Chapter V
DISCUSSION

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Nutrition plays an important role in improving the growth and development of the animals. The silkworms from the same genetic stock responded variedly when fed on the leaves of different nutritional quality, which is an indicator of efficient utilization and conversion of food into silk substance. Highest settling of larvae as observed in the tender leaves of Castor followed by Borpat revealed that these two food plants are the suitable plants for rearing of eri silkworm larvae. The quality of leaves provided to silkworms for feeding has been considered prime factor influencing production of good cocoon crop. The importance of good nutrition in mulberry silkworm rearing had been established (Takeuchi, 1960; Ito and Arai, 1963; Parpiev, 1968; Krishnaswami *et al.*, 1970; Fonseca *et al.*, 1993; Sarkar *et al.*, 1997). Ito and Kobayashi (1978) reported that nutritive value of mulberry leaves varied depending on the season, temperature, nature of soil, kind of fertilizer, method of cultivation etc. Leaf quality of some mulberry genotypes through chemical analysis had been evaluated (Bose *et al.*, 1991; Bongale and Chaluvachari, 1993; Fotadar and Dandin, 1997). Li and Sanu (1984), Tangamani and Vivekanandan (1984) and Chaluvachari and Bongale (1995) observed wide range of variation in mulberry genotype and discussed the importance of quality of mulberry leaves used as feed for silkworm. Several studies have been carried out on foliar constituents of the food plants of muga silkworm, *A. assamensis* (Dutta *et al.*, 1997; Hazarika *et al.*, 1995, Neog, K., 2012, Sarmah *et al.*, 2013), tasar silkworm, *A. mylitta* (Kohli *et al.*, 1969; Sinha and Jolly, 1971; Sinha *et al.*, 1992), oak tasar, *A. proylei* (Sinha *et al*, 1986; Banerjee *et al*, 1993) and eri silkworm (Pathak, 1988; Shaw, 1998). Goswami *et al.* (2011) studied the feeding response and rearing performance of *A. assamensis* on the different genotypes of Som (*Persea bombycina* Kost). Chandrasekhar *et al.* (2013) reported the varietal variation of Castor in terms nutrition to feed the eri silkworm. Merenjungla and Kakati (2013) investigated the seasonal variation of nutrient contents in tender, semi-tender and mature leaves of four host plants of eri silkworm in Nagaland condition.

In the present investigation, it was observed that, young eri silkworm larvae settled more on the tender and medium leaves of all host plants except in the case of

Borkesseru. Maximum settling per cent was observed in the tender and semi-mature leaves of Castor and Borpat. Preference of tender and semi-mature leaves of host plants by the eri silkworm larvae may be due to the higher content of β-sitosterol, protein, carbohydrate, total phenol, phytic acid, *etc*. Moreover, as a whole, 'Borpat and Castor' were found to be superior in most of the chemical constituents under study (Table 27). The similar findings were also reported in case of "Som" plant, a host plant of muga silkworm by Neog *et al.* (2011). In case of semi mature leaves, young larvae were more attracted towards Borkesseru, as such leaves possessed higher percentage of some stimulatory chemicals like crude protein and chlorogenic acid. Semi-mature leaves possess comparatively lower trypsin inhibitor activity which may be another reason for such preference. There may be more accumulation of other stimulating substances like essential oils, phenolic compounds, alkaloids *etc*. and lesser content of deterrents like azaindole (Choudhury *et al.*, 2006) on the semi-mature leaves which have strong positive effect eliciting attraction of the larvae towards such leaves.

It was also observed that, when eri silkworms were reared on only a definite maturity group of leaf from brushing till spinning, a reduction in survival percent was noticed for all the host plants. The silkworms need particular age of leaf for its different larval instars and it is generally accepted that, newly hatched larvae prefer tender leaves, 2^{nd} and 3^{rd} instar larvae prefer semi-mature leaves and 4^{th} and 5^{th} instar larvae prefer mature leaves. House (1974) inferred that for optimum nutrition in insects, some balance is needed between the main classes of nutrients such as proteins, carbohydrates, lipids, vitamins etc. Quantitative requirements for each nutrient and consequently the required balance of nutrients can vary within and between species owing to many factors including the synthetic abilities of the organisms and metabolic activities involving specific interrelations between certain nutrients.

