

The Assessment of Knowledge, Attitude, and Practice (KAP) Model Survey on Anthelmintic Management, and highly prevalent diseases In the South Gezira, Sudan (2019-2022)

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Abstract: Background: *Gastrointestinal nematodes, which affect small ruminants, are very important problems that adversely affect animal resources in Tropics and Sub-Saharan areas hence, increasing the margin of poverty, especially in the rural communities. Objectives:* The study was conducted to evaluate the consequences of endogenous knowledge of animal keepers about the uses of Anthelmintic (Ivermectin, Tetramizole, Levamisole, and Albendazole) in the goats, this is together in line with the occurrence of GIN nematodes infection in goats among different seasons. The surveyed population comprised 25 Respondents to collect information about the misuse of some anthelmintic (Albendazole Ivermectin, Tetramizole, and levamisole), especially in drug administration frequency and its influence on drug's efficacy and resistance. Also to know the highly prevalent diseases throughout the year. **Results** The outcomes of the existing study disclosed that 20% of the Respondent was using Albendazole Ivermectin, Tetramizole, and levamisole for two to three intervals or more in the different seasons. The efficacy of these drugs was found to be higher in the second administration but was very low in the third one. This indicated that some sensitive (GINs) worm's development acquired resistance to those drugs. These consequences might furthermore provide epidemiological data on (GINs) infections. **Conclusions and Recommendations:** The study concluded that (GINs) infection is highly prevalent in the tested areas of the locality. Therefore, the study abstracted that *Haemonchus spp* is the most predominant parasite identified. More studies must be conducted to study the (GINs) at molecular intensity using candidate anthelmintic resistance associated with gene expression and sequence polymorphisms

Keywords: Gastrointestinal nematodes (GINs), Knowledge, practice, and attitude (KAP), Anthelmintic Gezira, Sudan

Introduction:

Sudan's animal resources are regarded as among the richest Arab and African countries. According to the Ministry of Animal Resources and Fisheries (2013), Sudan's animal assets are predictable to be 162,340,000 heads of various species. The goat population in Sudan was projected to be over 43 million. ^[1] Goats (*Capra hircus*) are valuable resources for poor farmers who raise them for cash revenue, savings, meat, milk, fertilizer, and family employment. It had, however, been commonly recorded in the humid and sub-humid regions. ^[2] Moreover, goats play a significant role in the economic phases in both rural and urban areas. Parasites are a major cause of health problems in goats. Animals become not unthrifty exhibiting weight loss, poor birth weights, and difficulty in kidding. ^[3] Due to Parasitism makes animals vulnerable to various health complications, which could also cause their death. ^[4] Goats have a wide range of parasites in their gastrointestinal tracts, some of which are carried through both species. Among these, helminthes are the most important gastrointestinal tract parasites (GIT) that affect the growth as well as the production of the animal. Gastrointestinal nematodes (GINs) of the Trichostrongylidae family are perhaps the most important parasites of small ruminants worldwide,

causing significant morbidity and loss of productivity. ^[5] Haemonchosis is primarily a disease in tropical and subtropical regions. ^[6] However, high humidity, at least in the microclimate of the faecal and the herbage is also essential for larval development and their survival. ^[7] It is a serious health problem, which causes lower production due to high morbidity, mortality, and cost of treatment and control measures. The frequency and severity of the disease largely depend on the rainfall in any particular area. ^[8] Many surveys in different countries around the world have shown that domestic animals, sheep, and goats suffer more frequently from haemonchosis. ^[9] Nevertheless, the intensive and semi-intensive production systems of Sudan are distributed either within aggregation sites in different locations or in small herds located in different sites around towns. Nonetheless, due to the high need for animal proteins especially milk and milk products in Gezira State. The dairy producers are oriented to import milk-high-producing breeds to meet human consumption. This procedure had been increased recently as a result of the increasing human population owing to the migration from other states caused urbanization as well as natural disasters and conflicts. ^[10] The increase of crossbred animals in

