CHAPTER 4

RESULTS

The experimental findings and observations on the biochemical and immunological responses of Eri silkworm, *S. ricini* based on the host plants used for rearing are described under different subheadings as follows

4.1. Meteorological data

The district experiences a sub-tropical and humid climate with heavy rainfall and hot summer. The meteorological data were recorded during the entire study period and the maximum and minimum temperature, relative humidity, and rainfall were recorded. The result indicates the average value recorded which is as shown in Figure 4.1.

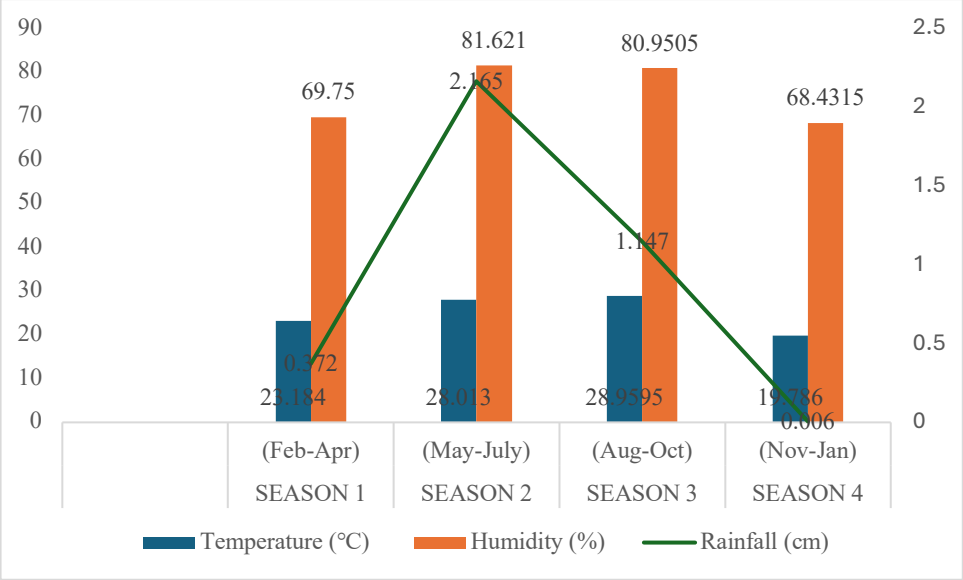

Figure 4.1: Meteorological data of different seasons

4.2. Evaluation of host plants

Literature and field survey was done to evaluate the types of host plants used by the eri rearers of the district. Out of all the host plants used by the farmers and based on the preferences and availability of the host plants in the study area, five host plants were selected, the photographs of which is presented in Plate 2. Herbarium specimen of the selected host plants were prepared by collecting the leaves which was dried and pasted

into herbarium sheets. The herbarium specimens were then submitted to the Department of Botany, Bodoland University for identification and authentication (Plate 3).

1. ***Ricinus communis*** **L. (Plate 3)**

Kingdom	: Plantae
Phylum	: Trachaeophyta
Class	: Magnoliopsida
Order	: Malpighiales
Family	: Euphorbiaceae
Genus	: *Ricinus*
Species	: *R. communis*
Vernacular name	: Castor
Accession no.	: BUBH0000869

2. ***Manihot esculenta*** **Crantz. (Plate 3)**

Kingdom	: Plantae
Phylum	: Trachaeophyta
Class	: Magnoliopsida
Order	: Malpighiales
Family	: Euphorbiaceae
Genus	: *Manihot*
Species	: *M. esculenta*
Vernacular name	: Tapioca
Accession no.	: BUBH0000870

3. ***Gmelina arborea*** **Roxb. (Plate 3)**

Kingdom	: Plantae
Phylum	: Trachaeophyta
Class	: Magnoliopsida
Order	: Lamiales
Family	: Lamiaceae
Genus	: *Gmelina*
Species	: *G. arborea*
Vernacular name	: Gamari
Accession no.	: BUBH0000871

4. *Heteropanax fragrans* Schott. (Plate 3)

Kingdom	: Plantae
Phylum	: Trachaeophyta
Class	: Equisetopsida
Order	: Apiales
Family	: Araliaceae
Genus	: *Heteropanax*
Species	: *H. fragrans*
Vernacular name	: Kesseru
Accession no.	: BUBH0000872

5. *Carica papaya* L. (Plate 3)

Kingdom	: Plantae
Phylum	: Trachaeophyta
Class	: Magnoliopsida
Order	: Brassicales
Family	: Caricaceae
Genus	: *Carica*
Species	: *C. papaya*
Vernacular name	: Papaya
Accession no.	: BUBH0000873

4.3. Study on the total hemocyte count of *S. ricini* fed on different host plants

The total haemocyte count of the haemolymph of *S. ricini* was done and the result obtained is presented in Table 4.1. The highest number of haemocytes (2280±32.66 cells/mm^3) was recorded in *S. ricini* fed using *R. communis* leaves (Sample C) followed by *S. ricini* fed using *M. esculenta* (Sample T) while the least haemocyte count (893.33±48.89 cells/mm^3) was recorded in silkworms fed with *C. papaya* leaves (Sample P).

Table 4.1: Total hemocyte count of *S. ricini* fed on different host plants

SAMPLE	TOTAL HEMOCYTE COUNT (cells/mm^3)
C	2280±32.66
T	1520±32.66
G	1106.67±18.86
K	1506.67±67.99
P	893.33±49.89

Data are presented as mean ± SD

4.4. Study on the differential haemocyte count of the hemolymph of *S. ricini* fed on different host plants

The data obtained from differential haemocyte count (DHC) is presented in Table 4.2. The haemocytes in Sample C consisted of highest number of Plasmatocytes (PL), followed by Granulocytes (GR), Spherulocytes (SP), Prohaemocytes (PR), and least number of Oenocytes (OE). Similar trend was also observed Sample G with maximum Plasmatocytes and least number of Oenocytes while in Sample K, Sample T and Sample P, the most abundant haemocyte was recorded to be Granulocytes followed by Plasmatocytes, Spherulocytes, Prohaemocytes, and least number of Oenocytes.

Table 4.2: Differential haemocyte count (DHC) of *S. ricini* fed on different host plants

SAMPLE	DIFFERENTIAL HEMOCYTE COUNT (%)				
	Plasmatocytes (PL)	**Granulocyte (GR)**	**Oenocyte (OE)**	**Prohaemocyte (PR)**	**Spherulocyte (SP)**
C	34±1.40	33±0.70	4.33±0.40	18.33±1.08	19.67±2.85
T	30.66±2.00	31±0.70	6.66 ± 1.08	18.66±0.40	19.33±1.08
G	31.66±1.77	27.66±0.40	3.66±1.63	16.66±0.40	17±0.70
K	29.66±1.60	30.66±0.40	3.33±0.81	18± 0.70	21±0.70
P	29.33±0.40	23.33±1.77	6.66±1.08	16.33±1.77	13.66±0.40

Data are presented as mean ± SD

The total number of plasmatocytes present in the haemolymph of *S. ricini* fed with different leaves ranged from the lowest (29.33±0.40%) in Sample P to highest (34±1.40%) in Sample C. The total number of granulocytes present in the silkworms fed with different leaves ranged from the lowest (23.33±1.77%) in Sample P to highest (33±0.70%) in Sample C. The total number of oenocytes present in the silkworms fed with different leaves ranged from the lowest (3.33±0.816%) in Sample K to highest (6.66±1.08%) in Sample P and Sample T. The total number of prohemocytes present in the silkworms fed with different leaves ranged from the lowest (16.33±1.77%) in Sample P to highest (18.66±0.40) in Sample T. Lastly, the total number of spherulocytes present

in the silkworms fed with different leaves ranged from the lowest (13.66±0.40%) in Sample P to highest (21±0.707%) in Sample K.

4.5. Study on the effect of host plants on biological and economic parameters of *S. ricini*

4.5.1. Larval duration (days)

The larval durations of the eri silkworm, *S. ricini* reared on different host plants are presented in Table 4.3. The larval duration of *S. ricini* ranged from 22±0.71 to 31.42±0.75 days during season 1 (S1), 21.25±0.83 to 30.08±1.51 days during season 2 (S2), 21.83±0.99 to 36.83±2.04 days during season 3 (S3) and 34.67±2.53 to 41.75±1.24 days during season 4 (S4). The shortest larval duration was observed in Sample C during S2, and the longest duration was observed in Sample P during S4. It was also observed that the larval duration was shortest during S2 for Sample C followed by Sample G, Sample K, and then Sample P, while the duration of the larvae of Sample T was found to be shortest during S1. The longest larval duration was observed during S4 for all Samples (C, T, G, K, P). Statistical analysis was done, and it was observed that the larval duration was significantly different within the sample reared using different host plants during different seasons. It was also found that the larval duration was significantly different during every season among different samples.

4.5.2. Pupal duration (days)

The pupal durations of *S. ricini* reared on different host plants are presented in Table 4.4. The pupal duration ranged from 11.42±0.76 to 14.33±1.03 days during S1, 11.08±0.76 to 15.25±0.92 days during S2, 12.5±0.65 to 17.66±1.03 days during S3 and 13.25±1.01 to 17.91±0.76 days during S4. The shortest pupal duration was observed in Sample C and the longest duration was observed in Sample P during S4. It was also observed that the pupal duration was shortest during S2 for all groups except Sample P which had the shortest pupal duration during S1. The longest larval duration was observed during S4 for all the Samples (C, T, G, K, P). Significant difference was observed in sample C, T, G, K, and P reared during different seasons. The seasonal difference was also observed among the different host plants.