One of the most important components of silkworm feed is the minerals which also influence their growth and survival. Minerals like phosphorus and calcium are essential for gaining body weight by the larvae. Minerals are not synthesized within insects although they are essential nutrients and affect various metabolic processes. The inorganic part of the food is constituted by different minerals and their balance in the diet has an essential role in successive development of insects (House, 1974). There are similarities in dose requirements of each element among insect species, and mulberry leaves contain the adequate amount of minerals to maintain good growth of silkworm, *B. mori* (Horie, 1978). Sinha *et al.* (1992, 2003) reported that the contents of total minerals and crude fibre increases with the maturity of leaves in all the primary food plants of tasar silkworm *A. mylitta* Drury viz., *Terminelia arjuna, T. tomentosa* and *Shorea robusta*.

Crude fibre is the ash free material and reduction in the fibre content had been established as an advantage for better silkworm crop yield (Vasuki and Basavanna, 1969). It comprises largely of cellulose and lignin and these substances belong to polymeric carbohydrates, which cannot be digested by silkworm larvae. Fibre is not grouped under nutrients, but its intake along with all diet is essential because of regulatory function and help to maintain the normal peristaltic movement of the intestine to remove waste product from the intestine. Reduction in total mineral and fibre content had been established as an advantage for better silkworm crop yield (Vasuki and Basavanna, 1969; Neog, 2011). Bose *et al.* (1991) reported that succulent mulberry leaves with less fibre and higher mineral contents stimulate the metabolic activities in silkworm resulting in quantitative improvement in cocoon and silk. Merenjungla and Kakati (2013) reported that Kesseru exhibited the highest content of crude fibre and cellulose. In the present study, crude fibre content exhibited an increasing trend with maturity of leaves, and higher crude fibre content was observed in the leaves of Kesseru and lower in Castor, Borkesseru and Borpat. Shaw (1988) also reported that Borpat and Borkesseru contained the lower amount of crude fibre. It may be due to the translocation of minerals from the soil and longer accumulation in the comparatively aged leaves (Sinha *et al.*, 2003).

The role of proteins and amino acids in silkworm nutrition has been emphasized by Fukuda *et al.* (1959) and Takeuchi (1960). Nitrogen is the most distinguishing chemical element present in proteins which in turn are the most ubiquitous organic nitrogenous compound in food stuff and in all living cells. In fact, they appear to be involved in practically all the structure and functions of all cells (Mallette *et al*., 1960). The green leaves of plants are good sources of protein and may supply most of the essential amino acids required by growing cells. Nitrogen as protein and non-protein nitrogenous matter present in the food plant leaves is responsible for healthy growth of silkworm as silk substances consist of protein. Chandrasekhar *et al.* (2013) reported that higher protein content in local genotypes (34.56%) which was higher than other hybrid varieties. Merenjungla and Kakati (2013) reported higher content of protein in castor than tapioca, payam and kesseru. Kaleemurrahman and Gowri (1982) reported that total protein in castor was in the range of 10.33 % to 28.72% whereas in borkesseru, it was 7.42% to 12.80%. Sarmah *et al.* (2011) also reported mean crude protein content of 10.18 % in 8 different accessions of castor. Dutta (2000) described the crude protein content of castor in the range of 12.82% to 15.23% in respect of different maturity and seasons. In the present study, crude protein content was found maximum in Borpat leaves in the range of 12.48 % to 14.39 % followed by castor leaves in the range of 10.64 % to 12.15% of which the highest was in tender leaves. Hence, the present findings are in the conformity with reports of previous workers.

