ISSN 2277-8330 *(Electronic)*

J.Bio.Innov2(2),pp:356-363,2013

www.jbino.com

PRELIMINARY STUDY ON RODENT FLEA LARVAL FEED

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(Received on Date: 18th August 2012 Date of Acceptance : 25th February 2013)

ABSTRACT

Plague is a deadly disease that had caused millions of deaths in the Third Pandemic. The cyclic nature of plague outbreak always poses global threat. Rodent fleas, mainly *Xenopsyllaastia* and *X. cheopis* are the transmission vectors from rodent to rodent and to human being. The life cycle of rodent flea consists of four stages viz. egg, larva, pupa and adult flea. In the egg-stage there is hardly any nutritional requirement for its development to larval stage except the temperature, humidity and soil/supporting material. Rodent flea larvae were collected from the flea colony maintained in the lab.and segregated into 3 groups. The impact of different compositions of dried blood, yeast and soil was studied. It was found that the development from larva to pupa and adult flea was good in the feed consisting of dried blood + yeast and soil as compared to the feed with only yeast and only blood without soil. The period of study was August to November 2010 with the temperature range 18°C to 28°C, the relative humidity was in the range of 68% to 77% and occasional rain during that period. The conversion rate of larva to adult flea was 80% in dried blood with yeast and soil, 53% in case of yeast only and 20% in dried blood meal only. The present study showed that neither yeast nor dried blood alone can support the growth of larval stage of rodent fleas to its adult form. Both blood and yeast are required to provide the nutrients (may be proteins and vitamins) for the completion of cycle from larva to its adult flea form.

Keywords: *Plague, Rodent Flea, Larva.*

Number of Tables: 4 **Number of References: 11**

INTRODUCTION

Plague is a zoonotic disease,remains in rodent population & transmitted through the rodent flea bite. Rodent fleas are the main vectors for its transmission from rodents to rodents & rodents to human being. The plague disease is highly fatal in human being if not treated early. The third pandemic of plague started in 1890's caused a heavy death toll throughout the world(K Samuel, JR Cohn 2008). In India, (including Bangladesh & Pakistan) alone there was more than 25 million of deaths in two decades from 1898 – 1918. After the Second World War there was dramatic reduction in the plague cases. It was mainly attributed to the development of antibiotics such as Streptomycin & Sulphonamide which were found to be highly effective in plague treatment. The universal use of DDT spray in rural areas for mosquito control also played a key role in further reduction of plague vector because the rodent fleas were sensitive to DDT at that time (BiswasShyamal et al., 2011).

In 1958, the National Malaria Eradication Program (NMEP) was undertaken to control the mosquito vector of malaria. Under this program mass spray of DDT was carried out in rural & urban area which resulted in the reduction of not only malaria cases but also plague cases. The mortality rate of plague came down from 183 to 1.8 per population & finally reached to zero level during 1967. The resurgence of plague in bordering district of Tamil Nadu, Andhra Pradesh & Karnataka during 1959 to 1966 was reported, which may be attributed to discontinuation of DDT spray in this area. In 1966,Mulbagal area in Kolar district reported a last case of plague. Sporadic cases of plague were also reported after 1967 from Himachal Pradesh, Attebele Karnataka in 1983 & 1984. The sylvatic plague incidences were detected & reported by plague surveillance unit of National Institute of Communicable Disease in the tri-disjunction area of Karnataka, Andhra Pradesh & Tamil Nadu. After a quiescence of 28 years the plague re-emerged in 1994. Both types of plague (Bubonic & Pneumonic) cases were reported from Beed district of Maharashtra &Surat of Gujarat. The probable reason for this was the discontinuation of plague surveillance & control unit in these states. A lesson was learnt from this outbreak & plague surveillance & control units were restarted in both these states. Again after 8 years of long quiescence localized pneumonic plague outbreaks were reported from Hatkoti, Shimla (Himachal Pradesh) in 2002 & 2004 in Dangud village, Uttarkhand district. Uttarkashi.The seriousness of plague was well documented by W.H.O. Twenty six countries had reported 53,417 cases 4060 (7.6 %) deaths to W.H.O. Though it is well known fact that the under reporting is always these because of various factors which are beyond the control of administration (PHEIC:IHR 2005).

Balthazard etal., 1958 studied & concluded that plague is not localized but time to time it shifts from one place to other due to the rodent migration & the vector too. The rodent fleasthe main vectors are responsible for its continuity. Various biotic & abiotic factors are also responsible for the outbreaks of plague. The containment of plague was well done with the vector control by the use of DDT. But now the scenario has changed. In the beginning the rodent fleas were very sensitive & now it has developed resistance (B. Shyamal et al., 2008). This is posing a threat & generates a need to find the other ways or means to contain the development of rodent fleas. The life cycle of rodent fleas consist of four stages i.e. – egg, larva, cocoon & adult flea(G.K. Rathnaswamy,

1974). The efforts are needed to re-study the various factors in the development of these stages so that suitable deviation in them may help to stop/reduce the further development to adult flea. Moreover apart from bionomic, taxonomic & anatomical studies of the larva, the physiology is general & nutritional requirement in particular have been neglected to a great extent. Only few scientists studied the nutritional requirement. The literature about *Xenopsyllacheopis* is voluminous but the information about the nutritional requirement of its larvae is scanty(D. Robert et al., 1966). Hence, in the present scenario a preliminary study on the larval feed is carried out and the findings are presented below.