different areas played an important role in the dissemination of health problems due to their high susceptibility to different causative agents (particularly parasitic infections).^[11] In addition, the bad husbandry and poor management on the farms complicated the health status of dairy cattle. Other diseases are fairly under control by using vaccines or chemotherapeutic preparations.^[12] Helminthes infections can be treated by anthelmintic chemotherapy, however, treatment is costly and drug resistance has been developed in all major parasite species.^[11] However, in contrast to sheep, which develop a strong natural immunity around 12 months of age, goats acquire a lower level of immunity to (GINs) parasites. The parasitic diseases affect the milk industry by the direct effect on milk production, high cost of treatment, and financial implications for farms management to prevent the parasitic infestations due to difficulty to control vectors.^[13] Anthelmintics are also required for the treatment of parasitism in goats. However, there is a significant difference in their physiology, which means that the level of the active ingredient in goat blood declines more rapidly after treatment than in sheep. This has the potential to reduce the effectiveness of treatment and because of that selection of drug-resistant, strains of parasites can be much quicker in goats than in sheep.^[14] Albendazole is a benzimidazole derivative, which is authorized for use in

Materials and Methods

Study area: Gezira state is located between latitudes (13- 32 ° S- 15-30° W) and longitudes (22-32° W-20-42° S. The entire area is approximately 23373) square kilometers. The state area covers around 2.5% of the country area. The state comprises seven localities. Their populations are about (2.796.330) consistent with the latest population census held in (2013). A percentage of 19.1% of the total population lives in rural areas while 80.4% lives in urban districts. In general, many agricultural Projects were established in the state. Gezira irrigated scheme is the prime scheme in Africa and the Middle East for the cotton industry and other crops. The state is located within the belt of the dry climate which is characterized by seasonal rains that fall between (July and

veterinary medicine, and had been used for decades in the treatment and control of GINs as well as liver flukes and cestodes.^[15] Therefore, this study was planned to estimate further assessment of the KAP model survey on Anthelmintic management and to examine the effects of season, age, sex, and husbandry system as risk factors on the distribution of infection. The current study also aimed to investigate the presence of internal parasites in dairy goats during different seasons in the south locality of Gezira state and analyze the risk factors associated with parasitic infections. In Sudan, Goats represent a good source of meat and milk, especially in sticking groups. These animals are susceptible to infection with different species of GINs among which haemonchosis is one of the important parasitic diseases. The infection rate of these parasites was reported.^[1] *H. Contortus* caused the disease, which dwells in the abomasum of sheep, goats, and to lesser extent cattle.^[16] Helminthiasis recognizes and remains a problem responsible for losses in the production of small ruminants in all regions worldwide. Parasitic nematodes causing mortality, severe weight losses, low milk, output, and reproductive failure had been identified as the major cause of production losses of resource-poor livestock farmers in tropical Africa.^[3] Whereas, in South Eastern Asia.^[17]

September). Reaching the peak in August and declining to zero in the dry seasons. Humidity ranges from 70 – 180 % in fall declines to 18 – 32 % in dry seasons. The land platform is flat plains that run from northern to southern state borders forming a sharp sliding stage for rivers and streams. The existing study was conducted in the South Gezira locality. Data was collected for Barakat, Elhoush, Elmadena Arab, and Wadelhadad veterinary units. The target animals are goats (*Capra aegagrus hircus*) and the Parasite gastrointestinal nematode (with more focus on strongly nematodes specially *Haemonch contortustus*). The Target drugs Albendazole, Ivermectin, Levamisole and Tetramizole



Fig.1. The map of Sudan shows the Gezira state map of the study area (south Gezira locality).

Study Design:

A longitudinal cross-sectional herd-based study was adopted to survey the GINS over a 12-month period. (350) dairy goats were selected by simple random sampling method with discrimination of their age, and sex and represent dairy goats at South Gezira locality.

The sampling includes all seasons between 2019 and 2022, throughout the years' seasons (summer, autumn, and winter). Fecal samples were collected during the same period to determine nematode eggs and then positive samples were cultured for nematode larvae identification

Study Population:

Dairy goats are raised in the South Gezira locality, they are a local breed of Nubain goat.