Carbohydrates, particularly reducing sugars are very important for growth and development of silkworms. Carbohydrates are utilized by the silkworms for energy source and for synthesis of both lipid and amino acids (Neog, 2011). These are very important for healthy growth of silkworm; especially they are effective for keeping healthy growth of early stage larvae. Some sugars possess a gustatory stimulation effect on larval feeding of the silkworm (Ito, 1960). The carbohydrates are generally the most effective in increasing fat body glycogen. The rate of increase of fat body glycogen and haemolymph trehalose is also dependent on the content of carbohydrate in diet (Horie, 1978). Yadav and Goswami (1992) reported an average of 4.85% and 4.71% total sugar content in the leaves of Som and Soalu, respectively, but higher in medium leaves. Neog (2011) reported a decreasing trend of total soluble sugar content for all the host plants of muga silkworm as per increasing trend of maturity. Merenjungla and Kakati (2013) reported higher content of carbohydrates in Payam as compared to Kesseru and

Castor. Chandrasekhar *et al*. (2013) reported that total carbohydrate content in Castor is in the range of 32.96% to 53.61%. Kaleemurrahman and Gowri (1982) reported total carbohydrate content in the range of 38.09 % to 43.81% in Castor depending on the different maturity level whereas in case of Borkesseru, it was 37.33%. Sarmah *et al.* (2011) reported total carbohydrate content ranged from 18.89±2.8% to 27.25±3.0 % in different accessions of Castor. In the present study, the highest total carbohydrate was recorded in castor leaves ranging from 35.12% to 41.04% in different maturity levels followed by Borpat (35.12% to 41.04%), whereas in Borkesseru the same was in the range of 29.75% to 33.52%. The role of higher content of carbohydrate in the leaves of Castor and Borpat on rearing is manifested by the shorter larval period, higher larval weight, cocoon weight and ERR. The present findings are in agreement with Kaleemurrahman and Gowri (1982) and slight variations with other reports might be due to variations in location, soil and climatic conditions.

β-sitosterol and β -d-glycoside of β -sitosterol present in mulberry leaf plays the role of a biting factor (Goto *et al*., 1965; Hamamura *et al*., 1962). First instar muga silkworms were reported to be more attracted towards tender leaves of *P. bombycina* (Chakravorty *et al*., 2004) and higher ß-sitosterol content may be the reason for the attraction of the larvae as this compound acts as biting factor for *B. mori* (Hamamura *et al*., 1962; Hamamura, 2001). Rajanandh and Kavita (2010) reported that β-sitosterol in *Moringa oleifera* may be responsible for hypolipidemic, and as well as antioxidant properties. Neog *et al*. (2011a) reported that β-sitosterol content exhibited a decreasing trend with the increase in maturity level, the highest being in tender leaves of Som (1.06%). It was also reported that first instar muga silkworms were reported to be more attracted towards tender leaves of *P. bombycina* which is due to the higher ß-sitosterol content in these leaves. In the present study, the β-sitosterol content also increased significantly with the increase in maturity level irrespective of food plants except in case of Borpat and Castor where its content decreased in mature leaves. In case of tender leaves, the castor contained the highest β-sitosterol content (36.40 mg/g) followed by Borpat (31.43 mg/g). In the semi-mature leaves, the highest content was recorded in Borpat (69.63 mg/g) followed by Castor (66.58 mg/g). This may be one of the reasons why the eri silkworms are attracted most towards the tender and semi-tender leaves of Castor as well as Borpat.

Secondary metabolites are organic compounds that are not directly involved in the normal growth, development, or reproduction of organisms. Unlike primary metabolites, absence of secondary metabolites does not result in immediate death, but rather in long-term impairment of the organism's survivability, fecundity, or aesthetics, or perhaps in no significant change at all. Secondary metabolites are often restricted to a narrow set of species within a phylogenetic group. Secondary metabolites often play an important role in plant defense against herbivores and other interspecies defenses. Secondary metabolites are chemicals produced by plants for which no role has yet been found in growth, photosynthesis, reproduction, or other "primary" functions. These chemicals are extremely diverse and a large number have been identified in several major classes. Secondary metabolites play a major role in the adaptation of plants to the changing environment and in overcoming stress constraints and secondary metabolites through their diversity of functions can be involved in the non-enzymatic plant defense strategy (Edreva *et al*., 2008). The apparent lack of primary function of these compounds in the plant, combined with the observation that many secondary metabolites have specific negative impacts on other organisms such as herbivores and pathogens, leads to the hypothesis that they have been evolved because of their protective value.