MATERIALS & METHODS

The study area was Kolar district of Karnataka, which is bordering to both Tamil Nadu & Andhra Pradesh which lies between77° 21' to 78° 35' east longitude and 20° 46' to 130° 58' north latitude(Wikipedia, the free Encyclopedia). This area is most significant because the last human case was detected from the Mulbagal area of this district in 1966. The sero-positivity for plague rodents was also detected in this district in the past.

Rodents were collected by digging from the wild situation & by using wondertraps (live multiple catch trap) from the domestic & peri-domestic situations. The fleas were retrieved from the live rodents collected, by combing & then sucking with the help of flea suction apparatus. The fleas so collected were transferred into a larger test tube & plugged with cotton. These are then transported to laboratory in a proper container whose temperature is maintained to 20^{o}C-25^{o}C. A flea colony was established in the laboratory in a steel rectangular jar (size2^{x}2^{x}2cubic ft.) with mesh top. Sterile soil was put to a height of 4$^{//}$ (inches). A pair of live rodent was left inside for free movement & for feeding of fleas. The humidity & temperature & darkness were well maintained for the survival of rodents and rodent fleas. Daily observations about the rodents, rodent fleas& larvae were made.

The soil was taken out from the flea colony & larvae were separated with great care so that they may not be harmed during handling. These larvae were divided into three groups of 15 each & put into three 250ml. flasks. The following feed was put in these flasks which consist of 1:1 ratio of yeast powder(Rust K. Michael, (1997)& dry blood along with sterile soil, second group consists only yeast powder without soil, third group consists of dry blood without soil(M. Sharif 1948). The dried blood was prepared from the rodent blood & the yeast powder used was of Baker quality. Daily observations were made upto 101 days.

RESULTS

In expt. No.-1 the emergence of adult flea started from 7th day to 24th day and maximum mortality took place in28thto 38th day period.In the second expt. the emergence of adult flea started from 18th day to 24th day and maximum mortality took place in 20th to 38th day period.In the third expt. the emergence of adult flea started from 20th day to 24th day and maximummortality takes place in 20th to 38th day period. The death of larvae took place on 6th day. The death of larvae in First and Second experiment was not observed. It was found that the conversion of larvae to cocoon was 100% in first two groups but it was 60% in the third group. The conversion of cocoon to adult flea was 80%, 53% & 20% respectively. All the adult fleas

emerged anddied by 101st day, but some survived up to one month. The fleas which emerged from the larvae under experiment were found to be *Xenopsylla astia* (25) & *Xenopsyllacheopis*(4).The laboratory conditions were found adequate as (the all larvae & fleas remained ok) there was no sudden death of larvae & fleas during experimentation.

DISCUSSION

The comparative nutritive value of dried rodent blood, mixed with yeast powder, yeast alone & dried blood alone was studied for the growth & development of rodent flea larvae (mostly *X. astia* & *X. cheopis*). It was found that over all conversion from larvae to cocoon & cocoon to adult flea was respectively 80%, 53% & 20%. This shows that the nutritive value of yeast powder mixed with dried rodent blood in 1:1 ratio was very good than yeast or dried blood alone. Even yeast alone was far better than the dried blood. Dried blood alone was not sufficient for the development of larvae to adult flea. In addition to dried blood (proteins & vitamins) additional proteins & vitamins are needed which are supplied by yeast. Thus it may be concluded that even with the passage of sixty years the nutritive values for the development of larvae is more or less the same. The source of these nutritive components (provided by yeast &dried blood) in natural conditions may be from the rodent faeces & microorganism flora present in their burrow soil. Most of adult fleas emergedwith in a monthand the mortality also started from the third week on ward. The non emergence of adult flea from the cocoon may be the indicator of abnormal conditions/lack of trace elements in the environment. Even in case of feed consisting of yeast & dried blood meal, not all the cocoon yielded the adult fleas. The lack of some triggering chemicals in sufficient quantity in the feed may be one of the reasons or it may be the natural way for keeping them in dormant phase. This may lead to replenishment of fleas in the soil as & when the nature wants/creates favorable condition. This may attribute to the resurgence of rodent born disease such as plague in the endemic areas.

