Antihelminthic and anticoccidial effects of *Zingiber officinale* Roscoe fortified diets fed to Yankasa rams

S A Adeniji, O A Adediran[1], T O Ososanya and E C Uwalaka[1]

Department of Animal Science, University of Ibadan
tososanya85@gmail.com
[1] Department of Veterinary Microbiology and Parasitology, University of Ibadan

Abstract

Parasitic burden results in sub-optimal ruminant livestock production. Synthetic coccidiostats and antihelminthes have been reported to induce resistance and leave residues in the carcass of animals with serious health implications. Although ginger rhizome is a potential alternative to coccidiostats and antihelminthes, its use has not been properly documented. In this study, ginger rhizome was processed into powder and added to a concentrate diet at 0g/kg (G1), 5g/kg (G2), 10g/kg (G3), 15g/kg (G4) and 20g/kg (G5). In a completely randomized design, twenty five pubertal Yankasa rams were allotted to the five dietary treatments. The rams were allowed to graze inside infested pastures for 50days to acquire helminthes and coccidia naturally. At day 51, the rams were confine in individual pens and fed experimental diets for 28days. Faecal samples (5g) were collected from rams for Faecal Egg Count Reduction Test (FECRT, %)) and Coccidia Oocyst Reduction Test (CORT, %) on days 0, 7, 14, 21 and 28. Data obtained were subjected to descriptive statistics and ANOVA $?_{0.05}$.

Results obtained showed that on day 28, the FECRT (%) was higher in G2 (100), G3 (100), G4(100) and G5(100) than G1 (7.43) while the CORT (%) was higher in G2 (100), G3 (100), G4 (98.83) and G5 (100) than G1 (22.60). The helminthes ova recovered from faecal examination using floatation techniques were *Haemonchus contortus, Trichostrongylus* spp, *Oesophagostomum* spp, *Strongyloides*,and *Moniezia*; while *Haemonchus contortus*, *Trichostrongylus* spp., N*ematodirus* spp., *Moniezia* and *Oesophagostomum* spp. larvae were identified on faecal culture. The result revealed that crude ginger rhizome is a potential alternative anti-helminth and anti-coccidia for resource poor farmers as it grossly reduced helminth and coccidia load in the rams.

Keywords: *anthelminth, coccidia, oocyst, pubertal*

Introduction

The use of herbs and herbal extracts has gained tremendous attention over the past decades. A number of ethno-biological inventions have yielded results in treating bacterial infections and intestinal parasites in plants and animals. Research findings have listed many plants as possessing medicinal properties (Nundkumar and Ojewole 2002; Athanasiadou and Kyriazakis 2004; Fajimi and Taiwo 2005; Githiori *et al* 2006; Adedapo *et al* 2007; Adediran *et al* 2014, Adediran and Uwalaka 2015). The use of seeds, stems, leaves and roots of some plants such as turmeric, mint, onion and garlic have been exploited to treat animals that suffer from gastro-intestinal parasitism. Guarrera (1999) reported that the leaves, dried flowers and oil from *Chenopodium ambrosioides*, a shrub that originated from Central America and has been distributed around the world, have all been used as anthelmintics since the early 1900s.

There are two principal reasons behind the changing trend in the use synthetic drugs in treating animals. The first is to combat the development of microbial resistance to antibiotic antihelmintic drugs in animals. The second is a response to consumer pressure to eliminate the use of all non-plant xenobiotic agents from the diet of animals. Hence, the only alternative means of treating livestock diseases available to the rural farmer is the use of phyto-medicines. Reports have shown that about 80% of the world population relies solely on medicinal plants for the treatment of diseases (Dwivdedi 1999). Some ethno veterinary practices have been reported in the northern part of Nigeria by some authors (Abdu *et al* 2000; Alawa *et al* 2003, Alawa *et al* 2010).

Many plants and plant parts have been shown to exhibit antibiotic, antimicrobial and anti-parasitic properties. Anosa and Okoro (2011) reported anticoccidial activity of the methanolic extract of*Musa paradisica* root in chickens while Adedapo *et al* 2007; Ademola and Eloff 2011; Adediran and Uwalaka 2015 reported anthelminthic activity of extracts of *Vernonia amygdalina* (bitter leaf) against various helminths in ruminants.

