	2.58	44.96	14.00
3	Seed treatment	1.55	2.72	43.01	9.33
4	Nursery management	1.32	2.28	42.11	24.00
5	Line sowing and transplanting	1.42	2.28	37.72	24.00
6	Nutrient management	1.32	2.38	44.54	20.67
7	Pest & disease management	1.42	2.57	44.75	14.33
8	Water management	1.42	2.28	37.72	24.00
9	Weed management	1.43	2.47	42.10	17.67
10	Crop rotation and mixed farming	1.20	2.05	28.33	31.67
11	Harvesting and post harvesting	1.38	2.30	40.00	23.33
12	Green manuring and composting	1.30	2.07	37.20	31.00
13	Bio-fertilizer and bio-pesticide	1.27	2.12	40.09	29.33
	Average	1.39	2.37	41.35	21.00

(Maximum obtainable score – 3)

The study district have the potentialities of fruits and vegetable cultivation and more suitable for off season vegetable cultivation. KVKs are also emphasising training on fruits and vegetable cultivation. The data analysed in table-2 revealed that there was overall increase of 46.09% on knowledge level of the respondents. But still there was overall gap of 23.33%. Comparatively less percentage of gaps was observed on variety, nursery raising, processing and value addition. Therefore, KVKs have to organise further training programmes on nutrient, disease and pest management, planting material production, water management and flower cultivation to enrich their knowledge further to develop competency.

Table 2 : Knowledge gained on horticultural crops (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Variety	1.38	2.50	44.80	16.67
2	Nursery raising	1.38	2.40	42.50	20.00
3	Planting material production	1.28	2.07	38.16	31.00
4	Nutrient management	1.17	2.13	45.07	29.00
5	Pest & disease management	1.18	2.13	44.60	29.00
6	Water management	1.27	2.30	44.78	23.33
7	Flower cultivation	1.30	2.33	44.21	22.33
8	Medicinal and aromatic plants	1.08	2.35	54.04	21.67
9	Processing and value addition	1.10	2.45	55.10	18.33
	Average	1.24	2.30	46.09	23.33

(Maximum obtainable score – 3)

Farm mechanisation is the prime importance at present due to labour scarcity and wage hike in farm activities. KVKs used to motivate farmers for use of farm implements and machineries for timely operations. The data in table-3 indicated there was overall increase of38.85% in knowledge level of the respondents on various aspects of farm mechanisation. At the same, significant gaps were also observed except spraying and dusting. Further training programmes have to be organised on soil and water conservation, fabrication of handy tools, repairing and maintenance of implements, land preparation, line sowing and transplanting, weeding, drip and sprinkler, harvesting and post harvesting to develop knowledge proficiency of the respondents on farm mechanisation.

Table 3 : Knowledge gained on farm mechanization (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Land preparation	1.43	2.17	34.10	27.67
2	Line sowing and transplanting	1.43	2.18	34.40	27.33
3	Weeding	1.28	2.25	43.11	25.00

4	Spraying and dusting	1.63	2.47	34.00	17.67
5	Harvesting and post harvesting	1.20	2.30	47.83	23.33
6	Repairing and maintenance of implements	1.23	1.87	34.22	37.67
7	Drip and sprinkler	1.23	2.28	46.05	24.00
8	Soil and water conservation	1.07	1.78	39.89	40.67
9	Fabrication of handy tools	1.15	1.75	34.29	41.67
	Average	1.29	2.11	38.85	29.67

(Maximum obtainable score – 3)

The tribal farmers have the affinity for animal component and traditional habit of keeping poultry and goatery in backyard system. Need based training programmes were also organised by KVKs. Analysis of data revealed (table-4) that there was overall 41.44% increase in knowledge on various aspects of animal production. Considering overall gap of 26.00% and significant gaps in all aspects of animal production covered under study, the respondents need to be further expected through training to equip sufficiently with knowledge and skill enabling to adopt the recommended practices for better income.

Table 4 : Knowledge gained on animal production (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Breeds and selection criteria	1.37	2.04	32.84	32.00
2	Up gradation of local breeds	1.13	2.03	44.33	32.33
3	Housing and maintenance	1.22	2.20	44.45	26.67
4	Feeding management	1.32	2.23	40.81	25.67
5	Formulation and preparation of feed	1.43	2.22	35.59	26.00
6	Kid, chick and calf rearing	1.30	2.37	45.15	21.00
7	Fodder cultivation and feeding	1.28	2.30	44.35	23.33
8	Health care	1.33	2.23	40.36	25.67
9	Value addition of milk	1.30	2.38	45.38	20.67
	Average	1.30	2.22	41.44	26.00

(Maximum obtainable score – 3)

Though the study districts have not the potentialities in pisciculture, still the Govt.of Odisha emphasising fish production in reservoirs and community tanks to become self sufficient in fish production. The findings observed from the table-5 indicated for overall increase of 28.65% knowledge on fish farming. Though the knowledge level significantly increased, but the gap percentage observed from 35.67% to 44.00% on different aspect with overall gap of 40.62% indicated that the respondents were considerably lacking in knowledge about various aspects of fish farming.

