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Effects of Neem (*Azadirachta indica*) Seed Kernel Powder on *Tribolium castaneum*, the Intermediate Host of Some Poultry Cestodes

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ABSTRACT

Cestodes negatively affect poultry production. Tribolium beetles act as intermediate hosts of the cestodes *Raillietina cesticillus* and *Hymenolipis carioca.* The effect of neem seed kernel powder on larvae and adults of *Tribolium castaneum* was studied. The LC 50 for *Tribolium castaneum* larvae was 2.99%, 1.88, 1.36% and 0.54% after 24 hours, 48 hours, 120 hours and 360 hours respectively. The LC50 for the adults after one month was 6.225 and the L99 was 6.41%. The progeny of the beetle has also been affected.

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INTRODUCTION

Tape worm infection is a disease which has a bad effect on poultry industry and leads to significant economic losses particularly in endemic areas. For the disease to develop, an intermediate host is needed for the completion of the parasite's life cycle. The grain red beetles *Tribolium castaneum and Tribolium confusum* transmit the cestodes *Railietina cesticillus* and *Hymenolipis carioca* to poultry (Horsfall, 1938, Reid, *et al*., 1964).

These beetles are famous as stored product pests. So the poultry ration forms a suitable food. They are usually found in stores of poultry farms.They are closely related species (Robert and Pfadt, 1985). *Tribolium castaneum* occurs in a wide variety of stored grains and is a major pest of flour mills, being a secondary pest feeding on the dust and broken kernels only (Campbell, *et al*., 2004). *Tribolium castaneum* is apparently more common in Sudan than *Tribolium confusum*, because the latter is probably less common in hot conditions (El Khatim, 2005). Infection is gained by ingestion of the intermediate host within the poultry feed. Breeding in poultry feed, or hiding under feeders or unclean feed bins near infected birds, may establish them as reservoirs of infection. Cysticercoids development in adults of *T. castaneum and T. confusum* was studied by Horafall, 1938 and detailed description of cysticercoids in the larvae of these beetles was given by Luttermoser (1940).

Elowni (1977) experimentally fed the adults of *T. castenum* with the gravid segment of *R. cesticillus.* Treatment of infected birds is expensive and reinfection could occur if the source of infection is not eliminated. So, elimination of the intermediate host together with the treatment of the infected bird will eradicate the disease. The chemical control of vectors proved to be effective; however these chemicals have negative impacts on birds and environment. Development of insect-resistance to these chemicals after repeated application is possible. Also, the cost of these chemicals render the usage of them difficult. An alternative for this has been found in plants, which provide a rich source of non-synthetic pesticides.

The Neem tree *Azadirachta indica A.* Juss. (Nicoletti, *et al*., 2012) which is widely grown in Sudan for shade and as avenue trees proved to be a potential source of non-synthetic pesticides. It is ecologically safe, cheap and abundant. Neem has a short residual action and a low mammalian toxicity (Murugan, *et al*.,1998 and Schmutter, 1995). Some species grown in Burma and Thailand are edible. All parts of the neem tree are effective pesticides specially

the seed kernel. The latter contain a number of chemical compounds, most important of which are Azadirachtin and Salanin the triterpenoid fraction (Johnon and Murgan, 1997).

The biological effects of the neem seed kernel and pure compounds isolated from it are diverse including repellant, antifeedant, insecticidal, fitness reducing and insect growth effects. In addition, neem is also reported to have direct toxicity and impairs egg hatchability (Schmuterer, 1995).

To investigate the effects of Neem powder on different stages of the intermediate host (*Triboluim castenum*) of some poultry tapeworms to control the disease by using a natural and safe pesticide.

MATERIALS AND METHODS

Collection of samples:

Neem seeds:

The ripe fruits of *Azadirachta indica* collected from Shambat area (Khartoum – Sudan). They were then soaked in water to remove the outer thin layer and hence dried under shade. The dried seeds were decorticated and ground in an electric mill. The powder obtained was stored in glass bottles till use.

Tribolium castaneum larvae

Tribolium castaneum adults were brought from Shamb at Research Station and left to breed. The 4th instar larvae were treated with different concentrations of neem seed kernel powder. For these concentrations, neem seed kernel powder and poultry ration were mixed making six concentrations by W/W values (20, 10, 5, 2.5, 1.25&0.625). Ten grams of each concentration were put in a petri-dish. Ten larvae of *Tribolium castaneum* were put in each petri-dish. The mortality percentage after 24, 48, 120 and 360 hours was recorded. The adults emerging were also noticed. For controls, 10 grams of poultry ration was used.

Tribolium castaneum adults

For neem seed kernel powder and poultry ration were mixed making six concentrations by W/W values. Ten grams of each concentration were put in a large mouthed glass jar. Ten adults *Tribolium castaneum* were put in each glass jar and covered with a piece of cloth tied

by a rubber bandage. The progeny and adult mortality was observed every week for a month period.

Statistical Analysis

1. Concentrations were converted to logarithms.

2. Empirical probit values, corresponding to the mortality percentage were plotted against log doses (Busvin, 1957).

3. From the graph, calculated probity is determined from the equation:

A = The intercept of the line with the axis.

B = Regression coefficient.

X = The corresponding log-dose.

4. Log-dose probit regression line is plotted from the calculated probit and log-dose values.

5. LC50 and LC99 are calculated.

RESULTS

To control *Tribolium castaneum* larvae and adults using six different concentrations of Neem sees kernel powder the results for the larvae are shown in Tables (1 – 4). The results of the adults mortality and progeny are shown in Tables (5) and (6). The mortality percentage of larvae and adults is also calculated.

