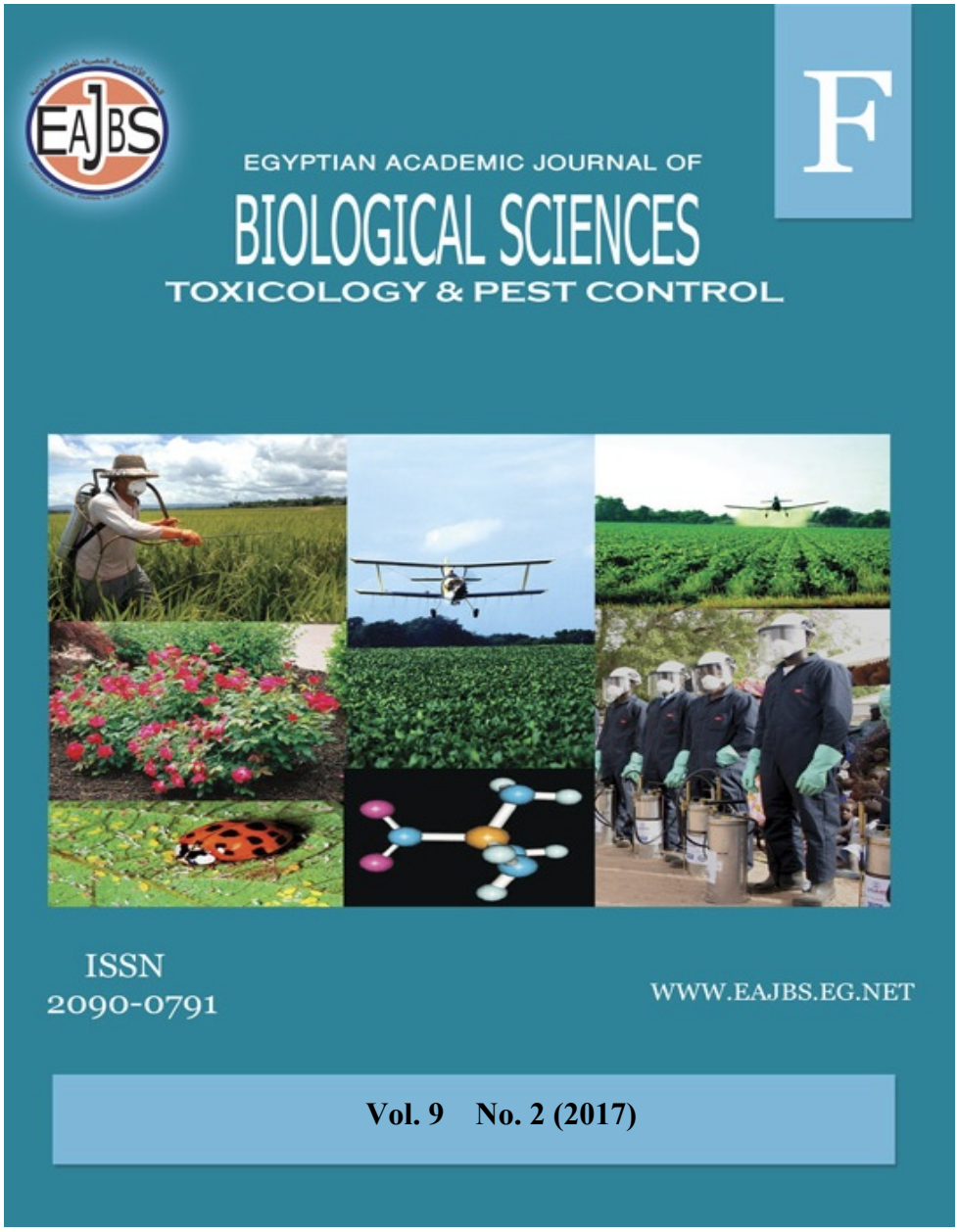

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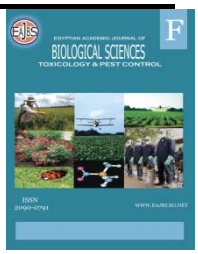

