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Effects of Comfrey Grass (Symphytum Spp.) Included Diets on the Growth Performance and Carcass Characteristics of Turkey

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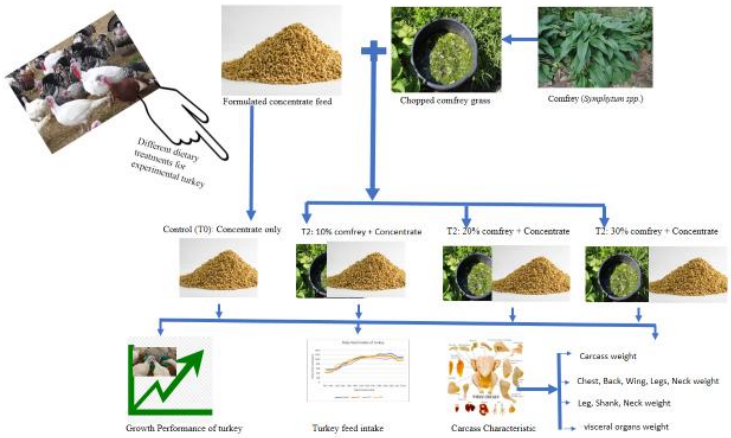
ABSTRACT

The study was conducted at National Animal Nutrition Research Center, Khumaltar to examine the effect of comfrey on growth performance and carcass characteristics of Turkey from 8th weeks to 22nd of age. A total of 84 8th week of age unsexed turkey chicks were allocated randomly into four treatment with three replication having seven birds in each replication using completely randomized design (CRD). All the turkey were kept in adjustment period for one week. During the experimental periods, four experimental diets were Control (concentrate diet, (T0)) and 10%, 20% and 30% comfrey included diet *i.e*. treatment (T1), treatment (T2) and treatment (T3), respectively. The results showed that at earlier days of experiment, the feed intake of comfrey inclusion diet was lower. However, the intake of feed increase significantly ($p<0.05$) at 30% comfrey included diet. The mean weekly weight of the turkey with diet of 30% comfrey included was significantly lower ($p<0.05$) up to 11th weeks of age, but the weight of the birds were found similar at later stage of growth. There was no significant difference in live weight, carcass weight and other visceral organs weight except chest, back, shank and lungs weight. The results implied that the comfrey forage can be incorporated in formulated diet of turkey at the inclusion level of 20% for higher production performance with low feed intake. In coming days, further study on nutrients component of comfrey improving immune modulation, meat quality and production of safe meat production need to be carried out.

Keywords*: Comfrey feeding, Turkey, Feed intake, Growth performance, Carcass characteristics*

Graphical Abstract



Introduction:

Turkey is an important poultry species for meat production, considered as one of the favored white meat and famous for its leanness and delicacy. Nepal introduced turkey in 2001 to diversify meat production from different avian species. It is predominant as backyard poultry under scavenging and semi-scavenging system, however some time they supplemented with small amount of maize grain. In the lean foraging season, scavenging only cannot meet the nutrient requirements of the bird, particularly, with respect to protein (Pousga, 2018) consequently the potential growth of the bird couldn't be achieved. Thus the scavenging bird should be supplemented properly (Macharia et al, 2015).

The native conventional feed supply in Nepal is not adequate to meet the demand of existing livestock and poultry (Osti, 2020), so poultry feed mostly depends on imported feed ingredients, consequently feed cost has been increasing day by day. The feed cost experienced about 65-70 % of total input

