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Tephrosia vogelii for control of fleas in free-range poultry

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Abstract

Chicken production is the leading type of poultry farming in eastern Africa. However, diseases and parasites are limiting factors in production. Ectoparasites in particular lead to reduced egg production, and reduced hatchability, since the hens usually abandon eggs following ectoparasitic infestation. Ethno-veterinary medicine may be the only readily accessible and affordable alternative for controlling diseases in rural areas, where access to modern medicines and extension service delivery is lacking. This study was conducted in Luuka district in eastern Ugandato validate the efficacy of *Tephrosia vogelii* (a shrub) in controlling fleas *(Echinophaga* spp*.)* on free-range poultry. Ectoparasites ranked second, after predators, in causing losses in poultry. The majority of the respondents had substantial knowledge of ethno-veterinary remedies, their side effects, and the required precautions of handling the drugs. In a majority of households, poultry was owned and managed by women. About 82% of the respondents had heard of *Tephrosia vogelii* as remedy for agricultural pests; while 68% admitted having used it on their poultry. Most respondents preferred using herbal medicine compared to conventional medicine, saying that the former was accessible, affordable, effective and environmentally friendly. Experiments were carried out and replicated in a completely randomised design. During experimental trials, it was found out that *Tephrosia vogelii* extracts of concentrations of 25, 33.3 and of 50% w/v had a long term protective effect. The effect lasted up to 5 days. These concentrations killed up to100% of the fleas. The difference in re-infestation between the treated and control chickens on Days 6, 7 and 8 was significant ($p < 0.001$). Permethrin at the recommended rates, killed 100% of the fleas. The rate of re-infestation by fleas varied with concentration, being higher at low concentrations for both *Tephrosia vogelii* and permethrin. There was no significant difference in efficacy between dry leaves extracts compared to fresh leaves extracts at similar concentrations. The LD 50 for the dried and fresh leaves extracts were 50 ml of the standard extract in 1200 and 800 ml at room temperature, respectively.

Key words: Fleas, free-range poultry, *Tephrosia vogelii,* Uganda

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Introduction

In Uganda, poultry plays a vital role in alleviating poverty, despite its low contribution to Gross Domestic Product (GDP). Uganda has a poultry population of more than 46 million birds, with the eastern region having the highest number in the country (UBOS, 2013). Local chicken, managed under the free-range system in rural areas, account for 87% of the total poultry population. Chicken production is the leading type of poultry farming in Uganda. Other poultry species include turkeys, ducks, guinea fowls, pigeons, geese and ostriches (Byarugaba, 2007).

The birds, which are mainly referred to in literature as 'village chickens', have a significant contribution towards socioeconomic welfare in rural settings and contribute greatly towards accomplishing cultural roles in Uganda (Ssewanyana *et al.*, 2001). Chicken contribute to improved nutrition and food security because it is a leading source of high quality protein in form of meat and eggs. The Government of Uganda targets to increase meat production from 60,500 to 150,000 metric tonnes annually, by the year 2016 (MAAIF, 2010).

Disease and parasites hinder proper growth of the chicken industry in Uganda. The most important diseases include Newcastle Disease and infectious bronchitis among many others; while the parasites include fleas, lice and mites (Kirunda and Mukiibi-Muka, 2003). These lead to reduced egg production and hatchability, since hens usually abandon eggs after ectoparasite infestation.

Ethno-veterinary medicine (EVM) is a scientific term referring to traditional animal health care that comprises of knowledge, skills, practices, methods and beliefs from animal health care within a community (McCorke, 1986). According to Misra and Kumar (2004), EVM is the community-based indigenous knowledge and methods of treating and managing livestock. EVM has developed globally in sub-Saharan Africa over time through farmers' deliberate trials and experimentation.

