EFFECTIVENESS OF INDIGENOUS TECHNOLOGIES FOR THE TREATMENT OF HELMINTHS IN CATTLE AMONG SETTLED AGRO-PASTORALIST IN SOUTH WEST NIGERIA

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ABSTRACT
Irrespective of the production systems employed, one of the major constraints to ruminants' production in Nigeria and elsewhere is gastro intestinal parasitism. The study examined the indigenous technologies for the treatment of helminths in cattle among settled agro-pastoralist in southwest Nigeria. Two hundred agro-pastoralists were selected using convenient sampling techniques, but 169 respondents were eventually interviewed and this account to the number of returned questionaire. Data collected on personal characteristics; indigenous technologies used by agro-pastoralist, preferred indigenous technology and effectiveness of indigenous technologies for the treatment of helminthes in cattle were subjected to both descriptive (such as frequency count, percentage, and mean) and inferential (ANOVA) statistical analyses. The findings showed that respondents' mean age was 47, years, mean household size was 12 persons and 43.8% had only Quranic education while 90.5% of them were married. The most commonly used, and preferred indigenous plant for the treatment of helminthes were *Ewuro* ($\bar{x} = 3.69$), *Efirin* ($\bar{x} = 3.29$), *Ata wewe* ($\bar{x} = 3.24$), *Alubosa* ($\bar{x} = 3.17$), *Ewe ibepe* ($\bar{x} = 3.16$) and *Iyere* ($\bar{x} = 3.10$). Conventional drug caused a significant decline between Day1 ($\bar{x} =$ 4300.00 SD±788.811) to Day 3 ($\bar{x} = 0.00$ SD±0.00). The herbal drug significantly cleared the worm loads between Day1 ($\bar{x} = 4500.00$ SD±623.61) to Day 4 ($\bar{x} = 0.00$ SD ±0.00) while there are no significant changes in the control group. The study concludes that agro-pastoralist communities were young with large household member, rich in traditional knowledge on medicinal plants used to treat their herds. It is therefore recommended that preservation of all the identified indigenous technologies used by the Agro-pastoralist should be avoided to go extinction and educate them on the proper usage of anti-helminthes drugs and administration.
Keywords: Effectiveness, Indigenous, Disease, Helminthes, Agro-pastoralist, Cattle

INTRODUCTION

Helminthosis is a disease condition caused by internal parasitic worms that invade the internal organs of livestock while Helminths are endo-parasites comprising of a large and varying group of invasive parasites. According to Lawal-Adebowale (2012) who noted that all the livestock that makes up the farm animals (ruminants) in Nigeria, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system. Nigeria has population of 34.5million goats, 22.1million sheep and 13.9million cattle. Prevalent helminthes in Africa are Nematode; *Haemonchus, Cooperia, Bunostomum, Trichuris, Oesophagostomum, Trichuris* and *Strongyloidiasis. Cestodes* include; *Monezia* while Trematodes consists of; *Paramphistomum, Fasciola, Dicrocoelium* which are usually more pronounced in the intestine of ruminant animals. Gastro-intestinal nematode infections are a major part of the health problem affecting cattle. Several workers have reported economic losses in cattle production due to these infections in the aspects of reduction in meat quantity and quality, milk production, organ condemnation (liver), loss of draught power, reproductive failure, mortality as well as risk of contracting zoonotic species (Hossain, Paul, Rahman, Hossain, Hossain and Islam 2011; Odigie and Odigie, 2013). One approach common among indigenous group for the control of helminths over diseases is the use of indigenous technology. The terms indigenous, traditional and/or local knowledge make reference to knowledge and know-how that is accumulated over generations and guides human societies in their innumerable interactions with their surrounding environment. Berkes (2012) defines such traditional, ecological knowledge as "a cumulative body of knowledge, practice and belief, evolving by adaptation processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with their environment". Agro-pastoralists would rather draw on years of knowledge and experience of indigenous technology practices conserved in oral histories and traditions among different groups. Cattle are parasitized by various helminths species, the most important being Gastro-Intestinal Nematodes (GIN), lungworms and liver fluke (Charlier, De-Waele, Ducheyne, van der Voort, Velde, and Claerebout, 2016). These pathogens can cause severe disease, affect productivity in all classes of stock, and are amongst the most important production-limiting diseases of grazing ruminants. Essentially all herds/flocks in a grass-

based production system are affected (Charlier, *et al.,* 2016). Infections with GIN and liver fluke are more chronic and the major economic impact is due to sub-clinical infections causing reduced growth, milk yield and fertility (Morgan, Charlier, Hendrickx, Biggeri, Catalan, von Samson-Himmelstjerna, Demeler, *et al.,* 2013). Infections with lungworm are more acute and can place a sudden high economic burden on a farm due to mortalities and sharp decreases in milk yield (Holzhauer, van-Schaik, Saatkamp and Ploeger, 2011).

