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Prevalence and Identification of Bovine Ixodide Tick in Dandi District, West Shoa Zone, Oromia Region, Ethiopia

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Abstract

A cross-sectional study was conducted with the aim of identifying and estimating the prevalence of cattle ixodid tick infestation with respect to host related factors in Dendi district, Western Shoa, Ethiopia. Adult ixodid ticks were collected from 384 randomly selected cattle by using forceps and preserved in separate collecting bottle with 70 % ethyl alcohol. The collected ticks were identification under stereomicroscope into generas and species based on their morphology. The present study revealed that there was high tick infestation with an overall prevalence of 264 (68.8 %). In the study area four genera of ixodid ticks (Amblyomma, Rhipecephalus (Boophilus), Hyalomma and Rhipecephalus) and four species *(Amblyomma variegatum, Rhipecephalus (Boophilus) decoloratus, Hyalomma dromedary, Rhipecephalus evertsi evertsi)* were identified with the prevalence rate of 26.6 %, 31.8 %, 3.4 % and 3.6 % respectively. All species of ticks had higher number of male, except *Rhipicephalus (Boophilus) decoloratus* (0.0048:1) and they were distributed and attached with statistically significant (P<0.05) variation among different parts of the host body. Different risk factors (age, sex, body condition score, breed and managements) were considered but they are statistically not significant (P>0.05). Their respective prevalence were; age (young 12.2 %, adult 45.5 % and old 10.9 %); sex (male 30.7 % and female 38 %); body condition score (poor 22.9 %, medium 43.7 % and good 2.1 %); breed (local 57.6 % and cross breed 11.2 %) and management system(extensive 63.3 %, semi-intensive 4.2 % and intensive 1.3 %). The present study indicates there is high prevalence of ixodide tick infestation, especially in local cattle breed, adult, female and medium body condition. Therefore, effective control measures should be undertaken to bring the needed health and productive animals in Dendi district.

Key words: Dendi; Identification; Ixodid Tick; Prevalence; Stereomicroscope;

Introduction

Ethiopia, located in the horn of Africa, between latitude of 30 to 15 N of the equator and longitude 33 to 48 E, is an agrarian country with an estimated total land area of 1,101,000 km2. The country has an extremely diverse topography, a wide range of climatic features and multitudes of agro-ecological zonations, which makes the country suitable for different agricultural production system. This in turn has contributed to the existence of large diversity of farm animal genetic resources [6]. The proportion of total population in agricultural sector is 82.4 %. The country has the largest number of livestock in Africa, approximately 44.3 million cattle, 46.9 million sheep and goats, more than 1.0 million camels, 4.5 millions equine, and 40.0 million chickens [11].

Among livestock, cattle play a significant role in socio-economic life of the people of Ethiopia. In addition to the products of meat and milk, cattle provide draught power for cultivation of the agricultural lands of many peasants. Skins and hides are also important components of the livestock sector in generating foreign export earnings [25, 43, 31]. Even though live stock provide such major importance for different people they are affected by different parasitic, bacterial, viral and fungal diseases which affects the skin which is one of the major causes of considerable economic loss from defective skin and hide export. 65 % of cattle with skin diseases are detected before slaughter and are therefore rejected because of poor quality [23, 52].

Ticks were considered as parasites of domestic animals as early as 400 B.C. Aristotle in his famous historia animalium, stated that the ticks were disgusting parasites generated from grass. Despite this early realization, little work was done until the latter half of nineteenth century, when a number of parasitologists all over the world started working on taxonomy, prevalence, and bionomics, seasonal and regional occurrence of the ticks [15, 45].

The body of a tick is comprised of two main regions that are the gnathosoma and the idiosoma. The gnathosoma includes the basis capituli and the mouthparts. The mouthparts of hard ticks consist of a pair of four-segmented palps, a pair of two-segmented chelicerae and a hypostome. Ticks use the chelicerae to penetrate the epidermis of their host and insert the hypostome with retrograde teeth into the wound. The retrograde teeth on the hypostome, together with cement secreted by the tick's salivary glands, enhances attachment of a tick to its host. The idiosoma bears the legs, genital pores and spiracles [50].

