*The Sudan J. Vet. Res. (2006), **21**: 37-42.*
With 2 tables and 2 figures in the text.

Behavioural Response of Flat Adult *Hyalomma anatolicum anatolicum* (Koch 1844, Acari: Ixodidae) to Various Relative Humidity Levels

El Ghali[1], A.; El Rabaa[2], F. M. A. and Osman[3], O.M.

ملخص البحث

تم إخضاع قراد هايلوما أناتوليكم اناتوليكم البالغ غير المتغذى لخيارات جافة و رطبة ، أى للاختيار بين رطوبة نسبيه أدنى ورطوبة نسبيه أعلى بإستخدام غرفة الخيارات.حسبت قدرة هذا القراد للتمييز بين أدنى وأعلى درجة بحساب معامل التفاعل الرطوبى.

أوضحت النتائج أن قراد هايلوما أناتوليكم أناتوليكم البالغ قد تمكن من التمييز بين الجانب الرطب و الجاف عند نسبة طرفى مدرج الرطوبة النسبيه الأعلى (92%و100%) و الأدنى (0%و35%) و ايضا بين أعلى و أدنى رطوبة (% 0 و100%) ولكنه لم يتمكن من التمييز بين أعلى و أدنى رطوبة نسبيه عند وسط المدرج (35.5 %و75% ،75%و92%).

Summary

Flat adult *Hyalomma a. anatolicum* ticks were subjected to dry and moist choices of relative humidity using a choice chamber.The ability of this tick to discriminate between higher (moist) and lower (dry) humidities was studied by calculating the intensity of humidity reaction. The results revealed that adult *H.a.anatolicum* ticks can discriminate between dry and moist sides at both ends of humidity scales (92% and 100%; 0% and 35.5 % RH) and between the lowest and highest ends of the humidity scale (0% and 100%) but couldn't discriminate at the middle level of the scale between 35% and 75% and 75% and 92% relative humidity (RH).

Introduction

Activity and behaviour of different tick species are regulated by environmental temperature and relative humidity (RH); other factors like day length or tick age should be considered (Arthur 1951; Lees and Milne, 1951; Browning, 1976; Short and Norval, 1981; Punyua *et al.*, 1984; Logan *et al.*, 1989; Pegram and Banda, 1990). Ticks respond to humidity differences and it is anticipated that some of the olfactory *sensilla* contain hygroreceptors (Waladde and Rice, 1982).

In the present study we ment to study the response of *H.a.anatolicum* flat ticks to relative humidity differences under laboratory conditions.

Materials and Methods

(a) Preparation of the choice chamber: -

The choice or alternative chamber used (Fig. 1) was almost similar to that described by El-Rabaa (1967). It is consisted of a Perspex dish (a), 9 cm in diameter and 1.5 cm in depth, divided into two equal halves by a perspex slide and perspex adhesive tape that was prepared by dissolving some perspex pieces in chloroform (b). Above the dish, a floor of voile (c) was stretched over a perforated perspex dish cover that was fixed above the dish by the perspex adhesive tape. The arena was enclosed in another perspex dish of the same dimensions (d). This dish was partially divided by another slide (e), in such a way to allow the ticks to move unhindered from one side to the other. This dish had a hole in the centre through which the ticks were dropped into the arena. This hole was usually covered with a microscopic glass slide (f). The whole apparatus was made airtight by an adhesive tape.

(1) Atbara Veterinary Research laboratory, P.O. Box 121, Atbara, Sudan. (2) Department of Zoology, P.O. Box no, Faculty of .Science, University of Khartoum, Sudan. (3) Ministry of Agriculture, Masquat, Sultante of Oman.

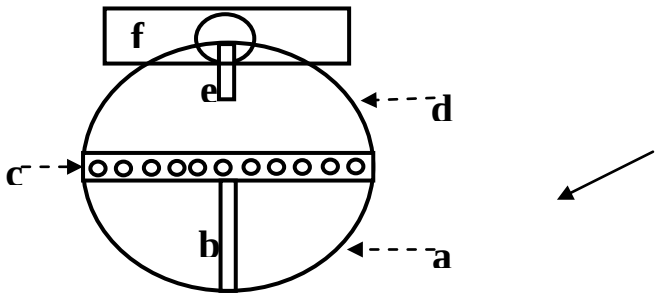

Fig. (1):The choice chamber compartments:

a) Perspex dish. b) Perspex slide.
c) Voile floor. d) Enclosing perspex dish
e) Perspex slide. f) Microscopic slide.

