CHAPTER-1

FOOD UTILIZATION BUDGET

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FOOD UTILIZATION BUDGETS

1.1 INTRODUCTION:

Food and water intake and utilization provides an introduction to the study of energy transformation in an organism. It is becoming increasingly apparent that both food and water utilization information are needed to gain a deep sense of the functional properties of the animals food energy in the most important concept of thermodynamics.

Bioenergetics is a powerful tool to study incremental impact on organisms (Brody, 1945; Kleibor 1961. Vernberg, 1971). Bioenergetics studies are made at three different levels; a) molecular level; b) organism level Shroedar 1971, 1973i Muthakrishnan and Delvi, 1973) and c) population and ecosystems levels weigert, 1965, Lawton 1969, 1971. Stockner 1971; Delvi and Pandian, 1979; Palavesam and Muthukrishnan, 1992. Among invertebrates, extensive studies have been made on the Bioenergetics of insects. The contribution of Hiratsuka (1920) on Bombyx mori is by far the most complete study on food utilization carried out on insects.

Understandably, the association of insects with man his cultivated crops and pet animals directly or indirectly is responsible for this. Behavioural and physiological strategies of food selection, consumption and utilization are species specific and widely vary with the tropic level to which the consumer belongs to the strategies can be better understood if they are compared with those followed by phyto-genetically related animals [Emlen, 1966, 1973, Ricklefs, 1973].
As “Change is the law of life”. The changed life stage of man from nomadic to settlement is community necessitated the domestication for animals and cultivation of plants, while achieving green revolution, in crossing the hurdles of pests to prevent loss of production (Brown, 1978) and to combat pests menace synthetic chemicals were invented.

Different food plants considerably influence the food consumption in insects (Soo Hoo and Fraenkel, 1966; Premaleela, 1986). Lack of adequate knowledge of nutritional physiology has hampered predictive capabilities about pest management (Scriber and Slansky, 1981). Sufficient energy and nutrients are necessary for an insect to moult and/or undergo metamorphosis pupae and adults belonging to the class lepidopteron are significantly effected depending upon their nutrition during the larval stages (Radhakrishna and Delvi, 1987, Srivastava, et.al., 1988).

Lepidopteran larvae exposed to fluctuating environmental conditions like temperature, photoperiod, reaction levels and presence of minute levels of insecticides in their food have shown remarkable capabilities to modify one or more parameters in moulting or metamorphosis (Radhakrishna and Delvi, 1987). Information regarding the success of terrestrial insects has been provided by Delvi (1972). Among the external factors nutritional quality of leaf is the most important factor that influence pupation (formation of the cocoon/silk) adult emergence and fecundity in silkworms like *P. ricini, B. mori*.

Legay (1952) reared silkworm in continual feeding and strictly controlled conditions, in order to appreciate the value of habitual check rearing (Four meals a
day at 22° c), the result mainly concerns with weight and time of development and
it showed different reactions with reference to growth, weight and yield, many
unequal were found with such experiments.

Fortification of mulberry leaves by supplementary nutrients Kamaraj et al.,
1972), while feeding silkworm is a new and useful approach in the rearing of the
silkworm B.mori. It has been shown that single cell protein from the algae
Spirulina fusiformis and Chlorella protothecoides fed to silkworm B. mori leads to
utilization of hydrolysate efficiently by Silkworm (Mathavan et al., 1984.

The problem of major environmental pollutants is authenticated by the rapid
industrialization which is fast transforming air, water and soil into natural reservoirs
of pollutants (Hodges, 1973). A large number of studies carried out in India and
abroad reveal that the major pollutants is the original form are often harmful to the
germination of the seeds and later to the growth of crops due to one or the other
reasons (Sachn and Menon, 1976; Arceivale, 1981 Chowdary et al., 1987; Dayma,

The toleration level of different plants when exposed to different antibiotics
has not been worked out. As the antibiotics have adverse effect on the flora, and
fauna. It is necessary to know the effect of the antibiotics on the food and water
utilization budget. The aim of the present work is to study the energy budget
related to food and water intake in three different antibiotics on Eri silkworms
Samia, Cynthia ricini (p.ricini).
1.2 REVIEW OF LITERATURE:

The growth promoting effect of antibiotics has been demonstrated in form animals and birds (Carpenter, 1951; Stoksted and Jukes, 1951; Clam and Couch, 1951). However, the Mechanism of action of antibiotics is still incompletely understood. There is controversy as to whether the antibiotics acts entirely through its antibacterial property or by affecting favourably the physiology and metabolisms of the host organisms itself. In the latter event, it mainly be aspected to manifest and by an increase in the feed efficiency or by the activation of enzymes or through harmonious which control and regulate growth (Broade et al., 1953; Stoksted, 1954).

Previous reports have shown the growth promoting activity exerted by chloromycetin, ampicillin in the larvae of the silkworm. It has also been shown that an increased field of silk protein occurs when an extra nitrogen source is provided along with the antibiotic to the silkworm diet (Murthy and Sreenivasaya, 1953 and 1954; Sharada and Bhat, 1956).

Further more, evidence has been provided in a report (Shyamala and Bhat, 1955) on the activation of the glutarnic-aspartic acid transmilmnase in the tissues of the Eri silkworm on Chloromycetin supplementation.

A great deal of work has been carried out in arthropods especially in insects. This is due to the impact of useful and harmful insects on man. His crops and domestic animals. Studies on herbivorous insects. (Price, 1975; Petrusewicz, 1970) and Sangivores insects (Friend and Smith, 1977; Longley, 1966) have proved the
climatological and physiological dependence. Energy budgets. A good amount of information on food and water utilization budgets of the silkworm *Bombyx mori* (Radhakrishna and Delvi, 1987; Hanumappa and Delvi, 1989) and on *philosamia ricini* (Pasha and Delvi, 1989; Radhakrishna et al., 1988) has been provided. Further work by the same team of workers on effect of insecticides permethrin, sumithion ad tafethion) temperature regimes, water utilization and photo and scotoperiods have been greatly depicted in their complete bio-energetic chart over normal bioenergetic conditions (Delvi, 1983; Naik and Delvi, 1984, 1997; Radhakrishna and Delvi, 1988; Hanumappa and Delvi, 1989; Asiya and Delvi, 1998a, 1998b, 1999).