Ixodids have a chitinous covering or scutum which extends over the whole dorsal surface of the male, but covers only a small area behind the head in the larva, nymph or female. The mouth parts carried on the capitulum are anterior and visible from the dorsal surface. Other distinguishing features are a series of grooves on the scutum and body, in some species, a row of notches, called festoons, on the posterior border of the body. Chitinous plates are sometimes present on the ventral surface of the males. The genital opening is in the ventral mid-line and the anus is posterior. Some ticks have coloured enamel-like areas on the body and these are called 'ornate ticks'. The adults have a pair of spiracles behind the fourth pair of legs. Eyes, when present, are situated on the outside margin of the scutum [41, 33].

Mating in the hard ticks takes place on the host, except with Ixodes where it may also occur when the ticks are still on the vegetation. Male ticks remain on the host and will attempt to mate with many females whilst they are feeding. The females mate only once, before they are ready to engorge fully with blood. When they finally engorge, they detach from the host and have enough sperm stored to fertilize all their eggs. Female hard ticks lay many eggs (2000 to 20,000) in a single batch. Female argasid ticks lay repeated small batches of eggs. Eggs of all ticks are laid in the physical environment, never on the host [12].

The lifecycle of ticks (both Ixodids and Argasids) undergo four stages in their development; eggs, 6-legged larva, 8-legged nymph and adult [29]. According to the numbers of hosts, Ixodids ticks are classified as one-host ticks, two-host ticks, three-host ticks and Argasids classified as multi-host ticks. In one-host ticks, all the parasitic stages (larva, nymph and adult) are on the same hosts; in two- host ticks, larva attach to one host, feed and moult to nymphal stage and engorged, after which they detach and moult on the ground to adult. In three-host ticks, the larva, nymph and adult attach to different hosts and all detach from the host after engorging, and moult on the ground. In multi-host ticks (Argasids), a large number of hosts are involved and it is common to have five moults, each completed after engorging and detaching from the hosts [45].

Ticks that are considered to be most important to domestic animals' health and production in Africa comprise about seven genera and forty species. Among these tick genera, the main ticks found in *Ethiopia are Ambylomma* (40 %), *Rhipecephalus (Boophilus)* (21 %), *Heamaphysalis* (0.5 %), *Hyalomma* (1.5 %), and *Rhipicephalus* (37 %) [13, 29]. Among these, *A. varigatum* and *Rh(Booph)*. Decoloratus are most important and widely distributed [2]. A. coherence, *A. gemma, A. lepidium, H. marginatum rufipes, H. truncatum,* and *R. evertsi* are also commonly found in Ethiopia [40, 41].

In Ethiopia, tick occupy the first place amongst the external parasites by the economic loss it incurred when they infest livestock particularly cattle. They reduce cattle productivity, such as milk yield, and increase susceptibility to other diseases. Ticks are important vectors for diseases like Babesiosis, Anaplasmosis and Erlichiosis in domestic ruminants. They are known to exacerbate non specific disease symptoms like anemia, toxicosis and paralysis [10,31]. Approximately 80 % of cattle population of the world are at risk of tick infestation and tick born diseases [22].

Regardless of losses due to tick infestation in Ethiopia, and a number of researchers reported the distribution and abundance of tick species in different parts of the country, there is still many problems faced by livestock owners due to the ixoded ticks infestation particularly in Dendi district. In addition, there is no work done regarding the above ecto-parasites in Dendi District.

Therefore, this study was conducted with the objectives of estimating the prevalence and identification of ixiodid ticks with respect to host related factors for making control measures to reduce tick burden in Dendi district.

Material and Methods

Study Area

This study was conducted between November, 2016 and April, 2017 in Dendi district of West Shoa, Ethiopia. Dendi district is located at 78km away from Ethiopian capital city, Addis Ababa, to the west and 35km away from Ambo to the east. This district is located at altitude of 2000mm-3288mm. Geographically, Dendi falls between 8 56'30''N and 8 59'30''N latitude and between 37 47'30''E and 37 55'15''E longitudes. The annual mean temperature ranges from 9.3co to 23.8co and receive annual rainfall ranges from 750 to 1170mm, the highest rain fall occurs from June to September. The districts and its surrounding areas are dominated by Eucalyptus trees. Major soils of the area are vertisols consisting of 46 % clay, 40 % silt, 8 % sand and 6 % organic matter. The livestock population is estimated to be 160,255 heads of cattle, 86,240 heads of sheep and 17,202 heads of goats, 18,639 horse, 19,244 donkey, 20,000 mule, and 79,002 avians in Dendi district. In the study area, ruminants are managed by communal holding of all species such as cattle, sheep, goats and equines together [16].