These indigenous veterinary practices have been in operation in bits and pieces from generation to generation, but have to become the driver for bottom-up development in cattle production for the sake of sustainability. Sustaining the aroused interest of agro-pastoralists in the use of indigenous technologies therefore becomes imperative. Instead of demonstrating presence/absence of infection in a cow or herd, it is more relevant to identify the associated production losses to convince farmers that further diagnoses, and control measures, are worth considering (Charlier, Vercruysse, Morgan, van-Dijk and Williams, 2014). It is therefore critical to create an enabling environment, for seamless fusion of indigenous and scientific knowledge by first documenting and utilising complimentary experiences of agro-pastoralists towards sustainable cattle health management. The study objectives are to: identify the indigenous technologies for the treatment of helminths in cattle by settled agro-pastoralists; methods of administration of identified indigenous technologies for the treatment of helminths in cattle; preferred indigenous technologies used for the treatment of helminths and the effectiveness of indigenous technologies for the treatment of cattle helminths compared to conventional methods of treating helminths among agro-pastoralist in the study area.

METHODOLOGY

The study was conducted in the South West region of Nigeria. The region is one of the six geo-political zones in Nigeria. It comprises six states which are Lagos, Ogun, Ondo, Osun, Oyo and Ekiti States (Figure 1). This region is more preferable by the Fulanis because of the longer rainy season as compared to the shorter rainy season of their traditional home in Northern Nigeria. The region lies between latitude $7^{0}01'$ and $8^{0}14'$ and stretches between longitude $2^{0}45'$ and $4^{0}15'$. The area is inhabited mainly by the Yoruba's who are traditionally sedentary agriculturists and traders. Ogun State is a heterogeneous state, inhabited predominantly by the Egba, Yewa, Ijebu, Remo, Awori, and Egun who belong to the Yoruba Ethnic group on the African Continent. Ogun State is located on the latitude $7^{0}18^{1}N$ and longitude $5^{0}55^{1}E$. Ogun State has green vegetation which favours many settled Fulani pastoralists. Oyo State was one of the three States carved out of the former Western Region of Nigeria in 1976. The climate in Oyo state favours the cultivation of forage crops and pasture. The State has an equatorial climate with dry and wet seasons and relatively high humidity. The population of this study were all settled agro-pastoralist household heads in South West Nigeria.

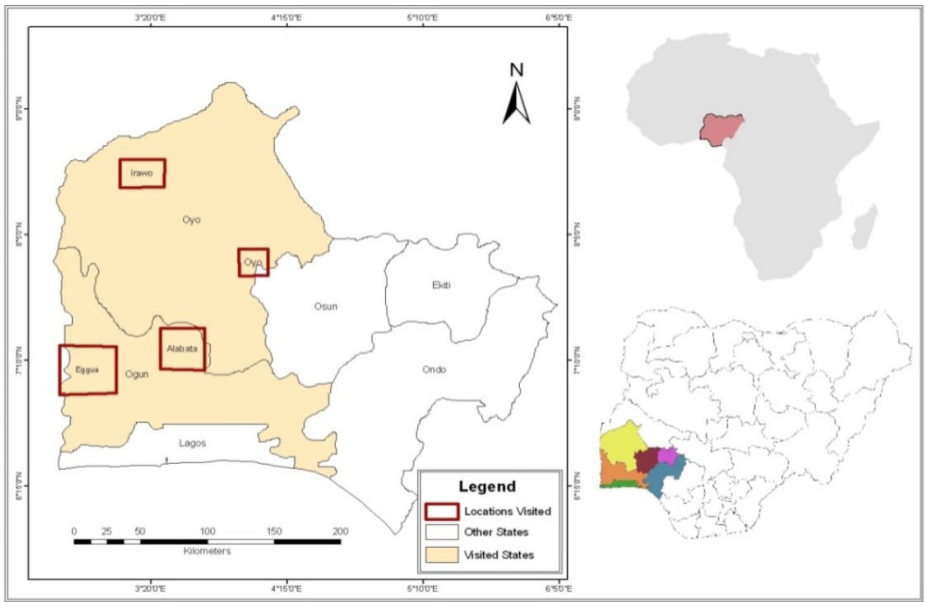

Figure 1: Map of the South Western region of Nigeria showing the study areas.