Table 5 : Knowledge gained on Fish farming (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Fingerling production	1.28	1.72	25.58	42.67
2	Pond management	1.30	1.72	24.42	42.67
3	Feeding management	1.37	1.83	25.14	39.00
4	Disease management	1.30	1.75	25.71	41.67
5	Composite fish farming	1.23	1.77	30.86	41.00
6	Fish farming in community tank and reservoir	1.38	1.93	28.50	35.67
7	Multiple stocking and harvesting	1.12	1.68	33.33	44.00
8	Freshwater prawn production	1.13	1.85	38.92	38.33
	Average	1.27	1.78	28.65	40.62

(Maximum obtainable score – 3)

The study districts have great opportunities for farm forestry enabling the tribals for optimum utilisation of degraded and unbounded uplands. The state Government is giving emphasis on Agro forestry in integrated approach for which training programmes organised by KVKs. It is observed from table-6 that there was overall 17.81% increase in knowledge level of the respondents on various aspects of farm forest. At the same time, average gap of 51.33% indicated that the respondents had poor knowledge and suggested for adequate number of training programme to enrich their knowledge on farm forestry.

Table 6 : Knowledge gained on Farm Forestry (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Nursery raising	1.33	1.67	20.36	44.33
2	Plantations and management	1.33	1.42	6.34	52.67
3	Forest based farming system	1.18	1.37	13.87	54.33
4	Fertilizer management	1.15	1.37	16.06	54.33
5	Disease management	1.15	1.42	19.01	52.67
6	Mulberry cultivation	1.13	1.55	27.10	48.33
7	Silk worm cultivation	1.18	1.48	20.27	50.67
8	Lac cultivation	1.17	1.45	19.31	51.67
9	Value addition of forest produce	1.20	1.43	16.08	52.33
	Average	1.20	1.46	17.81	51.33

(Maximum obtainable score – 3)

The tribals need additional income generating activities for their livelihood support. KVKs are regularly organising vocational training programmes for the rural youth for the generation of employment. Though the respondents had (table-7) 33.33% increase in knowledge on various vocational activities, still 39.00% gap exists which demand further exposure through skill training.

Table 7 : Knowledge gained on Income generating activities (N=240)

Sl. No.	Knowledge	Mean Score		Increase (%)	Gap (%)
		Before	After		
1	Mushroom production	1.45	2.03	28.57	32.33
2	Bee keeping	1.17	1.67	29.94	44.33
3	Seedling raising	1.22	1.93	36.79	35.67
4	Poultry rearing	1.32	1.93	31.61	35.67
5	Nutritional gardening	1.10	1.88	41.49	37.33
6	Preservation and value addition	1.30	1.92	32.29	36.00
7	Vermi compost	1.15	2.08	44.71	30.67
8	Goat and sheep rearing	1.20	1.80	33.33	40.00
9	Art and craft	1.12	1.45	22.76	51.67
10	Embroidery and tailoring	1.15	1.58	27.22	47.33
	Average	1.22	1.83	33.33	39.00

(Maximum obtainable score – 3)

Attempt was further made for a comparative analysis of the knowledge gained by the respondents on various farm activities. The data in table-8 revealed that the respondents had 33.00% of gaps against 36.82% increase in knowledge on various farm activities. Comparatively more gaps were observed on farm forestry (51.33%) followed by fish farming(40.62%), income generating activity(39.00%),farm mechanization (39.67%), animal production(26.00%), horticulture (23.33%) and crop production(21.00%).

Table 8 : Extent of knowledge gained on farm actvities

Sl. No.	Knowledge	Mean score		Increase %	Gap %
		Before	After		
1	Crop production	1.39	2.37	**41.35**	21.00
2	Horticulture	1.24	2.30	40.69	23.33
3	Farm mechanization	1.29	2.11	38.85	29.67
4	Animal production	1.30	2.22	41.44	26.00
5	Fish farming	1.27	1.78	28.65	40.62
6	Farm forestry	1.20	1.46	17.81	51.33
7	Income generating activity	1.22	1.83	33.33	39.00
	Average	1.27	2.01	36.82	33.00

Maximum obtainable score-3

Further attempt was made to assess the influence of socio-economic variables in increasing knowledge level of the respondents on various aspects of farm activities. Analysis of data made with correlation

co-efficient indicated (table-9) that the socio-economic attributes of the respondents had not much influence in increasing the knowledge level of the respondents.