CONCLUSION

It was found that for the development of rodent larvae to adult flea needs good nutrition and optimum temperature (18-28)ºC and humidity (68%-75%). The nutritive value of yeast powder mixed with dried rodent blood in 1:1 ratio was very good than yeast or dried blood alone. Even yeast alone was far better than the dried blood. Dried blood alone was not sufficient for the development of larvae to adult flea.

Experiment No. 1. Feed- 1:1 yeast:*dry blood in sterilized soil*

Date	Period /Days	Room Temperature (°C)			Rain / Drizzle / Thunder (R/D/T)	Ppt. (mm)	Humidity (%)	Experiment No. 1 Total No. of Larvae Placed = 15 1:1 = Yeast : Dry Blood food in soil				
		Min	Max	Average				No. of Live Larva	No. of Dead Larva	No. of Cocoon	No. of Live Flea	No. of Dead Flea
20-Aug-10	0	22	28	25	…	0	77	15	0	0	0	0
24- Aug-10	4	25	26	25.5	R, D	11	77	6	0	9	0	0
27- Aug-10	7	20	27	23.5	…	22	77	0	0	13	2	0
2- Sep-10	13	20	27	23.5	…	0	75	0	0	13	2	0
7- Sep-10	18	20	25	22.5	R, D	0	75	0	0	9	6	0
9- Sep-10	20	20	27	23.5	R, D, T	0	68	0	0	6	9	0
13- Sep-10	24	21	28	24.5	R, D	2.1	75	0	0	3	12	0
16- Sep-10	27	19	26	22.5	R, D	0	75	0	0	3	12	0
27- Sep-10	38	21	27	24	R, D, T	6.2	75	0	0	3	5	7
29-Nov-10	101	18	28	23	…	0	68	0	0	3	0	12

Experiment No. 2. Feed*- only dry yeast powder without soil*

Date	Period/Days	Room Temperature (°C)			Rain / Drizzle / Thunder (R/D/T)	Ppt. (mm)	Humidity (%)	Experiment No. 2 Total No. of Larvae Placed = 15 Only Dry Yeast Powder food (No soil)				
		Min	Max	Average				No. of Live Larva	No. of Dead Larva	No. of Cocoon	No. of Live Flea	No. of Dead Flea
20-Aug-10	0	22	28	25	…	0	77	15	0	0	0	0

24-Aug-10	4	25	26	25.5	R, D	11	77	6	0	9	0	0
27-Aug-10	7	20	27	23.5	…	22	77	5	0	10	0	0
2-Sep-10	13	20	27	23.5	…	0	75	0	0	15	0	0
7-Sep-10	18	20	25	22.5	R, D	0	75	0	0	7	8	0
9-Sep-10	20	20	27	23.5	R, D, T	0	68	0	0	7	5	3
13-Sep-10	24	21	28	24.5	R, D	2.1	75	0	0	7	4	4
16-Sep-10	27	19	26	22.5	R, D	0	75	0	0	7	4	4
27-Sep-10	38	21	27	24	R, D, T	6.2	75	0	0	7	3	5
29-Nov-10	101	18	28	23	…	0	68	0	0	7	0	8

Experiment No. 3. *Feed- only rodent dry blood powder without soil*

Date	Period/Days	Room Temperature (°C)			Rain / Drizzle / Thunder (R/D/T)	Ppt. (mm)	Humidity (%)	Experiment No. 3 Total No. of Larvae Placed = 15 Only Dry Blood Powder food (No soil)				
		Min	Max	Average				No. of Live Larva	No. of Dead Larva	No. of Cocoon	No. of Live Flea	No. of Dead Flea
20-Aug-10	0	22	28	25	…	0	77	15	0	0	0	0
24-Aug-10	4	25	26	25.5	R, D	11	77	7	0	8	0	0
27-Aug-10	7	20	27	23.5	…	22	77	1	6	8	0	0
2-Sep-10	13	20	27	23.5	…	0	75	1	6	8	0	0
7-Sep-10	18	20	25	22.5	R, D	0	75	0	6	9	0	0
9-Sep-10	20	20	27	23.5	R, D, T	0	68	0	6	6	3	0
13-Sep-10	24	21	28	24.5	R, D	2.1	75	0	6	6	2	1
16-Sep-10	27	19	26	22.5	R, D	0	75	0	6	6	2	1

27-Sep-10	38	21	27	24	R, D, T	6.2	75	0	6	6	0	3
29-Nov-10	101	18	28	23	…	0	68	0	6	6	0	3

Table1:

In One Month or 30 Days						In 101 Days		
Type of Feed	No. of Larva	No. of live Larva	No. of Cocoon	Fleas in one month (or 30 days)	Conversion rate %	No. of Cocoon	Fleas in (101 days)	
							Live	Dead
Yeast+ Dry Blood+ Soil	15	15	3	12	80	3	0	12
Yeast	15	15	7	8	53	7	0	8
Dry Blood	15	9	6	3	20	6	0	3

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