Bioenergetics comprises energy transformation in living organisms and growth, which is a broad of various physiological functions. To understand the action of zero biotics, qualitative and quantitative changes in metabolisms are studied at the level of organisms (Metcalf et. al., 1983).

Quality of caster leaf (*Ricinas communis*) is one of the major factors deciding the healthy growth of Eri silkworm and success of cocoon crop. The quality of leaf is influenced by a number of factors, such as variety, cultivation practices, incidence of pests and diseases, method of harvesting and preservation of leaves. Hussain and Elsharway. 1962: Narayanan et al., 1967; Krishnaswamy et al., 1970, Koul et al, 1980; Shastry et al., 1988). The growth and development of Eri silkworm larvae and the Economic characters of cocoons are known o be influenced by the nutritional content of Mulberry leaf (Krishnaswamy et al., 1971) quality of
Mulberry leaf is one of the most important factors governing the production of good cocoon crops (Ravikumar, 1988).


Literature is also available on the effect of food deprivation on silk production by Radhakrishnan et al., 1985, comparative food consumption and utilization, percentage, pupation and silk production on various varieties of mulberry (Sharma et al, 1986), food utilization in different races by Naik and Delvi, (1987); food utilization efficiency by Kuribayashi et al., (1990); Effect of deprivation on dry matter utilization by Nath et al., (1990), nutritional efficiency by Anantharaman et al., (1993); Correlation between food ingestion, utilization and quantitative breeding traits by 'Izenoo et al., (1995), Food conversion efficiency of improved multi-voltine hybrid by Trivedi and Nair, (1999), Enormous literature is
available on food consumption and its utilization by insects viz., Kelekowski et al., (1967) Schroeder (1971); Delvi and Pandian (1971); Sribber and Slansky (1981) Slansky (1982), effect of Photo-periodism including effect of different wavelengths and intensity have been studied by Kamm (1972), Wallace and Sullivan (1972); Cymboroski and Giebwtowicz (1976); Saunders (1976); Schroeder and Steinhauber (1976); Soloman et al., (1977); Ali and Salem (1978); Beek (1980); (1977); Premaleela (1986).

Effect of food quality on the bio-energetic have been studied by Engelmann (1963); Lawton et al., (1975); Sribber et al., (1975); Bailey and Mukharji (1976); Downor and Mathews (1976); Brown and Fitzpatrick (1978); Slansky (1979); Joshi and Misra (1985).


A survey of the papers on bioenergetics of insects published over the last few decades reveals that the aspect of the role of antibiotics on food and water utilization in insects have not received much attention. In the light of information presented above, the present study on, *Samia cynthia ricini* was the present experiments conducted in order to determine the influence of Ampicillin, chloromycetin, ciproflaxacin, on the feed efficiency and digestibility of the Eri Silkworm was undertaken with the following objectives.
1. To study the rate of growth, and to estimate the rates and efficiencies of utilization of food energy as function of concentration of ampicillin, chloromycetin, ciproflaxocin.

2. To estimate the rates and efficiencies of food consumption and utilization in the different at normal conditions and

3. To estimate the rates and efficiencies of food intake and utilization in *Samia, cynthia ricini* as function of concentration of ampicillin, chloromycetin, ciproflaxocin.
1.3 MATERIALS AND METHODS:

Eri Silk Worm Samia Cynthia ricini were selected for the study of food consumption and utilization.

Disease free layings of eggs were obtained from (Gandhi Krishi Vignana Kendra) G.K.V.K. (in the Department of Sericulture). After the Incubation period of 10 days. The freshly hatched larvae were brushed to Enamel trays (36 x 26 x 40) and transferred to a disinfected rearing laboratory. The laboratory was equipped with proper ventilation, temperature of 26± 2° C and 80±10% relative humidity was maintained through out the experiment.

The brushed larvae were fed caster (Ricinus communis) four times a day at 6.00 A.M. 11.00 A.M. 3.00 P.M. and 8.00 P.M. the brushed. Larvae were record till third instar on fresh leaf of Caster Ricinus communis and after the third instar, the moulted fourth instar larva were triplicated with 50 larvae in each group for the experimental study. They were transferred to enamel trays (36 x 26 x 4 am) covered with paraffin paper to prevent loss of water from the leaf bed. Wet rubber foam strips were provided at 4 sides of the tray to maintain the humidity level.

The try was also provided with double cages (2° x 1, 5° x 1, 5°, to prevent the attack of Uzi fly (Tricholygia bombycis).

The antibiotics was collected from a nearly antibiotic Research Centre at Bangalore. Three sets of Experiments were conducted in each group [Ampicillin, Chloromycetin, Ciprofloxocin]
Amoxicillin

Amoxicillin\textsuperscript{1,2,3} is designated by Chemical Abstracts as D-2-amino-2-phenylacetamido)-3, 3-dimethyl-oxo-4-thia-1-azabicyclo-[3.2.0] heptane-2-carboxylic acid. Amoxicillin is also known as 6\textsubscript{[D(-)-\alpha-aminophenylacetamide]} penicillanic acid, D(-)-\alpha-aminobenzylpenicillin\textsuperscript{4} and \alpha-aminobenzylpenicillin\textsuperscript{5}.

Formula and Molecular Weight

![Molecular Structure of Amoxicillin]

\[
\text{C}_{16}\text{H}_{19}\text{N}_{3}\text{O}_{8} \quad 349.41
\]

Chloramphenicol Palmitate (30.36)

Scheme 30.11
Properties and uses:

It occurs as a fine, yellowish-white, needle-like crystals. It is slightly soluble in water and has a bitter taste. Chloramphenicol was first isolated in 1947 from a soil sample collected in Venezuela from Streptomyces venezuelae. It contains a nitrobenzene moiety and is a derivative of dichloroacetic acid. Since, it has two chiral centers, four isomers are possible. However, only the natural isomer, the thereto is the biologically active form. Replacement of phenyl group results in loss of activity except nitrothienyl derivative. The p-nitro group can be substituted by strong electron-withdrawing substituents like acetyl (CH3O-), methylsulfonyl (CHSO2-) without appreciable loss of activity. The 2nHCOOCF3 derivative is 1.7 times as active as chloramphenicol. Shifting of p-nitro group to other positions reduces activity. Substitution of the dichloroacetyl group by acyls such as azidoacetyl (CH2N3) results in active compounds. The propanediol moiety should be present in three configuration.