Gastro-intestinal (GI) nematodes resistance to anthelmintic treatments causes poor productivity in small ruminants (Van Wyk *et al* 1997; Waller 1999) while coccidiosis is a common and damaging illness of sheep, goats, and cattle particularly young lambs, kids, and calves. It is a disease that causes young animals to be "poor doers," sometimes permanently (Coffey 2014). A strategic anthelmintic treatment increases productivity and financial profitability (Nwafor 2004). Resource-poor farmers find purchasing of synthetic anthelmintics too expensive in developing world (Hammond *et al* 1997). Hence, the development of alternatives for helminth and coccidia control which are less reliant on chemotherapeutics is considered the way forward. Therefore, this study was designed to assess the effects of ginger rhizome on the helminth and coccidia burden in Yankasa rams.

Materials and methods

The study was conducted at the Teaching and Research Farm of the University of Ibadan located on latitude 7^o27^1N and longitude 3 $^o45^1$E, at an altitude of 200m above sea level within the derived savannah zone of Nigeria. A total of 25 pubertal Yankasa rams weighing 11-13kg were used for this experiment. Procedures for the egg counts were carried out at the Veterinary Parasitology Laboratory, University of Ibadan.

Experimental diets

Sundried ginger rhizome (yellow variety, UG 1) was milled and mixed thoroughly with a concentrate diet (table 1) at 0, 5, 10, 15 and 20g/kg respectively with each inclusion level serving as experimental treatment.

Experimental layout

Treatment 1: Concentrate + 0 g/kg ginger root = T1

Treatment 2: Concentrate + 5.0 g/kg ginger root = T2

Treatment 3: Concentrate + 10.0 g/kg ginger root = T3

Treatment 4: Concentrate + 15.0 g/kg ginger root = T4

Treatment 5: Concentrate + 20.0 g/kg ginger root = T5

Table 1. Gross Composition of experimental diet without ginger inclusion

Ingredient	%
Dry Cassava Peel	35
Brewers Dry Grain	40
Palm kernel cake	12
Rice husk	8
Salt	3
Limestone	2
Calculated Crude Protein	11.47

Experimental animals

A total of 25 ram-lambs of ages between 28 to 32 weeks, weighing 14-17kg were used for this experiment. The rams were left to free-graze for over fifteen weeks to allow for suitable level of infection having individual egg counts which is above 150 eggs per gram of faeces (EPG). The rams were thereafter randomly allocated based on their ranking of faecal egg counts into control and treatment groups. Different groups were allocated to each of the ginger fortified concentrate feed for the tests. A control (untreated) group was created to allow for monitoring of natural changes in egg counts during the test period.

Treatments - Dosing regimen

The test samples were thoroughly mixed with the concentrate diet and introduced to the rams as a modification for dosing. The dosing regimen of ginger was at inclusion of 0, 5, 10, 15 and 20g/kg respectively in the concentrate feed .

Sampling procedures

For pre-screening of animals for sufficient egg counts, a minimum of 5g (10 to 15 pellets) of faeces was collected from each animal directly from the rectum. The same procedure was followed at the post-treatment sampling. Samples were placed in individually sealed containers and returned rapidly to the laboratory for egg count. The post-treatment collection of faecal samples was reviewed to 28 days.

Faecal Egg and Cyst Count

Faecal samples collected per rectum from all rams were subjected to the faecal egg and cyst counts using the McMaster method as described by Thienpont *et al*., (1979). The faecal culture, floatation technique of faecal examination was carried out as described by Khin Khin *et al*., (2007). Faecal egg counts, oocyst counts and helminth ova and larvae were recorded.

Processing of samples

The modified McMaster method was used for feacal egg count, where 3grams of faeces was weighed into a suitable container, while 42 ml of water was added and soaked for a few minutes to 1 h, until the faeces became soft. They were thereafter homogenised using a laboratory stirrer and shaken until all the pellets have been broken up. Afterward it was poured through a 100 mesh (0.15 mm aperture), 20 cm diameter sieve into a bowl.

The liquid was swirled and 15 ml was poured into a 17 ml centrifuge tube. It was centrifuged for 2 min at about 300 Ã—g (approximately 1500 rev/min on a bench-top centrifuge). Thereafter, the supernatant was gently poured or sucked off. The tube is agitated to loosen the sediment. Suitable flotation fluid was added to give the same volume as before (15 ml). The tube was inverted five or six times. A sample was immediately withdrawn with a Pasteur pipette to fill the chamber of a McMaster slide. The process of inversion was done again to fill the second chamber. At x10 magnification, all the eggs were counted under the two ruled grids (total volume 0.3 ml). Multiply the number of eggs by 50 to give the EPG in the faecal sample. For greater sensitivity all the eggs in each chamber was counted (total volume 1 ml and multiply by 15 to give the EPG).