Study design and study animals

A cross-sectional study design was implemented from November, 2016 to April, 2017 to determine the species and prevalence of ixodid tick infestation and associated effect in bovines in Dendi district. The study population consists of cattle managed under extensive, semi intensive and intensive management system, which constitute cross breed and local breeds.

Sample size determination

The sample size was determined by assuming the expected prevalence of 50 % tick infestation. The desired sample for the study was calculated by setting 95 % confidence interval at 5 % absolute precision [49].

$$n = \frac{1.96^2 (p_{exp}(1 - p_{exp}))}{d^2}$$

Where, n= required sample

P$_{exp}$= expected prevalence

d^2= absolute precision

Therefore, 384 cattle were examined under the study.

Sampling method

Simple random sampling was applied for tick collection from 384 cattle found within 3 peasant associations (PAs) of the Dendi district. The PAs were selected based on their accessibility to transport and information from the Districts manager. The animals were selected and examined randomly from the household.

Study methods

The host related factors like age and body condition were classified into groups for the convenience of the study. The age of the cattle were grouped into young (< 3 year), adult (3 to 7 years) and old (> 8 years) according to [17]. While body condition score were grouped into poor, medium and good according to [34].

Tick Collection and Preservation

The entire body surface of the animals was inspected for the presence or absence of ticks. Adult ticks were collected from different parts of body regions; dewlap, udder, groin, shoulders, belly, flank, perineum, under tail, scrotum, teat, prepuce, thigh and sternum of animals after being restrained using physical handling. Date of collections, address, sites of attachment, breed, age, sex, body condition score and management system of animals were registered.

Ticks were removed from the host skin whilst retaining their good condition for identification using hand manually [52]. The collected ticks from each body regions were preserved in separate pre-filled universal bottles with 70 % ethyl alcohol before transportation to parasitology laboratory for identification.

Laboratory Techniques for Tick Identification

From the bottle containing sample, the ticks were transferred to the petri dish by using forceps. The petri dish containing tick sample was placed under stereomicroscope. The collected ticks were identified and classified to different species levels based on size of mouthparts, color of the body, leg color, presence and absence of the eye. Furthermore, different morphology tick such as shape of scutum, body, coxae one, festoon and ventral plates were considered for species level identification [50].

Data Analysis

The data recorded was entered into Microsoft excel data base system for statistical analysis. SPSS version 20 statistical software was used to analyse the data. The association between tick infestation rate and study factors (such as age, sex, management system, body condition etc) was determined by pearson's chi-square (x^2) test. A statically significant association between variables exists when P<0.05 and at 95 % confidence level (CI). The prevalence of tick infestation was calculated as the number of positive animals for specific tick species sampled divided by the total number of animals examined and multiplied by hundred.

Results

The prevalence of ticks from the total examined cattle was found 68.8 % (264/384). Among these 320 were local out of which 221(57.6 %) were infested and 64 were cross breeds out of which 43(11.2 %) were infested. A total of 620 adult Ixodidae ticks were collected from different body region of infested cattle. From which, four Ixodidae tick species were identified from the study area. Those identified species are; *Rhipecephalus (Boophilus) decoloratus* (58.8 %) was the most abundant and widely distributed species followed by *Amblyomma variegatums* (34.4 %) and *Rhipicephallus evertsi evertsi* (3.5 %). However, *Hyalomma dromedari* (3.2 %) was found to be the least abundant tick species (Table 1).

