



# VARIATION OF TOTAL PHENOLIC CONTENT IN THE LEAVES OF FIVE DIFFERENT HOST PLANTS AND ITS INFLUENCE ON THE NUTRITIONAL INDICES OF *SPODOPTERA LITURA* (*LEPIDOPTERA: NOCTUIDAE*) LARVAE.

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**Abstract:** Secondary metabolites in plants, particularly phenolic compounds, serve as intrinsic chemical barriers against herbivores and pathogens. This study investigates the influence of total phenolic compounds on the nutritional indices of *Spodoptera litura* larvae at different developmental stages. Leaves from five host plants (*Ricinus communis*, *Colocasia esculenta*, *Carica papaya*, *Musa acuminata*, and *Ipomoea batatas*) were analyzed for their total phenolic content using the Folin-Ciocalteu method. Significant differences in phenolic content were observed, with *R. communis* having the highest content. The phenolic compounds affected the larvae's growth and consumption rates, indicating their crucial role in plant-insect interactions.

**Index Terms -** *Spodoptera litura*, phenolic content, host plants, nutritional indices.

## 1.INTRODUCTION

Plants have evolved various defense mechanisms against herbivorous insects, including the production of secondary metabolites like phenolic compounds. These compounds protect plants from herbivores and pathogens, contributing to their evolutionary success (Harborne, 1998). Phenolics are structurally different, broadly distributed natural compounds in plants and more than 2000 different compounds are reported occurring both in the free state or in the form of glycosides (Mukerjee, 2002). Based on the number of carbon atoms phenolic compounds are classified into various groups. The important general categories are flavones, isoflavones, flavonones, anthocyanidins and flavanols. Among the secondary metabolites phenolic compounds are pervasive in plants which are characterized by the presence of an aromatic ring bearing one or more hydroxyl groups (Parr and Bolwell, 2000). Some phenolic compounds isolated from the plants produce alterations in the insect behaviour and physiology. Insects, in turn, have developed sophisticated detoxification mechanisms to counter these chemical defenses (Zheng & Wang, 2001). This study aims to investigate the effects of total phenolic compounds on the nutritional indices of *Spodoptera litura* larvae at different developmental stages, enhancing our understanding of plant-herbivore interactions.

## 2. MATERIALS AND METHODS

Plant Material: Leaves from selected host plants (*Ricinus communis*, *Colocasia esculenta*, *Carica papaya*, *Musa acuminata*, and *Ipomoea batatas*) were collected from areas near Malabar Christian College, Calicut.

### 2.1. Quantitative Estimation of Total Phenolic Content in Leaf Tissue

Total phenol content was estimated using the Folin-Ciocalteu reagent (Malik & Singh, 1980) with catechol as the standard.

#### 2.1.2. Sample Extraction

Approximately 0.5 to 1.0 g of leaf tissue was ground in 80% ethanol. The homogenate was centrifuged at 10,000 rpm for 20 minutes. The supernatant was collected, and the residue was re-extracted with 80% ethanol. The combined supernatants were evaporated to dryness, and the residue was dissolved in 5 ml of distilled water.

### 2.3. Food Consumption and Utilization

#### (i) Insect Rearing and Experimental Setup

Newly molted sixth instar larvae of *Spodoptera litura* were selected for this study. The larvae were previously reared on each of the five selected host plant species: *Ricinus communis* (castor), *Colocasia esculenta* (taro), *Carica papaya* (papaya), *Musa acuminata* (banana), and *Ipomoea batatas* (sweet potato). Larvae of approximately similar size were chosen and starved for 3 hours prior to the experiment.

#### (ii) Experimental Design

For each host plant, twenty larvae were used and divided into two groups of ten each: a control group and a test group.

#### Control Group

Ten larvae and ten fresh leaf bits of the host plant were individually weighed and marked.

The larvae and leaf bits were then dried in an oven at 80°C and reweighed to obtain the dry weights.

#### Test Group

Ten larvae and ten leaf bits were individually weighed and marked. Each larva was provided with one marked leaf bit for a feeding period of 24 hours. After the feeding period, the larvae were starved for an additional 6 hours to allow for defecation. The larvae, leaf tissues, and faeces in each container were then weighed and dried in an oven at 80°C. The dried weights of the larvae, leaf tissues, and faeces were recorded.