Sampling procedure and sample size: The respondents were selected through a multi-stage sampling technique. Stage One: involved a purposive selection of two states (Ogun and Oyo States) out of the six states in South West Nigeria. The selection was based on high population of settled agro-pastoralists. Stage Two: From Ogun and Oyo states, two Local Government Areas (LGAs) were purposively selected which were Odeda and Yewa North LGAs from Ogun State and Atisbo and Oyo East from Oyo State. This is based on geographical or vegetation location and presence of settled agro-pastoralists. Stage Three: From each of the Local Government Areas selected, one community with large presence of agro-pastoralists was selected purposively. The communities are Alabata and Eggua in Odeda and Yewa-North, Ogun State respectively; Ido ide and Irawo in Oyo East and Atisbo, Oyo State respectively. Fifty (50) pastoralists household were conveniently selected in each LGA. The respondents were also selected on the basis of willingness of the settled agro-pastoralists to cooperate with the research team. A total of 200 respondents were selected for the study, but 169 respondents were eventually interviewed and this account to the number of returned questionaire

Measurement of variables

Available Indigenous plants used: Compendiums of the various indigenous plants used by agro-pastoralists were generated and with support from literatures (Nanule, Mbaria, Olila and Kimenju, (2011). It was measured at the ordinal level of 3 = most commonly used, 2 = less commonly used and 1 = Seldomly used,

Various methods of administration of identified indigenous plants: This was measured by providing a list of the identified indigenous plants used by settled agro-pastoralist to treat helminths and method of administration was measured at nominal level of 1 = Oral method, 2 = Drenching 3 = Skin massage and 4= Inclusion in feed.

Dependent variable: The dependent variable in this study is the percentage change in the fecal egg count (FEC) of the infected animals as shown in Table 1. A percentage in efficacy of compendium of indigenous plants used for treatment of helminths was generated on the basis of reduction in mean egg per gram (EPG) in percent. using the following formula as described by Sutherland and Leathwick, 2011).. This is to measure the efficacy of the plant extract use for treatment of helminths infection.

Mathematically:

$FECR(\%) = ((FEC_{bt} – FEC_{at})) / FEC_{bt}) \times 100$

Where: FECR (%) denotes percentage of faecal egg count reduction.

FEC_{bt} and $FEC_{at\ represents}$ the mean egg count before and after treatment respectively.

Therefore, the value of FECR (%) ranges between 1000 and 3000egg/gram while the Effectiveness index was on the basis of reduction in faecal egg count, the result was Categorised as follows:

Table 1: Fecal Egg Count (FEC)

Faecal count	Tolerable level of infection
≤ 1000	Low grade infection
2000- 3000	Moderate
> 3000	Severe infection

Methods of data analysis

In order to achieve the objectives of this study and test the research hypotheses, the data collected were subjected to both descriptive and inferential statistical analyses. Descriptive statistics such as percentages, mean and frequency distribution were used to describe the data collected in tables, charts and graphs. Inferential statistics such as Analysis of variance (ANOVA) were also used to test the hypotheses. For hypotheses testing, 0.05level of significance was used.

RESULT AND DISCUSSION

Results in Table 2 shows that mean age of the settled agro-pastoralists was 47±10.95 years. This is an indication or reflection of an increasing population towards old age. In a study conducted by Saleh, Atala, Omokore, Ahmed, Aliand and Kajang (2016) they reported that 63% of their respondents were above 35years of age in a study they conducted in Northern Nigeria. It was observed that the respondents have an average household size of 12 persons. This implies that a typical pastoral family is large and this large number of household members supplies the bulk of labour required for farm activities. This negate the finding of Timothy (2012) which noyed that the African rural average house hold size is 10. This may be because most of the household members marry very early and become independent. Result further reveals that most (90.5%) of the agro-pastoralists were married which shows that marriage is a treasury institution and still plays a very important role in the way of life of pastoralists. Responses gathered on educational status reveal that 35.5% of the pastoralists had no form of education while (43.8%) had only Quranic education. They were literate in Quranic education

indicating that on the basis of western education they were literate enough to understand and communicate better in the society. Some of the pastoralists disclosed that they have interest in formal education but they lacked the opportunity in the study area.