Table 4.3: Larval duration of *S. ricini* fed on different host plants during different seasons

SAMPLE	LARVAL DURATION (day)				Plant vs. variable
	S1	S2	S3	S4	
C	22±0.71	21.25±0.83	21.83±0.99	34.67±2.53	*H=28.71
T	23.5±1.04	23.67±0.94	25.25±1.01	36.58±1.55	*H=33.42
G	27.83±1.14	26.5±1.71	26.92±1.38	40.58±1.93	*F=204.4 DF=3,44
K	24±1.15	21.58±0.76	23.42±0.76	38.25±1.64	*H=37.77
P	31.42±0.75	30.08±1.51	36.83±2.04	41.75±1.24	*F=205.1 DF=3,44
Season vs. variable	*H=50.68	*H=51.05	*H=52.38	*H=41.35	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: Sample C- *S. ricini* reared using *R. communis*; Sample T- *S. ricini* reared using *M. esculenta;* Sample G- *S. ricini* reared using *G. arborea;* Sample K - *S. ricini* reared using *H. fragrans* and Sample P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

Table 4.4: Pupal duration of *S. ricini* fed on different host plants during different seasons

SAMPLE	PUPAL DURATION (days)				Plant vs. variable
	S1	S2	S3	S4	
C	11.42±0.76	11.08±0.76	12.5±0.65	13.25±1.01	*H=24.42
T	12.08±0.64	11.83±0.9	13.75±0.72	14.25±0.72	*H=30.13
G	14.33±0.85	13.08±0.76	14.17±0.9	16±1	*H=25.55
K	12.75±1.01	11.58±0.76	12.83±0.9	14.91±0.86	*H=28.8
P	14.33±1.03	15.25±0.92	17.66±1.03	17.91±0.76	*F=39.14 DF=3,44
Season vs. variable	*H=39.04	*H=39.93	*H=40.11	*H=43.27	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.3. Fecundity (nos.)

The fecundity of the silkworms reared using different host plants are presented in Table 4.5. The number of eggs laid by a female moth ranged from 347.50±10.65 to 462.42±10.65 during S1, 363.66±14.49 to 461.58±6.06 during S2, 355.08±14.49 to 471±8.81 during S3 and 317.08±5.54 to 363.83±7.57 during S4. The highest fecundity was observed in the silkworms reared in Sample C (471±8.81) during S3 and the lowest fecundity was observed in Sample P (317.08±5.54) during S4. The fecundity was highest during S3 for Sample C, Sample G and Sample K, while the silkworms in Sample T, and Sample P showed highest fecundity during S2. Statistical analysis showed that there was a significant difference in the fecundity of *S. ricini* reared using different host plants during different seasons and among the different host plants during each season.

Table 4.5: Fecundity of *S. ricini* fed on different host plants during different seasons

SAMPLE	FECUNDITY (No.)				Plant vs. variable
	S1	S2	S3	S4	
C	462.42±10.65	461.58±6.06	471±8.81	363.83±7.57	***F=579.9 DF=3,44**
T	440.83±7.05	443±7.3	430.75±8.04	335.58±8.27	***F=495.6 DF=3,44**
G	398.67±8.7	396.08±9.51	403.75±8.69	324.75±6.96	***F=212.7 DF=3,44**
K	435.42±5.40	439.92±7.80	451.67±7.8	341.24±12.35	***F=399.9 DF=3,44**
P	347.5±10.65	363.67±14.49	355.08±14.49	317.08±5.54	***H=28.47**
Season vs. variable	***F=396.5 DF=3,44**	***F=194.8 DF=3,44**	***F=152.2 DF=3,44**	***F=71.13 DF=3,44**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.4. Hatching (%)

The hatching (%) of *S. ricini* fed on different host plants are presented in Table 4.6. The hatching (%) was found to range from 82.78±5.9 to 93.89 ±3.56 during S1, 87.22±1.46 to 93.89±3.28 during S2, 83.61±3.17 to 94.72±4.18 during S3 and 80.28±5.52 to 86.11±1.21 during S4. The highest percentage of hatching was observed in Sample K during S2 while the lowest hatching (%) was observed in Sample P during S4. Silkworms in Sample C, Sample T and Sample G showed highest hatching (%) during S1 while in Sample K and Sample P the highest hatching (%) was observed during S2. Lowest hatching (%) was observed during S4 for all samples. It was found that no significant difference was observed in hatching (%) among *S. ricini* in Sample P during different seasons. It was also observed that there was no significant difference in hatching percentage during S4 among all Sample (C, T, G, K, and P).

Table 4.6: Hatching percentage of *S. ricini* fed on different host plants during different seasons

SAMPLE	HATCHING (%)				Plant vs. variable
	S1	S2	S3	S4	
C	93.89±3.56	93.06±4.18	94.72±4.18	86.11±1.21	***H= 17.62**
T	92.22±3.14	92.22±3.42	91.94±5.68	85.28±4.18	***H = 13.98**
G	89.72±3.17	89.17±4.73	88.33±4.81	81.94±3.71	****H=16.87**
K	93.61±3.71	93.89±3.28	91.94±2.53	84.17±3.87	****H=21.76**
P	82.78±5.9	87.22±1.46	83.61±3.17	80.28±5.52	**NS P=7.39**
Season vs. variable	*** H = 27.55**	*** H = 14.4**	*** H = 26.2**	**NS H = 8.423**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.5. Effective rate of rearing (%)

The effective rate of rearing (ERR%) of the silkworms reared using different host plants are presented in Table 4.7. The effective rate of rearing (%) was found to range from 81.5±4 to 85.52±6.06 during S1, 76.72±4.92 to 83.25±4 during S2, 78.13±3.77 to

85.43±3.58 during S3 and 62.23±6.36 to 81.2±7.05 during S4. The highest percentage of effective rate of rearing (ERR) was found in Sample C during S1 while the lowest ERR (%) was observed in Sample P during S4. Sample C, Sample T, Sample G and Sample P showed highest ERR (%) during S1 while the silkworms in Sample K showed highest ERR (%) during S2. The ERR (%) was observed to be lowest during S4 for all Samples. It was found that the percentage of ERR of *S. ricini* is significantly different during every season among the samples except during S1. It was also found that *S. ricini* Sample C, Sample T and Sample K did not show significant difference among themselves during different seasons.

Table 4.7: Effective rate of rearing (ERR) of *S. ricini* fed on different host plants during different seasons

SAMPLE	EFFECTIVE RATE OF REARING (%)				Plant vs. variable
	S1	S2	S3	S4	
C	85.52±6.06	82.54±6.14	85.43±3.58	81.2±7.05	NS H=2.82
T	82.25±3.33	81.09±3.52	79.66±4.63	73.58±8.65	NS H=7.32
G	81.78±3.56	76.72±4.92	78.14±3.9	73.75±6.72	* H=12.7
K	83.2±4.15	83.25±4	82.87±4.77	77±5.16	NS H=0.53
P	81.5±4	78.19±5.52	78.13±3.77	62.23±6.36	* H=17.6
Season vs. variable	NS H = 3.713	** H = 11.93	** H = 18.54	* H = 25.3	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.6. Emergence rate (%)

The emergence rate (%) of silkworms reared using different host plants are presented in Table 4.8. The emergence rate (%) was found to be in range from 87.59±4.29% to 91.4±2.59% during S1, 87.65±6.0% to 91.53±4.73% during S2, 83.13±7.4% to 91.75±4.14% during S3 and 76.56±6.15% to 90.18±4.59% during S4.

Sample C showed highest ER (%) during S3 and Sample T and Sample G showed highest ER (%) during S1 but Sample K and Sample P showed highest ER (%) during S2. The ER (%) was found to be lowest during S4 in all Samples (C, T, G, K and P). The *S. ricini* reared using different host plants did not show significant difference in emergence rate (%) during S2 while it was different during S1, S3 and S4. It was also found that *S. ricini* reared in Sample C did not show significant difference among itself when reared during different seasons.

Table 4.8: Emergence rate (ER) of *S. ricini* fed on different host plants during different seasons

SAMPLE	EMERGENCE RATE (%)				Plant vs. variable
	S1	S2	S3	S4	
C	91.4±2.59	91.53±4.73	91.75±4.14	90.02±4.1	NS H=4.2
T	91.23±2.91	89.1±3.4	91.08±4.57	88.29±3.98	*H=8.33
G	88.92±4.58	88.2±4.03	83.13±7.4	81.67±5.46	*H=12.9
K	90.06±3.44	90.83±5	89.8±3.09	90.18±4.59	*H=9.23
P	87.59±4.29	87.65±6.0	85.21±5.13	76.57±6.15	*H=28.07
Season. vs. Variable	* H = 10.89	NS H = 6.324	** H = 19.54	* H = 31.1	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.7. Survival ratio (%)

The survival ratio (%) of silkworms reared using different host plants are presented in Table 4.9. The survival ratio (%) was observed to be from 83.29±5.18 to 88.10±4.48 during S1, 82.36±4.86 to 86.79±4.49 during S2, 82.14±3.63 to 90.74±4.73 during S3 and 71.72±7.92 to 84.33±5.13 during S4. The survival ratio (%) was found to be higher during S3 for Sample C, Sample T and Sample K while the Sample G and Sample P showed highest survival ratio during S1. The survival ratio (%) of all the groups

of silkworms was found to be lower during S4. The survival ratio (%) of *S. ricini* was significantly different within the Samples (C, T and P) during different seasons. However, the Sample G and Sample K did not show significant difference during different seasons. It was also found that the survival ratio (%) was significantly different among different samples in every season.