#### 2.3.1. Calculation of Food Utilization Rates

Food utilization rates were calculated using the formulas provided by Waldbauer (1968). The following indices were measured

$$\text{Relative growth rate} = (D-C)/((C+D)/2) \text{-----}[1]$$

$$\text{Relative consumption rate} = (A-B)/((C+D)/2) \text{-----}[2]$$

$$\% \text{ Efficiency of conversion of ingested food} = (D-C)/(A-B) \times 100 \text{-----}[3]$$

$$\% \text{ Efficiency of conversion of digested food} = (D-C)/(A-B-E) \times 100 \text{-----}[4]$$

Approximate digestibility =  $(A-B-E)/AB \times 100$ -----[5]

where A is the weight of dried leaf tissues in the control, B is the weight of the dried leaf tissue in each test, C is the weight of dried larvae in the control, D is the weight of dried larvae in each test, and E is the weight of dried faeces in each test.

#### 2.4. Statistical Analysis

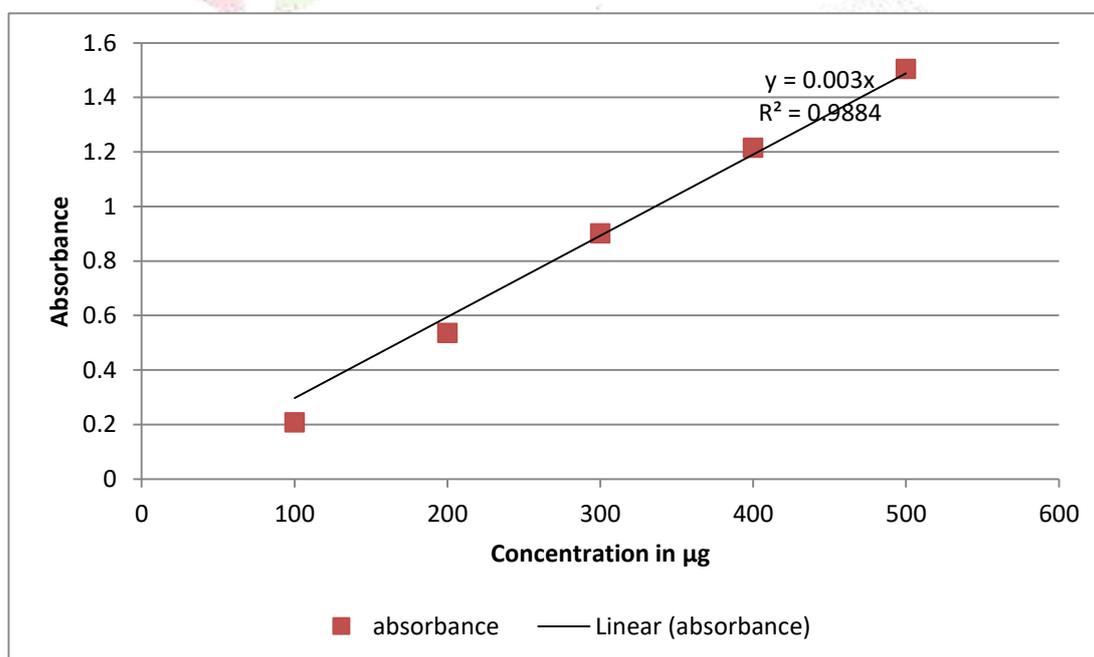
Data were analyzed using one-way ANOVA and post hoc tests (Scheffe test) with SPSS16. Results with  $p < 0.05$  were considered statistically significant.

### 3. RESULTS

The total phenolic content of selected host plant leaf extracts is presented in Table 1 and Figure 1. The phenolic content ranged from  $3.37 \pm 0.12$  mg GAE/g in *M. acuminata* to  $30.83 \pm 1.53$  mg GAE/g in *R. communis*. The calibration curve for gallic acid showed linearity with a correlation coefficient ( $R^2$ ) of 0.988.

**Table 1: Variation of total phenolic content in the leaves of selected host plants**

| Plant                                 | Mean±SD    | $R^2$ |
|---------------------------------------|------------|-------|
| <i>Carica papaya</i> L (papaya)       | 6.73±0.06  | 0.988 |
| <i>Ricinus communis</i> L (Castor)    | 30.83±1.53 |       |
| <i>Ipomoea batatas</i> (sweet potato) | 7.53±0.06  |       |
| <i>Musa acuminata colla</i> (banana)  | 3.37±0.12  |       |
| <i>Colocasia esculenta</i> (L.)       | 8.13±0.06  |       |



