# Effect of plant extracts on biochemical components of cabbage leaf webber, *Crocidolomia binotalis* Zeller

**C. Vijayaraghavan, C. Sivakumar, Zadda kavitha and P. Sivasubramanian**

**ABSTRACT**

The extracts of *Strychnos, Vitex, Lippia* and NSP 60 EC possess insecticidal properties. The impact of these extracts on protein, carbohydrate and lipid contents of the leaf webber larva was studied. Among the botanicals tested, the highest reduction of protein content (59.78 %) of the larvae was caused by NSP 60 EC and the lowest reduction was caused by *Strychnos* (10.25 %). *Lippia* and *Vitex* extracts reduced the carbohydrate content of the larvae by 93.38 per cent. *Lippia* extract caused 91.05 per cent reduction in lipid content however, NSP 60 EC increased the lipid content by 25.79 per cent.

**Key words:** Protein, carbohydrate, lipid contents, *Crocodolomia binotalis*, crop pest

## INTRODUCTION

Plant-derived extracts and phytochemicals have long been a subject of research in an effort to develop alternatives to conventional insecticides but with reduced health and environmental impacts. Plant derived insecticides are reported to have the ability to influence the proportion of various biochemical components (carbohydrates, lipids, proteins etc.) in the body of insects, thus disturbing the internal metabolism of the insect, causing their reduced activity or mortality. Impact of *Azadirachta indica* (neem), *A. excelsa* (sentang), *Melia volkensii, M. azedarach* (Chinaberry) and *Trichilia americana*, (all belonging to the family Meliaceae) along with commercial botanical insecticides ryania, pyrethrum, rotenone and essential oils of rosemary and clove leaf on the cabbage looper, and armyworm (Akhtar *et al*., 2008). The extracts of nuxvomica or etti (*Strychnos nuxvomica* Linn) (Leganiaceae), chast tree or notchi (*Vitex negundo* Linn.) (Verbenaceae), lemon bush or poduthalai (*Lippia nodiflora* Burm.) (Verbenaceae), neem, *Azadirachta indica* A. Juss (Meliaceae), sweet-flag, *Acorus calamus* Linn. (Aeraceae), pungam, *Pongamia glabra* Vent (Fabaceae) possess highly odoriferous chemical compounds that possess insecticidal properties. As the cabbage leaf webber, *Crocidolomia binotalis* is one of the notorious pests of cabbage, cauliflower and other cole vegetables and causes potential yield loss, the present investigation was undertaken to study the impact of these extracts on protein, carbohydrate and lipid contents of the leaf webber larva.

## MATERIALS AND METHODS

### Culturing of Test insects

*C.binotalis* egg masses were collected from the cauliflower fields and kept in Petri plates for hatching. Neonate larvae were transferred with the help of fine camel hair brush to tender cauliflower leaves. The petioles of the leaves were inserted in to pet bottles containing water to prevent the drying up of the leaves. Grownup larvae were transferred to plastic buckets, in which the cabbage leaves were kept and covered with muslin cloth. Food material (leaves) was changed once in two days for early instars and daily for late instars. Sterilized fine soil was provided to the last instar larvae for facilitating pupation. After the formation of pupae, they were transferred to adult emergence cage. Ten per cent sugar solution was served as adult food and fresh cauliflower leaves were provided for egg laying. Eggs with leaf were kept in Petri plates for hatching and the above procedure was continued for culturing the test insects.

### Extraction and formulation of botanicals

Seeds of neem, Strychnos and pungam, leaves of *Lippia* and rhizomes of sweet-flag were collected from local market and leaves of Vitex were collected from Thondamuthur village, Coimbatore, Tamil Nadu, India. The extracts of neem seed kernels (N), pungam (P) and *Strychnos* and rhizomes of sweet-flag (S) and leaf extracts of *Lippia* and *Vitex* were prepared using methanol as solvent. Seed kernels or rhizomes were ground to fine powder in pulverizer. One hundred gram of seed kernels or rhizomes or leaf powder was stirred with 500ml methanol for 3 hours using magnetic stirrer and filtered through Whatman No. 1 filter paper. The content was mixed with 500ml of methanol in a distillation unit at 50°C under reduced pressure. NSP 60 EC was formulated by mixing 1:1:1 ratio of neem, sweet-flag, and pungam extracts along with soap oil as emulsifier.

