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Evaluating the Effect of *Delthamethrine* on Prevalence of *Trypanosome* in Two Districts of Buno Bedelle Zone, Ethiopia

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Abstract

Introduction: *Trypanosomosis* is a bottle neck on the livelihood of farmers in study area and Ethiopian government has been using 0.4% *Delthamethrine* impregnated targets and 1% pour-on to reduce the impact of this disease on food security. However there was no any information on effect of this chemical on prevalence of *Trypanosoma*.

Objective: The aim of the study was to evaluate the effect of Deltamethrine in controlling *Trypanosomosis*.

Methods: Cross-sectional study was conducted in cattle of two districts of Buno Bedele Zone in April 2020 and 2022. Paired samples "T" Test statistic was used to summarize data by using SPSS Statistics version 21. The approach followed to complete the study was by implementing pre-intervention phase to know status of *Trypanosoma* before using chemical in April 2020 and intervention phase using *Deltamethrine* chemical on cattle at a rate of 1 ml/10 kg body weight and 0.4% *Delthamethrine* impregnated targets from October 2021 to March 2022. The post intervention was done in April 2022 to evaluate prevalence difference.

Results: Out of 576 cattle during pre-intervention 159 (27.60%) cattle were positive with mean packed cell volume 20.68%. During post intervention Out of 576 cattle 27 (4.70%) cattle were positive with mean packed cell volume 26.10%. From study there were strong evidence at 95% confidence interval ($t = 3.035$, $p < 0.05$) *Delthamethrine* chemical application reduce prevalence of *Trypanosoma* parasite by ten estimated mean. Also there were strong evidence at 95% confidence interval ($t = -84.66$, $p < 0.05$) *Delthamethrine* chemical application increase packed cell volume of cattle by five estimated mean.

Conclusion: An intervention was encouraging to suppress *Trypanosomosis* prevalence and should be continually implemented to keep the intervention difference.

Keywords: Cross-sectional;Ethiopia; *Delthamethrine;* Packed cell volume; Pour-on; Prevalence of *trypanosomosis;"T"* Test

Introduction

Trypanosomosis is an important livestock disease of the Africa continent and a big challenge for cattle health and economy performance in sub-Sahara Africa [1]. It reduces milk and meat production and income [2]. It indirectly impairs land use by reducing the draft power productivity of oxen. Because of the risk of this disease, farmers keep away from productive tsetse-fly-infested lands, which might very important to fill high food demand to current steady growing human population of sub-Sahara Africa [3]. It is predictable to cause three million deaths of cattle yearly direct economic loss of US$ 1–1.2 billion in cattle production. Accounting for indirect economic losses, sub-Sahara Africa might lose up to 4.75 billion of GDP per year [3]. In sub-Sahara Africa livestock production is responsible for forty percent of total farmers' income across all livestock production system [1]. Ethiopia is one of these countries that have been being challenged by *Trypanosomosis* and about 14 million heads of cattle which are exposed to the risk of *trypanosomosis*. It is not only production loses of animals recovering from the disease but the huge economic impact caused by the disease is that it has leads to thousands of hectors of land unfit for settlement and cultivation. In addition, some drugs are applied to treat the diseased animals, which are costly and drug resistance is becoming the big challenge. The direct losses from the disease in livestock include mortality, morbidity impaired fertility and the cost of implementing control operations. Indirect losses include: the segregation of livestock from tsetse infested grazing land and reduced crop production due to insufficient animal draft power. It is one of the most considerable and costly disease in Ethiopia hindering the effort made for food adequacy [4]. To overcome the impact of this disease, institutions like Food and Agriculture Organization (FAO), work together with the African Union by providing technical and financial support to eradicate the disease and spent a significant amount of financial and non-financial resources, however *Trypanosomosis* remains a threat to sub-Sahara Africa [5]. Various tsetse fly and *Trypanosomosis* controlling techniques have been used in the past years [6, 7]. Treating sick animals using trypanocide is one of the most commonly used approaches [8, 9]. Preventive actions that target the tsetse fly vector itself are broadly used in different communities. These actions include: clearing the habitat of the tsetse fly, using baited targets, sequential aerosol technique (SAT), ground spraying, insecticide-treated cattle (ITC), and sterile insect technique (SIT) [6, 10]. Despite the main successes of using these approaches, with few exceptions, sub-Sahara Africa has not still been able to control *Trypanosomosis* [11]. Implementers of the control techniques on the ground and African livestock policymakers face several challenges [12]. Drug resistance is one of the challenges facing livestock producers [13]. Low quality and counterfeit drugs further worsen the problem of resistance to trypanocides [6, 14]. Even though rearing trypanotolerant breed of animals seems promising, the proportion of animals with the