Toxicity of Taro Plant Leaves, *Colocacia esculanta*, Against the German Cockroach, *Blattella germanica*

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ABSTRACT

The toxicity of *Colocacia esculanta* leaves extracts on adult males and females of *Blattella germanica* cockroaches under laboratory conditions was investigated in Benha City, Egypt. Bioassays showed that ethanol and petroleum ether extracts had a toxic effect against the tested insects and mortality percentage for adult males and females increased with the increase in the concentration. The LC_{50} values indicated that males were more sensitive to both extracts than females and ethanol extract was more toxic than petroleum ether extract. At 48h post-treatment, the LC_{50} values of ethanol extract were 2.42 and 4.001% for treated males and females, respectively, while that of petroleum ether extract were 4.42 and 5.46%, respectively.

INTRODUCTION

The traditional approach to the control of cockroaches and other residential pests has been regular spraying of chemical pesticides (Dingha *et al*., 2013). However, heavy reliance on insecticide treatments and high frequency of use have led to the development of resistance to various classes of insecticide, including chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids (Nasirian, 2010), phenylpyrazoles (Scharf, 2012), and oxidiazines (Chai and Lee, 2010). This awareness has created worldwide interest in the development of alternative strategies, including the reexamination of using plant derivatives. In the last two decades, considerable efforts have been directed at screening plants in order to develop new botanical insecticides as alternatives to the existing insecticides. Research using plant extracts for controlling cockroaches is limited. Recently, the essential oil of catnip (*Nepeta cataria*) was reported to have repellency against adult males of *B. germanica* cockroach (Peterson *et al*., 2002). Thavara *et al*., (2007) studied seven commercial essential oil for repellency against cockroaches and found that *Citrus hystix* exhibited complete repellency against *Periplaneta americana* and *B. germanica*.

Taro plant *Colocacia esculenta* (CE) Linn. (Family: Araceae) is an annual herbaceous plant, and consumed throughout Asia, Africa, the Pacific Islands, and the Caribbean (Matthews, 2004). Corms, leaves, and possibly other parts (e.g., stalks) of the taro are commonly eaten cooked (Savage *et al*., 2009).

Phytochemically: taro leaves contain flavonoids; orientin, isoorientin, isovitexin, vicenin-2, orientin, isovitexin, vitexin, and luteolin (Iwashina *et al*., 1999). The leaves also contain calcium oxalate, fibers, minerals (calcium, phosphorus, etc.), starch, and vitamins A, B, and C (Prajapati *et al*., 2011). The toxicological effects of taro plant, *Colocacia esculanta*, against certain insects were recorded by many investigators as Neerage *et al*., (2013) who found that taro plant has defense compound (α-amylases inhibitors) against *Callosobruchus chinensis, Tribolium castaneum, Corcyra cephalonica*, and *Spodoptera littoralis* that interact with insect α-amylase causing insect mortality. Also, El-Monairy (2015) reported toxicological and histopathological effects of *C. esculenta* leaves extract on the immature stages of *Culex pipiens* mosquito.

The present work was designed to investigate the insecticidal activities of two leaves extracts of *C. esculanta* against the German cockroach as alternative to chemical insecticides used in cockroaches control.

MATERIALS AND METHODS

1- Tested Insects and Rearing Technique: The German Cockroach, *Blatella germanica,* was reared in laboratory of the Entomology Department, Faculty of Science, Benha, Egypt, under constant conditions of temperature and humidity (27 ± 2 ˚C and 65 ± 5% RH). Wooden frames (50 × 30 × 30 cm) (with a glass upper side) covered with muslin were used as rearing cages. Each cage was provided with corrugated papers for shelter. The insects were provided with an unlimited supply of food (white bread) and water (pieces of cotton soaked with water).

2- Preparation of Leaves Extracts: The fresh plant leaves of taro plant were collected from the taro plant fields of Arab El-Ghadeer Village, Shebeen El-Kanater, Qaliobia, Egypt. The fresh green leaves were thoroughly washed with tap water and shade dried under laboratory conditions then ground in an electric mill. Two solvents were used separately: ethanol and petroleum ether to extract the ingredient substance. The leaves extracts prepared according to Khan *et al*., (2011) and El-Gizawy (2012).