**Bioassay**

Cauliflower leaves were dipped in 1 per cent plant extracts for about 30 seconds. Excess plant extract was drained, leaves were shade dried and transferred in to plastic containers. The pre-starved third instar larvae were released in to the container and five replications were maintained for each treatment. After 36 hours of feeding, animals were sacrificed, total body protein (Lowry *et al.*, 1951), carbohydrate (Crompton and Brit, 1967) and lipid (Folch *et al.*, 1957) were estimated both in experimental and control categories. Leaves dipped in distilled water severed as control.

**RESULTS AND DISCUSSION**

**Protein content**

The total protein content was high in untreated larvae (2.73 µg/mg) when compared with the larvae treated with plant extracts (Table1). Among the tested plant extracts, NSP 60EC was found to be effective in reducing the protein content of larvae and per cent decrease of protein in this treatment was 59.78 followed by *Vitex, Lippia* and *Styrnchos*. All the plant extracts significantly reduced the total protein content of the larval body. Reduction of protein content in *C. binotalis* might be due to the toxic principles present in the plant extracts. Similar results were reported by Ramakoteswara Rao *et al*. (1995) in *Spodoptera litura*. The protein content in an insect is dependant upon its synthesis, breakdown, water movement between tissues and haemolymph. The reduction in protein content in larvae was attributed to any one or combination of factors like reduction in synthesis of proteins or increase of breakdown of proteins to detoxify the active principles present in the plant extracts. The documentation of quantitative reduction of total proteins by annona seed extracts in *Dysdercus koenigi* Fab. (Bhagawan *et al.*, 1992) and by carrot seed extract in *Euproctis fraterna* (Moore.) (Chokkalingam *et al.*, 1987) are in concurrence with the present results. The higher metabolic energy used in detoxifying the toxic principles of neem, *Vitex, Lippia, Strynchnos*, sweetflag, pungam and usage of lesser proportions of digested food in the synthesis of protein, might also be the reasons for the reduction of total protein content in the treated larvae. The findings of Chitra and Ramakoteswara Rao (1996) and Vijayaraghavan and Chitra (2002) are in agreement with our results. Brisca Renuga and Sahayaraj (2009) also reported that the total head protein of *Spodoptera litura* was reduced due to the application of *Ageratum conyzoides* and *Ageratum vulgaris* extracts. Animals require high energy under stress conditions and the energy demand may have led to the protein catabolism. The decrease in protein content might also be due to the mechanism of lipoprotein formation, which will be used to repair damaged cells and tissue organelles. Reduction in total protein content due to the botanicals might also be due to their insecticidal properties. Similar trend was observed with chemical insecticides in the experiments conducted by Bashyia and Hazarika (1996) in *Dicladispa armigera,* treated with methoprene and diflubenzuran, by Verma and Nath (1995) in *Spodoptera litura* treated with carbamates and by Olga Sak *et al.* (2006) in *Pimpla turionellae* (L.) treated with cypermethrin.

**Table 1.** Effect of plant extracts on protein, carbohydrate and lipid contents of *C.binotalis*

| Treatment | Protein (µg/mg) | Carbo-hydrate (µg/mg) | Lipid (µg/mg) |
|---|---|---|---|
| Control | 2.73(1.65)[a] | 0.12(0.35)[a] | 2.46(1.57)[b] |
| NSP 60 EC | 1.10(1.05)[d] | 0.06(0.24)[b] | 3.31(1.82)[a] |
| Lippia Extract | 2.43(1.56)[b] | 0.01(0.10)[c] | 0.22(0.47)[e] |
| Vitex Extract | 2.08(1.44)[c] | 0.01(0.10)[c] | 1.82(1.35)[c] |
| Strychnos Extract | 2.45(1.57)[b] | 0.06(0.24)[b] | 1.27(1.13)[d] |

Means followed by same letter(s) are not significantly different by DMRT (P=0.05); Figures in parentheses are transformed values.

**Carbohydrate content**

The carbohydrate content of the untreated larvae was 0.12 µg/mg. The amount of carbohydrates was drastically reduced in the treated larvae and 93.38 per cent reduction was observed in the larvae treated with *Lippia* and *Vitex* extracts. NSP 60EC and strychnos extracts reduced the carbohydrate content by 50.00 per cent than control. The plant extracts tested in the present investigation had considerably reduced the carbohydrate content of the cabbage leaf webber larvae. The carbohydrate level was drastically reduced in *Lippia* and *Vitex* extracts treated larvae. NSP 60 EC registered the lowest reduction while; the carbohydrate level in the strychnos treatment recorded 51.24 per cent reduction over control. Under stress conditions, more sugars might be metabolized to meet out the energy expenses. This could be the reason for the carbohydrate level depletion in the treated insects. Similar results were obtained by Seyoum *et al.* (2002) in desert locust and by Abdul Razak and Sivasubramanian (2007) in *Chelomenus sexmaculata* Fabricius and *Chrysoperla carnea* Stephens.