in turkey production (Jha, 2016). In this context inclusion of nutrients rich forage in poultry diet could be a best alternate for economic poultry production. In this regard a plant comfrey (*Symphytum spp*.) could be a potential forage for poultry production. It is a perennial herbs that requires minimal maintenance after planting and can adopts to a wide range of soil (Hills, 2011). This plant is very vigorous, can be grown in large quantities and harvested multiple times a year (Robinson, 1983). It can give high, sustained yields of nutrient-rich leaves. The comfrey leaves contents 18.6% crude ash, 35.2% crude protein (28.2% digestible protein), 2.7% crude fat, 12.6% crude fiber, 1.08% calcium, 0.69% phosphorus, and 6.49% potassium (Oster et al., 2020) and 0.144% iron (Berkelaar, 2014) in dry matter basis. The nutritional profile is consistent with reports from varying climates (Robinson, 1983; Bareeba et al., 1992). Due to its nutritional profile the use of comfrey could have the potential to establish the uses of forage (Tufarelli, 2018), and to reduce cost of production in non- ruminants livestock production, including turkey farming. Hills (2011) wrote that up to 30 percent of pig feed can be replaced with the wilted comfrey without course stem. It showed beneficial effects on intestinal health in pigs (Oster et al, 2021). The comfrey leaves have already been successfully supplemented by Oster et al (2020) to poultry diets as protein and mineral source. Ponte et al (2008) also reported that the legume based forages as can be used as a source of fiber, protein and natural antioxidants for poultry which promotes bird's performance with preferred sensory attributes. Moreover, Luscher et al (2014) reported that forages as feed for poultry, contribute to improve sustainability of animal production within farming systems.

However, very few research work have been done on turkey feeding in Nepal. Under scavenging condition turkey performed well in growth performance where male and female gained 10.9 kg and 6.46 kg body weight, respectively, in 10.5 months (Karki et al, 2004). The higher weight gain, higher efficiency of feed utilization and higher profit could be achieved at the age of 16 to 20 week turkey when fish meal @ 6%, lysine @0.03% and methionine @ 0.125% supplemented in the layer starter ration (Karki, 2005). Similarly, he (2006) suggested that the supplementation of soybean cake@10% and fishmeal @5% in commercial broiler ration could be beneficial for enhancing higher growth performance and higher gross income as compared to basal diet of broiler ration. Unfortunately, the research regarding to forage inclusion in turkey diet has not been found, yet. Therefore, the study was intended to evaluate whether turkey accept the fresh comfrey leaves as a part of diet in different level and its effect on growth performance and carcass characteristics, so that the production cost of turkey bird could be reduced.

Materials and Methods

Experimental site and Design

The experiments were carried out on brooded turkey at the Swine and Avian Research, Khumaltar, for 98 days after adjustment period of seven days. Total 120 one-day old turkey birds were procured from Swine and Avian Research Program, Khumaltar, Lalitpur and after brooding for 60 days, 84 birds wereallotted into four treatments with three replications having 7 birds in each replication by using Complete Randomized Design (CRD). All the experimental birds were vaccinated with F1 vaccine @on drop /birds against Ranikhet disease at the first week. The deworming was one before experiments starts.

Diet composition

The feeds were formulated containing 20 % crude protein and metabolizable energy at the level of 2900 Kcal/Kg to meet the requirement. The compound feed formulation composition of concentrate mixture is given in Table 1.

Table 1: Composition of concentrate compound feed mixture fed to the experimental turkey

Ingredients	**Percentage**
Maize	60
Rice bran	4.88
Soya Meal	30.17
Soya-oil	0.06
Bone Meal	3
OST/Shell	0.8
Lysine	0.16
Methionine	0.18
Mineral Vit	0.25
Liver tonic	0.1
Salt	0.3
Toxin binder	0.1
Total	**100**
Protein %	20
ME	2900

Note: ME= Metabolizable Energy

Comfrey Leaves and experimental diet:

Growing leaves of comfrey forage was used as part of the diet in different inclusion level as shown in table 2. The average dry matter (DM) contents in the comfrey leaves was 14.26 % and average crude protein, crude fiber and ether extract of the comfrey sample were 20.42 %, 18.2% and 2.65% respectively on the DM basis.

Table 2: Treatments and diets to the experimental turkey

Four experimental diets were composed for experimental birds which is presented in Table 2.