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required level of resistance is small, and importing these breeds to other production contexts proved difficult [9]. The financial sustainability of some of the techniques (e.g., aerial or ground spraying, SAT, and SIT) has been questioned [6]. Clearing forests and vegetation, killing game animals, and pesticide spraying are not environmentally friendly [9]. In Buno Bedelle zone Borecha and Dabo Hana districts *Trypanosomosis* is endemic due to high tsetse infestation. In these areas to minimize the impact of this disease on livelihood of poor farmers application of *Delthamethrine* chemical has been implemented. Accordingly 0.4% impregnated targets and 1% pour-on formulation to control tsetse and *Trypanosomosis* carried out in two selected districts. So the objective of this study was to measure the prevalence of *Trypanosoma* parasite difference after intervention done using *Delthamethrine* chemical.

Materials and Methods

Study area

The study was conducted in April 2020 and 2022 in Borecha and Dabo Hana districts of Buno Bedelle Zone, Oromia regional state of Ethiopia. Buno Bedelle Zone is located on the western part of Ethiopia and is bounded on the south by Ilubabor Zone, on the north by the East Wollega zone, on the west again Ilubabor Zone and on the East Jimma Zone (Figure 1). Borecha district is located about 464 km west of Addis Ababa at an altitude between 1400-2100 meters above sea level. District town, Yanfa lies between 08° 14' N latitude and E 36°35' E longitude with temperature range of 15-21°C. It receives rainfall ranging from 1300-2000 mm. Livestock population of the district estimated to be 249786 cattle, 35321 sheep, 37895 goat, 8,417 equine. The study was done in three peasant associations namely Danaba, Nataro and Markafo with cattle population of 19740, 11230 and 8533 respectively. In these three kebele Danaba, Nataro and Markefo 119L, 122L and 130L of 1% *Delthamethrine* was respectively applied to cattle in 2021 (66 cattle per 1L of 1% *Delthamethrine)*. Also 450 targets were deployed in three kebel of Borecha District [11]. Dabo Hana district is located about 510 km west of Addis Ababa at an altitude between 1600-2200 meters above sea level. District town, Kone lies between 08° 41' N latitude and 36° 17' E longitude with temperature range of 18-24°C. It gain rainfall ranging from 1200-1800 mm. Livestock population of the district estimated to be 78,576 cattle, 22,428 sheep, 25,516 goat and 9,966 equine. The study was done in three peasant associations namely Dhidessa, Loko and Lilo Sato with cattle population of 3512, 2717 and 29,300 respectively. In these three kebele Didessa, Loko and Lilo Sato 79L, 134L and 111L of 1% *Delthamethrine* was respectively applied to cattle in 2021 (66 cattle per 1L of 1% *Delthamethrine*). Also 900 targets were deployed in three kebele of Dabo Hana district [14].

Study Populations

Study population was bovines from six kebele's of two districts. The farming system of cattle in the study areas was extensive mixed crop-*livestock production system.* The assessment of prevalence of *Trypanosomosis* was done in 2020 (pre-intervention) and 2022 (post intervention). The intervention phase was done in 2021 by *Deltamethrine* (0.4% impregnated targets and 1% pour-on formulation) to control tsetse and Trypanosomosis. Post intervention of *Trypanosomosis* prevalence (monitoring) was done after intervention in 2022 to estimate prevalence difference due to application of *Delthamethrine* and targets on control of *Trypanosomosis.*