Mode of Action: Chloramphenicol inhibits protein synthesis in bacteria. It acts primarily by binding reversibly to the 50s ribosomal subunit and appears to prevent the binding of the amino acid containing end of aminoacyl tRNA to the acceptor site on the 50s ribosomal subunit. The interaction between peptidyl transferase and its aminoacid substrate cannot occur, and peptide bond formation is inhibited.
Ciprofloxacin (Cipro: Floxip-Max India, Cifran-Ranbaxy): 1-cyclopropyl-6-fluoro-1, 4-dihydro-4-oxo-7-piperazine Synthesis (Scheme 22.16).

Properties and uses:

It is very effective for the treatment of urinary tract infection and prostatitis and for acute diarrheal disease caused by E. Coli, Shigella, Salmonella, and Campylobacter. It is decidedly better choice over chloramphenicol in enteric fever, and a logical antibacterial for lower respiratory infections. Ciprofloxacin and rifampin should be administered for the treatment of methicillin resistant staphylococci. The bioavailability of ciprofloxacin is 60%. The half-time for elimination is 3 to 4 hours. Antacids reduce the bioavailability of ciprofloxacin.

The castor leaf dipped in the experimental solutions and fresh leaves fed to maintained as control the larvae well fed on castor leaf dipped with 0.2 percent, 0.4% and 0.6% diluted with distillery water.
The mature young caster leaf (Ricinus Communis) collected from B.U.B. Garden, Control and treated plates were red to fourth and fifth instar larvae of ‘Samia Cynthia ricini) p.ricini. The caster leaves were cut into two halves. One half was further cut into two or three pieces with a fine razor, removing the mid rib and fed to the worms. While other half was used at control to estimate the water loss during feeding period. Wald Bauer, 1968, Delvi 1972). Since the Lepidopteran larvae consume 98% of the total food during the fourth and fifth instars Waldbauer, 1968) the mass and water utilization was studied in the fourth and fifth instars of the Eri Silkworm P.ricini.

The experimental larvae were weighed at the initial and also at the pre moult stage in each instar. Growth of laboratory insects (Delvi, 1972) was accessed just before offering the first feed. Few larvae were randomly selected at the beginning of each instar and were weighed to record the wet weight and freeze killed dried in a hot air oven at 100° c. to note the dry weight (Waldbauer, 1968).

The “Sacrifice method” described by Maynord and Looshi (1962 for accessing the growth of laboratory. Mammals and fishes Gerkng 1954, Menzel, 1960, Pandian, 1970 and insects (Delvi, 1972) was employed in the present study.

Conversion of food into body substance was estimated by subtracting the dry weight of the individuals at the beginning of the experiment from that at the termination of the experiment. The sample individuals of the same life stage, nutritional stage and temperature represent the corresponding test individuals at the
beginning and at the end of each experiment. All weight were recorded on milligram dry weight except for the growth expressed in wet weight.

The Eri silkworm faeces, as well as the food offered were weighed on a single pan balance precica 125 SCA with 0.1 mg accurately. The food utilization was analyzed using modified IBP terminology petrusiewicz and Mac Fodyen, 1970) after Scriber and Slansky (1981).

\[ I = B + M + F \]

where

\[ I = \text{Ingested Food} \]
\[ B = \text{Biomass gained} \]
\[ M = \text{Assimilated Food Metabolized} \]
\[ F = \text{Undigested food Excretory Products} \]
\[ B = I - (M + F) \]

The difference between the final weight and initial weight is the growth of insect in each instars food ingested was calculated by subtracting the weight of uneaten food from the weight of food offered. Necessary corrections were made for moisture loss during the feeding period Waldbauer (1968).

The data collected were statistically analyzed with PSS 7.5 and 10.05 computer package.
1.4 RESULTS:

1.4.1 Food Intake

The performance of an insect depends on the quality of food and amount of food intake, utilization, growth and development. Lepidopteran larvae consume more than 98% of the food during penultimate two instars (Waldbauer, 1968). The present study deals with food intake and utilization in Eri silk worm, *Samia cynthia ricini* (Philosamia ricini) during penultimate two instars. The values are expressed in mg dry weight per insect per day, while rates are expressed in mg dry weight/mg live insect/day. Efficiencies alone are expressed in percent.

Consumption of food fluctuated as function of instar period in the larvae fed experimental food and also in the larvae fed control leaf. The fourth instar larvae took five days to complete the larvae period during which the food consumption remained more or less uniform and declined on the last day of moulting. The fifth instar larvae took nine days to complete the larvae period. During which the food consumption progressively increased from the minimum during the first day to the maximum during final day. The consumption fluctuated at each instar level. Maximum amount of food was consumed during fifth instar and minimum during the fifth instar period. The increase in consumption as function of larvae stage was found in all the races of *Bombyx mori* (Delvi and Pandian 1972) while in *S. ricini* for instance, 98.5 mg of dry food was consumed during the fifth instar period which increased to 5392.7 mg during the final instar period.
Effect of antibiotics on food consumption:

Food consumption fluctuated in the larvae fed different selected antibiotics and was dependent on the concentration and type of antibiotics used. For instance in the larvae fed leaf with 0.2% ampicillin, the consumption increase from 98.5 mg at control to 1150.4 mg during fourth instar period. While the consumption increased from 5390.2 mg at control to 5796.4 mg at 0.2% ampicillin during fifth instar. The total food intake in larvae fed 0.2% ampicillin increased from 6391.2 mg at control to 6946.3 mg. Similarly, the food consumption increased in the larvae fed both 0.4% and 0.6% ampicillin. The consumption increased not only as function of concentration of antibiotic and ampicillin but also as function of larval stage. For instance at 0.4% ampicillin feeding the consumption increased from 998.4 mg at control to 1185.7 mg during fourth instar. Similarly the increase was from 5392.7 mg at control to 5798.5 mg at 0.4% feeding. Such an increases in food consumption was also found in larvae fed 0.6% Ampicillin treated leaf. However the percent of difference in the consumption in larvae fed different concentrations of ampicillin from that of the larvae fed control leaf was about 8.7% to 9.8%. Though the total amount of food consumed differed considerably as function of ampicillin concentration from that of the control, the percent of difference did not differ considerably among the different concentration.

