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Biochemical changes in the leaves of brinjal (*Solanum melongena* L) infected with ladybird beetle, *Epilachna vigintioctopunctata*

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Abstract

Brinjal (*Solanum melongena* L) belongs to the family Solanaceae is having considerable importance as a vegetable crop in South East Asia and South Asia. Some of the local names of brinjal in different native languages across the globe are Aubergine, Baingan, Egg plant, Garden egg, Guinea squash, Melongene. In India subcontinent brinjal were cultivated since last 40 centuries. The present study was taken to determine the biochemical changes in the brinjal plant leaves infected with *Epilachna* beetle (*Epilachna vigintioctopunctata*). The changes in the biochemical constituents like chlorophyll content, proteins, carbohydrates, phenols, carotenoids, anthocyanins were analysed. The chlorophyll a, chlorophyll b and total chlorophyll content in uninfected leaf were 0.082 mg/g, 0.136 mg/g and 0.536 mg/g respectively however these chlorophyll substance were decreased in *Epilachna* infected brinjal leaves were 0.012 mg/g, 0.01 mg/g and 0.025 mg/g respectively. The amount of carbohydrate content in uninfected brinjal leaves was 0.174 mg/g which was diminished to 0.148 mg/g in the infected brinjal leaves. Protein content in the leaves of brinjal infected with *Epilachna* beetle (0.20 mg/g) was reduced than in the leaves of uninfected brinjal leaves (0.22 mg/g). There is a decrease in total phenols content in the *Epilachna* infected leaves (0.028mg/g) than the uninfected leaves (0.07mg/g). There is a significant decrease in the carotenoids content in *Epilachna* infected brinjal leaves (0.245 mg/g) than in uninfected healthy brinjal leaves (0.345 mg/g). There is a reduction in anthocyanin content in *epilachna* infected leaves (0.207mg/g) than in uninfected brinjal leaves (0.224mg/g).

Keywords: Brinjal, *Epilachna vigintioctopunctata*, biochemical changes, chlorophylls, carbohydrates, proteins, phenols, anthocyanins, carotenoids

Introduction

Brinjal (*Solanum melongena* L) belongs to the family Solanaceae have considerable importance as a vegetable crop in South East Asia and South Asia. Some of the local names of brinjal in different native languages across the globe are Aubergine, Baingan, Egg plant, Garden egg, Guinea squash, Melongene. In India subcontinent brinjal were cultivated since last 40 centuries. China is at the top in brinjal production followed by India and Iran throughout the world. Brinjal also have some medicinal importance like high potassium contents and low calories made it useful for hypertensive, obese and diabetes patients [1].

There are several constraints in brinjal production which are responsible for reduction in yield. Insect pest is one of the most important factor among them. Brinjal crop had been damaged by one hundred forty (140) species of insect pests at different stages of the crop growth [2]. *Epilachna* beetle (*Epilachna vigintioctopunctata*; Coleoptera: Coccinellidae), locally known as hadda beetle is also one of the most destructive pests extensively found all over India and in other countries [3]. It is a polyphagous pest which illustrate its existence on brinjal and other economically important solanaceous and cucurbitaceous crops. It is highly destructive at both, adult and larval stages which feed on the epidermal tissues of leaves, flowers, and fruits by scrapping the chlorophyll content and cause a big yield loss [4]. The adult beetle and its larvae feeds on the epidermal tissues of leaves, fruits of solanaceous plants [11]. The grubs and adults with chewing type of mouthparts scrap the chlorophyll of the epidermal layers of leaves resulting in typical ladder-like windows [12]. External manifestations of disease symptoms are the results of altered host metabolism. The extent of crop loss is mainly associated with severity of visible symptoms [5]. No such reports are available on biochemical changes in brinjal leaves infected with *Epilachna* beetle. Therefore, the present study was undertaken to determine changes in chlorophyll content, proteins, phenols, carbohydrates, anthocyanin and

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carotenoids in brinjal leaves due to infection of *Epilachna vigintioctopunctata*.

Materials and Methods

Biochemical studies:

Source of plant material:

The samples for analysis were taken from healthy and naturally infected with *Epilachna* beetle at Brinjal fields of Meenampatti, Sivakasi.

Estimation of chlorophyll

Chlorophyll a, chlorophyll b and total chlorophyll were estimated by using the following formulae (Arnon, 1949).