Table 2: Personal characteristics of the agro-pastoralist (n = 169)

Variables	Frequency	Percentage	Mean /Std. dev
Age (yrs)			
18-27 years	15	8.9	
28-37 years	35	20.7	
38-47 years	45	26.6	47.5/10.95
48 -57 years	61	36.1	
57 years and above	13	7.7	
Household size			
1-5	8	4.7	
6-10	15	8.8	
11-15	76	45.0	12.7/11.21
16-20	30	17.8	
21-25	22	13.0	
26 and above	18	10.7	
Educational status			
No formal education	60	35.5	
Quranic education	74	43.8	
Primary education	26	15.4	
Secondary education	6	3.6	
Adult education	3	1.8	
Marital status			
Single	11	6.5	
Married	153	90.5	
Divorced	2	1.2	
Separated	1	.6	
Widowed	2	1.2	

Source: Field Survey, 2016.

Indigenous technologies used by agro-pastoralist

Result in Table 3 shows that the most commonly used plant in the treatment of helminthes were *Ewuro, Efirin, Iyere*, *Ata wewe*, *Alubosa* and *Ewe Ibepe* with the mean value of ($\bar{x}$ = 3.69), ($\bar{x}$ = 3.29), ($\bar{x}$ =3.26), ($\bar{x}$ = 3.24), ($\bar{x}$ = 3.17) and ($\bar{x}$ = 3.16) respectively. The significance of helminthiasis has been recognized by livestock farmers right from the earliest of times and various methods have been employed by them to control helminthes in their animals including the use of medicinal plants and herbs and different grazing techniques (Bukhari and Sanyal, 2011). Scientific validation of anthelmintic effects and possible side-effects of plant products in ruminants is necessary prior to their adoption as a novel method for parasite control (Veerakumari, 2015). This kind of herbal medicine provides a valuable alternative to and complements the western veterinary drugs.

Method of administration of identified indigenous technologies

Result in Figure 2 reveals that majority (78.11%) of the agro-pastoralist practices oral method of administration which is a voluntary intake of fluid per cattle, 66.27% drenching method is a forceful intake of fluid through the mouth cavity into the system of the cattle, 59.17% inclusion into feed and 38.46% practices skin massage method of administration in the study area. While medicinal plants may appear to have limited role in these approaches, several medicinal plants and traditional medicines derived from them have been used to enhance immune response to several disease agents (Di Pierro, Rapacioli, Ferrara and Togni 2012; Ramakrishna, Goda, Baliga, and Munsh, 2011).

Table 3: Regularity of indigenous technologies usage by agro-pastoralist (n = 169)

Indigenous plants used	Species scientific name	$\bar{x} - value$	Mean
Ewuro	*Vernoniaamygdalina Del.*	3.69	1st
Efinrin	*Vernoniagrantii Olive*	3.29	2nd
Iyeye	*Euphorbia heterophylla Linn.*	3.26	3rd
Ata wewe	*Physalisperuviana L*	3.24	4th
Alubosa	*ClerodendrumrotundifoliumOliv.*	3.17	5th
Ibepe	*Carica papaya L.*	3.16	6th
Iyere	*Kigelia Africana*	3.1	7th
Dagunro	*Flueggeavirosa (wild) Voigt/ Securinega. Virosa*	3.07	8th
Ejirin-nla	*Memordicafoetida*Schumach	3.04	9th
Efirinwewe	*Justiciaexigua +Ocimumbasilicum*	2.75	10th
Imi-esu	*Rhoicissustridentata (L.f.) Wild and R.B. Drummond*	2.67	11th
Ayin	*ZanthoxylumchalybeumEngl*	2.66	12th
Epa-ikun	*Asparagus tuberosum*	2.65	13th
Moringa	*Moringaoleifera Lam.*	2.63	14th
Taaba	*Nicotianatabacum L.*	2.57	15th
Erin mado	*Secamoneafricana (Oliv) Bullock*	2.56	16th
Kasu	*Cyphostemmaadenocaule (A.rich.)willd Drummond*	2.54	17th
Agbo	*HarrisoniaabyssinicaOliv.*	2.54	18th
Ojuologbo	*PhytolaccadodecandraL'Herit*	2.53	19th
Ewe ogbo	*Cassia occidentalis L.*	2.51	20th
Iwere-jeje	*Coleus latifoliusAndr, SennadidymotryaFresen*	2.48	21st
Aborere	*Justiciaexigua*	2.46	22nd
Ewe	*TetradeniaripariaHochst) Codd*	2.45	23rd
Egbogi	*Lagenariasphaerica*	2.42	24th
Abrangbe	*Cassia obtusifolia L*	2.41	25th
Aloko-agbo	*Sapiumellipticum (Hochst)*	2.36	26th
Ewe iyalode	*Veprisnobilus (Del.) mziray (Tecleanobilis)*	2.31	27th
Esekannakanna	*Sporoboluspyramidalis*	2.29	28th
Ewe aloe	*Aloe sp*	2.29	29th
Lapalapa	*Jatrophacurcas L.*	2.25	30th
Atayee	*Brillantaisiaowariensis P. Beauv.*	2.24	31st
Ewe amunimuye	*Curcubito maxima*	2.21	32nd
Ewe ato	*Justiciabetonica L*	2.19	33rd
Igbo	*Cannabis sativa L*	1.89	34th
	Grand mean	2.64	