Analysis and interpretation of data

The percentage reduction, FECR % i.e. Percentage efficacy was calculated using the formula modified from that described by Arundel (1985) as follows:

% Efficacy = N – n X 100 N

Where: N = Mean number of helminth egg or cyst in control (untreated) animals.

Resistance is considered to be present if:

(i) The percentage reduction in egg counts is less than 95 percent and

(ii) The 95 percent confidence level is less than 90 percent.

If only one of the two criteria is met, resistance is suspected.

Table 2. Effect of ginger powder fortification on the percent reduction of helminth eggs in Yankasa rams (%)

Days	T1	T2	T3	T4	T5
7	4.78^{b}Â±4.33	94.13^{a}Â±5.42	80.97^{a}Â±21.20	86.57^{a}Â±10.11	80.90^{a}Â±12.28
14	4.81^{b}Â±4.33	86.73^{a}Â±9.59	84.70^{a}Â±11.87	81.03^{a}Â±14.43	58.03^{a}Â±40.14
21	7.88^{b}Â±4.15	87.93^{a}Â±7.85	93.20^{a}Â±10.51	90.10^{a}Â±17.15	92.50^{a}Â±9.01
28	7.43^{b}Â±1.98	100.00^{a}Â±0.00	100.00^{a}Â±0.00	99.20^{a}Â±8.31	100.00^{a}Â±0.00

a,b: means in the same row with different superscripts are significantly different ($P<0.05$)
T1 = Concentrate + 0g/Kg Ginger; T2= Concentrate + 5g/Kg Ginger; T3= Concentrate + 10g/Kg Ginger;
T4= Concentrate + 15g/Kg Ginger; T5= Concentrate + 20g/Kg Ginger

Photo 1. Egg of helminthes as seen under the microscope (Mag. x40)

Photo 2. The cultured larvae as seen under the microscope (Magnification x 40)

Results and discussion

Effect of ginger powder supplementation on the percent reduction of helminth eggs in Yankasa rams

This study describes the anthelmintic and anticoccidia activity of *Zingiber officinale* Roscoe (family Zingiberaceae) rhizome which is normally used in traditional ethno veterinary medicine. The result showed that feeding pubertal Yankasa rams with crude powder of ginger is generally effective against helminthes and coccidia. From Table 2, the percent faecal egg count reduction (%FECR) for the control ranged between 4.78 and 7.88% throughout the experimental period, showing that helminth egg count did not reduce significantly when ginger was not included in the diet. However, at the lowest level of ginger inclusion, (5g/kg), there was a high percent reduction in egg count (94.13, 86.73, 87.93 and 100.00% at days 7, 14, 21, and 28 respectively). The other ginger inclusion rates elicited similar egg count reduction in Yankasa rams. This result is similar to that obtained by Iqbal *et al*., (2006) who observed a dose and time-dependent anthelmintic effect in infested sheep when crude aqueous extracts and crude powder of dried ginger were administered. The result from this study showed that crude ginger powder was more effective against helminthes than standard

Levamisole (7.5 mg/kg) which exhibited 99.2% reduction in EPG as reported by Iqbal *et al (*2006*)*. Its effectiveness is comparable to that of *Vernonia amygdalina* which cleared helminthes eggs and coccidia cysts in goats with an efficiency of 100% and 99.4% respectively (Adediran *et al* 2014).

The EPG in faeces of the treated groups before administration of ginger ranged from 55 to 285 while that of the control group ranged between 224 and 426. The animals in treated groups recorded 0 – 6 EPG post administration while the control group exhibited increased EPG. The helminthes ova recovered from faecal examination using floatation techniques were *Haemonchus contortus, Trichostrongylus spp, Oesophagostomum spp, Strongyloides, and Moniezia.* However, on faecal culture,*Haemonchus contortus, Trichostrongylus spp, Nematodirus spp, Moniezia and Oesophagostomum spp* . larvae were identified. The percentage efficacy of ginger powder against helminthes was 100%. This shows that ginger possesses in vivo anthelmintic activity in rams and its use against helminthes infestation is justified.