The main issue in promoting ethno-veterinary medicine in rural areas is to equip farmers with knowledge that has already been developed within the communities. In most cases, ethno-veterinary medicine is practiced concurrently with conventional modern medicine. There is a risk of losing the indigenous livestock disease control system, together with the knowledge involved, due to increased dependence on modern medicine. In Uganda, ethno-veterinary medicine is commonly used by farmers to treat various diseases of livestock, and *Tephrosia vogelii* is among the plants frequently used (Matovu and Olila, 2007). To improve this situation, governments in developing countries should incorporate EVM and EVK issues into the already existing agriculture promotional programmes. Another problem hindering the development and extensive use of EVM is the lack of property rights.

The objective of this study was to validate the efficacy of *Tephrosia vogelii* in controlling fleas; and to assess its long term residual effect in free-range poultry.

Materials and methods

Tephrosia vogelii Hook F is a leguminous plant belonging to class *Magnoliopsida* (dicotyledons), subclass *Rosidae*, order *Fabales*, family *Fabaceae*, genus *Tephrosia*; and species *vogelii* Hook F -

Vogel's tephrosia (USDA, 2015). It is a branched shrub, reaching up to 4 m high. It has yellowish or rusty pods. The stems are somehow erect and the leaflets grouped in five or more pairs (Fig. 1). Rotenone is classified by the World Health Organization (WHO) as a moderately hazardous compound Class II (2001). It is a selective and non-systemic insecticide, but possesses some acaricidal properties as well (Kumar, 1984). The use of rotenone as an insecticide is allowed under European Union Regulation 2092/93, amended by 1488, Annex II (B). However, rotenone is highly toxic to fish, and act through the gills (Matsumura, 1975).

The study was conducted in Luuka District located in Eastern Uganda. Sixty six poultry farmers were interviewed using a questionnaire.

Data captured in the questionnaires included common causes of losses of chicken in the area; veterinary extension service delivery; and the use of ethno-veterinary remedies, especially *Tephrosia vogelii* for control chicken diseases in the study area. Also, included in the data were the type of medicinal plants used for control of chicken diseases, and their mode of preparation. Some background information about the farmers was also captured.

An experiment was carried out to validate the efficacy of *T. vogelii* when in fresh as well as in dried form for controlling fleas; and to assess its residual effect on free-range poultry. *Tephrosia vogelii* leaves were picked and dried in a cool room, at room temperature, 3 weeks prior to carrying out the trials. The *T. vogelii* extract was obtained in the serial extraction method by squeezing the extract through a cotton cloth. A total of 50 g of *T. vogelii* paste was soaked in 100, 150 and to 200 ml water (Kambewa *et al*., 1997; Gadzirayi *et al*., 2007). The extract powder was soaked in 100, 150

Figure 1. A *Teprosia vogelii* shrub.

and 200 ml water, hence, obtaining different dilution levels, i.e. 50, 33.3and 25% w/v water, respectively.

Soaking of the mixture from the fresh as well as dried leaves was carried out for 12 hours before sieving out the extracts sieved through a 12 mm sieve. Then, the extracted water was used to smear the chickens using cotton wool. A demonstration of how fleas on chickens can be killed using *T. vogelii* extracts was carried out under controlled conditions. Ten chickens naturally infested with fleas *(Echinophaga* spp.*)* on the combs, eyelids and wattles were screened. Infested areas were marked and the fleas on these areas counted. A magnifying glass was used to enhance accuracy in flea counting. The marked areas of each chicken were thoroughly pasted each with a different concentration of fresh and others of dried *T. vogelii* extracts. The chickens to be pasted were chosen at random. Some chickens were left untreated to act as controls. The time taken for the fleas to die was recorded. The fleas were confirmed dead after observing them in the illuminated ring magnifier (Luxo, type LFM – 102β, 1* 22W). For comparison of the efficacy of dried *T. vogelii* leaves with that of the fresh ones, the results from the dried leaves were plotted against those obtained from the fresh leaves. The long term effects of the extracts got from the fresh as well as of the dried leaves were assessed. Thus, *in vitro* experiments were carried out to ascertain the efficacy of *T. vogelii* on fleas on poultry.