Table 4.9: Survival ratio (SR) of *S. ricini* fed on different host plants during different seasons

SAMPLE	SURVIVAL RATIO (%)				Plant vs. variable
	S1	S2	S3	S4	
C	88.1±4.48	86.69±4.50	90.74±4.73	84.33±5.13	***H=8.78**
T	86.16±2.87	84.07±2.92	86.65±5.05	80.68±6.8	***H=8.4**
G	85.81±3.44	82.73±5.8	85.06±3.95	79.83±6.68	**NS H=7.53**
K	87.35±3.52	86.79±3.49	87.36±4.09	83.31±3.95	**NS H=7.05**
P	83.29±5.18	82.36±4.86	82.14±3.63	71.72±7.92	****H=15.62**
Season. vs. Variable	* **H = 27.51**	* **H = 39.98**	* **H = 17.9**	* **H = 39.89**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.8. Cocoon weight (g)

The weight of the cocoons of the silkworms reared using different host plants are presented in Table 4.10. The weight of the cocoons (g) ranged from 2.15±0.05 to 3.22±0.02 during S1, 2.29±0.12 to 3.12±0.03 during S2, 2.9±0.08 to 3.19±0.05 during S3 and 2.73±0.16 to 3.04±0.09 during S4. The cocoon weight of Sample C, Sample G and Sample K was found to be higher during S1 while in Sample T and Sample P, the cocoon weight was highest during S3. The cocoon weights of all the groups were found to be lowest during S4. Significant difference was seen in the cocoon weight of *S. ricini* reared using different host plants. The weight of cocoon is also influenced by the difference in

seasons. The effect of host plants were seen significantly in the weight of pupa and hence, the cocoon weight.

Table 4.10: Cocoon weight of *S. ricini* fed on different host plants during different seasons

SAMPLE	COCOON WEIGHT (g)				Plant vs. variable
	S1	S2	S3	S4	
C	3.22±0.02	3.12±0.03	3.19±0.05	3.04±0.09	***H = 28.83**
T	3.08±0.03	3.02±0.12	3.11±0.05	2.91±0.1	***H=22.8**
G	2.85±0.1	2.69±0.1	2.83±0.08	2.76±0.1	****F=5.6 DF=3, 44**
K	3.14±0.05	3.12±0.01	3.11±0.04	3±0.14	****F=7.27 DF=3, 44**
P	2.15±0.05	2.29±0.12	2.9±0.15	2.73±0.16	***H=37.38**
Season vs. variable	***H=53.66**	***H= 49.32**	***F = 32.07 Df = 4, 55**	***F= 13.56 Df=4, 55**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.5.9. Shell weight (g)

The shell weights of the silkworms reared using different host plants are presented in Table 4.11. The shell weight (g) ranged from 0.27±0.02to 0.44±0.02 during S1, 0.28±0.01 to 0.43±0.01during S2, 0.37±0.01 to 0.44±0.02 during S3 and 0.32±0.02 to 0.41±0.01during S4. The shell weight of the silkworms reared using different host plants was found to be higher during S1 and S3 with the lowest shell weight during S4. The shell weight of the silkworms reared using different host plants is significantly different within the sample as well as among the samples during different seasons.

Table 4.11: Shell weight of *S. ricini* fed on different host plants during different seasons

SAMPLE	SHELL WEIGHT (g)				Plant vs. variable
	S1	S2	S3	S4	
C	0.44±0.02	0.43±0.01	0.44±0.02	0.41±0.01	***H=13.39**
T	0.41±0.08	0.4±0.02	0.42±0.01	0.38±0.01	***H=19.64**
G	0.36±0.01	0.34±0.01	0.37±0.01	0.35±0.01	***F=9.255 DF=3,44**
K	0.43±0.01	0.43±0.01	0.42±0.01	0.41±0.01	***F=11.72 DF=3,44**
P	0.27±0.02	0.28±0.01	0.37±0.01	0.32±0.02	***H=37.76**
Season vs. variable	***H = 52.58**	***F = 203.8 Df= 4, 55**	***H=4.89**	***H= 49.03**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.)

4.5.10. Shell ratio (%)

The shell ratio (%) of the eri silkworm, *S. ricini* reared using different host plants are presented in Table 4.12. The shell ratio was found to be ranging from 12.56±0.59 to 13.69±0.46 during S1, 12.23±0.5 to 13.78±0.75 during S2, 12.76±0.76 to 13.79±0.6 during S3 and 11.68±0.58 to 13.67±0.44 % during S4. The silkworms in Sample C and Sample K showed highest shell ratio (%) during S2 while in case of Sample T, Sample G and Sample P, the shell ratio (%) was found to be highest during S3. The shell ratios of all the groups were lowest during S4. Significant difference was observed in the shell ratio of Sample P during different seasons while the rest of samples did not show significant difference in the shell ratio (%) when reared in different seasons. It was also found that the shell ratio (%) was significantly different among different samples during every season.

Table 4.12: Shell ratio (SR) of *S. ricini* fed on different host plants during different seasons

SAMPLE	SHELL RATIO (%)				Plant vs. variable
	S1	S2	S3	S4	
C	13.66±0.75	13.78±0.75	13.79±0.6	13.49±0.56	**NS H=0.42**
T	13.31±0.25	13.25±0.72	13.50±0.48	13.06±0.26	**NS H=2.09**
G	12.63±0.45	12.64±0.58	13.07±0.62	12.68±0.44	**NS H=3.23**
K	13.69±0.46	13.78±0.36	13.50±0.26	13.67±0.44	**NS H=1.32**
P	12.56±0.59	12.23±0.5	12.76±0.76	11.68±0.58	* **H=11.45**
Season vs. variable	* **H= 27.51**	* **H = 39.98**	** **H = 17.9**	* **H = 39.89**	

Data is represented in Mean ± S.D, * Significant level at $p < 0.05$; ** Significant level at $p < 0.01$, NS Non-significant.
Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* S1- Season 1 (Feb.-April); S2- Season 2 (May-July); S3- Season 3 (Aug.-Oct.); S4- Season 4 (Nov.-Jan.).

4.6 Study on the biochemical parameters of *S. ricini* reared on different host plants

4.6.1 Estimation of the total protein content

The total soluble protein content of the hemolymph of *S. ricini* fed on different host plants are presented in Table 4.13. It was recoded that the hemolymph of Sample K contains highest amount of total soluble protein (41.07±0.303mg/mL) followed by Sample C (40.04±1.425mg/mL) while the lowest amount of soluble protein was recorded in Sample P (26.94±2.02mg/mL).

4.6.2 Estimation of the total carbohydrate content

The total carbohydrate content of the haemolymph of *S. ricini* fed with different host plants are presented in Table 4.13. It was found that the highest amount (mg/mL) of carbohydrate content was found in Sample C (16.02± 0.291mg/mL) followed by Sample K (15.21 ± 0.172mg/mL) while the lowest amount of carbohydrate was in the hemolymph of Sample P (9.75± 0.415mg/mL).

4.6.3 Estimation of total free amino acid

The total free amino acid content in the hemolymph of *S. ricini* reared using different host plants is presented in Table 4.13. It was found that the highest amount of free amino acid (mg/mL) was found in Sample C (36.22±3.953mg/mL) followed by Sample K (33.48±2.511mg/mL) while the lowest amount of carbohydrate was found in the hemolymph of Sample P (17.62±1.315mg/mL).

Table 4.13: Total soluble protein, total carbohydrate, and total amino acid content of hemolymph of *S. ricini* reared on different host plants

SAMPLE	Total protein (mg/mL)	Total carbohydrate (mg/mL)	Total free amino acid(mg/mL)
C	40.04±1.425	16.02± 0.291	36.22±3.953
T	33.10±1.196	13.24 ± 0.172	18.92±2.463
G	28.98±2.331	10.84 ± 0.374	19.4±1.051
K	41.07±0.303	15.21 ± 0.172	33.48±2.511
P	26.94±2.028	9.75± 0.415	17.62±1.315

Data is represented in Mean ± S.D.
Note- Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.*

4.6.4 Mineral content of larvae of *S. ricini* fed on different host plants

The mineral composition of the silkworms reared using different food plants was investigated, with a focus on sodium (Na), magnesium (Mg), potassium (K), calcium (Ca), manganese (Mn), iron (Fe), copper (Cu), and zinc (Zn) concentrations. The results presented in table 4.14 revealed significant differences across the groups, showing the influence of food plants on the mineral content of silkworms. The Sample K showed the highest quantities of Na, Mg, K, Ca, Mn, Fe, Cu, and Zn, Sample P, on the other hand, had very high phosphorus (P) content (50.82ppm) while the rest of the samples had comparatively lower phosphorus (P) content.

Statistical analysis was done to study the influence of different season and food plants on mineral content using analysis of variance (ANOVA). The ANOVA findings revealed differences among the silkworms reared using different food plants and different minerals. P-values were found to be smaller than the preset significance level of 0.05,

indicating the presence of significant differences. Data also revealed that the differences across the groups were statistically significant (F=4.2994108, p= 0.00775868), showing that mineral content differed significantly among the groups of silkworms reared using different host plants. Similarly, differences in mineral concentrations were extremely significant (F=98.8056407, p=4.9104E-18), indicating that certain minerals were present in significantly different amounts in each group. Therefore, the mineral content of silkworms was influenced by the host plants, and the variations observed are statistically significant.