**Figure1: Standard calibration curve of gallic acid.**

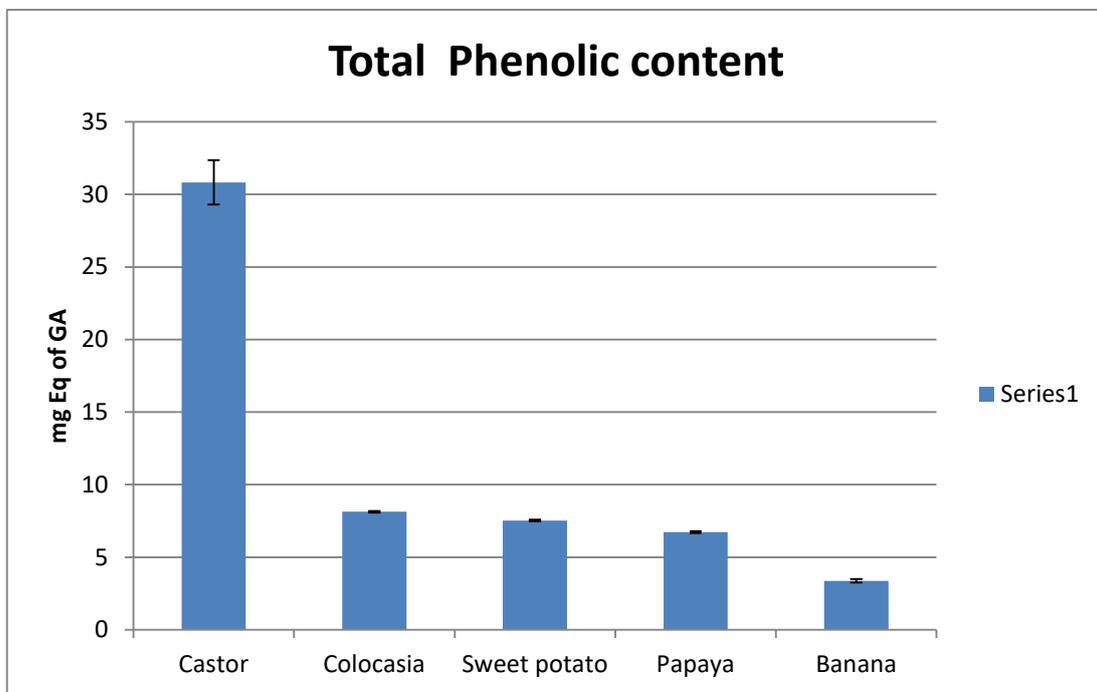
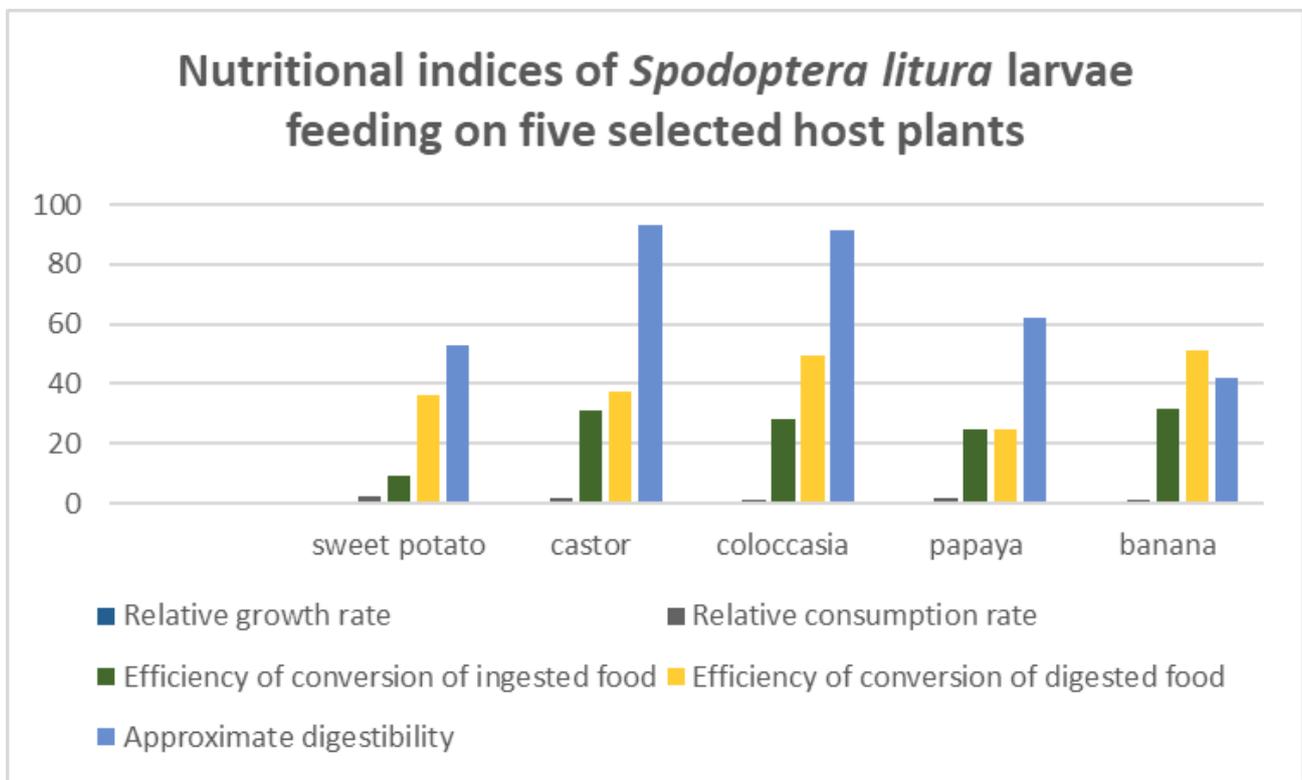