To assess the residual effect of extracts from dry as well as fresh *T. vogelii* leaves, 21 chickens were selected randomly and arranged in groups of three birds each. The number of fleas on each chicken were recorded. One group comprising of three chickens, was left out to act as a control group. The average daily number of fleas from each group was calculated. Fifty milliliters of the original extract was diluted with100, 200, 400, 800, 1600 and 3200 ml of water, respectively. At each dilution stage, half of the extract was left undiluted for the purpose of testing on fleas. On the other hand, fresh *T. vogelii* leaves were pounded using wooden pestle and mortar (Lale, 2002). Fifty grams of the pounded fresh *T. vogelii* leaves were added to 100 ml of water and this mixture was left for 12 hours before sieving out the extract using a 12 mm sieve.

A study of how the different dilutions levels killed the fleas was carried out until a point where only 50% of the fleas were killed by a certain dilution, thus LD50 for *T. vogelii* was ascertained.

The marked areas of each chicken were thoroughly pasted each with a different concentrations of fresh and others with dried *T. vogelii* extracts. The chickens to be pasted by each diluted extract were labeled. Some chickens were left untreated to act as controls. The chickens were left in the cages in the poultry houses.

Observations of fleas dying were made at 1, 2, 4, 6, 8 and 10 then 12 hours after administering the treatment._The filtrates were tested on chickens infested with fleas on a daily basis. Data obtained from all the sources was analyzed using Statistical Package for Social Sciences (SPSS) software Version 16.

Results

Fourty eight (73%) of the respondents were men, while the rest (27%) were women. Up to 39 (59%) had beyond primary school education; while 24 respondents (36%) ended in primary school level; and three respondent (5%) did not attend formal education at all (Table 1). Hence, 95% (majority) of the respondents attended some kind of formal education.

The responses showed that most of the losses in poultry were due to predators (55%) (Fig. 2). Ectoparasites ranked second in causing losses (50% of the responses); and diseases were third (45%). Other causes of losses were accidents (9%), poor feeding (4.5%); and adverse weather conditions (4.5%).

For chicken ailments that could be treated using indigenous veterinary remedies, Newcastle disease (NCD) had the highest number of responses (64%); followed by ectoparasites (36%), fowl typhoid had 23% and worms had 18% of the respondents. Plant species used for controlling Newcastle disease (NCD) included: *Vernonia amygdalina* (bitter leaf), *Cyphostemma adenocaule, Solanum incanum, Oxygonum sinuatum, Aloe vera* and *Nicotiana tobacum. Vernonia amygdalina* was also used to treat fowl typhoid. *Papaya* spp. (pawpaw) was used to control worms. Plants used for ectoparasites control included: *Tephrosia vogelii* (fish bean), *Capsicum frutescens* and *Ricinus communis.* Farmers interviewed knew some side effects associates with the use of some of the herbal plants. Some of the side effects mentioned included: fruits can prick; poisonous to humans; and can cause sneezing. Some respondents (60%) also knew the main precautions taken to avoid the side effects (Tables 1 and 2).

All the herbs used in the treatment of NCD, fowl typhoid and worms were administered to the birds *via* drinking water. The part of the plant to be used

Table 1. Educational levels of respondents

Level of education	No. of responses	Percent	Cumulative percentage (%)
Never attended	1	5	5
Primary	8	36	41
Secondary	10	45	86
Tertiary	3	14	100