The trend of food intake in the larvae fed chloromycetin treated leaf was similar to the intake found in larvae fed ampicillin treated leaf. The consumption increased with the increase consumption of chloromycetin in the food. The larvae fed 0.2% chloromycetin consumed 6.8% more food then the larvae at control. Similarly the intake increased from 7.5% at 0.4% feeding and 8.4% at 0.6%
concentration of Chloromycetin. In the larvae fed ciprofloxacin the total amount of food consumed was lowest in the experimental larval when compared to ampicillin and chloromycetin feeding. The increase in food intake in the larvae fed ciprofloxacin ranged from 5.1% to 6.6% and the increased depended on the concentration of ciprofloxacin. Irrespective of quantum of food consumed the intake increased as functions of larvae period and also function of concentration of the three different antibiotics used (Table-1).

1.4.2 Defecation (Egestion):

Egestion is directly related to the amount of food consumed. Faeces defecated takes place after a definite interval after food intake in Samia Cynthia ricini faeces include negligible fraction of dead cells of gut lining and nitrogenous waste materials represented by (u) uric acid in the undigested food (F). The amount of faeces defecated is specific to instars and depends on the amount of food consumed and the efficiency of digestion. The larvae fed control leaf defecated the least amount of faeces as the larvae consumed lowest food. The faeces defecation in the larvae fed control leaf increased with the increase in the larval period. The fourth instar larvae defecated lowest amount of faeces, which averaged 284.3 mg which increased to 2198.7 mg during the fifth instar. The total amount of faeces defecated during the penultimate two instars was 2483.0 mg at control.

Effect of Antibiotics on defecation:

The total amount of faeces defecated increased in the larvae fed antibiotics. The defecation not only increased as function of larval period but also increased as function of concentration of antibiotics. For instance defecation increased from
284.3 mg in larvae fed control leaf to 302.8 mg in larvae fed 0.2% of Ampicillin during fourth instar. Similarly the increase was 2198.7 mg at control to 2298.5 mg during fifth instar period. As such the total amount of faeces defecated increased from 2483.0 mg at control to as much as 2601.3 mg in larvae fed 0.2% ampicillin during penultimate two instars. The defecation increased as function of ampicillin concentration and reached a maximum of 2710.8 mg during 0.6% Ampicillin feeding. Such increase in defecation was also found in the larvae fed chloromycetin and ciproflaxocin at different concentrations. The larvae fed chloromycetin defecated 2483.0 mg at control which increases to 2531.2 mg at 0.2% concentration and 2591.2 mg at 0.4% concentration and 2686.9 mg at 0.6% concentration during penultimate two instars (Table-2).

Similarly the defecation increased in the larvae fed ciproflaxocin from its minimum during control to 2488.7 mg at 0.2% concentration, and 2534.3 mg at 0.4% concentration and 2646.0 mg at 0.6% concentration during penultimate two instars. The percent of increase in defecation due to presence of ampicillin was 4.8% at 0.2% feeding which increased steadily with the concentration of ampicillin and reached the maximum of 9.2% at 0.6% ampicillin concentration. Similarly, increase in defecation was found at the other two feeding levels.

1.4.3 Assimilation :

Net metabolized energy is calculated by quantification of faeces. Faeces is collected, dried and weighed. The faeces weights is subtracted from the total amount of food consumed. The quality of uric acid, nitrogenous material in faeces
is negligible (0.24 to 0.5% of faces) (Hiratsuka, 1920, Waldbauer, 1968, Lowton, 1969, Scribes and Slansky, 1981)

Food assimilation increased as a function of body weight and life stage irrespective of the type of antibiotics used. The assimilation in the larvae fed control leaf increased from 714.2 mg during fourth instar to 3194.0 mg during fifth instar period. The total food assimilated at control was 3908.3 mg during the penultimate two instars (Table-3)

Food assimilation was maximum during final instar of *S. ricini* at all the feeding levels. This may be due to the fact that maximum food assimilation takes place during the penultimate instars in lepidopteron insects (Delvi and Pandian, 1972). The increase in food assimilation during final instars is to accumulate sufficient energy for the pupae and adult stages which are non feeding (Fig.3).

Effect of antibiotics on Assimilation:

Total assimilation differed considerably, depending on the type of antibiotics used. The assimilation increased as function of life stages irrespective of the antibiotics present in the food. For instances in the larvae fed 0.2% ampicillin the assimilation was 994.0 mg during fourth instar period which increased to 3421.5 mg during fifth instar period.

Similar increase in assimilation was found in the larvae fed chloromycetin, ciproflaxocin. The total amount food assimilated differed a little about at both 0.4%
and 0.6% feeding labels in the larvae fed all the three antibiotics. The differences were not significantly different (Table-3).

1.4.4 Conversion:

Conversion of food into body substance was calculated by deducting the dry weight of the larvae from the final dry weight. The weight of exuvia at each instar level was calculated with food conversion into body weight. Sufficient food energy was found to have been accumulated during final instar period to tide over the pupal and adult stages. Conversion of food into body substance differed considerably as function of larval stage at control as well as at different antibiotic feeding. For instance the food converted was 105.6 mg during fourth instar which increased to 874.2 mg during fifth instar at control. The total amount of food converted was 979.7 mg during the penultimate two instars at control.