Source: Field Survey, 2016

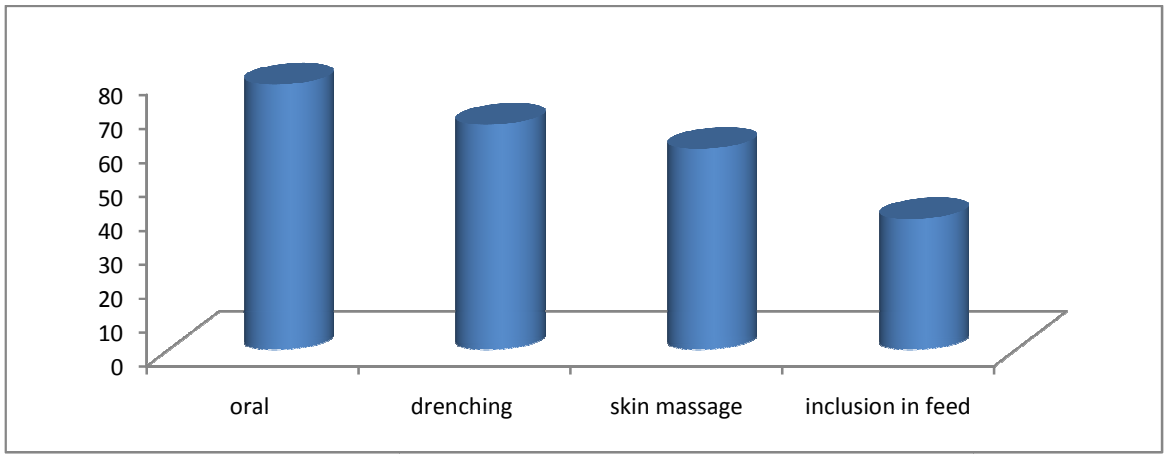

Figure 2: Method of administration of identified indigenous technologies for treatment of helminthes.

Preferred indigenous technology

Table 4 shows that respondents preferred using *Ewuro* with the mean value of ($\bar{x}$ =2.49), *Igbo* ($\bar{x}$ = 2.41), *Ata wewe,* ($\bar{x}$ = 2.39), *Esekannakana,* ($\bar{x}$ = 2.37), *Iyeye,* ($\bar{x}$ = 2.36), *Ibepe,* $\bar{x}$ = 2.34), *Moringa* ($\bar{x}$ = 2.33), *Ewe Aloe,* ($\bar{x}$ = 2.28), *Ewe ogbo,* ($\bar{x}$ = 2.22), *Ewe ato*, ($\bar{x}$ = 2.21), *Efirin,* ($\bar{x}$ = 2.23) and *Dagunro,* ($\bar{x}$ = 2.19) in the treatment of helminthes in the study area. These respondents preferred using these plant-based technologies compare to other plant for the treatment of helminths. The significance of helminthes has therefore been recognized by local people and herdsmen from the earliest times which have led to various attempts at controlling the effects through the use of medicinal plants. Fulani herdsmen in Nigeria recognize animal helminthosis to be a menace of greatest significance in cattle production, most especially calves of less than a year old. These pastoralists employ the usage of indigenous/traditional knowledge system which has been passed from generation to generation through oral tradition and practice to manage helminthes in their cattle. Nigeria is endowed with vast and readily available indigenous control methods that are within the reach of the herdsmen which they can choose from instead of depending only on modern technologies for feasible solutions that are available within their environment (Usman, Bzugu, Pur and Abdullahi, 2017).