Treatments	Diets
T0 (control)	Compound feed without Comfrey leaves.
10% Comfrey (T1)	Compound feed replaced with 10% Comfrey leaves.
20% Comfrey (T2)	Compound feed replaced with 20% Comfrey leaves.
30% comfrey (T3)	Compound feed replaced with 30% Comfrey leaves

Feeding regime

Concentrate compound feed mixture and comfrey leaves were given on group basis and were provided to the experimental birds once a day (morning) on *adlib* basis during the experiment period. Drinking water was provided in adequate amount.

Chemical analysis

The samples of feed ingredients were analyzed to the National Animal Nutrition Research Centre, Khumaltar, Lalitpur for proximate analysis. Representative samples from offered concentrate mixture were analyzed for Dry Matter (DM), Crude Protein (CP), Crude fiber (CF), total ash (TA) and energy. The DM was determined by oven drying at 100°C for 24 hrs. Crude protein of the samples was determined using the Kjeldahl method. Ash content was determined by ashing at 550^0C in a muffle furnace for 16 hrs. (AOAC, 1980).

Data measurement

Total concentrate feed and comfrey grasses offered to the experimental birds on the dry matter basis was recoded daily in group basis and refusal next morning. The water measured daily on group basis. The body weight gain was measured in individual basis in seven days' interval in the morning before feeding.

Data analysis

Data of feed intake and body weight were analyzed by using software Statistical Packages for Social Science (SPSS) Version 20.0. The descriptive and "One wayAnova" were used for analysis and interpretation of data. The present study was carried out with the regard to the ethical treatment of animals.

Result and Discussion:

Feed Intake:

The table 3 showed the weekly feed intake of the experimental birds. The results showed that there was significant difference in feed intake of birds at different inclusion level of comfrey grass in feed. In 9^{th} and 10^{th} week's age of birds, the feed intake was higher in control and 20% comfrey diet. After 10^{th} weeks of experiment, the feed intake increased significantly in 30 % comfrey inclusion diet and control diet in next 3 weeks. After 14^{th} weeks of age, the feed intake was higher in control and 30% comfrey inclusion diet which was statistically similar with 20% comfrey inclusion diet in 16^{th}, 17th, 19^{th} and 20^{th} weeks of age. On later ages of birds, the higher feed intake was found higher in control diet which was similar with that of feed intake in 20% and 30% comfrey inclusion diet. The decrease in feed intake with higher inclusion level of comfrey at early age might be due to the lower palatability and adaption time required by monogastric physiology of turkey. No flavor was used in the experimental diets. Palatability is one of the factor determining the feed intake by animals. Additionally, the elevated total dietary fiber content and the lower energy content of the comfrey diet in early stage of bird could be possible reason for the lower intake. However, at later age of birds, feed intake increase at 30% comfrey inclusion diet which might be due to the high nutrient requirement by the body to fulfill the physiological needs and could be digest the higher fiber contents by modifying the intestinal length and weight of the organs as well as the rate of passage through the different segments of the gastro intestinal tract (Mateos et al 2012). In favor of the result, Oster et al (2021) observed lower intake of comfrey supplemented diet in a feasibility study of comfrey in pig feeding.

Table 3: Mean total dry matter intake of experimental turkey fed at different level of comfrey grass included diet

Age of birds	Total DM Intake in gm.				p value
	Control (T0)	10% comfrey (T1)	20% comfrey (T2)	30% comfrey (T3)	
9^{th} week	559.68^{a}±26.41	417.19^{b}±26.41	554.45^{a}±26.41	445.56^{b}±26.41	<0.01
10^{th} week	566.89^{a}±26.41	447.63^{b}±26.41	507.21^{a}±26.41	460.95^{ab}±26.41	<0.01