(b) Adjustment of relative humidities:

The experiment was conducted at room temperature (20-22^{o}C). According to Winston and Bates (1960), 100%, 92%, 75%, 35.5% and zero % RHs were obtained at these temperatures by distilled water and saturated solutions of sodium carbonate, sodium chloride, sodium thiocyanate and phosphorus pentoxide, respectively. Two different

solutions were usually poured into the two halves of the dish to obtain two different RHs within half an hour. According to the salt solutions used the chamber was divided into dry side with low RH and moist side with high RH. Then 5 choices were obtained (Table 1).

(c) Ticks testing:

A total of five groups of 30, 28, 24, 24, and 30 flat adult, one-month-old *H.a. anatolicum*, kept at 75% RH at room temperature, were exposed to the above - mentioned five choices, respectively. Three replicas were made for each experiment. The ticks were dropped onto the arena through the hole of the enclosing dish. The hole was then covered with a microscope glass slide that was fixed by an adhesive tape. The ticks were observed for 60 minutes and the number of ticks at each side, moist and dry, and those at the mid-line were counted every five minutes.

The intensity of humidity reaction was calculated using the formula W-D/N x 100,where W= number of ticks at the moist side, D= number of ticks at the dry side and N= total number of ticks used (El Rabaa, 1967).

Results

According to Table2 and fig.2, respectivley, the adult *H.a.anatolicum* showed significant $p<0.01$ hygropositive reactions (100/92%; $p<0.001$) and lower (35.5/0 RH; $p<0.01$) sides of the humidity scale. The ticks showed also a marked hygropositive reactions when offered a choice between 100 and zero RH. At the middle part of humidity scale (92/75 and 75/35.5% RH), the intensities of humidity reactions were negative (-5.9±4.1 and 1.4±17.5) but they were not significant hygronegative reactions ($p>0.05$). However, at this part of the humidity scale the percentage of ticks attracted to either humidity was higher than that of ticks remained at the mid- line.

Table 1:Choices of humidities.

Experiment No.	Moist side	Dry side
1	100%	0%
2	100%	92%
3	92%	75%
4	75%	35.5%
5	35.5%	0%

Table 2 : Percentage of adult H.a.anatolicum on either relative humidity choice.

No.	Humidity choice%	Mean intensity of humidity Reaction	% of ticks in the moist side	% of ticks in the dry side
1	100/92	+37.5±16.7	60.7±8.9	23.3±8.1***
2	92/75	-5.9±4.1	36.8±2.4	42.7±1.9 INS
3	75/35.5	-1.4±17.5	42.4±8.3	43.1±8.6 INS
4	35.3/0	+20.0±8.6	48.1±10.8	30.0±4.2 **
5	100/0	+57.8±8.7	77.5±6.0	19.7±6.0 ***

P ≤0.01;* P ≤0.001; INS=insignificant.