Effect of Antibiotic on Food Conversion:

The food converted into body substance increased as function of life stage irrespective of the concentration and the type of antibiotic present in the food. For instance the food converted in the larvae fed 0.2% Ampicillin was 108.1 mg during fifth instar which increased to 113.5 mg during the fifth instar period. The initial amount of food converted at 0.2% ampicillin was 1221.6 mg during the penultimate two instars. The food conversion increased with the increase in concentration of ampicillin and it was a maximum of 1453.5 mg at 0.6% ampicillin during penultimate two instars. The conversion increased as a function of life stage during the ampicillin feeding irrespective of the concentrations. For instance the conversion was 108.8 mg during fourth instar which increased to 1113.5 mg during
fifth instar at 0.2% ampicillin feeding. Similar increase in the conversion was found at 0.4% and 0.6% feeding levels (Table-4). The conversion of food into body substance in the larvae fed chloromycetin increase from 979 mg at control to 1110.1 mg at 0.2% chloromycetin, 1175.7mg at 0.4% Chloromycetin feeding and 1385.0 mg at 0.6% chloromycetin feeding during penultimate two instars. The conversion in the larvae fed Chloromycetin increase as function of larval stage irrespective of the concentrations of chloromycetin. Similar trend in food conversion was found in the larvae fed ciproflaxocin though the total amount of conversion was the least during ciproflaxocin feeding at all dilution levels. (Fig.4)

The total amount of conversion was maximum in the larvae fed ampicillin at all the three dilution levels. Whereas it was minimum in the larvae fed ciproflaxocin at all the three dilution levels.

The conversion reduced from maximum in ampicillin fed larvae to minimum in the larvae fed ciproflaxocin. The conversion in larvae fed chloromycetin was less than the conversion of the larvae fed ampicillin, which was the least in the larvae fed ciproflaxocin.

The increase in the conversion of food into body substance as function of life stage was dependent on type of antibiotics. It may be due to the presence of the three types of antibiotics used along with feed at different concentration.
1.4.5 Metabolism:

Food energy lost on metabolic heat production was calculated directly as the difference between the food assimilated and growth as the net metabolisable energy and physiologically useful energy is partitioned between the respiration and growth as they acquire energy from the same sources (Browdy, 1945). The food metabolized increased as function of life stages in the larvae fed controlled leaf and also in the larvae fed different antibiotics irrespective of concentrations. For instance the metabolism was 608.7 mg during fourth instar which increased to 2319.9 mg during fifth instar, while it was 2928.6 mg during the penultimate two instars at control.

Effect of Antibiotics on Metabolism:

The amount of food metabolized was more in the larvae fed leaf with different antibiotics when compare to the larvae at control.

Oxidation in the larvae fed ampicillin increased from 2928.6 mg at control to 3123.9 mg at 0.2% ampicillin, 2947.0 mg at 0.4% Ampicillin 2853.2 mg at 0.6% ampicillin during penultimate two instars. Oxidation was considerably more during fourth instar at different concentration of ampicillin when compare to control. It was maximum of 866.4 mg at 0.6% ampicillin when compare to 608.7 mg at control during fourth instar. However the increase was not statistically different from that of the control. In the larvae fed 0.6% ampicillin the oxidation decrease from 2319.9 mg at control to as little as 1986.8 mg during fifth instar period (Table-5).
Similar results were found with regards food oxidation in the larvae fed Chloromycetin and Ciproflaxocin at different concentrations. The oxidation increased as function of larval stage irrespective of concentration of antibiotics. The total amount of oxidation was maximum in the larvae fed ciproflaxocin when compared to ampicillin and chloromycetin. It was 3355.1 mg in the larvae fed 0.2% ciproflaxocin, which decreased with the increase in concentration of ciproflaxocin. Similarly in the larvae fed Chloromycetin the oxidation increased in the larvae fed 0.2% Chloromycetin and decreased with further increase in antibiotics.

1.4.6 Feeding Rate:

The rate of nutrients in the digestive system is measured by feeding rate. Rate of food consumption in insects was based on the fat free weight biomass (FFWB) (Garden 1972). Many authors have used the term Relative Consumption rate” (RCR) which refers to mg dry weight of food per mg mean dry larval weight per day Waldbaer, 1968, Srihari, 1979; Bhat and Battacharya, 1978; Slansky, 1982a). Feeding rate may change in insects of same age due to difference is body weight and larval period. Delvi (1972); Delvi and Pandian (1972); Muthukrishnan and Pandian (1987) recommended the rate form of consumption i.e., mg or J as food per unit weight of insect per day.

Feeding rates altered due to changes in the initial and final weight of the insects. Waldauer, (1968) proposed the use of mid point in the growth curves of insects i.e., mid-body weight. Overall rates can be calculated as (1) calculation rates of each life stage with references to mid body weight and duration corresponding to life stage to dividing the sum of products of the rate and duration
for different stages by a total feeding period. (Muthukirshnan and Pandian, 1987). In the present study, feeding rate has been calculated during penultimate two instars in Eri silkworm Samia Cynthia ricini following the procedure of "Muthukrishnan and Pandian (1987). Feeding rate decreased with the increase in age/body weight as function of larval period irrespective of antibiotics or concentrations. The feeding rate, for instances was 0.7139 mg/mg/day during fourth instar which decrease to 0.3490 mg/mg/day during fifth instar at control. The total feeding rate was 1.0629 mg/mg/day during penultimate two instars at control.

Effect of Antibiotics on Feeding rate :

Feeding rate decreases as function of larval period irrespective of the type and concentrations of antibiotics used for feeding. The rate in the larvae fed 0.2% ampicillin was 0.657 mg/mg/day during fourth instar, which decreased to 0.4184 mg/mg/day during fifth instar period. The total rate was 1.0767 mg/mg/day during penultimate instars in the larvae fed 0.2% ampicillin. Further, increase in the concentration of ampicillin resulted in increased feeding rate. For instance at 0.4% ampicillin it was 1.1621/mg/mg/day which increased to 1.3100 mg/mg/day at 0.6% ampicillin feeding. The rate was lowest of 1.0629 mg/mg/day at control.