Table 4: Preferred indigenous technology for the treatment of helminthes in cattle

Preferable indigenous plants	Species scientific name	Mean	S.D.	Rank
Ewuro	*Vernoniaamygdalina Del.*	2.49	0.66	1
Igbo	*Cannabis sativa L*	2.41	0.8	2
Ata wewe	*Physalisperuviana L*	2.39	0.73	3
Esekannakanna	*Brillantaisiaowariensis P. Beauv.*	2.37	0.81	4
Iyeye	*Euphorbia heterophylla Linn.*	2.36	0.89	5
Ibepe	*Carica papaya L.*	2.34	0.75	6
Moringa	*Moringaoleifera Lam.*	2.33	0.85	7
Ewe aloe	*Aloe sp*	2.28	0.83	8
Efirin	*Vernoniagrantii Olive*	2.23	0.78	9
Ewe Ogbo	*Cassia occidentalis L.*	2.22	0.81	10
Ewe ato	*Justiciabetonica L*	2.21	0.85	11
Dangunro	*Flueggeavirosa (wild) Voigt/ Securinega. Virosa*	2.19	0.76	12
Ejinrin-nia	*Memordicafoetida*Schumach	2.16	0.88	13
Kasu	*Cyphostemmaadenocaule (A.rich.)willd Drummond*	2.14	0.85	14
Egbogi	*Lagenariasphaerica*	2.14	0.89	15
Taaba	*Nicotianatabacum L.*	2.13	0.81	16
Aborere	*Justiciaexigua*	2.09	0.8	17
Lapalapa	*Jatrophacurcas L.*	2.08	0.94	18
Ayin	*ZanthoxylumchalybeumEngl*	2.02	0.92	19
Imi-esu	*Rhoicissustridentata (L.f.) Wild and R.B. Drummond*	2	0.85	20
Iyere	*Kigelia Africana*	1.97	0.87	21
Alubosa	*ClerodendrumrotundifoliumOliv.*	1.93	0.79	22
Efirinwewe	*Justiciaexigua +Ocimumbasilicum*	1.93	0.84	23
Erin mado	*Secamoneafricana (Oliv) Bullock*	1.92	0.91	24
Agbo	*HarrisoniaabyssinicaOliv.*	1.89	0.9	25
Iwere-jeje	*Coleus latifoliusAndr, SennadidymotryaFresen*	1.86	0.89	26
Epaikun	*Asparagus tuberosum*	1.86	0.89	27
Ojuologbo	*PhytolaccadodecandraL'Herit*	1.84	0.82	28
Ewe	*TetradeniaripariaHochst) Codd*	1.83	0.88	29
Abrangbe	*Cassia obtusifolia L*	1.79	0.81	30
Ewe amunimuye	*Curcubito maxima*	1.78	0.81	31
Ewe iyalode	*Veprisnobilus (Del.) mziray (Tecleanobilis)*	1.76	0.83	32
Aloko-agbo	*Sapiumellipticum (Hochst)*	1.69	0.81	33
Atayee	*Sporoboluspyramidalis*	1.67	0.77	34
	Grand mean	2.07	0.83	

Source: Field survey, 2016

Effect of treatment on faecal egg count (FEC)

Table 5 shows that conventional drug caused a significant decline between Day1 ($\bar{x}$ =

4300.00 SD±788.811) to Day 3 ($\bar{x} = 0.00$ SD±0.00). The herbal drug significantly cleared the worm loads between Day1 ($\bar{x} = 4500.00$ SD±623.61) to Day 4 ($\bar{x} = 0.00$ SD±0.00) while the no significant changes was observed in the control group. However, while the FEC increased faster after the third month for the animals in the herbal treatment group than the conventional the control remains chronically infected. FEC monitoring in a selective treatment approach unless mandated by prescription-only legislation (Nielsen, Branan, Wiedenheft, Digianantonio, Garber, Kopral, Phillippi-Taylor, and Traub-Dargatz 2018; Becher, van Doorn, Pfister, Kaplan, Reist, and Nielsen, 2018). While it should be beneficial to reduce overall treatment intensity, the lack of FEC monitoring means that the typical approach remains to always treat the entire herd, and not leave a proportion untreated regardless of their maturity or need.

Table 6: Anova result showing mean differences and the effect of treatment on FEC EGGS.