Estimation, importance and biological relevance of secondary metabolites on the cocoon production of mulberry silkworm, *B. mori* are well documented. Sterol compound, β-sitosterol and β -d-glycoside of β -sitosterol present in mulberry leaf plays the role of a biting factor (Goto *et al*., 1965 and Hamamura *et al*., 1962). Terpene compounds, terpinyl acetate, linalyl acetate, linolool and citral act as attractants for *B. mori* (Hamamura *et al.,* 2001). Plants need phenolic compounds for pigmentation, growth, reproduction, resistance to pathogens and for many other functions.

One phenolic acid, chlorogenic acid, is reported to have strong growth promoting action and a role in moulting of *B. mori* larvae. The acid is indispensable for normal growth of the silkworm on a synthetic diet.

Phenols comprise the largest group of plant secondary metabolites found in both edible and non-edible plants. These compounds have been represented to have multiple biological effects including antioxidant property. Hazarika *et al.* (1995) reported that good quality plants (as identified on the basis of rearing performance) showed higher total phenol content, which ranged from 1.98% in least preferred leaves to 6.26% in most preferred genotypes of *P. bombycina*. Phenolic compounds are important in several respects during the development of *B. mori*. Apart from acting as biting factors, morin and chlorogenic acid enhance the rate of development, especially in the early stages (Kato, 1978). Naito and Hayashiya (1965) isolated chlorogenic acid from mulberry leaves and noted that it is also a "biting factor" of *B. mori*. Chlorogenic acid acts as a biting factor for mulberry silkworm, *B. mori*. It is indispensable for normal growth of the silkworm on a synthetic diet. Chlorogenic acid could not be replaced by phenylalanine, tyrosine or dihydroxy-phenyl-alanin, which has commonly been proposed as precursors of the polyphenols. Because of this, phenolic compounds were used in the synthetic diet of young larvae and confirmed the growth promoting action of chlorogenic acid (Hamamura, 2001). In the present investigation, the total phenol content was found the highest (2.49 mg/g) in mature leaf of Borkesseru which was statistically at par with Castor (2.40 mg/g) whereas the lowest (0.97 mg/g) was recorded in semi-mature leaves of Kesseru. The highest phenol contents were recorded in the mature leaves irrespective of type of all the host plants followed by tender and semi-mature leaves. Among the tender leaves, the Castor contained the highest total phenol content (2.11 mg/g) followed by Borpat (1.78 mg/g) and Borkesseru (1.46 mg/g). Chlorogenic acid content in the leaves of Borkesseru was more in mature leaves (1.79%) compared to tender or mature leaves. Hence, to establish the complex role of chlorogenic acid in eri silkworm as a biting factor needs further detail studies. However, it is evident from the present study that the total phenol content had definite role in enhancing growth and feeding efficiency in eri silkworm which is in conformity with that of muga silkworm as reported by Hazarika *et al.* (1995).

Lignins are phenolic polymers present in the cell walls of plants which together with cellulose are responsible for the stiffness and rigidity of plants stems. It acts as a physical barrier against invading pathogens. Lignin also plays significant role in the carbon cycle, sequestering atmospheric carbon. A close relationship between lignifications and disease resistance demonstrated in a number of experiments showed that pathogen resistant plants accumulated lignins more rapidly and/or exhibited enhanced lignin deposition as compared with susceptible plants (Sticher *et al.*, 1997; Nicholson and Hammerschmidt, 1992; Vance *et al.*, 1970; Lewis and Yamamoto, 1990; Yates *et al.*, 1997). Similarly, the presence of highest content of lignins in the mature leaves of Borpat (11.07 % to 16.95%) followed by Borkesseru (8.78% to 13.85%) as observed in the present study might have influenced disease resistance in the eri silkworms as evidenced by the higher ERR of the silkworms reared on such leaves. The present findings are in agreement with various researchers worked on medicinal uses of *Ailanthus* trees.

