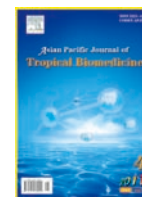




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Effect of insulin on *Blattella germanica* Linnacus

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ABSTRACT

Objective: To determine the sensitivity of *Blattella germanica* L (*B. germanica* L) to different doses of insulin. **Methods:** *B. germanica* were reared in laboratory conditions at (25±2) °C and (50±5)% relative humidity (RH), and exposure period of 12:12 L/D. Different concentrations, viz. 5, 10, 15, 20 and 25 µ of insulin N, R, (N+R) were prepared and injected to 10 treated cockroaches with another 10 cockroaches which were injected with normal saline as control group. **Results:** Insulin N with a dose of 20 µ caused more than 70% mortality of *B. germanica* in this study. There was a significant difference between 20 µ of insulin N with other doses of 5, 10, 15 and 25 µ, and its comparison with other forms of medication also showed obvious difference ($P<0.05$). **Conclusions:** It can be concluded that effective drug doses of insulin which can be used as poison bait or gel against German cockroaches could be utilized in the control of *B. germanica* in the future field studies.

1. Introduction

German cockroaches *Blattella germanica* (*B. germanica*) is one of the most potential mechanical vectors and responsible for transmission of many protozoan, bacteria, viruses and intestinal parasites to humans^[1].

German cockroaches can also cause irritation and allergies in human hosts^[2–6]. Based on mentioned above, control of cockroaches is very important^[7,8]. German cockroaches are becoming resistant to pesticides through special mechanisms and survive successfully due to quick adaptation to environment these years^[9–16]. The recent research shows that environmental contamination which is regarded as a significant contamination does not affect the cockroaches with pathogenic bacterial^[16]. Society urgently needs to find new materials used as a control tool against this pest which is pesticide-resistant arising from high and irregular use of pesticides in the world. Insulin drugs are used to the treatment of diabetic patients. This type of diabetes occurs when the pancreas can not produce enough insulin to help the body target cells. Paul Langerhans, a medical student in 1869 during the study in pancreatic

tissue specialized cells under a microscope found that these cells were mediated by insulin secretion, so pancreatic tissue was called by the name of the first scholar researcher. Minkowski and Joseph Van Mryng removed a dog pancreas during the surgery in Germany in 1889. The observation of flies gathering in dog urine showed the presence of sugar in dog urine. The relation between pancreatic function and diabetic diseases was found more specific in 1901. Steiner and Federwisk *et al* cited secret material responsible for regulation of blood glucose (insulin) from the pancreas gland in 1920^[17,18].

Currently, common forms of insulin are R (Human regular insulin), NPH (Isophane insulin suspension), N (Insulin isophane, novolin)^[18].

So far, several methods have been exploited to the cockroaches control and some control tools such as poisoned bait gel can be seen as an effective tool^[19,20].

Poison bait which can be treated in the appropriate places is very effective due to its adsorbent and scentless property. Other pharmaceutical compounds such as tetratoxin found in sex glands, liver, intestines and skin of puffer fish were used as poison bait to the control of cockroaches^[23]. It should be mentioned that its combination effect on sodium channels and nerve membranes has been demonstrated previously^[21–24]. This combination wipes off neural activity in the species of cockroaches, especially *B. germanica* L and it seems that the killing effects with type 1 pyrethroids,

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carbamates, DDT, have less similar characteristics as compared with combination with type 2 pyrethroides, organophosphate, nicotine and muscarine[25,26].

No studies of the effect of insulin on *B. germanica* L have been investigated previously. Therefore, we conduct the study to determine the susceptibility of *B. germanica* L to different doses of insulin.

2. Materials and methods

2.1. Rearing

B. germanica L were reared in the special glass containers containing bread, sugar, water in the laboratory conditions (25 ± 2) °C and (50±5)% relative humidity and exposure period of 12:12 L/D[27]. Then the *B. germanica* strains were kept without any contact with insecticide in Insectary of School of Public Health Tehran University of Medical Sciences and this susceptible strains were used in various studies.