Table 4.14: Mineral content of *S. ricini* fed on different host plants

SAMPLE	Na (ppm)	Mg (ppm)	K (ppm)	Ca (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	Zn (ppm)
C	3.57	11.95	33.23	12.9	0.06	1.04	0.06	1.34
T	3.46	15.6	39.27	16.91	0.06	1.19	0.08	1.3
G	3.35	10.97	38.36	15.32	0.11	1.31	0.04	1.31
K	3.76	25.9	45.37	24.03	0.15	2.17	0.11	2.13
P	3.48	17.16	50.82	20	9.17	2.18	0.09	1.93

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.*

4.7 Study on the nutritional content of eri silkworm fed on different host plants

4.7.1 Proximate analysis of the larvae of *S. ricini*

The proximate analysis of *S. ricini* was analysed using standard protocols and the result are presented in Table 4.15. The proximate analysis of the larvae of *S. ricini* provides valuable insights into the nutritional composition of the larvae. The nutritional profile varies significantly depending on the host plants used for rearing. The larval extract Sample C exhibited 5.3g/100g of crude fibre, 10.58g/100g of nitrogen, 14.14g/100g of fat, 64.39g/100g of moisture, 4.47g/100g of ash and 60.78g/100g of crude protein. Comparatively, Sample T showed slightly higher crude fibre at 5.56g/100g of sample while the Sample P showed the lowest crude fibre content at 3.341g/100g. The sample K exhibited highest nitrogen content (11.34g/100g). The fat content was relatively higher in Sample C and Sample K, while a notable moisture content at 74.02g/100g and higher ash content at 6.8g/100g was observed in Sample P. The crude protein content

(N×6.25) was higher in Sample C (60.78g/100g) while the lowest protein content was found in Sample P (56.68g/100g).

Table 4.15: Proximate analysis of larvae of *S. ricini* fed on different host plants

SAMPLE	CRUDE FIBRE (g/100g)	NITROGEN (g/100g)	FAT (g/100g)	MOISTURE (g/100g)	ASH (g/100g)	CRUDE PROTEIN (N×6.25)
C	5.3	10.58	14.14	64.39	4.47	60.78
T	5.56	10.12	11.02	72.83	4.39	57.98
G	3.34	9.27	11.09	70.6	4.64	56.94
K	5.01	11.34	13.48	69.47	4.35	59.47
P	3.31	9.04	12.4	74.02	6.8	56.68

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.*

4.7.2 Proximate analysis of leaf extract of the host plants used for rearing *S. ricini*

The proximate analysis of the host plants were analysed using standard protocols and the results are presented in Table 4.16. It was found that the crude fibre was highest in Sample C1 while the lowest was found in Sample P5. Sample K4 contains highest nitrogen content while it was lowest in Sample P5. Fat content was highest in Sample C1 and lowest in Sample P5. The moisture and ash content was found to be highest in Sample P5 while the moisture content was lowest in Sample C1. The lowest ash content was found in Sample C1. The highest crude protein content was found in Sample C1 and lowest in Sample P5.

Table 4.16: Proximate analysis of leaves of host plants used for rearing *S. ricini*

SAMPLE	CRUDE FIBRE (g/100g)	NITROGEN (g/100g)	FAT (g/100g)	MOISTURE (g/100g)	ASH (g/100g)	CRUDE PROTEIN (N×6.25)
C1	7.55	11.65	5.23	5.46	7.66	33.76
T2	6.32	12.76	2.44	6.33	8.59	31.87
G3	4.55	10.54	3.21	6.88	10.22	26.54
K4	7.01	13.43	4.19	5.82	8.43	31.32
P5	3.31	7.04	2.23	7.41	12.34	24.22

Note: C1- leaves of *R. communis*, T2- leaves of *M. esculenta,* G3- leaves of *G. arborea,* K4- leaves of *H. fragrans* and P- leaves of *C. papaya.*

4.7.3 Fatty acid profiling using GC-MS

i. GC-MS analysis of *S. ricini* fed on *R. communis*

The GC-MS study of the larvae of *S. ricini* indicated the presence of 6 compounds namely, Heptacosanoic acid, 25-methyl-, methyl ester **(C1)**, 13-Methyltetradec-9-enoic acid methyl ester **(C2)**, 3-Methyl-2-(2-oxopropyl) furan **(C3)**, Octadecane, 1,1-dimethoxy **(C4)**, 9,12,15-Octadecatrienoic acid, (Z,Z,Z) **(C5)**, 2-Trimethylsiloxy-6-hexadecenoic acid, methyl ester **(C6).** The retention time, peak area, molecular weight and formula of the identified compounds are presented in Table 4.17 and chromatogram at Figure 4.2 (a). The 2D structure is represented in Figure 4.3.

Table 4.17: List of compounds recorded in extract of *S. ricini* fed on *R. communis*

Sl no.	Compound name	Retention time	Area (%)	MW (g/mol)	MF
1.	Heptacosanoic acid, 25-methyl-, methyl ester	28.872	0.722	438	$C_{29}H_{58}O_2$
2.	13-Methyltetradec-9-enoic acid methyl ester	31.303	1.086	254	$C_{16}H_{30}O_2$
3.	3-Methyl-2-(2-oxopropyl) furan	31.468	0.697	138	$C_8H_{10}O_2$
4.	Octadecane, 1,1-dimethoxy	31.568	0.742	314	$C_{20}H_{42}O_2$
5.	9,12,15-Octadecatrienoic acid, (Z,Z,Z)	31.773	1.418	278	$C_{18}H_{30}O_2$
6.	2-Trimethylsiloxy-6-hexadecenoic acid, methyl ester	33.964	0.128	356	$C_{20}H_{40}O_3Si$

*MW=molecular weight; MF=molecular formula

ii. GC-MS analysis of *S. ricini* fed on *M. esculenta*

The GC-MS study of the larvae of *S. ricini* fed on *M. esculenta* leaves indicated the presence of 5 compounds namely, Tetradecanoic acid, 10,13-dimethyl-, methyl ester **(C7)**, Heptacosanoic acid, 25-methyl-, methyl ester **(C1)**, 9,12-Hexadecadienoic acid, methyl ester **(C8)**, 9,12,15-Octadecatrienoic acid, (Z,Z,Z)- **(C5)**, Carbonic acid, Heptadecyl methyl ester **(C9)**. The retention time, peak area, molecular weight, and formula of the identified compounds are presented in Table 4.18 and chromatogram in Figure 4.2(b). The 2D structure is represented in Figure 4.3

Table 4.18: List of compounds recorded in extract of *S .ricini* larvae fed on *M. esculenta*

Sl no.	Compound name	Retention time	Area (%)	MW (g/mol)	MF
1.	Tetradecanoic acid, 10,13-dimethyl-, methyl ester	28.607	2.580	270	$C_{17}H_{34}O_2$
2.	Heptacosanoic acid, 25-methyl-, methyl ester	31.198	2.747	438	$C_{29}H_{58}O_2$
3.	9,12-Hexadecadienoic acid, methyl ester	31.34	2.524	238	$C_{17}H_{30}O_2$
4.	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	31.678	3.193	278	$C_{18}H_{30}O_2$
5.	Carbonic acid, Heptadecyl methyl ester	33.899	0.288	314	$C_{14}H_{28}O_3$

*MW=molecular weight; MF=molecular formula

iii. GC-MS analysis of *S. ricini* fed on *G. arborea*

The GC-MS study of the larvae of *S. ricini* fed on *G. arborea* leaves indicated the presence of 6 compounds namely, Heptacosanoic acid, 25-methyl-, methyl ester **(C1),** Octadecanoic acid, 11-methyl-, methyl ester **(C10)**, 11,14-Octadecadienoic acid, methyl ester **(C11)**, 3-Methyl-2-(2-oxopropyl) furan **(C3),** 9,12,15-Octadecatrienoic acid, (Z,Z,Z) **(C5),** Z,Z-6,28-Heptatriactontadien-2-one **(C12).** The retention time, peak area, molecular weight and formula of the identified compounds are presented in Table 4.19 and chromatogram in Figure 4.2 (c). The 2D structure is represented in Figure 4.3.

Table 4.19: List of compounds recorded in extract of *S. ricini* fed on *G. arborea*

Sl no.	Compound name	Retention time	Area (%)	MW (g/mol)	MF
1.	Heptacosanoic acid, 25-methyl-, methyl ester	28.528	1.224	438	$C_{29}H_{58}O_2$
2.	Octadecanoic acid, 11-methyl-, methyl ester	31.163	2.334	312	$C_{19}H_{34}O_2$
3.	11,14-Octadecadienoic acid, methyl ester	31.308	1.323	438	$C_{19}H_{34}O_2$
4.	3-Methyl-2-(2-oxopropyl) furan	31.433	0.441	138	$C_8H_{10}O_2$
5.	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	31.623	6.799	278	$C_{18}H_{30}O_2$
6.	Z,Z-6,28-Heptatriactontadien-2-one	33.869	0.243	530	$C_{37}H_{70}O$

*MW=molecular weight; MF=molecular formula

iv. GC-MS analysis of *S. ricini* fed on *H. fragrans*

GCMS analysis of the extract of *S. ricini* fed on *H. fragrans* detected 14 compounds namely Tetradecanoic Acid, 10,13-Dimethyl-, Methyl Ester **(C7)**, L-(+)-Ascorbic Acid 2,6-Dihexadecanoate **(C13),** Heptadecanoic Acid, 16-Methyl-, Methyl Ester **(C14),** Methyl 5,12-Octadecadienoate **(C15),** Octadecane, 1,1-Dimethoxy **(C16**), 11,14,17-Eicosatrienoic Acid, Methyl Ester **(C17),** Z,Z-6,28-Heptatriactontadien-2-One **(C12),** Methyl 18-Methylnonadecanoate **(C18),** Tricosanal **(C19),** 3-Methyl-2-(2-Oxopropyl)Furan **(C3),** 1,3-Dioxolane, 4,5-Dibutyl-2,2-Bis(Difluoromethyl)-, Cis- **(C20),** Glycidyl Oleate **(C21),** Linolenic Acid, 2-Hydroxy-1-(Hydroxymethyl) Hexa-2,4-Dienoic Acid **(C22),** Pentadecanoic Acid, 14-Bromo**-(C14).** The details of the identified compounds are presented in Table 4.20 and chromatogram in Figure 4.2 (d). The 2D structure is represented in Figure 4.3.

