nfluence of Low and High Temperatures on the Development of *Haemonchus Contortus* and *Oesophagostomum Columbianum* Larvae in Nigeria

E. D. OKON and U. K. ENYENIHI*
Department of Veterinary Pathology,
University of Ibadan,
Nigeria.

SUMMARY

EGGS of *Haemonchus contortus* and *Oesophagostomum columbianum* exposed to a constant temperature of 13.8°C at 100% relative humidity developed to the infective third stage larvae within 15 and 18 days respectively. Exposure of eggs for nine hours at 40.6°C and 100% relative humidity was lethal but development to the infective stage was achieved by culturing at 27°C after six hours of exposure at 40°C and 100% relative humidity. The normal Nigerian temperature range of 13.8°C [lowest minimum for Obudu Cattle Ranch] to 40.6°C (maximum for Maiduguri) is therefore suitable for survival and development of these strongyle eggs to the infective stages at any season in the country.

INTRODUCTION

WORKERS in different parts of the world have reported that temperature plays an important part in the hatching and development of nematode eggs to the infective larvae. Studies by Shorb (1944), Saramsakov (1959), Crofton (1965), Chhabra and Singh (1965) and Andersen, Wang and Levine (1966) have shown that the eggs of the various strongyle species develop to the infective larvae at temperatures between 7°C and 37°C. These results have been obtained by exposing the eggs to various temperatures at 100% relative humidity.

The mean monthly maximum and minimum temperatures for Nigeria are 40.6°C and 13.8°C respectively (Enyenihi, 1972). In order to know the effect of these temperatures on the development of nematode eggs on pasture, this paper gives the report of culturing the eggs of *H. contortus* and *O. columbianum* (two of the most common nematode species in Nigeria; Okon, 1975) at 40.6°C and 13.8°C and the results are related to field conditions in areas where these temperatures are recorded.

MATERIALS AND METHODS

Eggs for this investigation were obtained by macerating adult female worms collected from goats naturally infected with *H. contortus* and *O. columbianum* in a universal bottle containing physiological saline and glass beads. Sediment obtained by centrifuging the contents of each bottle after the glass beads had been removed was suspended in a small amount of the supernatant. The maturity of the eggs was determined by examining a drop of the egg suspension on a slide under the microscope. The percentage of mature eggs was determined by the number of segmented eggs in 100 counted for each sample.

To examine the development of the eggs at 13.8°C, five drops of the egg suspension were mixed thoroughly with autoclaved powdered goat faeces in a petri dish and moistened. Several petri dishes prepared were put into a wide mouthed jar and cultured in a water bath at 13.8°C. Examination of the culture for larvae was carried out daily when larvae were extracted by the Baermann technique.

Three experiments were designed to examine the development of the eggs at 40.6°C.

* Present Address: Department of Biological Sciences, University of Nigeria, Calabar Campus, Calabar, Nigeria.

Experiment 1

Egg suspension mixed with moistened autoclaved powdered goat faeces was cultured in a water-bath at 40.6°C for five days and the Baermann technique used for extraction of the larvae.

Experiment 2

Instead of culturing the eggs in faeces as described above, two drops of the egg in faeces as described above, two drops of the egg suspension were placed at the centre of a piece of filter paper 10 cm long and 1 cm wide and this was put into a test tube containing about 0.5 ml of water. Each tube prepared was plugged with cotton wool and incubated at 40.6°C in a water bath. At two-hourly intervals the filter paper and the test tube were washed with a small amount of water into a petri dish for examination under the dissecting microscope.

Experiment 3

Eggs cultured in faeces as described above were removed from the water bath after 3, 6, and 9 hours and cultured in an incubator at 27°C for seven days. Infective larvae obtained were extracted by the Baermann technique.

RESULTS

In all samples examined 60 to 70 % of the eggs in the suspension prepared were mature. Eggs of *H. contortus* hatched to the first stage larvae at 13.8 C in 5 to 8 days, second stage larvae in 9 to 14 days and the third stage larvae from the 15th day. At 13.8°C first stage larvae of O. *columbianum* were obtained in 6 to 8 days, second stage larvae in 9 to 17 days and the third stage from 18 days.

Development of the eggs at 40.6°C

Experiment 1

No larvae of the two species were recovered by the Baermann technique from the culture at 40.6°C after 5 days.

Experiment 2

First stage larvae developed within the eggs but did not hatch out and at six hours, most of the larvae in the eggs were dead.

Experiment 3

When eggs were cultured at 40.6°C for three hours and removed to an incubator at 27°C for one week 100 and 60 infective larvae of *H. contortus* and *O. columbianum* respectively were recovered. After six hours exposure, twenty *H. contortus* and fifteen *O. columbianum* larvae were recovered. After 9 hours at 40.6°C, no larvae were recovered.