Effect of ginger supplementation on the control of coccidia in Yankasa rams

Table 3 shows the effectiveness of ginger inclusion on the coccidia reduction level. Ginger powder effectively reduced coccidia count in the rams fed. The percentage level of reduction of oocyst is highly significant between the unfortified and the ginger fortified groups. The coccidia cyst count varied between 33 and 413 pre-treatment in treated and control groups. There are no significant differences in the percent reduction in the level of oocyst in the rams fed fortified diet, however there is increases in the efficacy of ginger for all the treated group as the number of days increased, thus an 100% efficacy was observed in all the fortified group on day 28 as against the control group where there is increase in the number of oocyst over the period of the experiment.

Table 3. Effect of ginger supplementation on the percent (%) reduction of coccidia in Yankasa rams over a period of 28days

Days	T1	T2	T3	T4	T5	SEM
7	16.32^{b}	66.53^{a}	52.33^{a}	53.53^{a}	57.15^{a}	9.65
14	18.72^{b}	72.97^{a}	72.00^{a}	67.03^{a}	58.87^{a}	8.73
21	18.34^{b}	86.10^{a}	87.57^{a}	82.43^{a}	76.20^{a}	5.83
28	22.60^{b}	100.00^{a}	100.00^{a}	98.83^{a}	98.37^{a}	4.43

a,b, means in the same row with different superscripts are significantly different (P<0.05).

On day 28 of the study, the coccidial count was zero, 0, except in one animal that had oocyst count of 21 from 114 post treatment as observed in table 5. However, there was increase in the coccidian count in the control group except in ram where the count decreased from 413 to 249. In the same vein, the percentage efficacy of ginger as a coccidiostat was 100% on day 28 as shown in table 3.

Table 4. Egg count (egg per gram of faeces) of the treated and control groups pre and post administration o ginger powder.

Treatments	Class	Day 0	Day 3	Day 7	Day 14	Day 21
Control group						
T1	*Strongyloides*	93	1	0	62	60
	Strongyles	131	120	0	252	248
T1	*Strongyloides*			2	33	35
	Strongyles	342	341	342	340	303
T1	*Strongyloides*	15	22	17	19	20
	Strongyles	405	407	403	410	405
	Monieza	6	8	5	11	5
Treated group						
T2	*Strongyloides*	71	0	1	11	2
	Strongyles	214	11	3	41	7
T2	*Strongyloides*			9	5	4

	Strongyles	201	27	24	37	13
T2	*Strongyloides*			11	2	6
	Strongyles	94	15	4	1	0
T3	*Strongyloides*			17	6	0
	Strongyles	153	98	66	41	1
T3	*Strongyloides*					0
	Strongyles	293	62	32	9	2
T3	*Strongyloides*	0	0	0	4	2
	Strongyles	131	9	4	21	18
T4	*Strongyloides*	13	2	0	0	0
	Strongyles	41	7	0	4	2
	Monieza		2	0	0	0
T4	*Strongyle*	130	34	14	15	7
	Monieza	2	27	19	0	0
T4	*Strongyloides*	5	0	0	0	0
	Strongyles	118	87	29	42	26

	Nematodirus fillus	5	1	0	0	0
	Monieza	3	0	1	0	0
T5	*Strongyloides*		5	9	2	0
	Strongyles	3	21	15	7	0
T5	*Strongyloides*		13	6	9	4
	Strongyles	42	63	13	37	4
T5	*Strongyloides*	0	0	0	0	0
	Strongyles	171	37	11	39	3

Table 5. Coccidia count in treated and control groups pre and post administration of ginger powder.

Treatments	Day 0	Day 3	Day7	Day 14	Day21	Day 28
Control group						
T1	413	311	297	244	256	249
T1	114	210	208	201	211	232
T1	289	292	301	309	321	319
Treated Group						

T2	314	111	110	109	53	-
T2	111	32	30	29	13	-
T2	213	84	53	31	28	-
T3	411	117	93	73	51	-
T3	93	61	28	13	3	-
T3	23	21	15	12	5	-
T4	101	71	52	34	20	-
T4	91	31	24	1	15	-
T4	114	81	66	53	31	21
T5	33	11	9	8	6	-
T5	63	39	34	27	7	-
T5	34	17	16	15	9	-

Conclusion

- Ginger powder incorporation in the feed of rams provides an alternative and natural antiparasitic activity against their helminth and coccidia load.

- The spice which is much available in the tropics is environmentally friendly and had no visible signs of chemical residues in the animals since no adverse effect was physically observed throughout the duration of treatment.

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