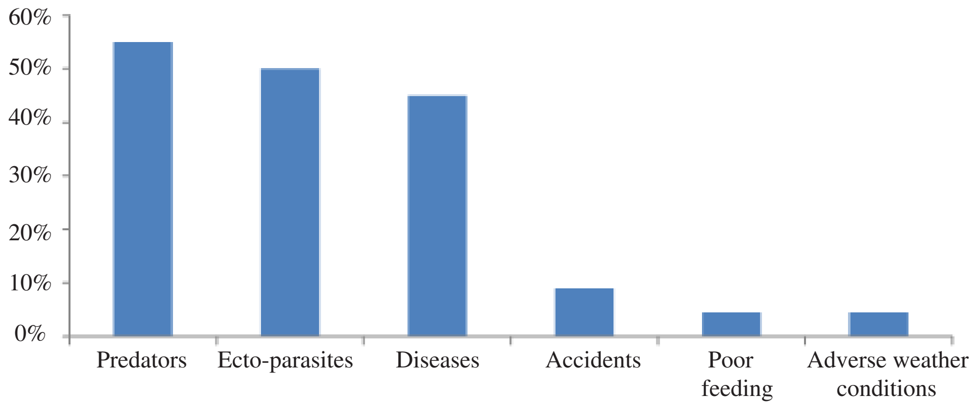

Figure 2. Causes of losses in poultry in Luuka district in eastern Uganda.

Table 2. Medicinal plants used to treat poultry diseases rather than ectoparasites

Local name	Common name	Botanical name	Part of plant used	Targeted disease	Side effect	Precaution required
Lubirizi (S) Mululuza (G)	Bitter leaf	*Vernonia amygdalina*	Leaves or roots	NCD and fowl typhoid	Can cause sneezing during preparation	Avoid direct inhalation
Ebbombo (S,G)	-	*Cyphostemma adenocaule*	leaves	NCD	None	-
Entulatula (S) Entengotengo (G)	-	*Solanum incanum*	Fruits	NCD	Very toxic to humans	Avoid ingestion
Obukenge (S) Kafumita bagenge (G)	-	*Oxygonum sinuatum*	leaves	NCD	Fruits can prick if stepped on	Remove and burn fruits
Papali (S,G)	Pawpaw	*Carica papaya*	seeds	Worms	Extract can corrode skin	Avoid contact with skin
Kikaka (S) Kigagi (G)	-	*Aloe vera*	leaves	NC D	Extreme bitter to humans	Avoid ingestion
Taba (S) Taaba (G)	Tobacco	*Nicotiana tobacum*	leaves	NCD	-	-

S = Local name of plant in Lusoga, the native language in the study area. G = Local name of plant in Luganda, one of the main languages spoken in Uganda, NCD = Newcastle disease was crushed and added to water prior to giving the birds. Most farmers applied the medicines to the body parts of the birds which were infested by the parasites. The herbs were pounded using the wooden pestle and mortar (Fig. 3) before application. For some medicinal plants, e.g. *Capsicum frutescens* (red pepper), the medicine was added to fire and smoked inside the chicken house, to control ectoparasites. It took on average 2 hours for the parasites to fall and/or die when herbal extracts were applied directly on the ectoparasites on chicken. However, some farmers preferred adding the medicines to cow's urine; while others added it to ash and water before letting the birds to drink it.

About 77.5% of the farmers received veterinary services, at most twice a year. About 90% of the farmers kept chicken for food and income; while 10% were used to cater for cultural obligations and emerging rituals in society. Fourty five respondents (68%) mentioned female adults as owners of the chicken in the respective households. Twelve respondents (18%) referred to adult males as the owners of poultry; and nine respondents (14%) said that poultry in their homesteads belonged to children.

Management of chicken was mainly by women (91%) and only six respondents (9%) indicated that the activity was carried out by children. None of the respondents associated the management of chicken with men.

The major purpose for keeping chicken in Luuka district was as a source of income (82%), followed by 14% for use in carrying out cultural ceremonies. Only three (14%) owned flocks of between 51 and 100 chickens and none had more than 100 chickens.

Use of *Tephrosia vogelii (Muluku)*

Most of the farmers interviewed (82%) had heard about *Muluku* as a remedy for controlling agricultural pests; and (68%) used *Muluku* on their poultry farms to control ectoparasites (Table 3). The pests for which *Muluku* was used included fleas and lice in poultry, mites in dogs and in poultry, mole rats in cassava and potato, ticks in cattle and nematodes, which attack cabbage plantations. None of the respondents mentioned cultural norms associated with the use of *T. vogelii*. Most of the respondents noted that *Muluku* was very effective in controlling ectoparasites on animals, post-harvest crop weevils and other crop pests (Table 3). Majority of the respondents preferred herbal medicines to modern methods of using acaricides to control ectoparasites. The reasons for their preference were that herbal