Table 9 : Influence of socio-economic variables on knowledge (N=240)

Sl. No.	Variable	Correlation value			Pooled
		Keonjhar	Sundargarh	Nuapada	
1	Age (X_1)	-0.066	-0.130	-0.126	-0.102
2	Education (X_2)	0.101	-0.109	0.117	0.047
3	Family type (X_3)	0.046	-0.151	-0.140	-0.069
4	Family size (X_4)	-0.126	0.089	-0.058	-0.034
5	Social participation (X_5)	-0.066	-0.449**	-0.071	-0.197*
6	Cosmopoliteness (X_6)	0.038	0.064	0.043	0.043
7	Media exposure (X_7)	0.147	-0.095	0.142	0.061
8	Housing pattern (X_8)	0.007	0.044	-0.015	0.008
9	Holding size (X_9)	0.023	0.183*	0.019	0.060
10	Occupation (X_{10})	-0.066	0.119	-0.048	0.019
11	Material possession (X_{11})	-0.252*	0.186*	-0.167	-0.066
12	Annual income (X_{12})	-0.200*	0.146	-0.159	-0.065
13	Social aptitude (X_{13})	-0.158	0.358**	-0.157	-0.007
14	Economic aptitude (X_{14})	-0.102	0.393**	-0.111	0.028
15	Scientific orientation (X_{15})	-0.155	0.263*	-0.171*	-0.041

*** Significant at 0.01 level*

** Significant at 0.05 level*

IV. Conclusion

The analysis of data indicated that KVK training has made significant impact in increasing the knowledge level of the tribal farmers and farm women on various farm activities. At the same time, average gap of 33.00% indicated that the tribals were still lacking in adequate knowledge. More knowledge gaps were observed on farm forestry, fish farming, income generating activities, farm mechanisation, animal production and horticulture in comparison to crop production. Socio-economic attributes of the respondents had not much influence in increasing the knowledge level of respondents.

It is therefore suggested that KVKs have to organise more need based training programmes to enrich the knowledge and skill competency of tribal farmers on their farm activities. So that tribal farmers and farmwomen will adopt the changed practices and increase production as well as income for their sustainable livelihood.

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Effect of Heavy Metals on Plant Growth and Ability to Use Fertilizing Substances to Reduce Heavy Metal Accumulation by *Brassica Juncea* L. Czern

By Nguyen Xuan Cu
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Abstract- Heavy metal pollution in soil and water is a global environmental concern. In Vietnam, accumulation of heavy metals in soil, water and plant biomass has been widely reported. Cultivation of crops on contaminated sites may result in both growth inhibition and tissue accumulation of heavy metals with resulting possible risks to humans health. In this paper, plant growth inhibition and accumulation of Cu, Pb and Zn by *Brassica juncea* L. Czern are studied in pot experiments.

Keywords: *brassica juncea, heavy metal accumulation, lime, phosphate, sawdust.*

GJSFR-D Classification : *FOR Code: 070199*

Effect of Heavy Metals on Plant Growth and Ability to Use Fertilizing Substances to Reduce Heavy Metal Accumulation by *Brassica Juncea* L. Czern

Nguyen Xuan Cu

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The heavy metal concentrations in above-ground tissue of *Brassica juncea* indicated a possible accumulation of heavy metals due to plant uptake by the high levels of Cu, Pb and Zn in soil. The contents of Cu, Pb and Zn in plant were related more closely to heavy metal of EDTA-extractable concentrations in soils. More effects to reduce the accumulation of Cu, Pb and Zn in *Brasica juncea* was observed in all experiments with phosphate fertilizer, lime or sawdust was applied. However, the application of phosphate fertilizer and lime are more effective to reduce Cu, Pb and Zn uptake by *Brassica juncea* than sawdust. Phosphate fertilizer was founded most effective to reduce Pb accumulation in plant, whereas lime for Zn.

Keywords: brassica juncea, heavy metal accumulation, lime, phosphate, sawdust.