Treatment	Herbal	Conventional	Control
Days	Mean ± SD	Mean ± SD	Mean ± SD
Day 1	4500.00 ± 623.61[a]	4300.00 ± 788.811[a]	4750.00 ± 1086.53[a]
Day 2	1010.00 ± 521.643[b]	680.00 ± 345.768[a]	5200.00 ± 918.94[c]
Day 3	410.00 ± 357.305[a]	0.00 ± 0.00[a]	5250.00 ± 824.958[b]
Day 4	0.00 ± 0.00[a]	0.00 ± 0.00[a]	4990.00 ± 2247.196[b]
1st month after	0.00 ± 0.00[a]	0.00 ± 0.00[a]	6700.00 ± 1159.502[b]
2nd month after	1810.00 ± 1384.397[b]	450.00 ± 772.082[a]	6100.00 ± 1197.219[c]
3rd month	2700.00 ± 1358.103[a]	2370.00 ± 1531.920[a]	6800.00 ± 1229.273[b]

*Means with different subscript are significantly different from each other at 0.05 level of significance

Effect of treatment on mean weight of cattle after 12 weeks

Table 7 shows that mean weight for cows exposed to herbal drug significantly change between week 0 ($\bar{x} = 84.20$ SD±3.293) and week 12 ($\bar{x} = 90.36$ SD±4.780). The conventional treatment significantly improves the weight gain between week 0 ($\bar{x} = 83.50$ SD±7.472) and week 12 ($\bar{x} = 85.65$ SD±7.405). There was significant weight loss observed in the control group from week 0 ($\bar{x} = 82.80$ SD±3.736) and week 12 ($\bar{x} = 76.68$ SD±6.435).

Table 7: Anova result showing mean differences and the effect of treatment on mean weight of cattle after 12 weeks

Treatment	Herbal	Conventional	Control
Weeks	Mean ± SD	Mean ± SD	Mean ± SD
0 week	84.20 ± 3.293a	83.50 ± 7.472a	82.80 ± 3.736[a]
2 weeks	86.68 ± 5.347[c]	83.00 ± 7.777[b]	80.54 ± 7.637[a]
4 weeks	87.17 ± 5.166[c]	83.65 ± 7.587[b]	78.05 ± 8.120[a]
6 weeks	87.99 ± 5.193[c]	84.51 ± 7.359[b]	76.37 ± 7.534[a]
8 weeks	90.80 ± 3.810[c]	85.25 ± 7.144[b]	76.55 ± 7.162[a]
10 weeks	89.81 ± 5.130[c]	86.23 ± 7.014[b]	77.59 ± 6.224[a]
12 weeks	90.36 ±4.780[c]	85.65 ±7.405[b]	76.68 ±6.435[a]

*Means with different subscript are significantly different from each other at 0.05 level of significant

CONCLUSION AND RECOMMENDATION

Based on the findings of the study, there has been a progressive increase in the usage of indigenous technology over years and studies from literatures supports that thirty four (34) different herbs/plants were being used by settled agro-pastoralists among which were *Ewuro, Efirin, Iyeye, Alubosa, Ewe ibepe, Iyeye*, Dagunro, *Ejinrinnla*, *Ayin*,*Imi-esu*, *Epaikun*, and moringa. Based on multiple responses on method of administration of identified indigenous technologies used for treatment of helminthes, result revealed that majority of the agro-pastoralist practices oral method of administration in the study area. Based on the findings of this study, it is recommended that:

1. Government should facilitate the establishment of unorthodox services in the rural communities to further increase utilisation of available services within medical sphere.
2. Since agro-pastoralists' patronage of traditional health care services has not been totally eradicated, prompt attention should therefore be on quality assurance for all stakeholders in health sector.
3. The animal health-care centers require expansion in terms of experienced personnel and equipment since most

settled agro-pastoralists in the rural areas patronize more of these animal health-care centers.

4. Preservation of all the identified indigenous technologies used by the Agro-pastoralist should be avoided to go extinction and educate them on the proper usage of anti-helminthes drugs and administration.

REFERENCES

Becher, A. M., van Doorn, D. C., Pfister, K., Kaplan, R. M., Reist, M., and Nielsen, M. K. (2018). Equine parasite control and the role of national legislation - a multinational questionnaire survey. *Vet. Parasitol*. 259:6–12.

Berkes, F. (2012). Sacred Ecology, Third Edition. Routledge, New York, USA

Bukhari, S., and Sanyal, P. K. (2011) Epidemiological Intelligence for Grazing Management in Strategic Control of Parasitic Gastroenteritis in Small Ruminants in India – A Review. Vet. World, 4(2): 92-96.