Similar results were found in the larvae fed chloromycetin and Ciproflaxacin. However, the rate initially decreased a little at 0.2% chloromycetin and further increased at 0.4% and 0.6% feeding levels. Their exist a linear relationship between feeding rate and food intake. Delvi and Pandian (1972), Muthukrishnan and Pandian (1987) have reported regression co-efficiency and correlation coefficient and correlation coefficient for the relation between feeding rate
and mid body weight of several insects. According to Brody (1945), Paloheimo and Dickie (1966) the intercept on Y of the regression line [usually indicated by “a] represents the “maximum feeding level” and the slope of the regression usually used indicated by “b”] represents the “weight exponent”. A higher feeding level (intercept) followed by a smaller food exponent (slope) obtained in the present study (Figure 6) points out maintenance of high feeding rate. (Table-6).

1.4.7 Conversion Rate ;

Growth represents the conversion rate. Many workers have studied the conversion rate (Delvi and Naik 1987) Radhakrishna and Delivi 1992, Algesan, 2003).” It depends on body weightage, race and quality of food offered. In the present study the rate was calculated taking the penultimate two instars into conversions. The rate increased as function of life stages in the larvae of S.ricini fed control leaf. It increased from 0.05904 mg/mg/day during fourth instar to 0.07852 mg/mg/day during fifth instar at control. The total concentration rate was 0.13756 mg/mg/day during the penultimate two instars at control.

Effect of Antibiotics on Conversion Rate :

The conversion rate differed considerably in the larvae fed different antibiotics. For instance the rate increased from 0.105904 mg/mg/day at control to 0.06104 mg/mg/day at 0.2%, 0.06327 mg/mg/day at 0.4% 0.06236 mg/mg at 0.6% ampicillin feeding during fourth instar period. Similarly the rate increased from 0.07852 mg/mg/day at control to 0.07915 mg/mg/day at 0.2% and further increased 0.08115 mg/mg/day at 0.6% ampicillin feeding during fifth instar period.
However, the larvae fed 0.04% ampicillin converted the food at the rate of 0.6580 mg/mg/day during fifth instar which was lesser than the corresponding conversion at control. The total conversion rate increased from 0.13756 mg/mg/day at control at 0.14019 mg/mg/day at 0.2% ampicillin feeding. Further increase in the concentration of ampicillin to 0.4% resulted in decreased rate of 0.12911 mg/mg/day. However the larvae fed 0.6% ampicillin displayed a total higher rate of 0.14351 mg/mg/day during the penultimate two instars.

Similarly, the rate increased as function of life stage and concentration of antibiotics in the larvae fed chloromycetin and ciproflaxocin. However, the conversion rate decreased during 0.4% feeding in the larvae fed chloromycetin and ciproflaxocin from that of the control. As such the conversion rate initially increased from the lowest at control to a higher rate at 0.2% feeding at all the three antibiotics decreases to the lowest rate at 0.4% and then further increases to the highest rate at 0.6% concentration of ampicillin, chloromycetin, and ciproflaxocin.

Their exists a linear and positive ration between food converted and the conversion rate. It increases with the increases in the food conversion at each instar level and at all the concentrations of antibiotics used except, at 0.4% concentration of antibiotics

1.4.8 Assimilation Rate :

Assimilation rate is the mirror image of rate of defecation. (Muthukrishnan and Pandian, 1987). It is determined by the amount of food consumed and quality of faces produced. Assimilation rate indicates the metabolic level and production in
insects (Delvi and Pandian 1972). The rate has been calculated by relating the amount of food assimilated (mg) to percent weight (mg of insect) per unit time (mg/mg/day) (Delvi, 1972). The rate has been calculated in the present study as per the procedure described by Muthukrishnan and Pandian (1987).

Assimilation rate decreased as function of life/stage/body weight. The eight instar larvae assimilated the food at the rate of 0.5341 mg/mg/day which decrease to 0.24859 mg/mg/day during fifth instar at control. The total assimilation rate was 0.78269 mg/mg/day during the penultimate two instars at control.

Effect of Antibiotics on Assimilation rate:

The assimilation rate increase as the function of life stage and different dilution of all the 3 tests antibiotics. For instance the rate increased from 0.7827 mg/mg/day at control to a 0.8024 mg/mg/day at 0.2% ampicillin feeding and further increase to 0.8426 mg/mg/day at 0.4% and 0.8346 to mg/mg/day at 0.6% ampicillin feeding during the penultimate two instars. Similarly the rate increased in the larvae fed Chloromycetin to 0.7925 mg/mg/day at 2% which further increased to 0.8428 mg/mg/day at 4% and 0.8326% mg/mg/day at 0.6% chloromycetin feeding to differences in the rate in the larvae fed ciproflaxocin was not statically significant at 0.2% feeding from that of the control. However the rate significantly increased to 0.8367 mg/mg/day at 0.4% ciproflaxocin feeding, which was almost maintained at 0.6% feeding level. The relationship between the food assimilation and the assimilation rate was linear and positive (Table-8).
1.4.9 Metabolic Rate:

The metabolic rate was calculated indirectly as per Delvi (1972), Muthukrishna and Pandian (1987). The rate decreased as function of life stage. The rate was 0.654 mg/mg/day during fourth instar, which decreased to 0.2199 mg/mg/day during fifth instar at control. The total metabolic rate was 0.8659 mg/mg/day during the penultimate two instars at control.

Effect of Antibiotics on Metabolic Rate:

The rate of metabolism increased as function of life stage and concentrations at different test antibiotics feeding. The rate increased from 0.8659 mg/mg/day at control to 0.8952 mg/mg/day at 0.2% which further increased to 0.8965 mg/mg/day at 0.4% and 0.9325 mg/mg/day at 0.6% ampicillin feeding during penultimate two instars.

Similar results were found in the other two tests antibiotics where minimum rate was found at control which increased gradually within the concentration of antibiotics to reach the maximum of 0.19220 mg/mg/day at 0.6% chloromycetin feeding and 0.9175 mg/mg/day at 0.6% Ciproflaxocin feeding. The relation between metabolic rate and food oxidized is linear and positive (Table-9).