I. Introduction

Increasing environmental pollution caused by heavy metals, released by industries and agricultural activities, is a major problem in the world. Heavy metal pollution in soil and water is a global environmental concern (Shyama R et al., 2009). The hazardous levels of heavy metals in vegetables grown in peri-urban areas affected by the effluent waste water from cities and industrial areas also reported by Ravi Naidu et al. (2003). *Brassica juncea* L. Czern has the capacity to take up and accumulate heavy metals such as Cd, Cu, Ni, Zn, Pb and Se to high levels ((Shyama R et al., 2009; Blaylock et al., 2000). In recent years, the use of waste water from the city in agriculture irrigation have made significant accumulation of heavy metals in soils and in agricultural products in Vietnam (Nguyen Xuan Cu and Le Duc, 1988; Nguyen Xuan Cu, 2008). Many studies showed hazardous levels of unsafe vegetables in daily meals for residents due to high accumulation of heavy metals such as Cu, Pb, Zn and Cd (Cheang Hong and Nguyen Dinh Manh, 2003; Dang Thi An and Chu Thi Thu Ha, 2005; Ho Thi Lam Tra, 2007).

Generally green vegetables, i.e., *Brassica juncea* L. Czern are very common use in daily diet of Vietnamese people. *Brassica juncea* is a plant with high capable of accumulation of heavy metal elements, and then affect human health through pathway of bio-accumulation (Ravi Naidu et al., 2003). However, the solutions for soil treatment do not handle effective because the actual pollution levels of heavy metals due to wastewater or fertilizer use often unreasonably low and scattered distribution. It is also difficult to prevent farmers from cultivation on these land in practice.So agricultural products containing high concentrations of heavy metals have been used in the daily diet of the people. Use of fertilizers to reduce heavy metal uptake and accumulation in agricultural products are considered towards positive solutions to maintain the production process should easily be accepted by farmers. Organic amendments such as farmyard manue or inorganic additives such as lime, zeolites, and iron oxides where they are found to reduce the transfer of metals into crops (Iwona Grabowska, 2001).

The main purpose of this study is to examine the impact of the heavy metals (Cu, Pb, Zn) as stress factors to growth and heavy metal uptake of *Brassica juncea* L. Czern, and determine the ability to use phosphate fertilizer, lime and sawdust to reduce heavy metal accumulation in plants grown on contaminated soils with different levels of heavy metals.

II. Materials and Methods

The pot experiments were carried out at the green house of Vietnam Academy of Agricultural Sciences in Hanoi, Vietnam. The soil and fertilizers are mixed and contaminated by heavy metals in different rates and place in pot experiments (5kg soil/pot), left it overnight and then sown seeds of vegetables (*Brassica juncea* L. Czern), 30 seeds/pot. After 15 days of sowing pruning conducted to ensure appropriate density for

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growing plants (10 plants/pot). The soils used in the experiments is Red river alluvial soil collected at a vegetable growing areas of Thanh Tri district, Hanoi, Vietnam. Some properties of soil is as follows: pH (KCl) 6.15; SOM 2.44 %; CEC 23.46 Cmol/kg; total N 0.22 %, total P_2O_5 0.19 %, total K_2O 1.02 %; total of Cu 21.29 ppm, Pb 57.16 ppm and Zn 7.24 ppm.

The treatments were contaminated with heavy metals at levels of 50 ppm, 100 ppm, 200 ppm for Cu and Pb; and 100 ppm, 300 ppm, 500 ppm for Zn. The phosphate fertilizer at the rates of 17ppm, 26ppm and 34 ppm P_2O_5 (equivalance 40 kg, 60 kg and 80 kg P_2O_5/ha); lime use at the rates of 435ppm, 870ppm and 1305 ppm $CaCO_3$ equivalance (1 ton, 2 tons and 3 tons $CaCO_3$/ha); while sawdust applied at 6522ppm, 9783ppm and 13044ppm (equivalance 10 tons, 15 tons and 20 tons/ha).

The treatments were arranged individually responsible for determining the influence of the levels of added Cu, Pb, Zn, phosphate, lime and sawdust on the growth, yield and heavy metal accumulation in plant of *Brassica juncea*. The fertilizers used in the forms of urea (NH2)2CO; potassium chlorua KCl, superphosphate and lime (CaO). Chemical contaminants Cu^2+, Pb^2+ and Zn^2+ is added as the chemicals of $CuSO_4.5H_2O$, $Pb(NO_3)_2$ and $ZnSO_4.7H_2O$. Control treatment fertilized with $(NH_2)_2CO$ and KCl at the rates of 33ppm N and 13ppm K_2O (75 kg N and 30 kg K_2O/ha).