Study design, sample size and sampling

The study was conducted to estimate prevalence difference of

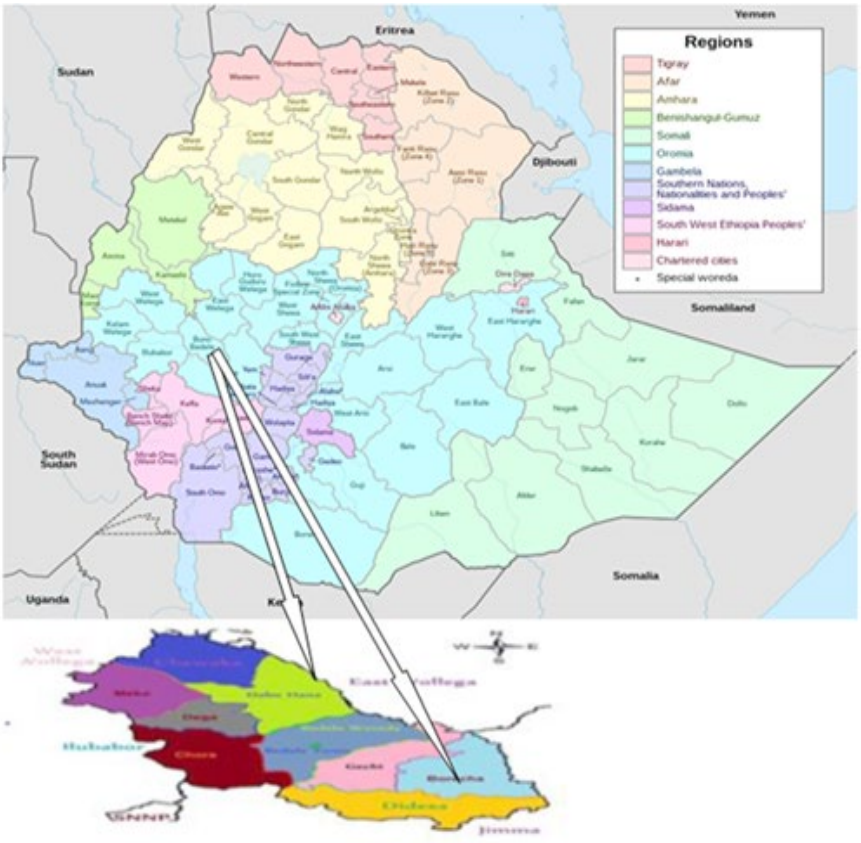

Figure 1: Map of study area.

Trypanosomosis using cross-sectional study design and simple random sampling technique was used to select sampling unit [14]. Sample sizes from the two districts were 576 cattle which was large sample size [13].

Methodology

Monitoring of *Trypanosome* infections. Blood was collected from the ear-vein via heparinized capillary tubes, centrifuged at 8000 for 5 minutes and examined for the presence of *trypanosomes* using the phase-contrast, buffy-coat technique and its packed red cell volume [13]. Packed- red cell volume (PCV) was then considered and the buffy coat method was functional: thin smears were done with buffy coats and examined for *trypanosome* detection with a microscope (40x10). *Trypanosome* species were recognized morphologically. PCV measurements and microscope examination were carried out on the field. During the assessment period, positive animals to the buffy coat method were treated with Diminazene aceturate 7 mg/kg [12].

Packed Cell Volume (PCV)

Haemoparasites affects the volume of cells by haemolysis which results in anaemia. Therefore, PCV will help to analyze the concentration of blood cells in the animals' body [14].

Data Management and Analysis \

All the data obtained from the field was recorded in the record sheet format and later entered into the computer and managed using Microsoft Excel work sheet and Paired samples "T" Test statistic was used to summarize data by using SPSS Statistics version 21. Prevalence was defined as the number of bovines found positive for one or more *trypanosomes* from sample population which was representative of study population.

Results

Assessments during pre-intervention were done in both districts of six kebele and 576 cattle were sampled with total prevalence of 27.60%. The most common species of *Trypanosoma was Trypanosoma congolense (12.67%) followed by T. vivax* (8.70%), mixed infections (5.60%) of (*T. congolense, T. vivax,* and *T. brucei*) and (5.20%) *T.brucei* (Table 1). Post intervention assessment after application of chemical was done in the same kebele and herd. Accordingly, the most common species of *Trypanosoma* was *Trypanosoma congolense* (2.6%) followed by *T. vivax* (2.1%) and no mixed infections (Table 2). The prevalence of *Trypanosoma* species were reduced after intervention (Table 2). The overall differences of prevalence between pre and post intervention of *Delthamethrine* chemical application showed positive association of the chemical with *Trypanosoma* species ($P<0.05$, Table 3) and negative associations with increase packed cell volume of cattle after intervention ($P<0.05$, Table 4). The overall mean PCV was increased from pre-intervention (20.68%) to 26.10% (post intervention) the significance of the mean difference between interventions showed association of *Delthamethrine* chemical with PCV ($P<0.05$, Table 4). From this research there was strong evidence at 95% confidence interval ($t = 3.035$, $p < 0.05$) *Delthamethrine* chemical application reduce prevalence of *trypanosoma* parasite by ten estimated mean (Table 3). Also there was strong evidence at 95% confidence interval ($t = -84.66$, $p < 0.05$) *Delthamethrine* chemical application increase packed cell volume of cattle by five estimated mean (Table 4).