1.4.10 Assimilation Efficiency

Waldbauer (1968) used the term assimilation efficiency equivalent to the approximate digestibility (AD). Trager, (1953); Wald bauer, (1964); Hoses (1969) used coefficient of digestibility equivalent to the percentage of the ingested food transferred through the Gut lumen into the insect body. The total digested food
does not result in absorption (Pandian, 1967; Delivi, 1972; Muthukrishnan and Pandian 1987). Assimilation efficiency can be referred to as approximate digestibility (AD) (Waldbauer, 1968), Scribe and Slanskey, 1980). In the present study the assimilation efficiency is used following Lawton (1970a, b).

Calculation of assimilation efficiency involves tedious gravimetric method, which influenced various workers to use indirect methods. In insects the difficulty persists in the faeces ferric separation. Several indirect methods have been involved like the insect markers in food and faeces. Chromic oxide method of Mc. Ginnis and Kasting (1964), twin tracer method of Callow and Fletcher, (1972), the ash ratio method of Conver (1966). The nitrogen content of the food can be used as reliable index of assimilation efficiency (Pandian, and Marian, 1985, a,b, 1986) Assimilation efficient in the present study decreased as function of life stage at control. It was 62.3% during fourth instar which decreased to 59.2% during fifth instar and average 61.3% during the penultimate two instar at control.

Effect of antibiotics on Assimilation Efficiency:

The assimilation efficiency appreciated a little in the larvae fed different antibiotics. But the differences were not statistically significant.

1.4.11 Conversion Efficiency:

The efficiency by which the ingested food is converted into body substance is also referred to as the efficiency of conversion (ECI)” or Gross Conversion efficiency (K1) (Delvi, 1972). Conversion efficiency is expressed in different terms. The efficiency of food conversion is expressed in percent of food consumed (K1) or
as percent of food assimilated ($K_2$) (Delvi, 1972). The efficiency of digested food into body substances (ECD) is known as net conversion efficiency or $K_2$ (Waldbuera, 1968). The food absorbed by an insect is converted into body substances and proteins are synthesized from the assimilated food. Thus the term "conversion" was used instead of conversion by Delvi (1972). The present study deals with gross conversion efficiency and net conversion efficiency.

### 1.4.12 Gross Conversion Efficiency ($K_1$):

A gross conversion efficiency ($K_1$) increased as function of life stage in *S. ricini*. The efficiency increased from 10.6% during fourth instar to 16.2% during fifth instar at control. The total efficiency was 13.4% during the penultimate two instars at control.

**Effect of Antibiotics on Gross Conversion Efficiency:**

The gross conversion efficiency increased as function of life stage in the larva fed ad libitum caster leaf with various concentrations of the antibiotics, ampicillin, chloromycetin and ciproflaxacin. The efficiency increased as function of life stage irrespective of the type of antibiotic or concentrations. The efficiency range between 9.3% to 9.9% during fourth instar in the larvae fed all the test three antibiotics and at all the concentration levels. However the efficiency changed considerably during fifth instar depending on the antibiotics used and the concentration. For instance it was 19.2% at 0.2% concentrations which increased to 22.4% at 0.4% concentrations in the larvae fed ampicillin. The total efficiency range from 14.3% at 0.2% concentrations to 16.4% at 0.6% concentration ampicillin.
Similarly in the larvae fed chloromycetin the efficiency was 17.4% at 0.2% concentration, which increased gradually with the increase in concentration of chloromycetin to a maximum of 21.5% at 0.6% concentration. The total efficiency also increased to 13.7% at 0.2% Chloromycetin and to 15.7% at 0.6% concentration.

Similarly in the larvae fed ciproflaxocin the efficiency was 13.7% at 0.2% concentrations, which increased gradually with the increase in the concentration of ciproflaxocin to 18.8% at 0.6% concentration during fifth instar. The total efficiency also increased from 11.5% during 0.2% ciproflaxocin which increased 14.2% at 0.6% concentration during penultimate two instar.

1.4.13 Net Conversion Efficiency (K₂):

The Net Conversion Efficiency increased as the function of life stage in the larvae fed control leaf. The efficiency was 14.8% during fourth instar, which increased to 27.4% during fifth instar at control. The total efficiency was 21.1% during the penultimate two instars at control.

Effect of Antibiotics as Net Conversion Efficiency (K₂):

The net conversion efficiency increased as function of life stage irrespective of the antibiotics used and the concentrations of the antibiotics. The efficiency range from 10.8% to 12.7% during fourth instar at different concentrations of all the three antibiotics. However the efficiency during fourth instar differed considerably and was minimum of 29.6% at 0.2% concentration of chloromycetin during fifth
instar. The maximum efficiency of 40.2% was found at 0.6% concentration of ampicillin during fifth instar.

The total efficiency differed considerably in the larvae fed different concentration of the antibiotics in the larvae fed ampicillin. The total efficiency was 22.15 at 0.2% concentration, which gradually increased to 26.1% at 0.6% Ampicillin concentration.

Similarly in the larvae fed chloromycetin the efficiency increased from 20.1% at 0.2% concentration to 25.3% at 0.6% concentration of chloromycetin, while the increase was from 17.15 at 0.2% of ciproflaxocin to 22.9% at 0.6% ciproflaxocin.

1.4.14 Growth:

Conversion of food into body substance results in growth, involving the process of feeding, digestion, assimilation and synthesise. In insects growth can be somatic or reproductive (Sperms, eggs, egg cases, exuvia and secretions like silk). In the silkworm S.ricini the larval growth can be calculated as the difference in weight or energy of the test insect between the time intervals. During estimation of growth, it is necessary to empty the gut lumen of the insect (Delvi 1972).

In the present study growth is considered as wet live weight, which do not include the substances like exuvia, egg or gut content. Since, large amount of food is assimilated and converted during penultimate two instars to over come the non-feeding pupae and moth stages, growth was estimated during final instars. The dry
matter present in the body due to aging or pupation is referred to as net growth (Delvi, 1972; Naik and Delvi, 1985; Premaleela, 1986; Radhakrishna, 1980; Noor Pasha, 1991; Radhakrishnan, 1992; A Siya Nuzhat, 1993; Aftab Ahmed 1994) Sunita 2000; Kurinji, 2002a).