Plant growth and yield (above ground), and the contents of heavy metals determined for *Brassica juncea* in response to Cu, Pb and Zn stress. Plants were observed for their growth and harvested after 45 days. Heavy metal contents (Cu, Pb and Zn) in soil and plant (above ground) were estimated using Atomic Absorption Spectroscopy; extractions to assess mobilization of Zn^2+, $Pb^2+$and Cu^2+ in EDTA solution.

III. Results and Discussion

a) Effect of Cu, Pb, Zn on growth and their accumulation in Brassica juncea

i. *Effect of Cu on the growth and Cu accumulation in Brassica juncea*

The research results on the effects of applied Cu on plant growth and Cu accumulation in plants of *Brassica juncea* are presented in Table 1. The data in Table 1 show the amount of added Cu quite markedly influence the plant height. When the amount of added Cu increased to 50 ppm, 100 ppm and 200 ppm as the height of the plant decreases significantly corresponding to 23%, 25% and 36% compared to the control.

Table 1 : Effect of added Cu on growth and Cu accumulation in *Brassica juncea* (fresh weight)

Added Cu (ppm)	Plant height		Yield		Content of Cu in plant	
	cm	%	g/pot	%	ppm	%
0	19.5	100	70.3	100	2.75	100
50	15.0	77	55.9	80	3.17	115
100	14.7	75	50.0	71	5.21	190
200	12.5	64	33.1	47	8.46	308

The amount of added Cu not only reduces plant height but also affect the yield of plants. At the rates of 50 ppm, 100 ppm and 200 ppm the vegetable yields decreased 20%; 29% and 53% respectively to the control. Such changes tend to yield of plants are also similar to the height of plants, however the level of influence is much higher, especially at the rate of 200 ppm Cu.

The effect of added Cu to soil on Cu accumulation in plants is also significant. The results showed when the rate of added Cu increased from 0 to 50 ppm; 100 ppm and 200 ppm the content of Cu in plants have increased 15%, 90% and 308% respectively. Thus at the rate of 200 ppm, Cu accumulation in plants increased markedly. This result is consistent with a decline in the growth of vegetables has been discussed above. We can say that cultivation of crops in or close to contaminated sites may result in both growth inhibition and tissue accumulation of heavy metals, with resulting possible risks to humans or livestock health if these products are ingested.

The similar results of growth inhibition and accumulation of Cu, Pb and Zn for *Brassica* species were reported by Carmina Gisberta et al. (2004). The research of Naiyanan and Banchagan (2006) on copper removal from soil by Brassica juncea (L.) Czern also showed the maximum concentrations of copper in *Brassica juncea* (L.) Czern was 3,771 mg/kg (dry weight) in the pots experiment with 150 mg Cu/kg soil. The statistical analysis indicated that copper accumulations between shoots and roots of *Brassica juncea* (L.) Czern were not significantly different when Cu was added lower than 50 mg/kg. However, in the experiment amended with 100, 150 and 200 mg Cu/kg, copper concentration in the roots was greater than those in the shoots. The highest accumulation efficiency of *Brassica juncea* (L.) Czern was 1.61% in the pot with 150 mg Cu/kg soil.

ii. *Effect of Pb on the growth and Pb accumulation in Brassica juncea*

The effect of added Pb to plant growth and Pb accumulation in plants are presented in Table 2. The height of plant decrease from 19.5 cm to 14.5 cm, 13.4 cm and 11.0 cm when the rates of added Pb increase from 0 ppm to 50 ppm, 100 ppm and 200 ppm,

respectively. That is calculated to reduce the plant height corresponding to 25%, 31% and 44% compared to the control. Similarly, the yield of plant also tends to decrease rapidly with increasing the rates of Pb; i.e., at the rates of 50ppm, 100ppm and 200 ppm Pb the yield corresponding reduction of 27%, 51% and 56% compared to the control.

Table 2: Effect of the added Pb to plant growth and Pb accumulation in plant (fresh weigh)

Added Pb (ppm)	Plant height		Yield		Content of Pb in plant	
	cm	%	g/pot	%	ppm	%
0	19.5	100	70.3	100	0.17	100
50	14.7	75	37.0	53	0.96	565
100	13.4	69	34.7	49	1.67	982
200	11.0	56	31.0	44	1.79	1053

The amount Pb applied to soil rapidly increased Pb accumulation in plants. The lowest content of 0.17 ppm Pb in plant is observed in the control (without Pb applied), and the highest value of 1.79 ppm Pb in the treatment with 200 ppm Pb applied. The results show that Pb accumulation in plants increase more than 5; 9 and 10 times compared to the control, corresponding to the amount of added Pb at 50 ppm, 100 ppm and 200 ppm. These results also show the ability uptake and accumulation of Pb in plant increase quickly and it decrease when the rates of added Pb higher than 100 ppm. The similar results of effects of Pb on plant growth and accumulation was reported by John et al (2009) that indicated the exposure of *Brassica juncea* to Cd and Pb results is an decrease in growth and *Brassica juncea* can be used as a heavy metal accumulator in heavy metal affected soils.