Questionnaire Method

The questionnaire survey assigned for endogenous knowledge of herd men about Anthelmintic and nomadic drug application for treating ruminants in the south Gezira locality was conducted in

the four units namely Barakat, Elhoush, El Madina, Arab, and Wadelhadad. The surveyed population comprises 25 owners

Statistical analysis:

Statistical analysis was performed using Statistical software besides individual descriptive measures. Gomes and Gomez used the Chi-square tests (χ^2) and one-way (ANOVA).^[18] Comparative data were also subjected to descriptive statistical analysis. Student-independent T-test was also used to compare differences between means of the observations. The least significant difference (LSD) was used to cope with

differences among means. Tests for equal proportion have been applied to explore the dependencies between the count variables where these were significant they were reported along the corresponding p-value. The comparative survey was entered into Ms. Excel and analyzed using SPSS version 21. Differences among studied parameters were explored under probability levels of 5% and 1%.

Ethical Approval:

The ethical approval was obtained from the faculty of veterinary medicine department of Parasitology University of Butana (U of B) and permission was obtained from the Faculty of laboratory sciences university of Gezira (Uof G).

Limitations and strengths of the study

Limitations of the study: In the cross-sectional study. It is impossible to assess any temporal relationships between exposures and outcomes). Without longitudinal data, it is not possible to establish an exact cause-and-effect relationship.

Strength of the study:

The main strength of a cross-sectional study is relatively quick and inexpensive to conduct. It is the best way to determine the prevalence and to study the associations of multiple exposures and

Results

The frequency of herd data concerning the studied parameters is abstracted in (Table: 1). These parameters such as herd men types, education levels, experience, types of husbandry, and veterinary training represented by 25 individuals who participated in the questionnaire. Whereas, the flocks' composition and the main reasons for selling an animal are shown in (Tables: 2 and 3). The

outcomes. The subjects are neither deliberately exposed nor treated; thus, there are seldom ethical difficulties

frequency of Albendazole, Ivermectin, Tetramizole, and levamisole dispersing during the survey was diverted in (Tables: 4.5.6 and 7). In addition. The most important animal diseases during different seasons are publicized in Table: 8. while the drugs management and the flock size are found in (Tables: 9 and 10)

Table: 1. The frequency of herd data concerning herd men's type of husbandry and training as represented by 25 individuals who participate the in the questionnaire

No	Parameter	Respondent	Percent
1	Educational level		
	Illiteracy	3	12%
	Educated	16	80%
2	Experience		
	Poor	1	4%
	Fair	4	16%
3	Type of husbandry		
	Mobile	8	32%
	Stable	1	4%
4	Veterinary training		
	No	24	96%
	Yes	1	4%

Table: 2.The flocks composition

Parameter	Respondent	Percent
Cattle	6	24%
Sheep	1	4%
Goats	6	24%
Cattle + Sheep	1	4%
Cattle + Sheep + Goats	8	32%
Sheep + Goats	2	8%
Cattle + Goats	1	4%

Table.3: The main reasons for selling an animal from the herd

Parameter	Respondent	Percent
self requirement	20	80%
drugs for treating	1	4%
therapeutic failure	2	8%
self requirement + drugs for treating	2	8%

Table.4. The frequency of Albendazole dispersing during the survey (RE Respondent and PE Percent)

Frequency	Autumn						Winter						Summer					
	Cattle		Sheep		Goats		Cattle		Sheep		Goats		Cattle		Sheep		Goats	
	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER
1time	4	16%	3	12%	4	16%	5	20%	5	20%	3	12%	3	12%	5	20%	3	12%
2 time	5	20%	3	12%	1	4%	1	4%	0	0	1	4%	3	12%	0	0	1	4%
3 time	0	0	0	0%	1	4%	0	0	0	0	0	0	0	0	0	0	0	0
Mor than 3 times	0	0	1	4%	1	4%	0	0	0	0	0	0	0	0	0	0	0	0
Missing	16	64%	18	72%	18	72%	19	76%	20	86%	21	84%	19	76%	20	80%	21	84%