Tannins are secondary metabolites of plants, non-nitrogenous, phenolic in nature and are present in all plant materials. It gives immunity to seeds attack by birds and diseases; they on the other hand display impaired nutritional quality, lower digestibility and reduction of food consumption. The tender leaves of Som possessed significantly higher tannin content (6.71%), while semi-mature and mature leaves of Diglotti possessed higher tannin content. Soalu leaves of all maturity levels contained significantly higher lignin content (Neog *et al.*, 2011a). In the present study, the highest tannin content was recorded in Castor (1.33% to 2.40%). Tannins are usually considered to be anti -herbivore chemicals forming indigestible complex compound with protein which however might not play significant role as anti-herbivore in case of Castor. However, the significant lower tannin content was recorded in Barpat, Borkesseru and Kesseru compared to Castor.

Phytic acid (myo-inositol hexaphosphate) is a common storage form of phosphorus in seeds and is considered as an antinutritional factor. It also interferes with calcium and iron absorption and phosphorus in phytic acid is not nutritionally available to monogastric animals. Phytic acid constitutes 1-3% of most plant seeds. The content of this acid in *P. bombycina* leaves has been recorded in an increasing trend with maturity level being significantly the highest in mature leaves (Neog *et al.*, 2011a). Similar trends were also observed in Castor, Borpat and Kesseru leaves in the present study. The highest phytic acid content was recorded in Castor from 2.14 mg/g to 4.08 mg/g in different maturity levels.

Crude fat is a collective term including fats, oils, waxes and plant pigments in feeds which is measured using high temperature petroleum spirit extraction. True fat provides approximately 2.25 times more energy than carbohydrates and proteins. Hence, it is the good source of energy for silkworm for their growth and development. Shaw (1998) analyzed the chemical composition of three *Ailanthus* species in relation to growth, nutrition and cocoon characters of eri silkworm and found higher amount of crude fat in Borpat (*A. grandis*). Dutta (2000) estimated the crude fat in different castor varieties with highest level of 6.52% in non-bloomy red variety. In the present study, the highest crude fat was recorded in all types of Castor leaves (6.93% to 8.10%) followed by Borpat leaves (5.48% to 7.60%) which caused the superiority of both the plants for eri silkworm rearing. The present findings were in conformity with Dutta (2000) and Shaw (1988).

Since protease inhibitors constitutes a significant part of the chemical changes that occur during development of plants leading to increased resistance against herbivores (Gatehouse *et al.*, 1999), it is an ideal biochemical marker for selecting host plants of enhanced feeding. These are class of compounds found in a wide range of plant families and are studied for their activity as anti-herbivore compounds. In tasar silkworm host plant *Terminalia arjuna*, Rai *et al.*, (2006) observed maximum protease inhibitor activity in young leaves and lowest in mature leaves while semi-mature leaves showed intermediate protease inhibitor activity between that of young and mature leaves. They supported the optimal defence theory which argues that defence metabolites are allocated preferentially to tissues with high fitness value and a high probability of attack. Young leaves, stem and reproductive parts tend to have the highest concentration of defence metabolites, whereas roots and older leaves the lowest. The selective feeding of all the instars ranging from 1st to 5th instars on semi-mature leaves is a kind of strategy adopted by tasar silkworm for its optimum survival and coexistence with the host plant. Neog (2011) reported that maximum protease inhibitor activity was exhibited by the tender and semi-mature leaves compared to the mature leaves. The present study also revealed significantly highest protease inhibitor activity in the tender leaves of all host plants, which decreased with the advancement of maturity levels of leaves except in the case of semi-mature leaves of Borkesseru which leaded to selective feeding of silkworms.