3- Toxicity Tests: In order to study the toxicity of the plant extracts, preliminary tests were carried out according to a slightly modified method of Khan *et al*., (2011). Cockroaches were left 24 hours in the test conditions before bait introduction for starvation (Sallehudin *et al*., 2007) and acclimation (Wang *et al*., 2004; Anaclerio and Molinari, 2012). After 24 hours of starvation, 1gm of white bread mixed well with each concentration (1, 2, 4, and 6% / total weight of white bread) was introduced to the tested insects in each replicate and placed inside the center of the jar. The control insects were provided with white bread separately mixed with the different solvents and then left for 2 hours to evaporate the solvents (El-Gizawy, 2012). Mortality of cockroaches was recorded after 48 hours of treatment. Four replicates were carried out for each concentration, for each sex and for the control.

4. Statistical Analysis: Data were expressed as mean% ± standard error. The statistical significance of differences between individual means was analyzed using SPSS statistical analysis one-way (ANOVA, version 20-32bit) program followed by Duncans test. The level of significance of each experiment was stated to be non-significant ($p > 0.05$), and significant ($p < 0.05$). The LC_{50} values were obtained by LT_{50} program (version 6.0.0).

RESULTS AND DISCUSSION

The toxic effect of taro plant leaves extract at four concentrations (1, 2, 4, and 6%) against adults of *B. germanica* cockroaches within 48 hours is presented in Table (1).

Table 1: Toxicity of Taro plant leaves, *Colocacia esculanta*, against the German cockroach, *Blattella germanica*, adults under laboratory conditions.

Conc. %	Mortality (mean% ± SE)							
	Ethanol extract				Petroleum ether extract			
	♂	♀	LC_{50}		♂	♀	LC_{50}	
1	35.0 ± 0.70[a]	22.5 ± 0.28[a]	♂	♀	25.0 ± 0.47[a]	17.5 ± 0.25[a]	♂	♀
2	45.0 ± 0.62[b]	30.0 ± 0.47[b]			32.5 ± 0.50[a]	20.0 ± 0.47[a]		
4	67.5 ± 0.86[c]	50.0 ± 0.20[c]			47.5 ± 0.40[b]	35.0 ± 0.64[b]		
6	92.5 ± 0.94[d]	77.5 ± 0.47[d]	2.41	4.001	75.0 ± 0.47[c]	60.0 ± 0.75[c]	4.42	5.46
Slope	2.03 ± 0.14	1.85 ± 0.13			1.61 ± 0.13	1.52 ± 0.14		
Chi Square	4.54	3.25			3.18	2.96		
Probability (P)	0.10	0.20			0.20	0.23		
Control	0	0			0	0		

N: 4 replicates for each treatment, percentage mortalities in the same column followed by the same superscript are not significantly some (ANOVA) followed by Duncans test, $p< 0.05$.

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ARABIC SUMMERY

سمية أوراق نبات القلقاس، كولوكاسيا إسكولنتا، ضد الصرصور الألماني، بلاتيلا جيرمانيكا

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تم قياس سمية أوراق نبات القلقاس، كولوكاسيا إسكولانتا، على ذكور وإناث الصراصير الألمانية، بلاتيلا جرمانيكا، تحت ظروف المختبر في مدينة بينها، مصر. وأظهرت القياسات الحيوية أن لمستخلصات الإيثانول والأثير البترولي تأثير سمي على الحشرات المختبرة ونسبة الوفيات للذكور والإناث. وأشارت قيم LC_{50} إلى أن الذكور أكثر حساسية للمستخلصات من الإناث وكان مستخلص الإيثانول أكثر سمية من مستخلص الأثير البترولي. وبلغت قيم ال LC_{50} بعد ٤٨ ساعة من المعالجة بمستخلص الإيثانول ٢.٤٢ و ٤.٠٠١٪ للذكور والإناث المعاملة على التوالي، في حين بلغت قيم ال LC_{50} بعد ٤٨ ساعة من المعالجة بمستخلص الأثير البترولي ٤.٤٢ و ٥.٤٦٪ للذكور والإناث المعاملة على التوالي.