Table. 5: The frequency of Ivermectin dispersing during the survey (RE Respondent and PE Percent)

Frequency	Autumn						Winter						Summer					
	Cattle		Sheep		Goats		Cattle		Sheep		Goats		Cattle		Sheep		Goats	
	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER
1time	2	8%	4	16%	1	4%	4	16%	4	16%	2	8%	4	16%	3	12%	2	8%
2 time	4	16%	2	8%	5	20%	1	4%	2	8%	6	24%	4	16%	2	8%	2	8%
3 time	2	8%	0	0	1	4%	1	4%	1	4%	0	0	1	4%	1	4%	0	0
More than 3 imes	1	4%	0	0	0	0	0	0	1	4%	1	4%	0	0	0	0	0	0
Missing	16	64%	19	76%	18	72%	19	76%	17	68%	16	64%	16	64%	19	76%	21	84%

Table.6: The frequency of Tetramizole dispersing during the survey (RE Respondent and PE Percent)

Frequency	Autumn						Winter						Summer					
	Cattle		Sheep		Goats		Cattle		Sheep		Goats		Cattle		Sheep		Goats	
	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER
1time	6	24%	5	20%	4	16%	3	12%	5	20%	4	16%	4	16%	4	16%	4	16%
2 time	0	0	0	0	1	4%	1	4%	0	0	0	0	0	0	0	0	0	0
3 time	0	0	0	0	0	0	1	4%	0	0	0	0	0	0	0	0	0	0
More than3times	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Missing	19	76%	20	80%	20	80%	20	80%	20	80%	21	84%	21	84%	21	84%	21	84%

Table.7: The frequency of Levamisole dispersing during the survey (RE Respondent and PE Percent)

Frequency	Autumn						Winter						Summer					
	Cattle		Sheep		Goats		Cattle		Sheep		Goats		Cattle		Sheep		Goats	
	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER	RES	PER
1time	5	20%	4	16%	6	24%	6	24%	4	16%	3	12%	7	28%	5	20%	5	20%
2 time	5	20%	9	63%	7	28%	3	12%	6	24%	5	20%	4	16%	5	20%	2	8%
3 time	2	8%	0	0	2	8%	1	4%	0	0	2	8%	0	0	0	0	1	8%
More than 3imes	1	4%	1	4%	2	8%	0	0	0	0	1	4%	0	0	1	4%	1	4%
Missing	12	48%	11	44%	8	32%	15	60%	15	60%	14	56%	14	56%	14	56%	15	60%

Table.8: The frequency of the most important animal diseases during different seasons

Frequency	Autumn								
	Cattle		Sheep		Goats		Cattle		RE
	RES	PER	RES	PER	RES	PER	RES	PER	
Parasites	7	28%	7	28%	10	40%	3	12%	3
Protozoa	1	4%	0	0	0	0	3	12%	3
Ex – Parasites	6	24%	4	16%	4	16%	2	8%	1
Bacterial	0	0	3	12%	3	12%	2	8%	5
Virus	2	8%	1	4%	0	0	5	20%	2
Fungi	0	0	0	0	0	0	0	0	0
N – Disease	0	0	0	0	0	0	1	4%	1
Missing	9	36%	10	40%	8	32%	9	36%	10

Table. 9. The Flock size

Frequency	Cattle		Sheep		Goats
	RES	PER	RES	PER	
10 – 50	12	48%	6	24%	10
51 – 100	2	8%	4	16%	5
101 – 150	1	4%	1	4%	1
151 – 200	1	4%	0	0	0
More than 200	0	0	1	4%	1
Missing	9	36%	13	52%	8