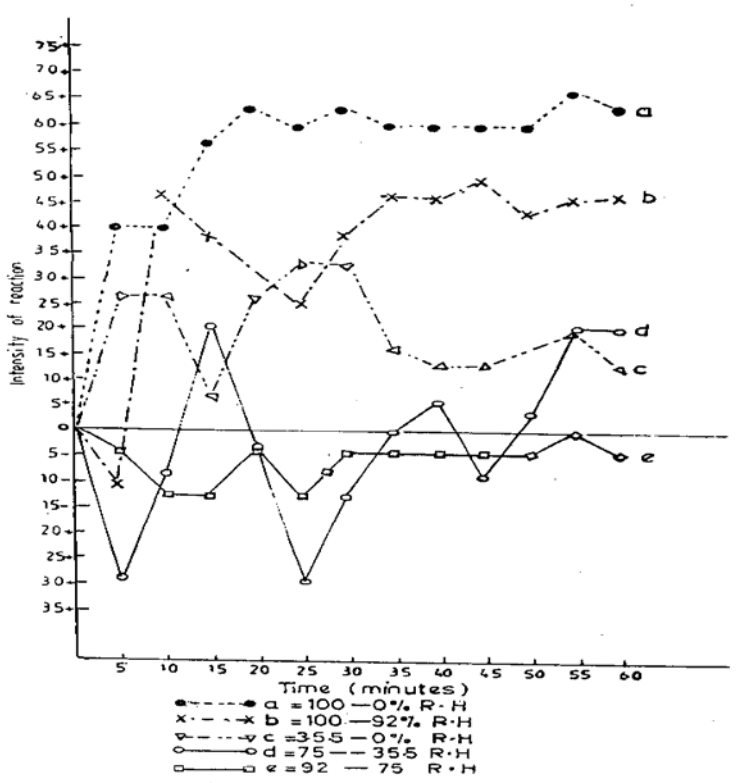

Fig.2: Humidity reaction of adult *H. a. anatolicum*

Discussion

According to Lees (1948), *Ixodes ricinus* ticks, when exposed to some sort of dehydration, go down to the base of grass where the humidity is near the saturation and replenish their lost water by absorption of water vapour from the atmosphere. This phenomenon was also observed by Hair *et al*.(1975), Camin and Drenner (1978), Punyua *et al*. (1984) and Short (1987). Knüle and Rudolph (1982) reported the positive response of dehydrated ticks to high RH and

opposite response after rehydration.Ticks respond to relative humidity differences ,and one could anticipate the presence of some hygroreceptors as suggested by Waladde and Rice (1982). Positive correlation was found between the host seeking activity of *Dermacentor variabilis* larvae and ambient temperature but no similar correlation was found between this activity and relative humidity or other factors (Harlan and Foster, 1986). In this investigation *H.a.anatolicum* had easily discriminated between low and high humidity levels. Their escape from zero percent relative humidity was logical as this humidity level causes desiccation and death. Hundred percent relative humidity attracted the ticks even from 92 percent relative humidity. At the middle part of the scale the ticks were not able to discriminate between moist and dry sides of the choice chamber. Such humidity differences prevail in the natural habitat of these semi-arid ticks which are common in farms in parts of the Sudan north to Wad Medani. The tick under such conditions seems to manage its water balance without great hygroreactions and therefore, discrimination between humidities at the middle part of the humidity scale is not of a great survival value.

Acknowledgements

The authors would like to thank the Director General, Animal Resources Research Corporation for permission to publish this article. They appreciate the efforts of Dr. Sahar Elias Elsafy in typing the manuscript.

References

Arthur, D. R. (1951). *Parasitol*., **41**:82 – 90.

Browing, T. O. (1976). *Phys. Entomol*.**, 1**: 107 – 113.

Camin, J. H. and Drenner,R. W. (1978). *J. Parasitol***., 64:905 – 909.**

El-Rabaa, F M.A (1967). Behaviour and sensory physioloy of *Alphittobius diaperinus* (*Coleptera: Tenebrionida*). MSc Thesis, University of Khrtoum, Sudan.

Hair, J. A.; Sauer, J. R. and Durham, K. A. (1975). *J. Med. Entmol*.**, 12**: 37-47.

Harlan, H. J. and Foster, W. A. (1986). *Ohio J. Sci*., **86** (5): 210 – 212.

Knülle, W. and Rudolph, D. (1982). Humidity relationships and Water balance of ticks. In: F.D.Obenchain and R.Galune (ed). Physiology of ticks, edn. Pergram Press. New York, USA Pp.43-70.

Lees, A. D. (1948). Cited by Knulle, W. and Rudololh, D. (1982). Humidity Relationships and water balance of ticks (eds) F. D. Obenchain and R.Galune. Physiology of ticks,. Pergram Press, New York, USA. Pp.eds 43-70.

Lees, A. D. and Milne, A (1951) . *J. Parasitol.,* **41**:189 – 208.

Logan, T. M.; Linthicum, K. J.; Kondig, J. P. and Baily, C. L. (1989). *J. Med. Entomol*.**, 26**(5): 479 – 490).

Pegram, R. G. and Banda, D. S. (1990). *Exp. Appl. Acarol*., **8**(4): 291 – 301.

Punyua, D. K.; Newson, R. M. and Mutinga, J. M. (1984). *Insect. Sci. Applic.,* **5**(4): 245 – 246.

Short, N. J. (1987). Behaviour and survival of unfed ticks in Zimbabwe. Aciar. *Proc. Inter. Workshop on Ecology of Ticks and Epidemiology of Tick-borne Diseases.* R.W. Sutherst (ed), *held at Nyanga, Zimbabwe*, 17th -21st Feb.1986.

Short, N. J.and Norval, R. A. I.(1981). *J. Parasitol*., **67**(1): 77 – 84.

Waladde, S. and Rice, M. J. (1982). The sensory basis of tick feeding behaviour. In: F. D. Obenchain and R. Galun (eds). Physiology of Ticks, Pergram Press, New York, USA., Pp. 71 – 118.

Winston, P. H and Bates, D. H.(1960). *Ecology*, **41**: 232-237.