2.2. Test

Effect of insulin was determined by injection of insulin N, R, (N+R) at a dose of 5, 10, 15, 20 and 25 μ into insect coelom. Initially different concentrations of insulin were prepared and injected into 10 divided cockroaches with another 10 as the control which was injected with normal saline. The results were analysed with SPSS software. The standard contact topical application test was used[28]. Different doses of 5, 10, 15, 20 and 25 μ of drugs were determined by the device driver. Then, these cockroaches were anesthetized with CO₂ gas and different doses of insulin, N, R, (N+R), were

injected. The control group was given doses of 5, 10, 15, 20 and 25 μ of 0.9% normal saline.

2.3. Statistical analysis

SPSS ver. 11.5, stata 80, and one way ANOVA test were used to compare the mortality of *B. germanica* L between two groups. A *P*-value less than 0.05 was considered statistically significant.

3. Results

The results of effectiveness of insulin by different doses was shown in Table 1. Significant difference was found between the mortality of German cockroaches exposed to insulin N with a dose of 20 μ in comparison with the control group (*P*<0.05) (Figure 1).

Insulin N with a dose of 20 μ was more effective than other doses. Also this dose was more effective than the same doses of other drugs separately (Figure 1).

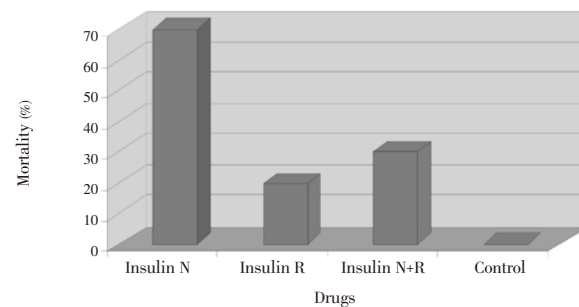


Figure 1. The mortality of German cockroaches (*B. germanica* L) exposed to insulin N, R, and N+R with a dose of 20 μ in comparison with the control group.

Table 1

The mortality rate of German cockroaches (*B. germanica* L) exposed to different dosage of insulin (*n*=10).

		Mortality rate (%)	Dead	Alive
N	5 μ	40	4	6
	10 μ	30	3	7
	15 μ	40	4	6
	20 μ	70	7	3
	25 μ	20	2	8
R	5 μ	0	0	10
	10 μ	0	0	10
	15 μ	0	0	10
	20 μ	20	2	8
	25 μ	30	3	7
R+N	5 μ	30	3	7
	10 μ	40	4	6
	15 μ	0	0	10
	20 μ	30	3	7
	25 μ	0	0	10

4. Discussion

This is the first study in relation to effects of insulin on German cockroaches while previous studies stated some

effects of insecticides, chemical pesticides and other drugs on cockroaches[28–31]. Effect of insulin-R reported 30 minutes post injection and the duration was 6–8 hours. The maximum effect reaches 6–8 hours post treatment. Onset of insulin N reported 2 hours post injection with the duration of 18–26 hours. In this report the maximum effect calculated was 4–12 hours post treatment by insulin N[32–41]. It is evident in our research that the common signs of post treatment were the reduction of irritability, decreased activity, less frequencies of drinking water, reduced weakness and eventually death.

Our studies showed that the most mortality rate occurred when *B. germanica* L were exposed to insulin N with a dose of 20 μ . The effectiveness of insulin on *B. germanica* L has not been evaluated yet. Nasirian *et al* reported that imidacloprid gel bait was more effective than the gel of Fipronil[26]. This difference may be due to size, metabolism and physiology of cockroaches.

Many studies reported the resistance of cockroaches to different insecticides, particularly organophosphate and pyrethroides, so the failure of control programs occurred subsequently[28,42–50].

In conclusion, the use of drug instead of common pesticides possesses the advantages of reduced contact or oral toxicity to people, especially to children and the elderly and also less environmental pollution. Our study indicates that insulin N with a dose of 20 μ which can be used as poison bait or gel against German cockroaches was deadly effective for preventing the occurrence of *B. germanica* L resistance. Results of our study show that injection of insulin N at a dose of 20 μ has greater impact than other modes with the common characteristics of decreased stimulation, activity, mobility, desire to drink water, weakness, hunger, and eventually death. The effective doses of insulin which can be used as poison bait or gel against German cockroaches are recommended in the future studies.

Conflict of interest statement

We declare that we have no conflict of interest.

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