Table (1): The effects of Neem seeds kernel powder on *Tribolium castaneum* Larvae, 24 hours post treatment

Concentration %	Log-dose (X)	Mortality %	Calculated probit (Y)
0.625	-0.2	27.5	-0.2
1.250	0.1	47.5	0.13
2.500	0.4	42.5	0.43
5.000	0.7	85.0	0.72
10.00	1.0	92.5	1.02
20.00	1.3	92.5	1.3

Table (2): The effects of neem seeds kernel powder on *Tribolium castaneum larvae*: 48 hours post treatment:

Concentration%	Log-dose (X)	Mortality %	Calculated probit (Y)
0.625	-0.2	30.0	-0.200
1.250	0.1	50.0	0.008
2.500	0.4	70.0	0.629
5.000	0.7	85.0	0.940
10.00	1.0	92.5	1.251
20.00	1.3	92.0	1.562

Table (3): The effects of neem seeds kernel powder on *Tribolium castaneum* larvae: 120 hours post treatment:

Concentration%	Log-dose (X)	Mortality %	Calculated probit (Y)
0.625	-0.2	32.5	-0.200
1.250	0.1	62.5	0.467
2.500	0.4	75.0	0.735
5.000	0.7	90.0	1.002
10.00	1.0	92.5	1.270
20.00	1.3	95.0	1.537

Table (4): The effects of neem seeds kernel powder on *Tribolium castaneum* larvae: 360 hours post treatment:

Concentration %	Log-dose (X)	Mortality %	Calculated probit (Y)
0.625	-0.2	57.00	0.548
1.250	0.1	70.00	0.760
2.500	0.4	85.00	0.973
5.000	0.7	90.0	1.186
10.00	1.0	92.5	1.398
20.00	1.3	95.0	1.611

Table (5): The effects of neem seeds kernel powder on *Tribolium castaneum adults*: One month post treatment:

Concentration %	Log-dose (X)	Mortality %	Calculated probit (Y)
0.625	-0.2	60	0.5
1.250	0.1	80	0.7
2.500	0.4	90	0.8
5.000	0.7	80	0.9
10.00	1.0	80	1.0
20.00	1.3	90	1.2

Table (6): The effects of neem seeds kernel powder on *Tribolium castaneum progeny for a month period:*

Concentration%	Number of larvae			
	1st week	2nd	3rd	4th
0.625	-	74	111	119
1.250	-	64	61	47
2.500	-	56	88	75
5.000	-	47	63	38
10.00	-	32	36	28
20.00	-	29	20	14

DISCUSSION

After several years of application of chemical pesticides, negative side effects showed up. These negative side effects created many social and health problems, such as, environmental pollution, residual problems, pest outbreaks, resistance…*etc*., beside their high price. This promoted the inclination towards naturally occurring pesticides such as neem products which are considered to be as effective as synthetic chemical pesticides (Isman, 2006).

There are 45 species of cestodes belonging to 10 different genera that have been reported to parasitize chickens (Elowni, 1977). In Sudan 7 species were found in foreign breeds of chicken (Ali, 1994). Ants, beetles and house flies inhabiting poultry houses, act as an intermediate host of the two large chicken tapeworms *Raillitinia cesticillus* and *Choanotaenia infundibulum* (Williams, R. 2013).

Several species of ants have been reported as intermediate hosts for *R. tetragona* (Mohammed, *et al*., 1988). *Tribolium castaneum* is more susceptible to experimental infection with *R. cesticillus* than with *C. infundibulum* and the development of the former occurs more rapidly in this beetle (Horafall, 1938; Elwoni, 1977). In this study, the Neem seed kernel powder used against *Tribolium castaneum* larvae and adults was found to affect the mortality of both stages and also affects the progeny of the adults. The lethal concentration that kills 50% of the population (LC50) was 2.99%,1.88%, 1.36%, 0.54% after 24, 48, 120 and 360 hours respectively. These results indicate that increase of exposure time leads to the decrease of LC50 values. The same is said about the concentration that kills 99% of the population (LC99) for the larvae. The LC99 starts with 9.34%, 8.61%, 4.81% and 2.65% after 24, 48, 120 and 360 hours respectively. The LC50 for the adult *T. castenum* after a month exposure time was 0.622% and the LC99 6.41% of the Neem seed kernel powder.

The progeny of the beetle has also been affected. The number of larvae for 0.625% concentration was 119 at the fourth week of exposure while 20% concentration at the same time of exposure led to the decreases to 14 only. These results are in agreement with Tripathi *et al*., 2002, who stated that *T. castenum* progeny was significantly dose dependant. Also, Neem seed kernel powder at 2.5% showed significant deterrence, mortality and decreases fecundity and hatchability of *T. castenum* (Nadeem *et al*., 2012).

The house fly *Musca domestica* is affected by neem latex, neem oil and neem seed kernel extracts. Concentration of 2.5% of them leads to significant deterrence, mortality, decreased fecundity and hatchability (Murgan *et al*., 1998). Similar anti-feeding and anti-oviposition effects on insects are reported with other products such as Neem oil, Neem seed kernel extract, Neem root extract and Neem gum (Adarkwah *et al*., and Murgan, 1997).

CONCLUSIONS

Neem seed powder was found to be effective as a natural insecticide for different stages of *Tribolium spp.* (intermediate hot of some poultry tape worm).

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