iii. *Effect of added Zn on plant growth and Zn accumulation in Brassica juncea*

The effect of Zn on plant growth and its accumulation in plant are presented in Table 3. At the rate of 100 ppm Zn, the plant height virtually unchanged comparing to the control treatment. However, at the rate of 300 ppm Zn, the height of plant has fallen by 14%, while at the rate of 500 ppm Zn reducing plant height by 20% compared to control. This results show that Zn only influence on plant growth at the high rates above 300 ppm. For the yield, low adding rate at 100 ppm Zn increase yield 8%, but at 300 ppm the yield decreased 9%, while at 500 ppm the yield dropped 38% compared to the control. The results show that Zn only discernible impact on the growth of *Brassica juncea* as high adding rates exceeded 300 ppm.

Table 3 : Effects of the adding Zn to plant growth and Zn accumulate in plants (fresh weigh)

Added Zn (ppm)	Plant height		Yield		Content of Zn in plant	
	cm	%	g/pot	%	ppm	%
0	19.5	100	70.3	100	9.05	100
100	19.7	101	75.7	108	18.06	200
300	16.7	86	64.1	91	20.40	225
500	15.5	80	43.8	62	22.82	252

The contents of Zn in plants increase coresponding to 100%; 125 % and 152 % when the adding rate of added Zn increase to 100 ppm; 300 ppm and 500 ppm compared to the control, respectively. So it can be said that the contents of Zn in soils is closed relationship with Zn accumulation in plants.

The rates of added Cu, Pb and Zn have significant influence on growth and yield of *Brassica juncea*, in which the influence of Pb is the most evident, followed by the effects of Cu and the lowest impact of Zn. Overall, the growth and yield of *Brassica juncea* decrease when the amount of added heavy metal increase. At 100 ppm, Pb reduce yield 51%, while Cu only reduces yield by 29%. For Zn, the amount of added 300 ppm decreased yield 9% and at very high rate 500 ppm Zn reduces yield 38%. At low amounts of added 100ppm, Zn influence on the productivity of vegetables is not clear.

iv. *The relationship between the concentration of Cu^2+, Pb^2+ and Zn^2+ mobilization in soil and plants*

The relationship between concentration of Cu^2+, Pb^2+, Zn^2+ in soil and in plants is presented in Table 4. The correlation between the of mobilization Cu^2+ in soil and Cu content in plants are represented by equations of $YCu=0.15x+0.868$ ($R^2=0.99$). While the correlation equation between mobilization Pb2+ in soil and Pb contents in plants can be in the form $Y_{Pb}=0.72lnx-0.182$ ($R^2 = 0.97$). But the relationship between mobilization Zn^2+ in soil and Zn contents in plants is represented through equation $Y_{Zn}=4.39lnx+2.299$ ($R^2=0.87$). In general, concentrations of heavy metals in soil are closely correlated with their contents accumulated in vegetables.

Table 4 : Relationship between concentrations of Cu^{2+}, Pb^{2+}, Zn^{2+} in soil and in plants (fresh weight)

Added Cu, Pb or Zn* (ppm)	Cu (ppm)		Pb (ppm)		Zn (ppm)	
	Cu^{2+} in soil	Cu in plant	Pb^{2+} in soil	Pb in plant	Zn^{2+} in soil	Zn in plant
0 (0)	13.38	2.75	1.88	0.17	7.24	9.05
50 (100)	15.52	3.17	4.10	0.96	17.81	18.06
100 (300)	27.20	5.21	11.23	1.67	75.20	20.40
200 (500)	51.10	8.46	18.27	1.79	112.83	22.82

**The numbers in parentheses are added Zn*

In contrast, the rates of adding heavy metals Cu, Pb, Zn are rapidly increasing their accumulation in plant of *Brassica juncea*, especially at the high rates of application. At the rates of 100 ppm and 200 ppm, Cu content accumulated in vegetables increased respectively 90% and 208%, while Pb contents increase corresponding 882% and 953% compared to the control. For Zn, when the rates of application increased to 100; 300 and 500 ppm the contents of Zn accumulation in vegetables increase respectively to 100% , 125% and 152% compared to the control. That is also an evidence for the high ability of heavy metals extraction of *Brassica juncea*. Ebbs et al. (1997) also remarked the *Brassica* spp. were the effective plant in removing Zn, Cu and Cd from the contaminated soil.