Table 4.20: List of compounds recorded in extract of *S. ricini* fed on *H. fragrans*

Sl no.	Compound name	Retention time	Area (%)	MW (g/mol)	MF
1	Tetradecanoic Acid, 10,13-Dimethyl-, Methyl Ester	28.597	3.341	270	$C_{17}H_{34}O_2$
2	L-(+)-Ascorbic Acid 2,6-Dihexadecanoate	29.938	6.948	652	$C_{38}H_{68}O_8$
3	Heptadecanoic Acid, 16-Methyl-, Methyl Ester	31.243	7.117	298	$C_{19}H_{38}O_2$
4	Methyl 5,12-Octadecadienoate	31.383	6.917	294	$C_{19}H_{34}O_2$
5	Octadecane, 1,1-Dimethoxy-	31.518	1.506	314	$C_{20}H_{42}O_2$
6	11,14,17-Eicosatrienoic Acid, Methyl Ester	31.703	7.501	320	$C_{21}H_{36}O_2$
7	Z,Z-6,28-Heptatriactontadien-2-One	32.599	10.940	530	$C_{37}H_{70}O$
8	Methyl 18-Methylnonadecanoate	33.719	1.273	326	$C_{21}H_{42}O_2$
9	Tricosanal	33.969	1.713	338	$C_{23}H_{46}O$
10	3-Methyl-2-(2-Oxopropyl)Furan	34.179	1.060	138	$C_8H_{10}O_2$
11	1,3-Dioxolane, 4,5-Dibutyl-2,2-Bis(Difluoromethyl)-, Cis-	36.060	0.271	322	$C_{13}H_{20}F_6O_2$
12	Glycidyl Oleate	36.800	0.832	338	$C_{21}H_{38}O_3$
13	1,3-Dioxolane, 4-Heptyl-5-Methyl-2,2-Bis(Trifluoromethyl)-, Trans	37.141	0.547	322	$C_{13}H_{20}F_6O_2$
14	Pentadecanoic Acid, 14-Bromo-	39.337	0.847	320	$C_{15}H_{30}O_2$

*MW=molecular weight; MF=molecular formula

v. GC-MS analysis of *S. ricini* fed on *C. papaya*

The GC-MS study of the larvae of *S. ricini* fed on *C. papaya* leaves indicated the presence of 10 compounds namely, Cyclononasiloxane- Octadecamethyl **(C24),** Tetracosamethyl- Cyclononasiloxane **(C25),** 3,4-Dihydroxymandelic acid, 4tms derivative **(C26),** Tridecanoic acid, 12-methyl, methyl ester **(C27),** Cyclooctasilixane, Hexadecamethyl **(C28),** Cyclodecaasiloxane-Eicosamethyl **(C29),** Heptadecanoic acid, 16-methyl-, methyl ester **(C14),** 11,14-Octadecadienoic acid, methyl ester **(C11),** 9,12,15-Octadecatrienoic acid, methyl ester, (z,z,z) **(C5),** Hexasiloxane, Tetradecamethyl **(C30).** The retention time, peak area, molecular weight, and formula of the identified compounds are presented in Table 4.21 and chromatogram in Figure 4.2 (e). The 2D structure is represented in Figure 4.3.

Table 4.21: List of compounds recorded in extract of *S. ricini* fed on *C. papaya*

Sl no.	Compound name	Retention time	Area (%)	MW (g/mol)	MF
1	Cyclononasiloxane-Octadecamethyl	23.475	0.114	666	$C_{18}H_{54}O_9Si_9$
2	Tetracosamethyl-Cyclononasiloxane	25.648	0.092	888	$C_{24}H_{72}O_{12}Si_{12}$
3	3,4-Dihydroxymandelic acid, 4tms derivative	27.556	0.092	472	$C_8H_8O_5$
4	Tridecanoic acid, 12-methyl, methyl ester	28.707	3.2224	242	$C_{15}H_{30}O_2$
5	Cyclooctasilixane, Hexadecamethyl	29.262	0.119	592	$C_{16}H_{48}O_8Si_8$
6	Cyclodecaasiloxane-Eicosamethyl	30.828	0.120	740	$C_{20}H_{60}O_{10}Si_{10}$
7	Heptadecanoic acid, 16-methyl-, methyl ester	31.433	4.045	298	$C_{19}H_{38}O_2$
8	11,14-Octadecadienoic acid, methyl ester	31.538	9.495	294	$C_{19}H_{34}O_2$
9	9,12,15-Octadecatrienoic acid, methyl ester, (z,z,z)-	31.883	41.334	292	$C_{19}H_{32}O_2$
10	Hexasiloxane, Tetradecamethyl	32.323	0.019	458	$C_{14}H_{42}O_5Si_6$

*MW=molecular weight; MF=molecular formula

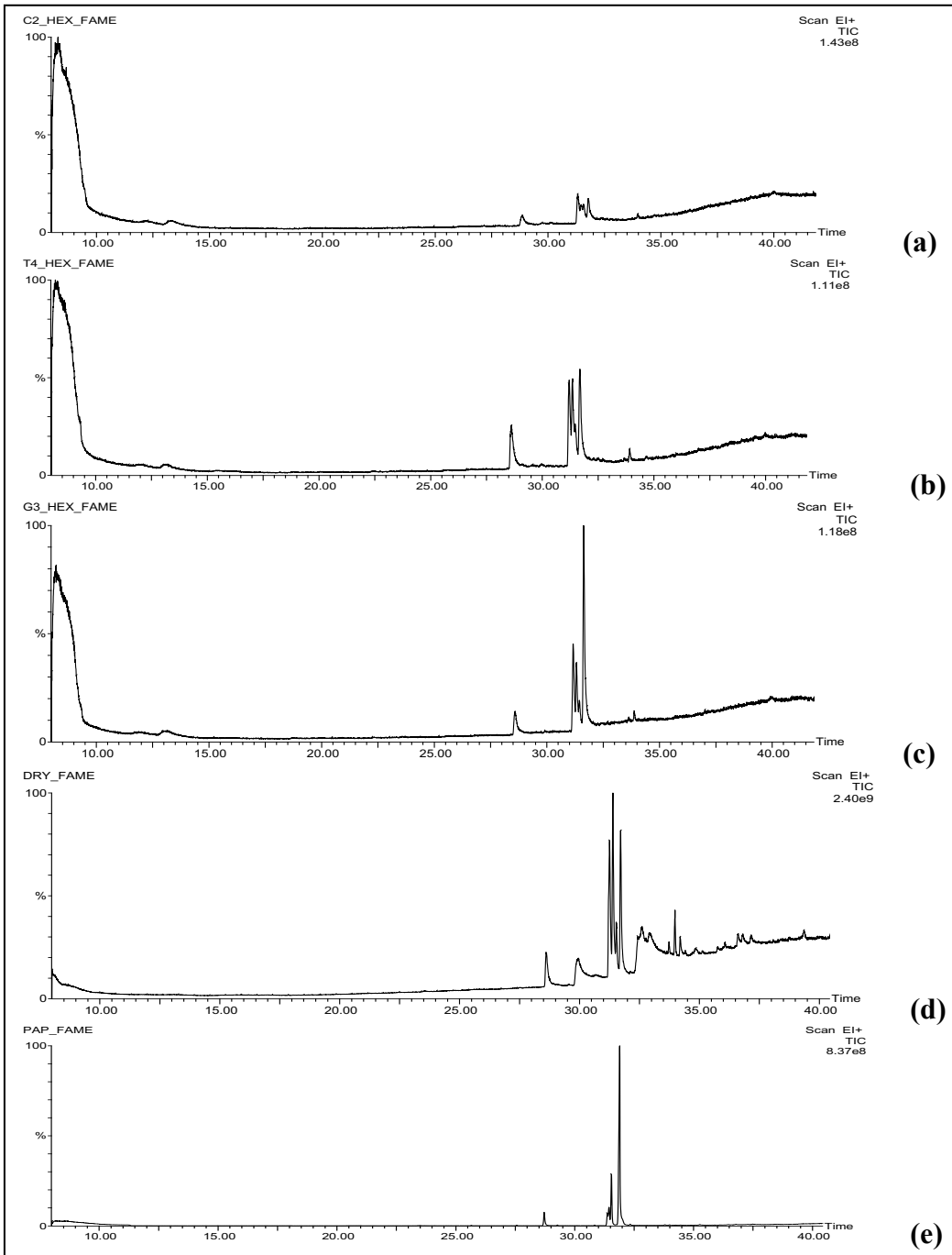

Figure 4.2: GC-MS chromatogram of larval extract of eri *S. ricini* fed on a) *R. communis*, b) *M. esculenta*, c) *G. arborea*, d) *H. fragrans* and e) *C. papaya.*