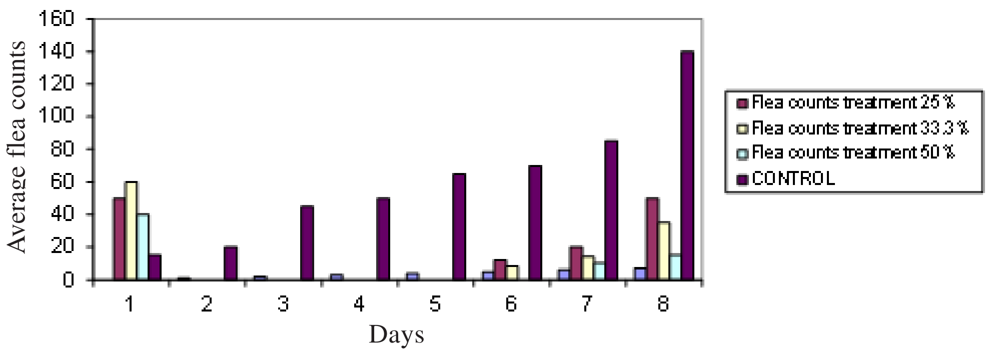

Figure 3. Effect of different concentrations on flea population (fresh leaves extract).

Table 3. Herbal medicines used for controlling ectoparasites in poultry in Luuka district in eastern Uganda

Local name	Common name	Botanical name	Part of plant used	Mode of application	Targeted Ectoparasites	Side effect	Pre-caution required
Muluku (S, G)	Fish bean	*Tephrosia vogelii*	Leaves	Add to water and wash infected body parts	Ticks, fleas, lice and mites in poultry and livestock	Poisonous to fish, causes itching if exposed to skin	Dispose of properly
Kamulali (S,G)	Red pepper	*Capsicum frutescens*	Fruit	Smoke dry fruit on fire inside animal house	Mites, lice and fleas	Irritates eyes and skin; causes coughin	Avoid body contact, keep off house
Mukakale (S) *Nsogasoga (G)*	Castor bean	*Ricinus communis*	Seed	Crushing and pasting on affected body parts	Mites, lice and fleas	Paste is extremely poisonous to both animals and humans	Avoid ingestion

S = Local name of plant in Lusoga, the native language in the study area. G = Local name of plant in Luganda, one of the main languages spoken in Uganda medicines were more accessible, affordable, more effective and environmentally safe.

Four hours after treating the chickens with *T. vogelii* extracts having dilutions of 50, 33.3 and 25% w/v water, fleas on all the 10 chickens were found dead; and none of the fleas in the control group had died. The first chickens to be re-infested with fleas were seen on the fifth morning after treatment. The extract from the fresh leaves used in the shelf-life test remained potent up to four days, after which its potency started dropping significantly, while that from the dried leaves remained potent up to six days.

Results from the long term effect test showed that it took five days for the first fleas to appear on the treated birds. On that day, no fleas were found on chickens treated with: 50% extract from the fresh leaves; 50% extract from dry leaves, and 33.3% w/v extract from dry *T. vogelii* leaves. There were, however, some fleas on chickens treated with 25% extract from fresh leaves, and with 25% extract from dry leaves, on the ones treated with 33.3% fresh *T. vogelii* leaves; and on the untreated chickens. On Day 7, however, there were fleas on all the other chickens, except on the ones treated with 50% extract from dry leaves. In the control group, the average number of fleas increased daily throughout the seven days (Fig. 5).Using the Student-Newman-Keules (SNK) test for homogeneity, and analysis of variance for regression, it is clear that in all cases post treatment, comparison between the results from the treated and the control groups on days 6, 7 and 8 showed significant differences: [($p < 0.001$, $F = 21.33$, $df = 2$), ($p < 0.001$, $F = 20.443$. $df = 2$), ($p < 0.001$, $F = 29.924$, $df = 2$)], respectively (Tables 4 and 5; and Figs. 3 and 4).