b) Effect of phosphate fertilizer, lime and sawdust on the growth and accumulation of Cu, Pb, Zn in Brassica juncea

i. *Effect of phosphate fertilizer on growth and Cu, Pb, Zn accumulation in plants*

The results showed that phosphate fertilizer has significant influence on growth and yield of *Brassica juncea*. The plant height increased from 14.7 cm in the control (without phosphorus fertilizer) to 16.3 cm at the rate of 17 ppm P_20_5; 17.4 cm at the rate 26 ppm P_20_5 and 19.1 cm at the rate 34ppm P_2O_5. Similarly, the yield also increased respectively from 50.0 to 53.1; 57.3 and 65.5 g/pot (Table 5). Thus in all rates of phosphate fertilizer, the plant height and yield are higher than the control treatment (without phosphate fertilizer). In particular, *Brassica juncea* have the best growth at the rate 34ppm, equivalence to 80 kgP_2O_5/ha.

Table 5 : Effects of phosphate fertilizer on growth and accumulation of Cu, Pb, Zn in plant (fresh weight)

Added phosphate (ppm P_2O_5)	Plant height (cm)	Yield (g/pot)	Contents of heavy metals in plant					
			Cu		Pb		Zn	
			ppm	%	ppm	%	ppm	%
0	14.7	50.0	5.21	100	1.67	100	20.40	100
17	16.3	53.1	5.10	98	1.42	85	19.63	96
26	17.4	57.3	4.78	92	1.02	61	17.97	88
34	19.1	65.5	4.46	86	0.96	58	17.35	85

Adding phosphate also have a significant impact to the heavy metal accumulation in plants. At the rate 17ppm P_2O_5, the contents of Cu, Pb and Zn in plant has declined 2%, 15 % and 4 %; at the rate 26ppm P_2O_5, the contents of Cu, Pb and Zn in plants decreased 8%, 39 % and 12 %; and at the rate 34ppm P_2O_5, the contents of Cu, Pb and Zn in plants decreased 14 %, 42 % and 15 %, respectively, compared to control. It can be said that application of phosphate fertilizer can reduce the accumulation of Cu, Pb, Zn in plants of *Brassica juncea*. When the amount of phosphate fertilizer increase the contents of heavy metals in plants decrease, in which the affects of phosphate fertilizer on Pb uptake by plants is the most evident. In this study, the rate 34ppm (80 kgP_2O_5/ha) is considered as best performance in reducing uptake ability and accumulation of heavy metals in plant of *Brassica juncea*. Phosphate decreased heavy metals uptake by vegetables and markedly promoted growth of vegetables was also reported by Tan Wan-Neng et al. (Tan Wan-Neng et al., 2011).

The phosphorus fertilizer is capable of reducing the concentration of heavy metals Cu, Pb and Zn in plants can be explained through the fixation processes between heavy metals and phosphate, and the results it can reduce uptake ability and accumulation of heavy metals in plants. Moreover, the presence of the cations come from phosphate fertilizer (especially Ca^{2+}, Mg^{2+}) also have the effect limiting uptake of heavy metals by plants due to the ion antagonist. In addition, the rapid growth of crops also contribute to reducing the contents of heavy metals in plants due to the phenomenon of "diluting".

ii. *Effects of liming on growth and Cu, Pb, Zn accumulation in plants*

In agricultural production, lime is considered as an effective fertilizer reduce soil acidity and provide some nutrients for crops. The effect of lime to promote growth and reduce the accumulation of heavy metals in *Brassica juncea* is also observed in this study.

The results showed that when the rate of liming increased from 0 to 435ppm, 870ppm and 1305ppm $CaCO_3$ increase the plant height from 14.7 cm to 15.9 cm, 16.4 cm and 18.2 cm; and the yield also increased from 50g to 51.8 g, 56.8 g and 62.5 g/pot, respectively (Table 6). The plant height and yield reached the highest

value at the rate of 1305ppm (3 tons $CaCO_3$/ha). However, compared with phosphate fertilizer mentioned above, lime has less effect on the growth of *Brassica juncea*.