Fig.1. Variation in total phenolic content in the leaves of selected host plants.

Table 2: Nutritional indices of *Spodoptera litura* larvae feeding on five selected host plants

| CATEGORY                                  | Rate $\pm$ SE       |                     |                     |                     |                     | F       | P     |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------|-------|
|   | Sweet potato        | Castor              | Colocasia           | Papaya              | Banana              |         |       |
| Relative growth rate                      | 0.157<br>$\pm$ 0.02 | 0.335<br>$\pm$ 0.01 | 0.292<br>$\pm$ 0.03 | 0.251<br>$\pm$ 0.02 | 0.169<br>$\pm$ 0.01 | 11.069  | 0.000 |
| Relative consumption rate                 | 2.53 $\pm$ 0.17     | 1.97 $\pm$ 0.07     | 1.37 $\pm$ 0.10     | 1.44 $\pm$ 0.12     | 1.19 $\pm$ 0.03     | 24.020  | 0.000 |
| Efficiency of conversion of ingested food | 8.91 $\pm$ 0.26     | 30.9 $\pm$ 0.62     | 28.2 $\pm$ 0.35     | 24.6 $\pm$ 0.39     | 31.8<br>$\pm$ 1.15  | 174.498 | 0.000 |
| Efficiency of conversion of digested food | 36.1<br>$\pm$ 0.80  | 37.52<br>$\pm$ 2.11 | 49.46 $\pm$ 1.22    | 24.50 $\pm$ 1.37    | 51.22<br>$\pm$ 1.60 | 166.255 | 0.000 |
| Approximate digestibility                 | 52.91<br>$\pm$ 1.12 | 93.31<br>$\pm$ 0.75 | 91.53<br>$\pm$ 0.34 | 62.02<br>$\pm$ 1.85 | 41.80 $\pm$<br>2.05 | 279.901 | 0.000 |



**Figure 3: Nutritional indices of *Spodoptera litura* larvae feeding on five selected host plants.**

#### 4. DISCUSSION

Phenolic compounds are known for their antioxidant properties and ability to neutralize free radicals (Orcic et al., 2011). This study recorded significant differences in total phenolic content among methanolic extracts of different host plant leaves. The highest phenolic content was observed in castor leaves, while the lowest was found in banana leaves. Environmental factors and experimental conditions can influence the phenolic content in plants (Jain et al., 2011). Phenolic compounds such as monoterpenoids, sesquiterpenoids, quercetin, epicatechin, ellagic acid, genticic acid, gallic acid, and rutin have been identified in *R. communis* (Darmanin et al., 2009), while *I. batatas* leaves are rich in caffeoylquinic acid, anthocyanins, and beta-carotene (Islam et al., 2002; Komaki & Yamakawa, 2007).

Plant phenolic compounds have gained attention for their interactions with other organisms, particularly their effects on insect growth rates. Variations in phenolic content among different plants and even different parts of the same plant influence insect nutritional indices. In this study, phenolic compounds were found to have antinutritional effects on *S. litura* larvae, leading to reduced larval and pupal weight. Similar effects have been observed in other studies with different insect species (Kathuria & Kaushik, 2005; Mrdakovic et al., 2011).

The positive correlation between phenolic content and insect feeding suggests that despite the high phenolic content in castor leaves, *S. litura* larvae consume them more. This could be due to the presence of other nutrients or the larvae's adaptation to detoxify the phenolic compounds. Further research is needed to understand the mechanisms behind this interaction.

## 5. CONCLUSION

This study demonstrates that phenolic compounds in plant leaves significantly influence the nutritional indices of *Spodoptera litura* larvae. The findings highlight the complexity of plant-insect interactions and the role of phenolic compounds in plant defense. Despite the high phenolic content in *Ricinus communis* leaves, *S. litura* larvae exhibit higher feeding rates on these leaves, suggesting potential adaptive mechanisms or compensatory feeding strategies. These insights contribute to our understanding of the ecological dynamics between host plants and herbivores and can inform pest management strategies.

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