Table. 10. The drugs management

No	Parameter	Respondent	Percent %
	Source of drug		
1	vet-hospital	1	4%
	vet-pharmacy	24	96%
	Drug uses		
	Depending on vet prescription	21	84%
2	depending on yourself	1	4%
	Depending on market saller opinion	2	8%
	Missing	1	4%
	Estimate animal body weight		
3	Weighing	2	8%
	estimated approximately	18	72%
	constant dose for large and small animal	5	20%
	Route of administration		
4	from leaflet	19	76%
	depending on my experience	6	24%
	Store successive drug doses		
5	drug exposes to sunlight	6	24%
	shelf store	19	76%
	Time to use successive drug doses		
6	during one month	5	20%
	during three month	12	48%
	until doses complete	8	32%

Discussion

In The contemporary study, animal keepers revealed that there are more adult goats in the locality brought for slaughter than young.

The results publicized that; adult females are more infected than their male counterparts. This could be a factor in the market price and the culling effect. In addition, they had shown a high level of worm infestation in adult goats than in young ones. These consequences agree with preceding studies tackled by [19,3,20] in Afghanistan, Nigeria, and Ethiopia respectively. Successive retrospective studies bared that the delayed exposure of camel calves and small ruminants to grazing fields can reduce early exposure of calves to parasites. [21,22] According to the questionnaire, the seasonal dynamic of the infection rate revealed that the highest infection rates occur in the dry season and score 24.4 percentage in summer. Whereas, an infection rate of 21.02% was recorded in autumn and the lowest in winter 14.8 %. These results might likely be attributed due to the mixing of goat flocks with other ruminant animals in overstocking pastures. This action was happening due to grazing the residues of harvested crops

in the Gezira scheme. The high population of animals in small grazing areas could cause plausible interpretations regarding the flux occurring in infection rates across the seasonal vibrant. In addition to the lack of an accessible, clean source of water. This situation may aggravate the occurrence of contamination in grazing pastures and may perhaps enhance the outbreak of the die incidences. Interestingly the infective larva of nematodes is very sensitive to winter conditions. Thereupon, larvae undergo an arrested form (hypobiosis) and complete their growth. In general, agreeing with the statistical datum collected via questionnaire, the nomadic group of goat owners has disclosed a high level of information about farm animal helminthes. The animal keepers, on the contrary, believe that goats are the most resistant and rarely affected by gastrointestinal worms and therefore, they do not consider deworming indispensable. These concepts have been circulated widely due to the entire absence of veterinary extension circuits. These impressions should be changed by activating the extension role to the degree that converted the of extension scientific idea into reality. The goat owners further stated that they dispose severely ill goats by slaughtering at the abattoir and for those showing mild sickness they administer locally by available antibiotics without observing any dosage procedure or regime. These notions are also could be linked with absence of veterinary extension sectors. Therefore, owners are not aware nor seek any veterinary intervention. [23] The study on intestinal parasitic infections of goats in pastoral Belgium areas by Zwanenburg. [24] who found that drenched goats prior to the sampling for the study were associated with a low level of helminthes excretion. The potential public health-associated risk could be arising from consuming meat or milk from severely ill slaughtered animals and drug resistance from consuming products of animals with the drugs in the milk of goats at Gezira state is mainly sold for commercial purposes. The lack of proper structural outlay and the hygiene standard may set up the main problems encountered by the dairy industry in the state. Although the state is compromised by, largely inhabited people of nomadic background who believe goat products are precious and even linked to medicinal myth and legend. The questionnaire interview with endogenous knowledge