TABLE 1

Development of *H.* Contortus and *O.* Columbianum eggs at 13.8°C

Parasite	*Larval stage*	*Range of period of development from egg*	*Average period of development*
Haemonchum contortus	1st	5 - 9days	6½days
	2nd	9 - 14days	11½ days
	3rd	15 - 18 days	16½ days
Oesophagostomum columbianum	1st	6 - 9 days	7½ days
	2nd	9 - 17 days	13 days
	3rd	18 - 21 days	19½ days

DISCUSSION

Under field conditions the development of helminth eggs to the infective stages are influenced by a number of environmen-

TABLE 2

Development of *H. contortus* and *O. columbianum* eggs at 40.6°C

Time of exposure at 40°C (hrs)	*No. of infective larvae recovered after culturing at 27°C*	
	H. contortus	*C. columbianum*
3	100	60
6	20	15
9	0	0

tal factors. Since it is extremely difficult to assess the relative importance or even the actual effects of single factors from experiments conducted under field conditions, the investigator must frequently conduct portions of his studies in the laboratory (Andersen Wang and Levine, 1966). That the eggs of *H. contortus* and *O. columbianum* develop to the infective larvae at 13.8°C in this study confirms Sprent's (1946) observation that the effect of low temperature on the development of strongyle eggs in Nigeria is not an important epizootiological factor.

At Obudu Cattle Ranch where this minimum temperature for Nigeria has been recorded, there is a considerable variation in daily temperature so that the lower limit of temperature is not maintained for a long time. Therefore under natural conditions the development of the eggs on pasture to the infective larvae would be faster than the 15 and 18 days recorded respectively for *H. contortus* and *O. columbianum*. Besides, the cold months at Obudu (July, August, and September) fall within the rainy season when other climatic conditions (high humidity and rainfall) are favourable for the development of the eggs. These parasites have been found at Obudu by the authors who visited the ranch.

Lack of development of the eggs to the infective larvae at 40.6°C in five days supports the observations made by Shorb (1944) and Agrawal (1966) that eggs of *H. contortus* and *O. columbianum* did not develop to the infective larvae above 37°C.

In nature a constant temperature of 40.6°C or above is not usually maintained for a long period. The development of the eggs of the two species to the infective larvae after 6 hours exposure at 40.6°C shows that the high temperature of 40.6°C as recorded for Maiduguri in the month of March is not inhibiting to the development of the eggs since such a temperature is not normally maintained for over 6 hours as shown in meterological records for Maiduguri.

The effect of such a temperature on the eggs also depends on the time of the day they are passed and on the place they are deposited. Under shades and on the edges of water courses when most of the animals are usually found during the hottest time of the day in the Sahel and Sudan zones of the country, the effect of high temperature on the eggs passed in faeces will be less. The development of the eggs will continue in the night when the temperature may fall to 22°C.

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REFERENCES

AGRAWAL, V. 1966. The effects of temperature on the survival and development of the free living stages of *Oesophagostomum columbianum*. Helminth. Abst. **35**, 2870.

ANDERSEN, F.L.; WANG, G.T. and LEVINE, N.D. 1966. Effect of temperature on survival of the free living stages of *T. Columbrirfomis*. Journal of Parasitology **52** (4).,

CHHABRA, R.C. and SINGH, K.S. 1965. Effect of temperature on free living stages of *Oesophagostomum* spp. *Helminthological Abstract* **36**, 443.

CROFTON, H.D. 1965. Effect of temperature on the hatching of eggs of some nematode parasites of sheep. *Cornell Veterinarian* **55** (2), 242-250.

ENYENIHI, U.K. 1972. Studies on the Bionomics and Epizootiology of *Necascaris vitulorum* Nigeria: The effect of temperature on development, longevity, and infectivity of *N. vitulorum* eggs. *Journal of West African Science Association* **17** (1) 25-33.

OKON, E.D. 1975. Ph.D. Thesis, University of Ibadan.

SARIMSAKOV, F.S. 1959. The epizootiology of Bunostomum infection in sheep and goats in Uzbekistan. *Helminthological Abstract* **30**, 750.

SHORB, D.A. 1944. Survival on grass plots of eggs and larvae of stomach worm *Haemonchus contortus*. *Jonrnal of Agricultural Research* **68** (8), 317-324.

SPRENT, J.F.A. 1946. Some observations on the Bionomics of *Bunostomum Phlebotomum* a hookworm parasite of cattle. *Parasitology* **37**, 202.