11th week	622.16^{b}±26.41	608.37^{bc}±26.41	547.79^{c}±26.41	756.11^{a}±26.41	<0.01
12th week	812.48^{ab}±26.41	728.12^{b}±26.41	729.84^{b}±26.41	853.13^{a}±26.41	<0.01
13th week	887.02^{b}±26.41	893.31^{b}±26.41	779.33^{c}±26.41	964.76^{a}±26.41	<0.01
14th week	1024.10^{a}±26.41	999.46^{ab}±26.41	922.57^{b}±26.41	1059.13^{a}±26.41	<0.01
15th week	1101.54^{a}±26.411	1084.70^{b}±26.41	1053.61^{b}±26.41	1152.09^{a}±26.41	<0.01
16th week	1132.78^{a}±26.41	1109.66^{a}±26.41	1074.48^{b}±26.41	1130.00^{a}±26.41	<0.01
17th week	1122.59^{a}±26.41	1140.33^{a}±26.41	1068.96^{b}±26.41	1154.38^{a}±26.41	<0.01
18th week	1240.42^{a}±26.41	1160.73^{b}±26.41	1060.59^{b}±26.41	1197.68^{a}±26.41	<0.01
19th week	1219.25^{a}±26.41	1113.84^{ab}±26.41	996.56^{b}±26.41	1166.39^{ab}±26.41	<0.01
20th week	1272.03^{a}±26.41	1141.99^{ab}±26.41	1073.12^{b}±26.41	1173.51^{ab}±26.41	<0.01
21st week	1110.73^{a}±38.27	954.92^{b}±40.34	1051.2^{ab}±42.79	1041.00^{ab}±40.34	<0.01
22nd week	1111.73^{a}±38.27	955.93^{b}±40.34	1052.2^{ab}±42.79	1042.00^{ab}±40.34	<0.01

Growth performance:

The table 4 showed the weekly mean body weight of the experimental birds at different inclusion level of comfrey. The results showed that at earlier days of the experiment, the body weight of the birds was significantly low at 30% comfrey inclusion diets however, at later days of experiment i.e. after 13th weeks of age of birds there was no significant difference in body weight of birds at different treatments. The lower body weight of birds at highest inclusion level of comfrey in diets at earlier days of experiment might be due to the lower palatability and digestibility of the higher fiber diet. Lower palatability means lower intake of feed which ultimately decrease the body weight the birds. According to the study by Zhang et al., (2023) the average daily weight gain of the broiler chicken increased as the fiber content increased in diet from 2 to 8% but decrease at 11% fiber content in diet. Similarly, according to the study of Oster et al., (2020), the supplementation of the comfrey leaves to chicken showed the reduced performance during early development *i.e.* the first weeks of life but could catch up at later age of life which supported this study why there was lower body weight at higher comfrey inclusion at earlier days of experiment and the no change of body weight at later ages.

Table 4: Weekly mean body weight of the experimental turkey fed at different level of comfrey grass included diet

Age of birds	Weekly Mean Body weight per bird (g) ±SEM in different treatments				Significance 0.05 level
	Control (T0)	10% comfrey (T1)	20% comfrey (T2)	30% comfrey (T3)	
9th weeks	1297.73±55.12^{a}	1258±45.21^{a}	1258.66±46.1^{a}	1055±51.89 ^{b}	Significant (p=0.003)
10th weeks	1546±64.21^{a}	1476.66±54.17^{ab}	1508±54.73^{ab}	1300±58.42^{b}	Significant (p=0.006)
11h weeks	1837.33±68.07^{a}	1707.33±61.8^{ab}	1748±77.33^{ab}	1568.33±70.49^{b}	Significant (p=0.001)
12th weeks	2204.66±88.65	2052.66±72.43	2152±78.63	1897.5±78.16	NS
13th weeks	2548±105.29^{a}	2338±84.69^{ab}	2444±83.25^{ab}	2142.5±103.01^{b}	Significant (p=0.005)
14th weeks	2701.33±114.41	2578.66±90.11	2710±96.98	2343.33±108.42	NS
15th weeks	3002.66±129.15	2819.33±101.13	2925.33±111.94	2620.83±123.85	NS
16th weeks	3192±149.71	3102.66±110.05	3184±122.84	2914.16±145.93	NS
17th weeks	3500±171.06	3325.33±109.36	3393.33±134.29	3095.83±152.66	NS
18th weeks	3714.4±196.3	3531.33±146.94	3717.73±140.3	3328.33±177.67	NS
19th weeks	3954.66±201.95	3792±144.15	4038±172.74	3509.16±206.96	NS
20th weeks	4280±220.9	3959.33±179.66	4138±210.97	3699.16±215.54	NS
21st weeks	4400.5.4±221.27	4071.33±179.67	4385.85±188.9	3837.75±226.87	NS
22nd weeks	4725.73±242.99	4355.33±203.49	4505±184.79	4128.33±271.75	NS