Although the number of fleas on most of the chicken increased daily, some difference was noted between the increases in number of fleas from the birds treated with the same concentration of

Table 4. Analysis of variance test results showing effects between treated and control chickens

Days	Source	Sum of squares	df	Mean square	F	Sig.
Day 6	Between Groups	11329.143	2	5664.571	21.331	.000
	Within Groups	4780.000	18	265.556		
	Total	16109.143	20			
Day 7	Between Groups	15127.111	2	7563.556	20.443	.000
	Within Groups	6659.556	18	369.975		
	Total	21786.667	20			
Day 8	Between Groups	33289.143	2	16644.571	29.924	.000
	Within Groups	10012.000	18	556.222		
	Total	43301.143	20			

Table 5. Student-Newman-Keules test results showing effects between treated and control chickens

Origin	N	Day 6		Day 7		Day 8	
		1	2	1	2	1	2
Dry leaves	9	1.33		4.33		21.33	
Fresh leaves	9	6.67		14.78		33.33	
Control	3		70.00		85.00		140.00
Sig.		.597	1.000	.384	1.000	.414	1.000

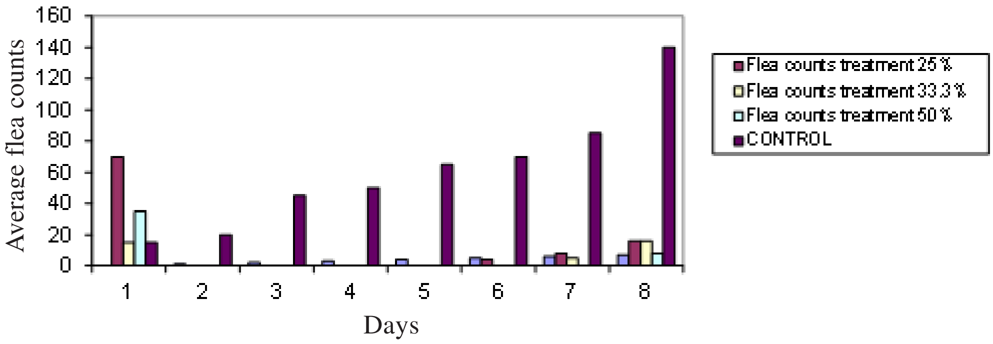

Figure 4. Effect of different concentrations on flea population (dry leaves extract).

extract from the dry *T. vogelii* leaves compared to those treated using extracts from fresh leaves. The differences, however, were not statistically significant, p > 0.05 (Fig. 5).

Results of confidence intervals taken on Day 6 showed no significant difference in flea re-infestation rates (Fig. 5) Chicken treated with the dried leaf extracts had lower infestation rates than those treated with fresh leaf extract. However, the differences were not significant (P > 0.05).

There were significant differences in re-infestation among 25, 33.3 and 50% extracts (p < 0.05). The higher the concentration the lower the re-infestation tended to be (Figs. 3, 4 and 5; and Tables 6 and 7).

The results from the dried *Tephrosia vogelii* extract showed that the LD_{50} was reached at that concentration after 50 ml of original extract were diluted with 1200 ml of water (Table 7). On the other hand, for fresh leaf, LD_{50} was reached when 50 ml of the original extract was diluted in 800 ml of water. At that_concentration, 50% of the fleas where found dead at room temperature. The trend shows some difference between the LD_{50} for the dried leaves extract and that from the fresh leaves.

Discussion

The rampant cases of predation (Fig. 2) may be associated with lack of proper housing and or due to bushy areas