In the present investigation, it has been revealed that, for the entire nutrient constituents as a whole, Castor and Borpat were superior over other host plants irrespective of season and type of leaves which is evidenced by the highest preference of this plant for eri silkworm rearing. Tender leaves of Castor which possessed significantly the highest amount of total carbohydrate, β-sitosterol, total phenol, tannin and trypsin inhibitor activity followed by in tender leaves of Borpat. However, the tender leaves of Borpat possessed the highest content of crude protein and lignin. Comparative analysis reflected that among the semi-mature and mature leaves of different food plants, the Borpat leaves were nutritionally more balanced and superior in terms of nutrient contents.

While rearing of the eri silkworm on different host plants during different seasons, it was observed that, Castor (I-II instar larva) in combination with Borpat (III-V instar larva) was the best combination of food plant in respect of higher larval weight, single cocoon weight, single shell weight, cocoon yield per dfl, ERR, cocoon shell yield per 100 dfl and the lowest larval period. The next best treatment was rearing of eri silkworm feeding Borpat leaves from brushing till spinning of eri silk. This is certainly because of the superiority of Castor and Borpat leaves at all maturity levels as discussed earlier. The findings of the present study were in conformity with the reports of Chowdhury (2004), Phukan (2006) and Shaw (1988).

Silkworms fed with Castor in combination Borpat leaves exhibited heavier larval weight and shorter larval duration during July- August crop which may be due to higher nutritional efficiency as well as high moisture retention capacity of Borpat as compared to other food plants. Besides, the environmental temperature had direct influence on the larval duration which is negatively correlated (Kumar and Elangovan, 2010; Verk *et al*., 2009). Sarmah *et. al.* (2013), reported the highest larval weight of 7.32 g in eri silkworm feeding Castor. The present study revealed the highest larval weight of the eri silkworm (7.61 g) fed with Castor in combination Borpat leaves. Food plants played a significant role for silkworm rearing and acquiring commercially important characters *viz*. effective rate of rearing (ERR), Silk ratio (SR), larval growth pattern and fecundity of muga silkworm (Neog, 2011). The shorter larval duration facilitated the less investment in rearing as well as more crops per annum.

The single shell weight , single cocoon weight, Cocoon yield per dfl and ERR were also recorded the highest in the treatment of silkworms fed with Castor in combination Borpat leaves (T_2) which was at par with Borpat leaves alone ((T_1). The quality, rate and quantity of food ingested by an insect larva influence its growth rate, development, final body weight and survival (Slansky and Scriber, 1985). There is correlation between the amount of mulberry leaves eaten by the silkworm and the silk protein in the silk gland and the eggs laid by the silk moth (Fukuda, 1960, Fukuda *et al*., 1963). The relationship between the amount of food intake and cocoon productivity of mulberry silkworm have been studied (Takano and Arai, 1978). Shaw (1988) reported that *A. grandis* emerged out as the most efficient host plant for rearing of eri silkworm as it contributed maximum to the larval growth rate, approximate digestibility (AD), efficiency of conversion index (ECI), efficiency of conversion of digested food (ECD) and all larval growth and economic cocoon characters of the silkworm than *A. excelsa* and *A. altissima.* The higher ERR or survivability rate of eri silkworm fed with Borpat or Borkesseru leaves might be attributed by the presence of antifungal, antibacterial and anti protozoan properties present in it as reported by Ogura *et al.* 1977; Shrimali *et al.* 2001; Joshi *et al.* 2003b and Chowdhury, 2006.