Chlorophyll a (mg g⁻¹ tissue) = [12.7 (A663) - 2.69 (A645)] × V/ 1000 × W

Chlorophyll b (mg g⁻¹ tissue) = [22.9 (A645) - 4.68 (A663)] × V/ 1000 × W

Total Chlorophyll (mg g⁻¹ tissue) = [20.2 (A645) +8.02 (A663)]x V/1000 x W

Where,

A = Optical density at respective wave length (nm)

V = Final volume of chlorophyll extract in 80% acetone

W = Fresh weight of the tissue extracted

Estimation of carbohydrates

Carbohydrates estimation was carried by using Anthrone method

Estimation of total protein

Total Protein estimation was carried out according to the procedure described by the Lowry *et al.*, (1951)

Estimation of total phenols

Total phenol estimation was carried out according to the Folin and Ciocalteu (1927).

Estimation of anthocyanin

Anthocyanin estimation was carried out according to the procedure described by the Murrey and Hackett (1991)

Estimation of carotenoids

Carotenoids estimation was carried out according to the procedure described by the Nagala & Yamashita (1992)

Results and Discussion

The damages caused by the *Epilachna* beetle was monitored. It is highly destructive at both, adult and larval stages which feed on the epidermal tissues of leaves, flowers, and fruits by scrapping the chlorophyll content and cause a big yield loss (Fig 1).

Biochemical studies

The chlorophyll content was reduced in infected brinjal leaves than uninfected leaves. The chlorophyll a, chlorophyll b and total chlorophyll content in uninfected leaf were 0.082 mg/g, 0.136 mg/g and 0.536 mg/g respectively however these chlorophyll substance were decreased in *Epilachna* infected brinjal leaves were 0.012 mg/g, 0.01 mg/g and 0.025 mg/g respectively (Table 1). Chlorophyll pigments are necessary in the plants for the manufacture of carbohydrates which form the basis of all foods for both plants and animals, which enter into the composition of all plant tissues. It is for this reason that chlorophyll pigments are regarded among the most

important chemical substances in nature. Decrease in chlorophyll content in infected leaves was due to chlorosis and necrosis of diseased plant parts especially leaves. Similar results were also obtained [6] in the leaves of *Capsicum annum* infected with Gemini virus [7], observed destruction of chlorophyll a, chlorophyll b and total chlorophyll in case of fungal infection in mulberry plants.

Carbohydrate content in the leaves of brinjal infected with *Epilachna* beetle was reduced than in the leaves of uninfected brinjal leaves. The amount of carbohydrate content in uninfected brinjal leaves was 0.174 mg/g which was diminished to 0.148 mg/g in the infected brinjal leaves (Table 1). [7] reported the similar outcome in mulberry leaves infected with fungi. The reduction in carbohydrate content is due to the utilization of starch by fungi. Comparable outcomes were gotten via [8] in fungus infected peanut plants, they reported that in the infected peanut plants starch contents is reduced than in the uninfected peanut plants. This may be due to the increased utilization of starch by the fungi and also due to the disruption in carbohydrate metabolism.

Protein content in the leaves of brinjal infected with *Epilachna* beetle (0.20 mg/ g) was reduced than in the leaves of uninfected brinjal leaves (0.22 mg/ g) (Table 1). This is may be due to the interruption in protein metabolism. Similar results were observed by [7] in the fungus infected mulberry leaves. They reported a significant decrease in biochemical contents carbohydrate, proteins, chlorophyll a, chlorophyll b and total chlorophyll content in the fungus infected mulberry leaves than in the uninfected mulberry leaves.

There is a decrease in total phenols content in the *Epilachna* infected leaves(0.028mg/g) than the uninfected leaves(0.07mg/g) (Table 1). Phenolics are well-known antimicrobial compounds occurring in plants and function as precursors to structural polymers such as lignin, or serve as signal molecules to activate plant defense genes [9]. A possible explanation for decrease in phenolic compounds in diseased plants of most genotypes is that many plant pathogens actively suppress the expression of plant defense reactions during successful infection [10, 8] reported the concentration of soluble phenolics was significantly lower in pea plants infected with fungus.

There is a significant decrease in the carotenoids content in *Epilachna* infected brinjal leaves (0.245 mg/g) than in uninfected healthy brinjal leaves (0.345 mg/g) (Table 1). Carotenoids are yellow, orange, or red pigments synthesized by many plants, fungi and bacteria. In plants, carotenoids can occur in roots, stems, leaves, flowers, and fruits. Carotenoids have two important functions in plants. First, they can contribute to photosynthesis. Second, they can protect plants which are over-exposed to sunlight. The reduction in carotenoids content leads to reduction in photosynthesis. The *epilachna* beetle infection disrupts photosynthesis, the reduction in photosynthesis leads to reduction in carotenoids.

There is a reduction in anthocyanin content in *epilachna* infected leaves (0.207mg/g) than in uninfected brinjal leaves (0.224mg/g) (Table 1). Anthocyanin is the water soluble vacuolar pigment. It have protective role in plants against temperature. Protect plants against cold stress with anthocyanins countering reactive oxygen species, leading to lower rate of cell death in leaves. Above results reveal that the biochemical contents in the *epilachna* infected brinjal leaves were reduced than in the uninfected healthy brinjal leaves.