Note: NS= Non Significant

Carcass characteristics

The table 5 showed the results of the average live weight, carcass weight, body organs and visceral organ weight of the experimental birds. There was significant difference chest weight, back weight, shank weight and lungs weight of turkey and there was no difference in other parameters and visceral organs weight at different treatment diets. According to the study by Oster et al., (2020), there was no difference in live weight and carcass weight in control and comfrey supplemented diet in broiler chicken which was similar to the present study. In contrast, Elham (2010) reported increased liver weight of broiler chicken for concentrate fed group and decreased for roughage treated group. The difference of the poultry type the cause of this variation.

Table 5: Average live weight, carcass weight, body organs and visceral organ weight of experimented turkey bird fed at different level of comfrey grass included diet

Organ weight (Kg)	T1 (Control)	T2 (10% comfrey)	T3 (20% comfrey)	T4 (30% Comfrey)	Significance
Live	4.331±2.4	4.355±2	4.795±1.8	4.005±2.7	NS
Carcass	3.430±.07	3.475±.38	3.836±.2	3.262±.26	NS
Chest	0.935^{b}±.04	1.001^{a}±.22	1.168^{a}±.04	0.913^{ab}±.98	***
Back	0.358^{b}±.03	0.432^{a}±.05	0.422^{ab}±.57	0.367^{ab}±.02	***
Wings	0.378±.047	0.371±.012	0.419±.07	0.346±.014	NS
Legs	0.889±.23	0.798±.07	0.877±.07	0.753±.04	NS
Neck	0.202±.03	0.214±.05	0.271±.05	0.177±.01	NS
Liver	0.075±.01	0.070±.02	0.084±.01	0.068±.01	NS
Heart	0.016±.00	0.018±.00	0.018±.00	0.016±.00	NS
Head	0.145±.02	0.146±.01	0.179±.01	0.140±.02	NS
Shanks	0.103^{ab}±.00	0.096^{b}±.00	0.107^{a}±.00	0.102^{ab}±.01	***
Lungs	0.263^{b}±.04	0.238^{b}±.02	0.305^{a}±.04	0.224^{b}±.01	***
Full Gizzard	0.158±.02	0.153±.03	0.176±.02	0.153±.00	NS
Empty Gizzard	0.112±.01	0.095±.00	0.107±.03	0.104±.03	NS

Conclusion:

Poultry production would benefit from feeding forage as substitute to conventional feed ingredients to reduce the dependence on the feedstuffs that could be used as human food. Comfrey grass could be a potential conventional feed replacer in a certain level of inclusion. Based on the present study it can be concluded that 10- 20 percent inclusion of comfrey grass in turkey diet would be beneficial for achieving optimum growth performance and carcass characteristics. It is imperative to optimize forage intake, which still requires further investigation in poultry. It is imperative to optimize forage consumption, which still needs further research in poultry. Moreover, There are many species of forage that are an alternative source of protein for poultry production, so forage could provide the basis of most poultry production for the coming days..

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Conflict of Interest Declaration:

The authors declare there is no conflict of interest.

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