Table 1: Prevalence and total number of ticks by species

Tick species	Total Infested	prevalence	x^2(P-Value)	Total ticks (%)
A.variegatum	102	26.60%	5.75(.84)	213 (34.4)
Rh(Booph) Dec	122	31.80%		365(58.8)
H.dromedary	13	3.40%		20(3.2)
Rh. evertsi evertsi	14	3.60%		22(3.5)
Mixed	13	3.40%		
Total	**264**	**68.80%**		**620(100)**

A(amblyomma, Booph(boophilus), H(hyalomma, Rh(rhipecephalus), Dec(decoloratus)

Each tick species tend to prefer a site of attachment on the animal body. The most favorable predilection site for *Rh (Booph). decoloratus* species and *H. dromedary* were mostly on body parts; flank, shoulder, thigh, dewlap, neck and sternum and *A. variegatum* was mostly collected from; udder, teat, scrotum, prepuce, groin, belly, dewlap, neck and sternum and also present on the rest of body parts. *Rhipicephalus evertsi* was collected mostly from; under tail and perineum area. There was statistically significant difference between all tick species and attachment site of ticks to host (P<0.05) (Table 2). In the present study, male to female sex ratio for tick species indicated higher number of males than females for all species of tick except Rhipicephalus *(Boophilus)* decoloratus, which had (0.0048:1) ratio of male to female tick (Table 3).

The highest prevalence (27.1 %) of tick infestation was observed in Horeta tulu luba followed by Faji borale peasant association (23.2 %), whereas the lowest prevalence was seen in Hubato dule with a specific prevalence of (18.5 %). Statistical analysis of the infestation rate of ticks showed insignificant difference (P>0.05) among the different peasant association (Table 4).

Table 2 : Ticks species and their predilection attachment site on cattle in Dendi district

Attachment site	Tick species			
	A. var	Rh (B). dec	H. dr	Rh. e.ev
Dewlap, neck, sternum no %	42(15.9)	39(14.8)	5(1.9)	-
Udder, teat, groin,scrotum, prepuce, belly no %	51(19.3)	21(7.9)	5(1.9)	2(.8)
Flank, shoulder, thigh no %	7(2.6)	73(27.6)	4(1.5)	5(1.9)
Under tail, perineum no %	11(4.2)	2(.8)	2(.8)	8(3.03)
x^2(p-value)	152.8(.00)	172.4(.00)	20.23(.003)	47.16(.00)

A.var (Amblyomma variegatum), Rh(B).dec(Rhipecephalus(boophilus) decoloratus,H.dr(Hyalomma dromedari), Rh.e.ev(Rhipecephalus evertsi evertsi), x2(chi square)

Table 3: Total number of male and female ticks with their ratios

Tick species	Sex of ticks		Male to female ratio
	No of male	No of female	
Ambylomma Variegatum	118	15	01:00.1
Rhipecephalus(Boophilus) Dec	3	362	0.0048:1
Hyalomma Dromedari	14	6	01:00.4
Rhipecephalus evertsi evertsi	19	3	01:00.2

No (number), Dec (decoloratus)

Table 4: Prevalence of tick species in different PA

PA	Total	Positive (%)	Tick species (%)				X^2(P value)
			A. var	Rh(B).de	H. dr	Rh.e.e	
HTL	150	104(27.1)	50(8)	45(7.2)	6(.96)	7(1.12)	5.75(.83)
FB	129	89(23.2)	33(5.3)	50(8)	6(.96)	5(.8)	
HD	105	71(18.5)	28(4.5)	40(6.4)	4(.64)	3(.48)	
Tot.	**384**	**264(68.8)**	**111(17.8)**	**135(21.6)**	**16(2.56)**	**15(2.4)**	

PA(Peasant association), A.var(Amblyomma variegatum), Rh(B).de(Rhipecephalus(boophilus) decoloratus, H.dr(Hyalomma   dromedary), Rh.e.e(Rhipecephalus evertsi evertsi), HTL(Horeta tulu luba), HD(Hubato dule),FB(Ffaji borale), CI(confidence interval), Tot(total)

Table 5: Prevalence of ticks with relation to age, sex, body condition score, breed and management system.