Table 1: Biochemical changes in the leaves of Brinjal infected with the insect pest, *Epilachna vigintioctopunctata*

Biochemical Parameten	Concentration of various biochemical compound (mg/g of fresh weight of tissue) in healthy and infected Brinjal leaves	
	Healthy leaf / uninfected leaf	Infected leaf
Chlorophyll a	0.082	0.012
Chlorophyll b	0.136	0.01
Total chlorophyll	0.536	0.025
Carbohydrates	0.174	0.148
Protein	0.22	0.20
Phenol	0.07	0.028
Carotenoida	0.345	0.245
Anthrocyanin	0.224	0.207

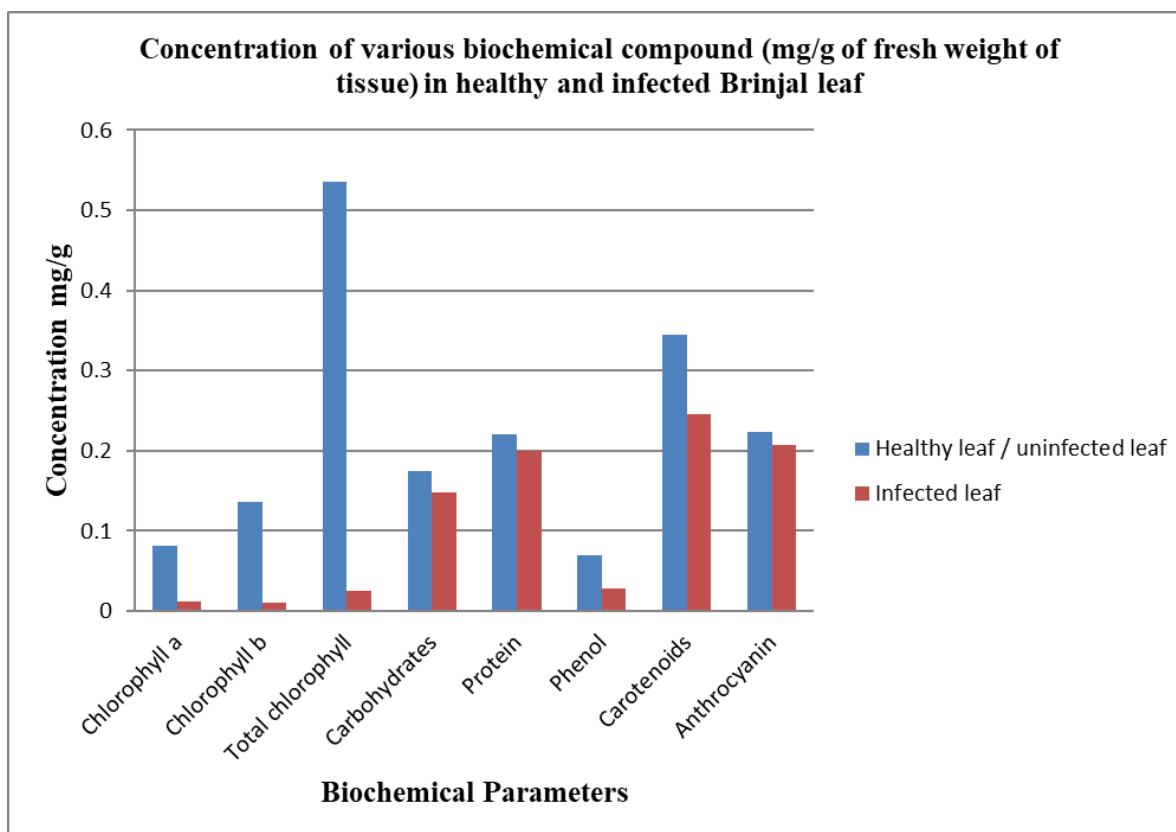


Fig 1: Concentration of various biochemical compound (mg/g of fresh weight of tissue) in healthy and infected Brinjal leaf



Fig 1: Damages caused by *Epilachna* beetle on Brinjal leaves.

Conclusion

The analyzed biochemical markers confirm that the ladybird beetle, *Epilachna vigintioctopunctata* induces biochemical changes in the biochemical status of the infected plants, which are detectable with observable symptoms. These biochemical

changes include reduction in the concentration of various biochemical contents like chlorophyll a, chlorophyll b, total chlorophyll, carbohydrates, proteins, phenols, carotenoids, anthrocyanins in the infected leaves than in the uninfected leaves.

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