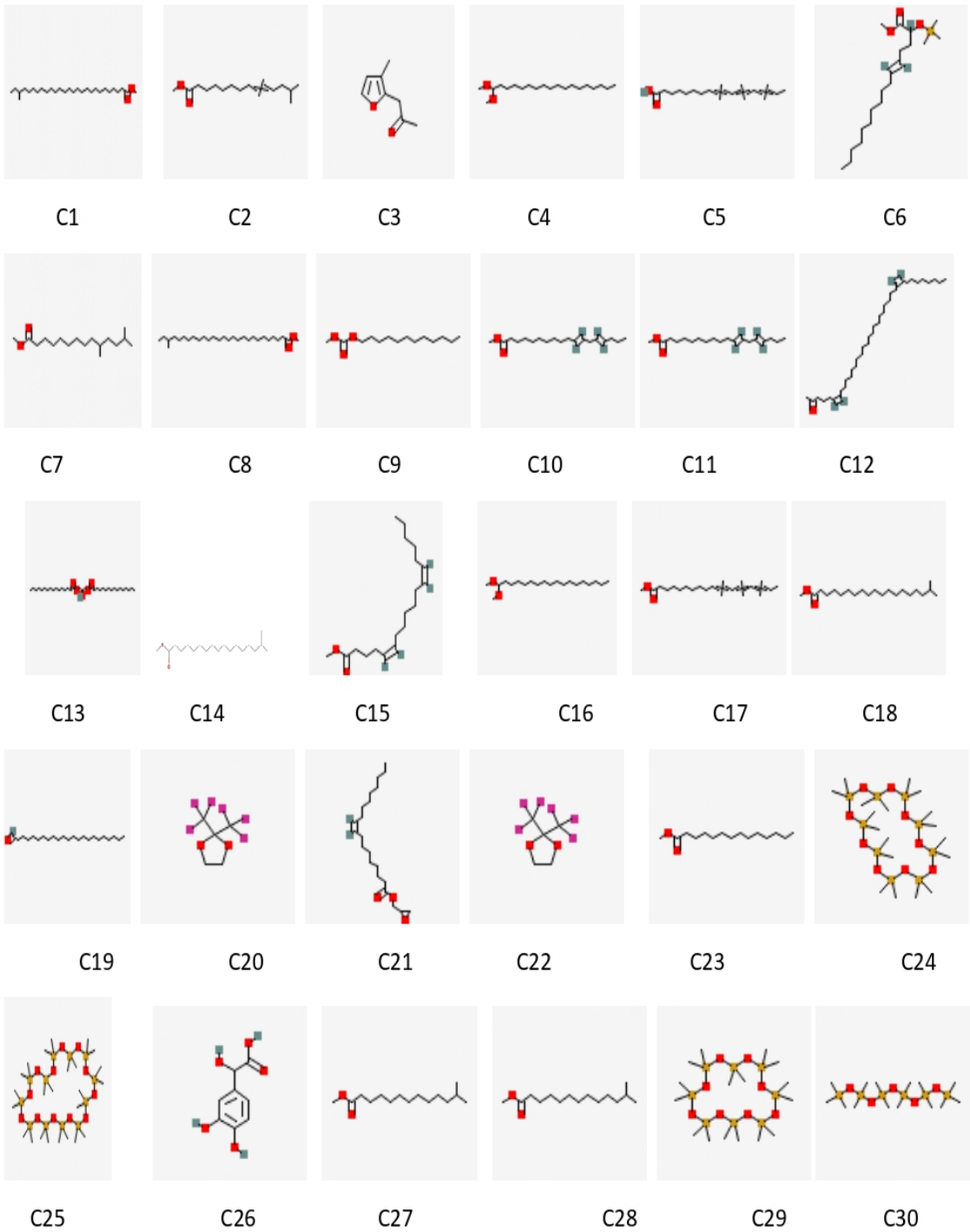

FIGURE 4.3: 2D structure of compounds found in the GC-MS larval extract of *S. ricini*. (Source: PubChem)

4.7.4. Study of the amino acid content of *S. ricini* fed on different host plants

The percentage of free amino acids (in moles) found in the larvae of *S. ricini* reared on five different host plants are presented in Table 4.22 and the chromatogram is represented in Figure 4.4 (a-e). The amino acid profile provides useful insights into the nutritional makeup of the larvae and its variation depending on their food. Histidine, a necessary amino acid, varied significantly across the samples. The larvae in Sample K had the highest concentration of histidine (4.61% mole), while Sample G had the negligible quantity. Arginine, an indispensable amino acid, exhibited a varied distribution, with the greatest concentration found in Sample G (3.73% mole) and the lowest concentration observed in Sample P (0.41% mole).

The larvae in Sample P had the greatest lysine concentration, which is 4.08% mole. However, the methionine level was quite low in all Samples. Valine was found in the highest concentration in Sample T (3.53% mole), isoleucine was most abundant in Sample P (2.06% mole), and leucine was most abundant in Sample K (3.94% mole).

Phenylalanine, which is an aromatic amino acid, showed considerable differences in content. The Sample C had the maximum amount (18.71% mole), while Sample T had the lowest amount (3.73% mole). The level of tryptophan, which was another type of aromatic amino acid, differs among the Samples. The larvae in Sample G had the greatest tryptophan concentration, which was 1.91% mole.

Serine, glutamine, and glycine are non-essential amino acids that participate in several metabolic activities. The quantities of these amino acids varied depending on the host plant. The larvae grown on different host plants exhibited significant variations in the presence of alanine, proline, and tyrosine.

Additionally, specific amino acids such as phospho ethanolamine, taurine, β-alanine, citrulline, sarcosine, α-amino butyric acid, ornithine, and ethanolamine were either not present or only found in small quantities.

Table 4.22: Free amino acid profiling of *S. ricini* fed on different host plants

S. No.	Name	TOTAL FREE AMINO ACID CONTENT (%mole)				
		Sample C	Sample T	Sample G	Sample K	Sample P
1	Histidine	3.93	3.53	00	4.61	3.78
2	Arginine	2.71	1.31	3.73	1.66	0.41
3	Threonine	1.54	2.49	2.06	2.37	2.46
4	Lysine	2.32	1.12	3.81	0.80	4.08
5	Methionine	0.06	0.75	0.45	0.63	0.26
6	Valine	1.27	3.53	2.93	3.14	3.08
7	Iso leucine	0.74	0.00	2.06	1.95	2.05
8	Leucine	1.22	2.27	3.34	3.94	2.60
9	Phenylalanine	18.71	3.73	13.82	17.14	13.47
10	Tryptophan	1.19	1.63	1.91	1.31	0.71
11	Asparagine	1.66	0.42	00	0.62	1.15
12	Serine	9.41	5.77	5.86	10.45	6.67
13	Glutamine	5.62	2.63	3.29	4.99	2.17
14	Glycine	7.50	13.35	8.72	8.40	8.72
15	Aspartic acid	0.48	0.49	0.82	0.78	0.40
16	Glutamic acid	5.43	12.99	10.30	6.05	8.59
17	Alanine	10.71	16.33	14.25	9.96	23.91
18	Proline	1.30	3.29	2.99	2.23	2.74
19	Cystine	0.47	0.55	0.20	0.11	0.53
20	Tyrosine	19.69	7.88	9.49	17.18	8.21
21	Phospho Ethanolamine	00	0.80	00	0.73	00
22	Taurine	1.04	0.10	5.47	0.04	1.23
23	Beta-Alanine	0.12	0.22	0.15	0.36	0.28
24	Citrulline	0.15	1.31	0.30	0.15	0.95
25	Sarcosine	0.59	0.47	0.68	0.38	0.48
26	Alpha amino butyric acid	1.88	00	0.25	00	0.19
27	Ornithine	0.25	00	0.52	00	0.87
28	Ethanolamine	00	00	2.59	00	00

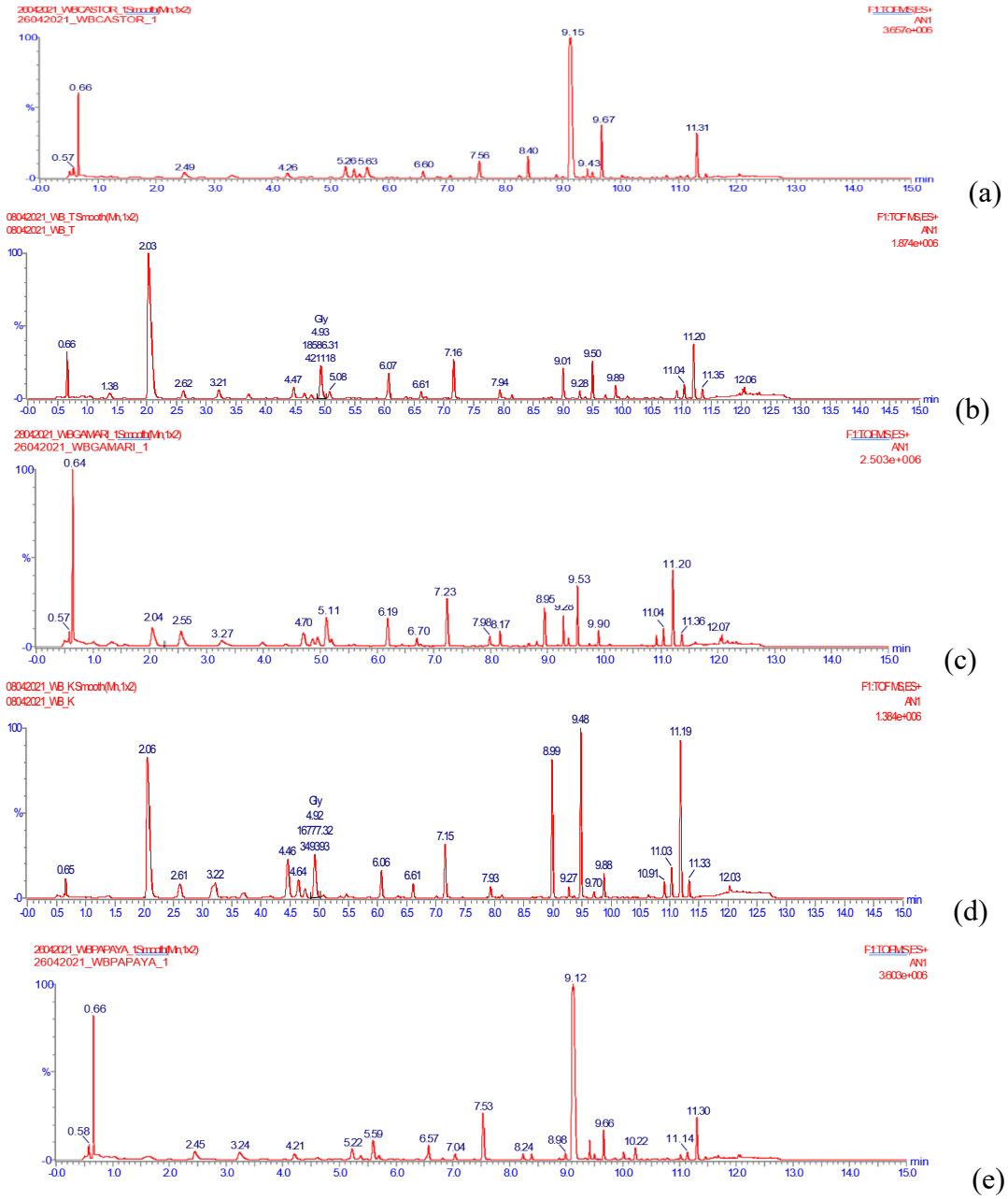

FIGURE 4.4: UPLC Chromatogram of larval extract of *S. ricini* fed on a) *R. communis*, b) *M. esculenta*, c) *G. arborea*, d) *H. fragrans* and e) *C. papaya*

4.8 Study on the scavenging and antioxidant activity of *S. ricini* fed on different host plants

4.8.1 Ferric Reducing Antioxidant Power Assay (FRAP)

The Ferric Reducing Antioxidant Power Assay (FRAP) of *S. ricini* reared using different host plants was performed and the data obtained from the absorbance reading at 593nm are presented in Figure 4.5 and the FRAP value of *S. ricini* larvae is expressed as gallic acid equivalent (GAE) in mg/g sample. The highest FRAP value was observed in Sample C while the lowest FRAP value was observed in the Sample P indicating lowest antioxidant capacity as compared to the silkworms reared using other host plants.