Risk factors	Animal examined	Positive animal	Prevalence (%)	P-value	X^2
Age				**0.32**	**2.26**
Young	73	47	12.20%		
Adult	245	175	45.50%		
Old	66	42	10.90%		
Sex				**0.07**	**0.43**
Male	176	118	30.70%		
Female	208	146	38%		
BCS				**0.89**	**0.21**
Poor	126	88	22.90%		
Medium	247	168	43.70%		
Good	11	8	2.10%		
Management				**1.27**	**0.5**
Extensive	357	243	63.30%		
Semi-intensive	20	16	4.20%		

Intensive	7	5	1.30%		
Breed				**0.11**	**0.08**
Local	320	221	57.60%		
Cross breed	64	43	11.20%		
BCS (body condition score)					

The prevalence of ticks in young, adult and old years was found to be, 12.2 %, 45.5 % and 10.9 % respectively. Based on the sex of the cattle infestation rate was 30.7 % and 38 % in males and female animals respectively. In farming system of extensive, semi-intensive and intensive, it was found that 63.3 %, 4.2 %, and 1.3 % respectively. Medium body conditioned animals were found severely affected with ticks than poor and good body condition animals as seen in table 5. Regarding the host related factors in the study, there was no statistically significant variation (P > 0.05) in prevalence of ticks between the breed, sex, age, body condition score and farming system of the cattle production (Table 5).

Discussion

Different tick species are widely distributed in Ethiopia and a number of researchers reported the distribution and abundance of ticks in different parts of the country [20]. In the present study the overall prevalence of ticks (68.8 %) was registered (Table 1). Similarly, high prevalence of ixodid ticks was reported from different part of the country including 82 % by, 81.25 %, 74 % and 65.5 % [32, 53, 26, 19]. This is probably due to similarities in agroecological setting and animal health practice in these study areas. The present study is not in line with the finding reported by with a prevalence of 25.64 %. The inconsistency among these studies could be attributed to a wide range of factors including agroecological, animal health practice, or management difference within their respective study areas [50]. In this particular study, there is insignificant statistical difference (P>0.05) of tick infestation within three peasant association of Dendi district (Table 4).

In present study, four genera (Amblyomma, Rhipecephalus (Boophilus), Hyalomma and Rhipecephalus) and species *(A. Variegatum, Rh (Boophilus). Decoloratus, H. Dromedary and Rhipecephalus evertsi evertsi)* of ixodid ticks were identified among which *Rhipecephalus (Boophilus)* decoloratus was found to be the most abundant species accounting for 31.8 % of the total infested cattle (Table 1). This finding is in line with the previous work by who reported *Rh (Booph). Decoloratus* as the most abundant tick with respective prevalence of 40.86 %, 26.3 %, 47.93 %, 32.3 %, and 26.6 %, respectively [5, 8, 18, 21, 32]. Similarly described Rh (Booph). Decoloratus as the most common and wide spread tick species in Ethiopia [27].

In the contrary, reported lower prevalence of (24.83 %, and 15.4 %) respectively. This might be due to the geographical location and altitude factors, which belongs to lower area of the country [3, 47].

Amblyomma variegatum was second most prevalent tick species in the infested cattle with the prevalence of 26.6 % (Table 1), which is in line with who reported as 25.43 % and 25 % respectively [20,37]. However, reports from different parts of Ethiopia such as in Asela, in Holeta, in Awassa report indicated that *A. variegatum* as the most abundant tick species in their respective study areas [40, 47, 50]In contrast, the lowest prevalence was reported by indicating a prevalence of 6.5 %, 4.7 % and 4.2 % respectively. These variations in the prevalence could be due to the geographical location as *A. variegatum* was reported to be the highest in number in the highland and high rainfall areas [3, 32, 36]. *Rhipecephalus evertsi evertsi* was the third prevalent tick among the infested cattle with the prevalence of 3.6 % which is in line with who indicated lesser prevalence (6.6 %) impling this tick species was less common in the present study district due to agroecology, humidity and amount of rainfall. In contrast to this a higher prevalence was reported by study in Bahir Dar (48.1 %) and (23.1 %). *Hyalomma dromedari* was found to be the least prevalent (3.2 %) among the infested cattle in the present study, which is in line with who reported a prevalence of H. dromedary 2.5 % and 1.86 % respectively [4, 18, 37]. This implies it is less common in the study area [47, 50]. This might be due to agroecology, host preference and amount of rainfall. In contrast to this higher result of Hyalomma tick was recorded in Bahir Dar [18].

Regarding the attachment site of the ticks, there was statistically significant (P < 0.05) difference in attachment site on host in present study (Table 2). The predilection sites found in this study correlated with another report who indicated that hard tick infestation on groin and mammary glands was most prevalent in cattle (48.75 %), whereas lowest in face and neck region (30.0 %) which is almost in line with present finding [20]. In fact, stated that short hypostome ticks like Rhipecephalus usually prefer upper body parts including nape of neck and margin of anus and under tail while long hypostome ticks like Ambloyomma attaches to lower parts of the animal body, which is also the case in the present study [44].