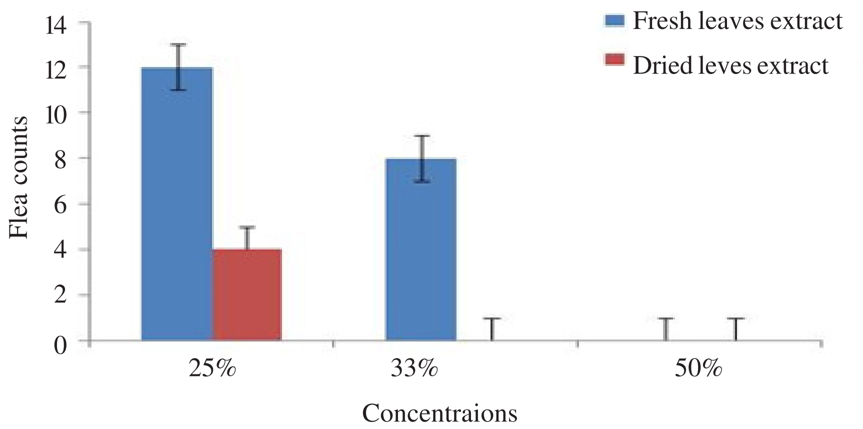

Figure 5. Comparison of flea re-infestation between dry and fresh leaves extracts. Percentages show proportion (%) weight of leaves used in making the extracts in water.

Table 6. Analysis of variance for comparison of effects of different concentrations among extracts

Response	Source	Sum of squares	df	Mean square	F	Sig.
Day 6	Between Groups	11393.143	3	3797.714	13.690	.000
	Within Groups	4716.000	17	277.412		
	Total	16109.143	20			
Day 7	Between Groups	14879.333	3	4959.778	12.207	.000
	Within Groups	6907.333	17	406.314		
	Total	21786.667	20			
Day 8	Between Groups	36038.143	3	12012.714	28.117	.000
	Within Groups	7263.000	17	427.235		
	Total	43301.143	20			

Table 7. Student-Newman-Keules comparison of effect among different concentrations

Concentration (%)	N	Day 6		Day 7		Day 8	
		1	2	1	2	1	2
50.0%	6	.00		5.00		11.50	
33.3%	6	4.00		9.67		25.50	
25.0%	6	8.00		14.00		45.00	
0.0%	3		70.00		85.00		140.00
Sig.		.741	1.000	.771	1.000	.056	1.000

clustered around poultry dwelling places. Both attributes may not be ruled out since they are common features in a typical free-range poultry farm. Keeping the chicken in confinement would be the appropriate solution, although it creates a necessity for additional labour for providing the birds with feeds rather than scavenging by themselves. Our observation compares favourably with the results of a similar study by Okoli *et al.* (2002) in southwestern Nigeria.

Fumigation of poultry houses was in agreement with similar findings whereby herbs *like Adansonia digitata;* and *Guiera senegalensis* (Nwude and Ibrahim, 1980) were used to fumigate poultry houses to control ectoparasites in Nigeria.

Since none of the respondents mentioned cultural norms associated with the use of *T. vogelii,* this implies that *T. vogelii* is socially acceptable in the study area. The low rate of access to veterinary services implies that it is necessary to equip the communities with readily available techniques to enable them improve on their poultry production. Ethno-veterinary remedies can be the best option in this respect.

The difference in potency between the flesh and dry leaf extracts (Figs. 3 and 4) might be as a result of the dried leaves having had high dry matter content compared to the fresh ones. It may also be due to the fact that the extract from the fresh leaves decomposed faster due to higher organic solvents content compared to that from dried leaves. This might have led to faster biodegradation of the former fresh leaves extract. Since higher concentrations gave better protection, this suggests that farmers should take precaution while preparing extracts. The effectiveness of *T. vogelii* extract, from either the fresh or the dried leaves, with concentration ranging between 25 and 50% w/v, presents a residual effect that can protect chickens from fleas up to five days.

Since there was no significant difference in re-infestation on birds treated using extracts from fresh *T. vogelii* leaves compared to extract from dry leaves, suggests that both fresh and dry leaves extracts are equally effective in controlling fleas on poultry. Hence, a farmer can use either the fresh or the dry leaves, whichever is most convenient, to formulate extracts without interfering with the end results. Another implication is that a farmer can collect the leaves and dry them appropriately for future use without possible deterioration during storage. This can be very important in ensuring a steady supply of *Tephrosia vogelii* leaves regardless of seasonal influence or its availability at a farmer's garden at all times.

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