Discussion

It has been an interesting to evaluate the effect of *Delthamethrine* chemical on *trypanosoma* parasite control since it was endemic and has been considered as a bottle neck on livelihood of poor farmers. Ethiopian government has been using this chemical to suppress the impact of this disease and bait techniques has been considered to be environmentally more friendly [12]. That was the major thrust in the recently launched project `Farming in Tsetse Control Areas of East Africa (FITCA)', which is sponsored by the European Union (EU). The aim of this study was to assess prevalence difference in both districts 1% or 20% *Delthamethrine* chemical was positively associated with *trypanosoma* parasites ($P< 0.05$). In study areas after chemical application via 0.4% impregnated targets and 1% pour-on prevalence and packed cell volume difference was assessed and significantly associated with *trypanosomosis* ($P< 0.05$) in agreement with studies [12] that showed Deltamethrine has successfully controlled bovine *Trypanosomosis* in different parts of Africa. Also in agreement with

Table 1: Pre-intervention prevalence and mean PCV.

Pre-intervention prevalence						Total	Mean PCV
District	No. animals	T. c	T. v	T. b	Mixed		
Dabo Hana	288	46	28	17	21	95	21.19
Boracha	288	27	22	13	11	64	20.16
Total	576	73	50	30	32	159	20.68
Prevalence		12.67%	8.70%	5.20%	5.60%	27.60%	

Table 2: Post intervention prevalence and mean PCV.

Post intervention prevalence						Total	Mean PCV
District	No. animals	T. c	T. v	T. b	Mixed		
Dabo Hana	288	9	1	0	0	10	26.48
Boracha	288	6	11	0	0	18	25.67
Total	576	15	12	0	0	27	26.1
Prevalence		2.6%	2.1%	0.0%	0.0%	4.7%	

Table 3: Prevalence Paired Differences.

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
pre - post	10.07	7.42	3.32	.85	19.29	3.035	4	.039

Table 4: Packed-cell volume Paired Differences.

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
pre - post	-5.40	.11	.064	-5.681	-5.132	-84.66	2	.000

study [12] that showed *Trypanosomosis* prevalence was significantly reduced and PCV of the treated cattle increased significantly.

In all study areas prevalence of *Trypanosoma congolense, T. vivax*, *T. brucei* and mixed infections (*T. congolense, T. vivax* and *T. brucei*) were reduced after intervention (P< 0.05) that in agreement with studies [11, 13]. This study was indicate Deltamethrine chemical was effective in killing biological flies(Tsetse fly) that intermediate host to *trypanosoma* parasites since the prevalence was reduced after intervention. The prevalence difference between districts could be dose, either chemical applied to animal or not, number of targets deployed, sites of target deployed, number of animals treated with chemical "pour on" and so on.

Conclusion

In both districts there were strong evidence at 95% confidence interval ($t = 3.035$, $p < 0.05$) *Ddelthamethrine* chemical application reduce prevalence of *trypanosoma* parasite by ten estimated mean. Also there were strong evidence at 95% confidence interval ($t = -84.66$, $p < 0.05$) *Delthamethrine* chemical application increase packed cell volume (PCV) of cattle by five estimated mean that showed an intervention was encouraging to suppress *Trypanosomosis* and should be continually implemented to keep the intervention difference.

Ethics approval

A local ethics committee ruled that no official ethics approval was required to carry out this study. Before conducting the study, informed permission was obtained from the owners of the cattle used in this study.

Study limitations

Due to long time between pre and post intervention studies there was some cattle dynamism from one kebele to other.

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Competing Interests

The author publicize that no conflict of interest.

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