of owner about anthelmintic and nomadic drug application for treating ruminants. This survey assigned in keeping with KAP model of survey. KAP is a caring of model survey stand for knowledge, attitude and practice A brief description of KAP is a quantitative method (predefined questions formatted in standardized questionnaires) that provides access to quantitative and qualitative information. KAP surveys reveal misconceptions or misunderstandings that may represent obstacles to the activities that we would like to implement and potential barriers to behavior change. It worth mentioning that KAP survey essentially records an opinion and is based on the declarative (statements). In other words, the KAP survey reveals what was said, but there may be considerable gaps between what is said and what is done. The study indicates that most of the owners of dairy goats are educated and well expert on animal husbandry. Even if the majority of them they are not subjected to any further training in veterinary amenities. This manner indicates the weakness and absences of veterinary authorities, particularly in the extension segments. The drugs management among the dairy goatherd keepers is based on over bridging or spanning the veterinary hospitals or authorities to the drug seller in veterinary pharmacy. This progression might attribute to the lack of well-established veterinary hospitals, laidback with no good medical supply and supervisions and accompanied by the weakness of extension fragments. It worth noting that the veterinary subdivision should create and activate the clinical pharmacology practices. This opinion should be applied in any further treatment consistent with the international drugs protocols. The drug prescription is depending on the dose restricted in the leaflet whether, estimated by body weight or other route of administration. In this study the composition of the flock mixed between cattle, sheep and goat are signify the share and contaminate of the pasture by microorganism and parasitic eggs. The herd men use anthelmintic all the season one to two times. The abuse of the drugs without any information about doses and administration might likely develop the drug resistance. Repeated applications may suggest the existence of multiple resistances to the major anthelmintic drugs. These outcomes are in consistent with the findings of the investigators. ^[1,25,26] The study also demonstrated that the herd keepers have possess a low confidence of the effectiveness of Albendazole against (GINs) worms. Thereby, the herd owners have high self-assurance about the efficacy of Levamisole and Ivermectin when they compared with Albendazole. These results in accordance with. ^[27-29] This could be refers to the abuse or miss handling of Albendazole drug prescriptions. This routine enriches the resistance to Albendazole drug. The study discovered that the herd keepers have applied high anthelmintic drugs during last five years such as antimicrobial and ectoparasite drugs. They have also possessed virtuous knowledge regarding animal diseases in different seasons. Therefore, the parasitic diseases are ranking high among important diseases bump into farm animals. These consequences in the same line with many studies conducted elsewhere. ^[27-29] In conclusions the study provided evidence for the occurrence of benzimidazole resistance in goats being naturally infected with GINs in South Gezira locality (Sudan). This finding was confirmed by using goats experimentally infected with local *H. Contortus* populations from consistent use of ABZ in goats at 10mg/kg /BW as well as the implementation of

target selective treatment(TST) and (TT) approaches in South Gezira locality are urgently needed to overcome the development of anthelmintic resistance. These outcomes might furthermore provide epidemiological data on GINs infections. The study concluded that GINs infections are highly prevalent in the tested areas of the locality. The study abstracted that, *Haemonchus spp.* being the most predominant parasite identified. The study concluded that in cases where goats are intermediate host, proper disposal of infected organs is very important. The study provided evidence for the occurrence of Albendazole resistance in goats being naturally infected with GINs in South Gezira locality (Sudan). This finding should be confirmed by using goats experimentally infected with local *H. Contortus* populations owing to consistent use of ABZ in goats at 10 mg/kg /BW as well as the implementation of target selective treatment(TST) and target treatment (TT) approaches in South Gezira locality immediately to overcome the development of anthelmintic resistance. These outcomes might furthermore provide epidemiological data on GINs infections. Significant changes were noticed between infected and healthy animals for milk production. Many research works showing the impact of GINs on reproductive parameters are needed to highlight the role GINs on animal reproduction .Therefore, the current study could not determine whether *Haemonchus*-induced anaemia was the primary cause compromising male reproduction or whether infection directly affected sperm traits. It is also important from a management perspective to assess whether the recorded depression in reproductive traits has an impact on the actual mating capacity of the rams under field conditions. The study recommended to deworm their animals using effective anthelmintic for deworming of goats. More research work for longer periods involving more goats to focus on the possibility of achieving the total worm counts and identification. The current study recommended for further studies that must be carried out immediately to study GINs at molecular levels using candidate anthelmintic resistance-associated with gene expression and sequence polymorphisms in a triple-resistant field isolate of *Haemonchus contortus*. Moreover, the detection of quantitative trait loci (QTL) for resistance to (GINs) infections in goats is of assessment for detection of (GINs) or by using Single nucleotide polymorphisms in candidate genes associated with (GINs) infection in goats.

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