Different species of ticks found to prefer different predilection sites. This is explained as *Amblyomma variegatum* found most predominately (19.3 %) on udder, teat, groin, scrotum, prepuce and belly, whereas, *Rh. evertsi evertsi* found predominating (3.03 %) in the under tail and perineum. Similarly *Rh. (Booph) decoloratus* found abundantly(27.6 %) in the flank, shoulder, thigh while *Hyalomma dromedari* predominantly (1.9 %) on dewlap, neck, sternum, udder, scrotum, prepuce, teat, belly and groin (Table 2).

Tick infestation was insignificantly higher in local breed cattle (57.6 %) as compared with cross breed cattle and this finding is in agreement with the findings of [7]. This might be attributed to the currently existing modified animal husbandry practice where crossbreed or high yielding animals are kept most of the time indoor with semi-intensive care, whereas local breed cattle are kept under extensive farming system. Therefore, the chance of occurrence in local breed cattle is greater than cross breeds. Furthermore, it can be assumed that it might be due to that farmer taking more care to cross breed than local cattle.

The current study indicates that the numbers of male ticks were higher than the number of females except in *Rh. (Boophilus) decolaratus* in which the number of females are higher than male ticks (Table 3). This finding was in agreement with the report of who reported the similar trend [1, 7, 8]. This might be attributed to the fact that male ticks take less food than females but remain longer on the host and can mate with several females and fully engorged female tick's drop-off to the ground to lay eggs [43, 48]. Furthermore, the observed female outnumbering of male ticks in *Rh. (Booph) decolaratus* in the current study might be due to the small size of male tick which may not be seen during collection according to [20, 32].

The difference in prevalence between sex of cattle was found statistically insignificant (P >0.05). Male animals were found less affected than females (in male 30.7 % and in female it was 38 %). This result is in line with the other author in Benchi Maji but it disagreed with the previous works in Assosa that the difference in prevalence was found statistically significant between sex groups [46, 10]. This result is also concurred with the results of [24]. This might be due to equal opportunities of oxen and cows to tick infestation in their production as well as in their management condition. The proportion of tick infestation was high in adult animals as compared to young and old animals. However, there was no statistically significant difference (P > 0.05) and the high proportion may be due to outdoor management and of long distant movement of adult animals to search feed and water as compared to younger and older animals, so the chance of exposure is higher. This finding is also in agreement with the findings of, who reported high proportion in adult cattle. Male and female animals are found to be with equal chance of infestation [16].

Body condition was not statistically significant in relation to tick infestation (p > 0.05). Tick infestation was mostly abundant in medium conditioned animal with prevalence of 43.7 % and lowest in good body condition (2.1 %). Similarly, reported a higher tick infestation in medium conditioned animals as compared to those with poor and good body condition [37]. This might be because medium-scored animals have reduced resistance and exposed to ticks when grazing on the field.

Poor body conditioned animals might be kept at home due to their inability to walk to distance areas thus less exposed to ticks as compared to medium body scored animals. Well-fed animals could be very resistant to any kind of diseases including tick infestation, when they grazed in the field or kept at home [41].

Conclusion and Recommendations

The present study indicated a high prevalence rate of cattle ixodid ticks with four tick genera and species identified. Among the four species *Rh(boophilus)* decoloratus was the most prevalent, followed by *Amblyomma variegatum, Rhipecephalus evertsi evertsi* and *Hyalomma dromedari.* Currently the ixodid tick infestation seems to be associated with different risk factors and result in severe constraint for agricultural activities in the settlement areas of the Dendi district. Almost all, the parasite affects each cattle owner in the area having socioeconomic impacts in the area. Therefore, bearing in mind the above conclusion the following recommendations were forwarded

Integrated control and prevention method should be implemented in order to combat the high prevalence of bovine ixodid ticks from and around the study area. Awareness creation should be given for the stakeholders regarding socioeconomic effects due to ixoded ticks.

There should be collaborative work between the government, non-government, veterinary professionals and communities to bring tick infestation to the very minimum burden.

Acknowledgement

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