Charlier, J, Vercruysse, J, Morgan, E, van Dijk, J, and Williams, D. J. (2014). Recent advances in the diagnosis, impact on production and prediction of *Fasciola hepatica* in cattle. Parasitology. 141(3):326–35. doi: 10.1017/S0031182013001662.

Charlier, J. De-Waele, V. Ducheyne, E. van der Voort, M. Velde, F. V. and Claerebout, E. (2016). Decision making on helminths in cattle: diagnostics, economics and human behavior. *Ir Vet J.* 2016; 69: 14. doi: 10.1186/s13620-016-0073-6.

Di Pierro, F., Rapacioli, G., Ferrara, T., and Togni, S. (2012). Use of a standardized extract from *Echinacea angustifolia* (Polinaceae) for the prevention of respiratory tract infections. Altern Med Rev. 17(1):36–41.

Holzhauer, M., van Schaik, G., Saatkamp, H. W., and Ploeger, H. W. (2011). Lungworm outbreaks in adult dairy cows: estimating economic losses and lessons to be learned. Vet Rec. 169(19):494. doi: 10.1136/vr.d4736.

Hossain M. M., Paul, S., Rahman M. M., Hossain, F. M. A., Hossain, M. T. and Islam, M. R. (2011). Prevalence and economic significance of caprine fasciolosis at sylhet district of Bangladesh. *Pak. Vet. J.* 3(12): 113 –116.

Lawal-Adebowale, O. A. (2012). Dynamics of Ruminant Livestock Management in the Context of the Nigerian Agricultural System, Livestock Production, Khalid Javed, Intech Open, DOI: 10.5772/52923. Available from: https://www.intechopen.com/books/livestock-production/dynamics-of-ruminantlivestock-management-in-the-context-of-the-nigerian-agricultural-system.

Morgan, E. R., Charlier, J., Hendrickx, G., Biggeri, A., Catalan, D., von Samson-Himmelstjerna, G., Demeler, J. (2013). Global Change and Helminth Infections in Grazing Ruminants: Impacts, Trends and Sustainable Solutions. Agriculture. 3:484–502. doi: 10.3390/agriculture3030484.

Nalule, A. S., Mbaria, J. M., Olila, D. and Kimenju, J. W. (2011). Ethno-pharmacological Practices in Management of Livestock Helminthes by Pastoral Communities in the Drylands of Uganda. *Livestock Research for Rural Development*, 23 (2):1-27.

Nielsen, M. K., Branan, M. A., Wiedenheft, A. M., Digianantonio, R., Garber, L. P., Kopral, C. A., Phillippi-Taylor, A. M., and Traub-Dargatz, J. L. (2018). Parasite control strategies used by equine owners in the United States: a national survey. *Vet. Parasitol*. 250:45–51.

Odigie, B. E., and Odigie, J. O. (2013). Fascioliasis in Cattle: A Survey of Abattoirs in Egor, Ikpoba- Okha and Oredo Local Government Areas of Edo State, Using Histochemical Techniques. International Journal of Basic, Applied and Innovative Research IJBAIR, 2013, 2(1): 1 – 9. www.antrescentpub.com.

Ramakrishna, Y, Goda, H, Baliga, M. S, and Munsh, A. K. (2011). Decreasing cariogenic bacteria with a natural alternative prevention therapy using phytochemistry (plant extracts) *J Clin Paediatr Dent*. 36(1):55–63.

Saleh, M. K., Atala, T. K., Omokore, D. F., Ahmed, B., Ali, F. S. and Kajang, G. Y. (2016). Performance of Improved Dairy Cattle Technologies among Farmers in Northern Nigeria. *Journal of Agricultural Extension.* 20 (1)1-12.

Sutherland, I. A., and Leathwick, D. M. (2011). Anthelmintic resistance in nematode parasites of cattle: a global issue? Trends Parasitol; 27:176–181.

Timothy, A. (2012). From Discovery to Development: Current Industry Perspectives for the Development of Novel Methods of Helminth Control in Livestock among Nomads in Eretria. *International Journal of Veterinary Parasitology*. 139:1-14.

Usman, I. S. Bzugu, P. M. Pur, J. T. and Abdullahi, A. (2017). Indigenous Control Methods for Parasites among Pastoralists Communities in Adamawa State, Nigeria. *Journal of Agricultural Extension*. 21 (1). 1- 13.

Veerakumari, L. (2015). Botanical Anthelmintics. Research Article. *Asian Journal of Computer Science and Information Technology* Vol.06, (Issue, 10): 1881-1894. http://www.journalajst.com