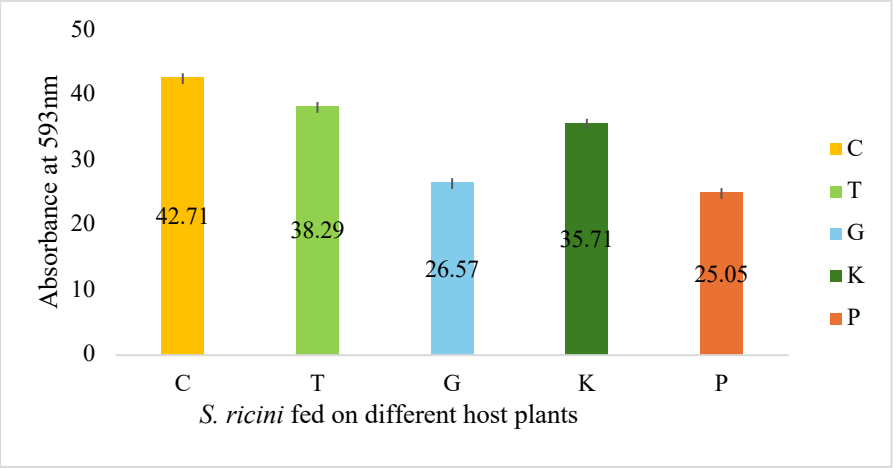

Figure 4.5: FRAP activity of *S. ricini* fed using different host plants. FRAP value is expressed as µg Fe^{2+} equivalent (FE)/mg of larval extract.

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K- *S. ricini* reared using *H. fragrans* and P- *S. ricini* reared using *C. papaya*. Ascorbic acid was used as standard for DPPH.

4.8.2 DPPH Scavenging activities of *S. ricini*

The percentage inhibition and IC_{50} value of DPPH scavenging capacity of *S. ricini* fed on different host plants are presented in Figure 4.6 and Table 4.23 respectively. The percent inhibition of DPPH scavenging activity resulted in a concentration dependent manner. The percent inhibition increased with the increase in concentration and vice versa. The IC_{50} value for DPPH scavenging capacity of *S. ricini* ranged from 26.85±0.54µg/mL to 57.01±0.29µg/mL while the IC_{50} value of standard Ascorbic acid was 8.60±1.29µg/mL. The lower IC_{50} value for DPPH scavenging activity Sample C (26.85±0.54µg/mL) indicated higher antioxidant activity

while the higher IC_{50} value for DPPH scavenging activity in Sample G indicated lower antioxidant capacity.

4.8.3 2, 2'-Azinobis-(3-ethlybenzothiazoline-6-sulfonate) assay (ABTS)

The ABTS assay was performed and the percentage inhibition and IC_{50} value of ABTS scavenging capacity of *S. ricini* fed on different host plants are presented in Figure 4.7 and Table 4.23 respectively. The percent inhibition of ABTS scavenging activity resulted in a concentration dependent manner. The percent inhibition increased with the increase in concentration and vice versa. The IC_{50} value for ABTS scavenging capacity of *S. ricini* ranged from 27.99±0.60µg/mL to 78.58±1.21µg/mL while the IC_{50} value of standard Gallic acid was 2.92±0.82µg/mL. The lower IC_{50} value for ABTS scavenging activity Sample C indicated higher antioxidant activity while the higher IC_{50} value for ABTS scavenging activity in Sample G indicated lower antioxidant capacity.

Table 4.23: IC_{50} values of DPPH and ABTS scavenging activity of *S. ricini* fed on different host plants

Sample	DPPH (µg/mL)	ABTS (µg/mL)
Standard	8.60±1.29	2.92±0.82
C	26.85±0.54	27.99±0.60
T	31.92±0.52	62.52±1.15
G	57.01±0.29	78.58±1.21
K	44.73±0.38	68.63±1.16
P	51.93±0.31	74.19±1.23

Values in table is expresses as mean ± SD (n=3). Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya.* IC50=Concentration required for 50% inhibition of a sample. Ascorbic acid was used as standard for DPPH and Gallic acid was used as standard for ABTS assay.

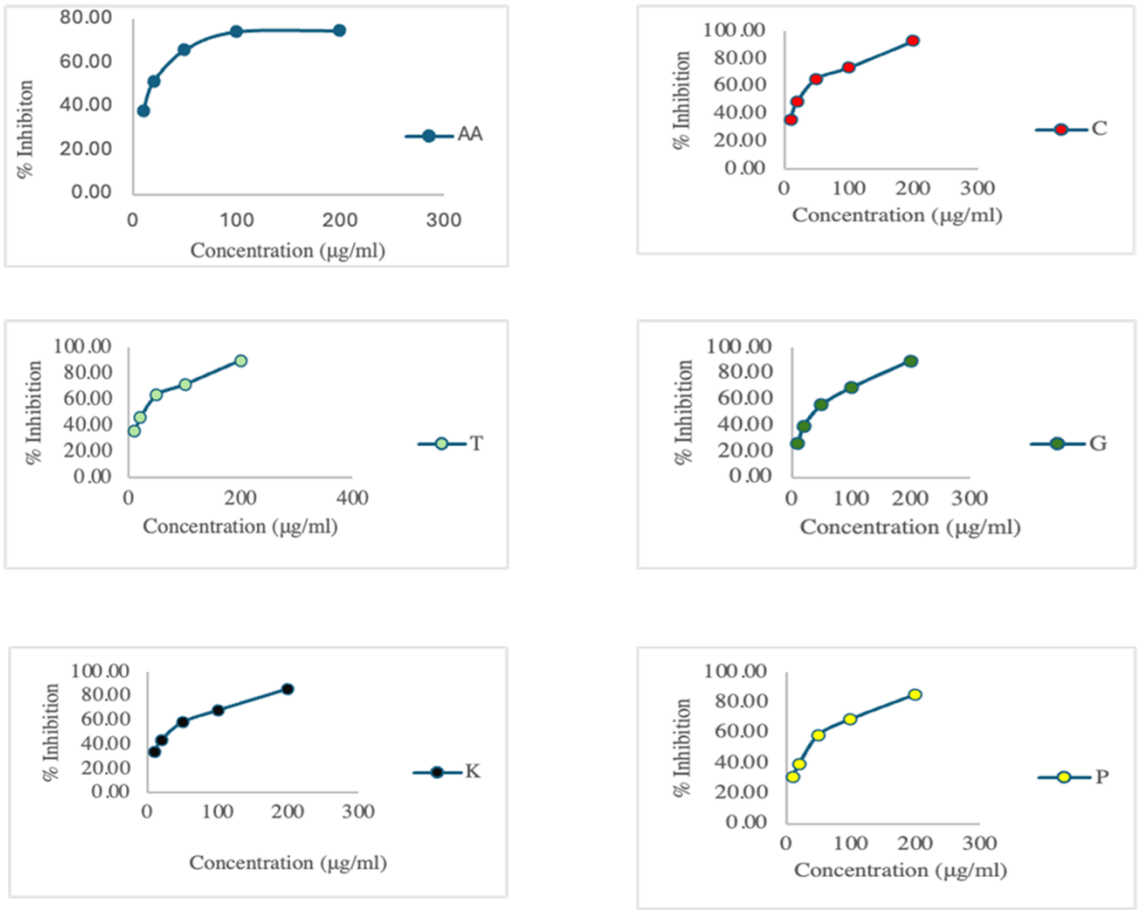

Figure 4.6: Percentage inhibition of DPPH free radical scavenging activity of *S. ricini* fed on different host plants

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya*. Ascorbic acid was used as standard for DPPH.