The highest cocoon shell yield per 100 dfls was recorded as 14.36 Kg during July- August season with average single shell weight of 0.52 g and effective rate of rearing of 90.15% in T_2 with significant variation within seasons and among the different treatments and the seasonal mean of the same treatment was 11.05 Kg which was at par with T_1 (9.83 Kg). Sarmah *et al.* (2013) reported the highest single shell weight of 0.47-0.53 g in case of castor fed worm. The productivity level of eri cocoon shell yield was 8 Kg per 100 dfls in the state sericulture farms. Hence, it indicated the cocoon shell yield improvement of 43.75% in T_2 (Castor + Borpat) and 22.86% in T_1 (Borpat alone). The comparative fresh leaf biomass productivity (MT per ha) was recorded highest in Borpat (33.45±2.45) followed by Borkesseru (28.24 ±1.23) and Kesseru (21.24±0.57). The lowest biomass production was recorded in Castor i.e. 11.45±0.67 MT/ha. It revealed that Borpat produced higher fresh leaf biomass of 57.48% and 192.14% in comparison with Kesseru and Castor, respectively. In case of Borkesseru, the annual biomass production was more by 33.15% and 146.64%. In eri silkworm rearing, more than 80-85% of food is consumed by 4th and 5th instar larvae (Sarmah *et al.*, 2013). Hence, substitution of Castor with Borpat leaves in 3rd instar onwards or rearing with Borpat alone from brushing till spinning would make the sector sustainable and economically vibrant among the primary stakeholders.

The treatment T_2 performed better in grainage or seed production parameters such as, moth emergence (%), fecundity, hatchability and Cocoon: dfl ratio as compared other treatments. The highest moth emergence (%), fecundity, hatchability (%) and Cocoon: dfl ratio of 93.72%, 373, 95.5% and 2.65:1, respectively was recorded in T_2. This might be due to healthy larval growth and spinning of larva on feeding the Castor and Borpat leaves which in turn helped in emergence of healthy moths. In muga silkworms, it has been found that variety of food plant fed by the larvae have significant effect on grainage performance (Singh and Goswami, 2012).

The treatments T_2 and T_1 also emerged superior in terms of post-cocoon parameters such as low boil of loss (%), low waste (%) and higher spun silk recovery (%). The highest boil off loss was recorded in Kesseru based treatments whereas it was lowest in Borpat and Borkesseru based treatments. It might be due to less sericin content in the cocoons of Borpat and Borkesseru fed silkworms. Further, lower boil off loss in Borpat and Borkesseru fed eri cocoons contributed higher yarn recovery with highest level of 86.70 % in T_2. Similarly, the waste (%) was also much lesser in the T_2 as compared to other treatments.

The results of field trial covering large number of farmers revealed that the better performances in terms of economic attributes such as hatchability, mature larval weight, cocoon yield per dfl (No.), cocoon yield per dfl (g), ERR (%), single cocoon weight (g), single shell weight (g) and shell ratio (%) as compared to laboratory data. The cocoon shell yield per 100 dfls was 13.07 Kg which was higher than laboratory data of 10.79 Kg observed during April-May season. This might be due to soil and climatic conditions and natural adaptability of the tree in the selected trial area.

Table 27. Leaves of host plants at different maturity level containing significantly higher level of chemical constituents

Sl. No.	Chemical constituents	Maturity Level: Tender	Semi-mature	Mature
1	Carbohydrate	Castor & Borpat	Castor & Borpat	Castor & Borpat
2	Crude protein	Borkesseru	Borkesseru	Borkesseru
3	Crude fibre	Kesseru	Kesseru	Kesseru & Borpat
4	Total Phenol	Castor	Castor	Borkesseru & Castor
5	Tannins	Castor & Borpat	Castor	Castor
6	β-Sitosterol	Castor & Borpat	Borpat & Castor	Castor & Borpat
7	Crude fat	Castor & Borpat	Castor & Borpat	Castor
8	Chlorogenic acid	Kesseru	Kesseru & Borkesseru	Borkesseru & Castor
9	Phytic acid	Castor & Borpat	Castor & Borpat	Castor
10	Lignin	Borpat	Borpat	Borpat
11	Trypsin inhibitor	Borkesseru & Kesseru	Kesseru & Borkesseru	Kesseru & Borkesseru