**Lipid content**

Among the plant extracts tested, lippia extract was effective in reducing the lipid content of the treated larvae as it

recorded 91.05 per cent reduction and the lipid content was 0.22 µg/mg as against 2.46 µg/mg in the untreated larvae (Table1). This treatment was followed by strychnos plant extract and it recorded 1.27 µg/mg of lipid content and 48.55 per cent reduction of lipid content over control. *Vitex* extract was found to be effective in reducing the lipid content of the larvae and it recorded 26.15 per cent reduction. Reduction of lipid levels in the larvae treated with plant extracts in the present study may be due to their effect on lipid metabolism and due to the utilization of these lipid reserves for energy generation as a result of induced stress (Sancho *et al.*, 1998 and Olga sak *et al*., 2006).

**REFERENCES**


Abdul Razak,T. and Sivasubramanian, P. 2007. Effects of three botanical oils on carbhohydrate content in *Cheilomenes sexmaculata* Fabricius and *Chrysoperla carnea* Stephens. *Asian journal of Biochemistry,* **2**(2): 124-129.

Bashiya, R. L and Hazarika, L. K. 1996. Effect of methoprene and diflubenzuron on water, lipid, protein and chitin content of *Dicladispa armigera*. *Entomon,* **21**: 7-11.

Bhagwan, C. N., Reddy, K. D. and Sukumar, K. 1992. Effect of annona seed extract on protein on protein metabolism and development in red cotton bug *Dystdercus koenigii*. *Indian Journal of Experimental Biology,* **30**: 908.

Brisca Renuga, F. and Sahayaraj, K. 2009. Influence of botanicals in total head protein of *Spodoptera litura* (Fab.). *Journal of Biopesticides*, **2**(1): 52-55.

Chitra, K. C. and Ramakoteswara Rao. 1996. Effect of certain plant extracts on the consumption and utilization of food by *Spodoptera litura* (Fab.). *Journal of Insect Science*, **9**: 55-58.

Chockalingam, S., Nalini Sundari M. S. S. and Thenmozhi, S. 1987. Prceedings of symposium Alternatives to synthetic insecticides CRMF, Madurai 99 **PP.**

Crompton, M. and Brit, L. M. 1967. Changes in the amount of phosphogen and related compounds during the metomorphosis of blow fly *Lucia cuprina*. *Journal of Insect Physiology,* **13**: 1575-1592

Folch, J., Lees, M. and Solance-Stanley, G. H. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry,* **226**:497-507.

Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J. 1951. Protein measurement with the folin phenol reagent. *Journal of Biological Chemistry*, **193**:265-275.

Olga sak., Fevizi Uckan and Ekrem Ergin 2006. Effects of Cypermethrin on total body weight, glycogen, protein, and lipid contents of Pimpla turionellae (L.) (Hymenoptera:Ichneumonidae). *Belgian Journal of Zoology,* **136**(1): 53-58

Ramakoteswara Rao, S., Chitra, K. C. and Kameswara Rao, P. 1995. Studies on the effects of certain plant extracts on the protein metabolism of *Spodoptera litura* (Fabr.). *Indian Journal of Entomology,* **57**(4) : 406-408.

Sancho, E., Ferrando, M. D., Fernandez, C. and Andreu, E. 1998. Liver energy metobolism of *Anguilla anguilla* after exposure to fenitrothion. *Ecotoxicology Environmental Safety,* **41**:168-175.

Seyoum, E., Bateman, R. P. and Charnley, A. K. 2002. The effect of *Metarhizium anisopliae* var *acridum* on haemolymph energy reserves and flight capability in the desert locust, *Schistocerca gregaria*. *Journal Applied Entomology,* **126**: 119-124.

Verma, A. and Nath, G. 1995. Toxicity of carbaryl on haemolymph protein of late larvae and pharate pupae of *Spodoptera litura* Fab. *Indian Journal of Entomology,* **57**: 83-88

Vijayaraghavan,C. and Chitra, K. C. 2002. Total protein and free amino acid content of *Spodoptera litura* (Fabr.) due to botanicals and conventional insecticides. *Indian Journal of Entomology,* **64:** 92-95.


---


**C.Vijayaraghavan*, C. Sivakumar, Zadda kavitha and P. Sivasubramanian**

Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu, India.

*Krish Vigyan Kendra, Costal Saline Research Centre, Ramanathapuram - 623 503, Tamil Nadu, India, Phone: 04567-230250, E-mail: vijayraghavanento@yahoo.co.in