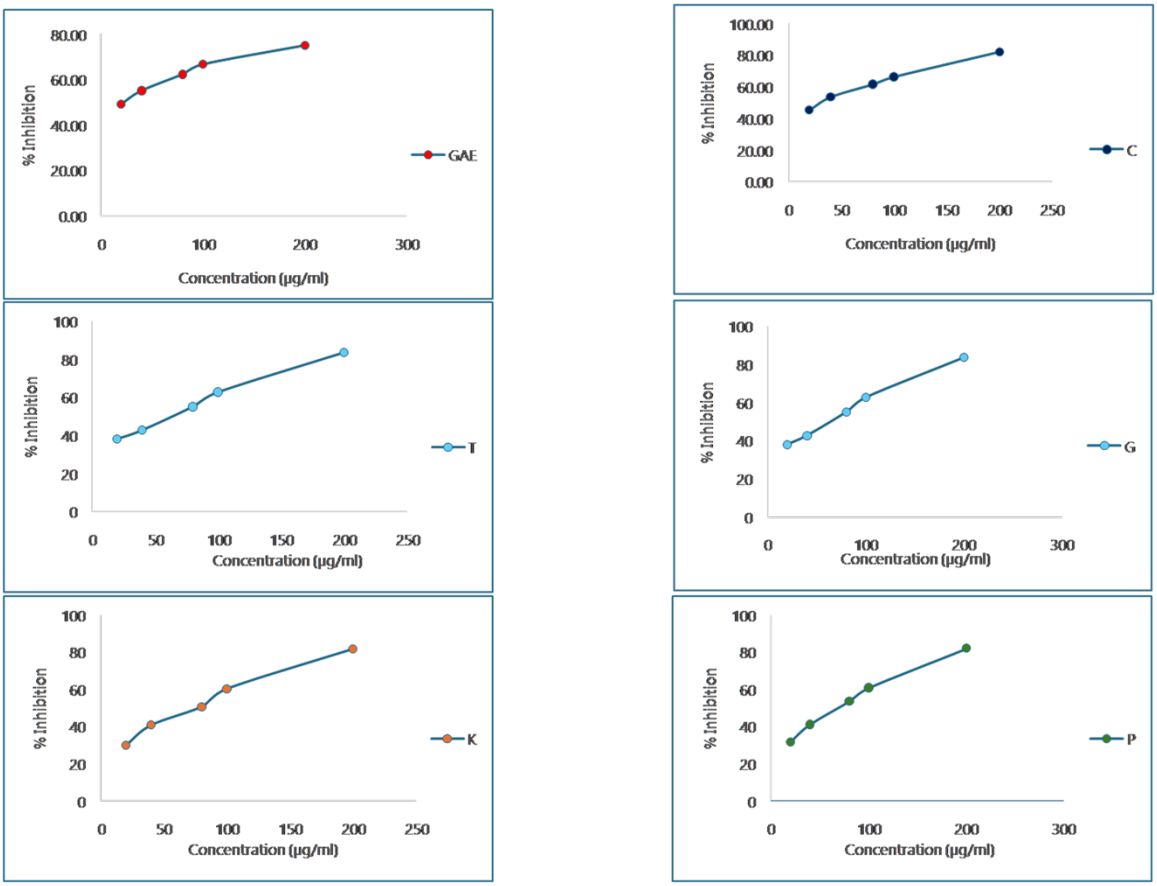

Figure 4.7: Percent inhibition of ABTS assay of *S. ricini* fed on different host plants.

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya*. Gallic acid was used as standard for ABTS.

4.9. Study on immunological response of *S. ricini* fed on different host plants using enzyme assay

4.9.1. Glutathione S-transferase assay (GST)

The glutathione s-transferase activity of *S. ricini* fed using different host plant was studied and the highest enzyme activity was observed in the Sample P while the lowest GST activity was observed in the Sample C (Figure 4.8).

4.9.2. Catalase enzyme activity

The catalase enzyme activity of *S. ricini* fed using different host plant was studied and the lowest enzyme activity was observed in the Sample P while the highest catalase activity was observed in the Sample C (Figure 4.9).

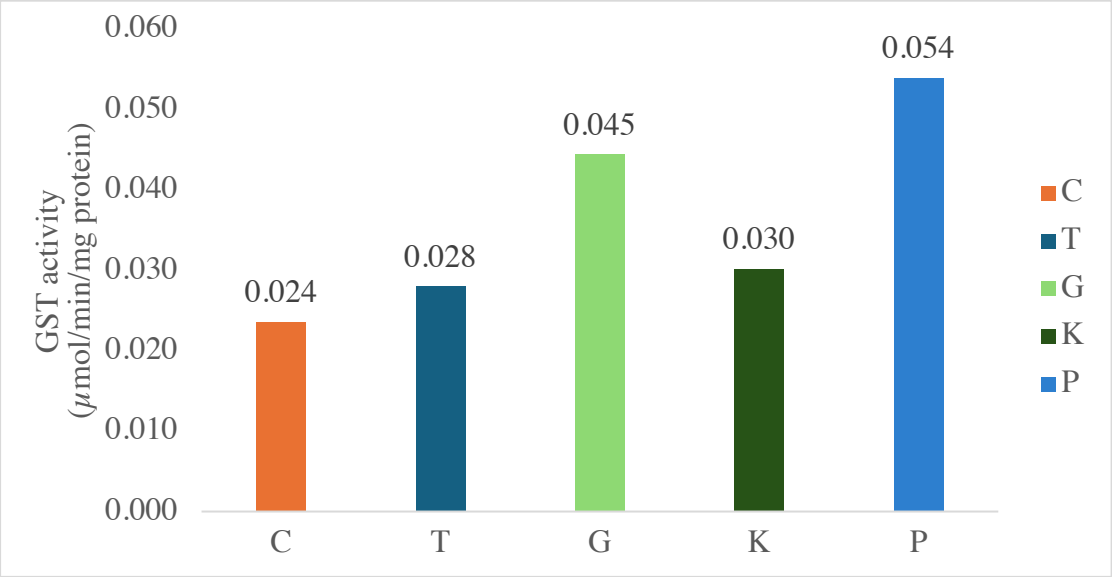

Figure 4.8: Glutathione s-transferase enzyme activity of *S. ricini* fed using different host plants.

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya*.

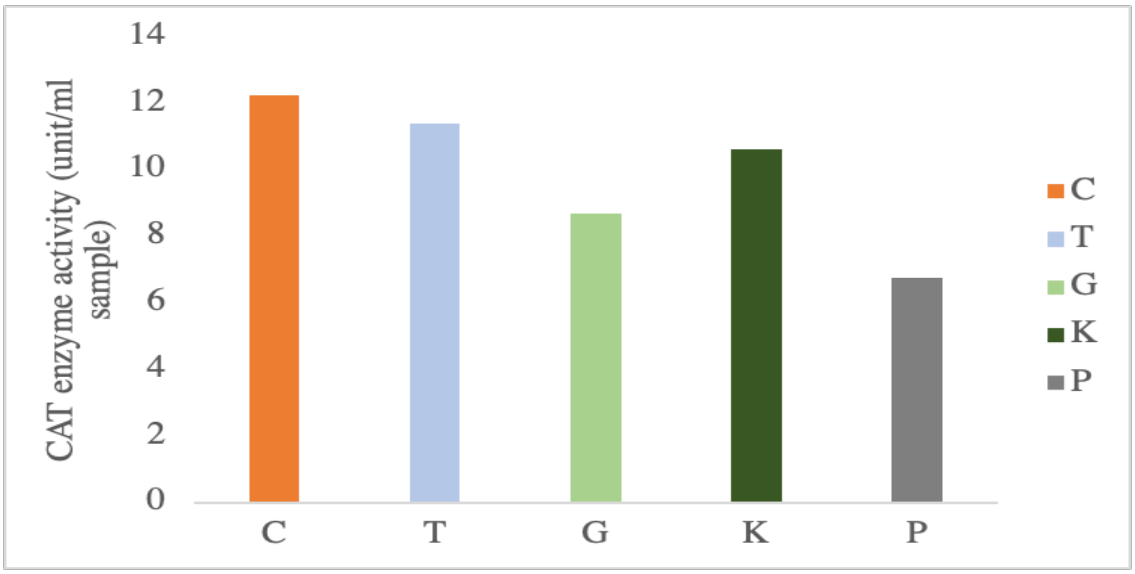

Figure 4.9: Catalase enzyme activity of *S. ricini* fed using different host plants.

Note: C- *S. ricini* reared using *R. communis*, T- *S. ricini* reared using *M. esculenta,* G- *S. ricini* reared using *G. arborea,* K - *S. ricini* reared using *H. fragrans* and P - *S. ricini* reared using *C. papaya*.

Plate 1

Photographs of *S. ricini* reared using different host plants

Sample C: *S. ricini* reared in *R. communis*

Sample G: *S. ricini* reared in *G. arborea*

Sample T: *S. ricini* reared in *M. esculenta*

Sample K: *S. ricini* reared in *H. fragrans*

Sample P: *S. ricini* reared in *C. papaya*

Plate 2

Photographs of host plants used for rearing *S. ricini*

A) *Ricinus communis*

B) *Manihot esculenta*

C) *Gmelina arborea*

D) *Heteropanax fragrans*

E) *Carica papaya*

Plate 3

Photographs of herbarium specimens of host plants used for rearing *S. ricini*

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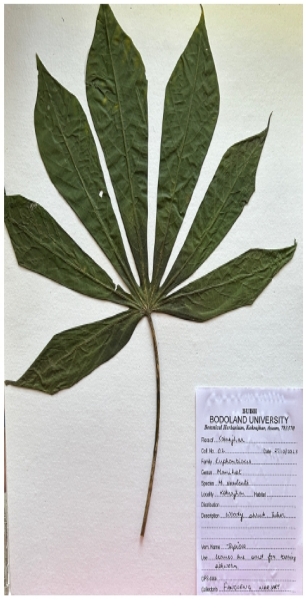

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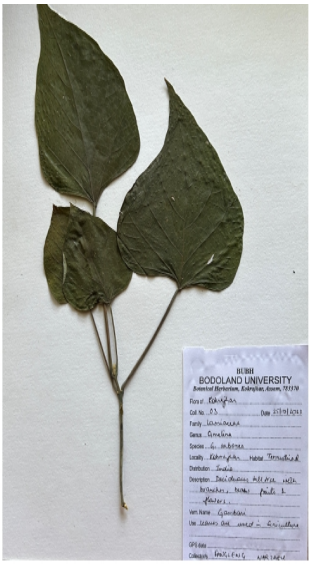

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