Table 6 : The effects of liming on growth and Cu, Pb, Zn accumulation in plants (fresh weight)

Liming (ppm $CaCO_3$)	Plant height (cm)	Yield (g/pot)	Contents of heavy metals in plant					
			Cu		Pb		Zn	
			ppm	%	ppm	%	ppm	%
0	14.7	50.0	5.21	100	1.67	100	20.40	100
435	15.9	51.8	5.01	96	1.60	96	19.46	95
870	16.4	56.8	4.95	95	1.30	78	14.29	70
1,305	18.2	62.5	4.02	77	0.95	57	13.20	65

The effect of the lime on the content of Cu , Pb and Zn in plants also shown clearly. At low rate of 435ppm (1 ton $CaCO_3$/ha), lime has little effect on the contents of Cu, Pb and Zn in plant, but at the high rate of 1305ppm (3 tons $CaCO_3$/ha), the contents of Cu, Pb and Zn in plant have declined sharply by 23%, 43% and 35% respectively compared to the control.

The addition of lime achieved higher plant biomass production, although effects concerning metal bioavailability and accumulation were masked somewhat by pH variability. These results are also consistent with the conclusions of Tan Wan-Neng et al. [14] suggested that liming is considered the most effective method to reduce absorption and reduce harmful of Zn to crops. Tissue metal concentrations of *Brassica juncea* were elevated for Zn, Cu and Pb, especially in leaves of plants from plots with low pH values (Clemente et al., 2005).

iii. *Effect of sawdust amendment on growth and Cu, Pb, Zn accumulation in plants*

Unlike phosphate fertilizer and lime as described above, sawdust tends to reduce the growth and yield of *Brassica juncea*. The causes may be due to the high ratio of C/N in sawdust leading to the nutrient competition between soil microorganisms and plants. The effect of sawdust amendment to heavy metal accumulation in plant is not significant as lime and phosphate fertilizer. At the highest rate of 13044ppm (20 tons/ha), sawdust only reduce heavy metal concentrations in plants about 13% for Cu , and 10% for Pb and 9% for Zn (Table 7). It can be said that sawdust has reduced the largest percentage of Cu, followed by Pb and Zn did not differ significantly.

Table 7 : The effects of sawdust amendment on growth and Cu , Pb and Zn accumulation in plants (fresh weight)

Added sawdust (ppm)	Plant height (cm)	Yield (g/pot)	Content of heavy metals in plant					
			Cu		Pb		Zn	
			ppm	%	ppm	%	ppm	%
0	14.7	50.0	5.21	100	1.67	100	20.40	100
6,522	15.0	49.2	4.99	96	1.56	93	19.23	94
9,783	14.9	51.8	4.61	88	1.55	93	19.01	93
13,044	14.1	47.0	4.53	87	1.51	90	18.57	91

IV. Conclusions

The applied rates of Cu, Pb and Zn have a tremendous impact on the growth and yield of *Brassica juncea*, in which the effect of Pb is highest, followed by Cu and Zn. The plant growth and yield of *Brassica juncea* decrease with the rates of heavy metals increases. At the rate of 100 ppm, Pb reduce yield by 51 %, Cu reduces yield by 29% but the effect of Zn is not clear. The effect of Zn on yield of *Brassica juncea* is only significant at very high rate of 500 ppm Zn where the yield decrease by 38%.

The rates of applied heavy metals (Cu, Pb, Zn) rapidly increase their accumulation in plants, especially at high rates. When applied 100 and 200 ppm, the content of Cu in plants increase 90% and 208% respectively, whereas the content of Pb increase corresponding to 882% and 953% compared to the control. For Zn, the contents of Zn in plants increase by 100%, 125% and 152% compared to control when the rates of applied Zn increase to 100; 300 and 500 ppm respectively.

Phosphate fertilizer not only affect the growth of plants but also effect the accumulation of heavy metals in plants. When the rate of phosphate fertilizer apply at the rates increase to 40 kg, 60 kg and 80 kg P_2O_5/ha the content of Cu in plant decrease corresponding by 2%; 8% and 14%; the contents of Pb in plants decrease 5%;

39% and 42%; and the contents of Zn in plants decrease 4%; 12% and 15% compared to the control.

Lime also has an important role to reduce the heavy metal accumulation in plants. At the liming rates of 1 ton, 2 tons and 3 tons of $CaCO_3$/ha, the content of Cu in plants decrease corresponding to 4%; 5% and 23%; the contents of Pb decrease 4%; 22% and 43%; and the contents of Zn decrease 5%; 30% and 35% compared to the control.

Sawdust amendment to soil has little impact on the growth of *Brassica juncea* but effective in reducing uptake of heavy metals in plants. However, their reduction is not much as applied phosphate fertilizer or lime. At the highest amount of sawdust 30 tons/ha, the contents of Cu, Pb and Zn in plants only reduced 13%; 10% and 9%, respectively, compared to the control.

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2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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