There were differences in the growth pattern in the larvae of *S. ricini* fed controlled leaf. The growth increased as function of life stage. The larval weight was 21.8 mg during fourth instar which increased to 159.9 mg during fifth instar and further increased to 16.5 mg prior to pupation at control.

**Effect antibiotics on growth:**

The larvae fed different antibiotic at different concentration levels displayed higher growth compared to growth at control. For example, the larvae fed 0.2% ampicillin displayed a initial weight of 29.2 mg during fourth instar which increased to 198.1 mg during fifth instar and was 2015.6 mg prior to pupation. The growth further increase with increase in concentration of ampicillin. The initial weight at 0.4% ampicillin concentration was 32.2 mg during fourth instar which increased to 255.0 mg during fifth instar at 0.6% and the decreased to 2324.6 mg prior to pupation. Further increase in concentration of ampicillin to 0.6% resulted in higher growth of 41.2 mg during fourth instar, 286.7 mg during fifth instar and reached a maximum weight of 2398.2 mg prior to pupation. Such increase in the growth as function of concentration of antibiotics was also found in the larvae fed chloromycetin and ciproflaxocin.
However maximum growth was found in the larvae fed different concentrations of ampicillin while the best next growth was found in the larvae fed chloromycetin; lowest growth was found in the larvae fed different concentration of ciproflaxocin (Table-13). Such increase in the weight of the larvae may be due to the influence of antibiotics on metabolic activity of the larvae.

1.4.15 Energy Allocation:

Partitioning of the consumed energy or the energy allocation in *Samia Cynthia ricini* was influenced by the consumption of caster leaf *Ricinus communis* (Table-13 and Fig.17). The larvae fed controlled leaf eliminated 38.8% of feces and the allocation of assimilation energy for assimilation was 61.2%. It is apparent that assimilation values under varying treatments were identical. The assimilated food was utilized by the larvae for production of energy to meet various activities and for the construction of 25.1% body tissue. About assimilated food was used for growth and 74.9% for respiration. The allocation of energy and elimination of feces did not alter much in the larvae fed 0.2% of ampicillin, chloromycetin, and ciproflaxocin. However the allocation of energy for conversion and respiration differed a little depending on the concentration of the antibiotics used. For instance in the larvae fed ampicillin, the energy allocation for conversion increased to 28.1% at 0.2% concentration and about 32.0% to 33.0% at 0.4% and 0.6% feeding. As such the allocated energy for respiration during ampicillin feeding was 71.9% at 0.2% and about 66% to 67% at 0.4% and 0.6% ampicillin feeding.

Similar values were found in the larvae fed different concentration of chloromycetin and ciproflaxocin. Maximum amount of energy was utilized for
respiration amounting to as much as 79.3% in the larvae fed 0.2% Ciproflaxacin. As such the energy allocation for conversion was lowest amounting to 20.7% which resulted in poor growth.

Irrespective of concentration of the antibiotics used or the controlled leaf used, the proportion of energy spend from the consumed food amounted to around 60.0% to 64.0%. In all the larvae except in the larvae fed 0.2% Ciproflaxacin the energy for growth was 51.1% and about 40.0% to 46.0% for respiration. Similarly, the allocation of food energy for assimilation was about 61.0% to 62.0% while about 38.0% to 39.0% was eliminated as faeces.

The values obtained for the energy allocation in the larvae fed different concentration of antibiotics and controlled, did not display statistically different variations.

1.4.16 Food Utilization Budgets:

The energy used for respiration from assimilated food was calculated by subtracting the amount of total substance converted including remains of exuvia from that of total food assimilated. The total food utilization in the larvae of *Samia Cynthia ricini* fed control leaf *Ricinus communis* and leaf with 0.2%, 0.4%, 0.6% of Ampicillin, Chloromycetin, Ciproflaxacin are represented (Table 14, to 17). The larval period varied little while varying quantities of food was consumed and utilized depending on not only the type of antibiotics used but also depending on the concentration.
The larvae of *S. ricini* fed fresh leaf of *R. communis* (control) consumed 639.3 mg of dry food during 14 days of larval period of which 2483.0 mg of faeces was eliminate (38.8%). The feeding rate during the experimental period was 1.062 mg/mg/day. The amount of assimilated food converted into body substance at control was 61.2%. The amount of assimilated energy used for respiration was 74.9% and 25.1% was used for conversion into body tissues.

Gross Conversion Efficiency (K₁) was 15.3% at control. The net conversion efficiency (K₂) was about 26.0% where as assimilation efficiency was 61.4%.

The food utilization budgets differed considerably in *S. cynthia ricini* larvae fed on *R. communis* leaf with different concentrations of Antibiotics namely ampicillin, chloromycetin, ciproflaxocin. *S. ricini* larvae fed 0.2% ampicillin consumed 6946.9 mg of dry food which gradually increased with the increase of concentration and reached the maximum consumption during 0.6% ampicillin feeding which amounted to 7017.5 mg. With increased in food consumption the defecation also increased from 2601.03 mg at 0.2% ampicillin feeding to 2710.8 mg at 0.6% ampicillin feeding. As such the food assimilated reduced from 4345.5 mg at 0.2% ampicillin to 4306.7 mg at 0.6% ampicillin. However, the food converted increased considerably from 1221.6 mg at 0.2% ampicillin feeding to as much as 1453.5 mg at 0.6% ampicillin feeding. The feeding rate also increased gradually with the increasing concentration of antibiotics from 1.0766 at 0.2% ampicillin to 1.3100mg/mg/day at 0.6% feeding. The rate was higher in the larvae fed different concentration of ampicillin than in the larvae fed control leaf. It is significantly to note that the assimilation efficiency was not different at different
feeding levels when compared to control feeding. The Net conversion efficiency changed a little and ranged from 28.0% to 38.0% with different concentration of ampicillin while it was significantly less at control amounting about 26.0% feeding rate decreased with the increase in age/body weight as function of larval stages irrespective of anti biotics were concentration. He feeding rate for instance was 0.17139 mg/mg/day during the fourth instar with decreased by 0.2490 mg/mg/day during the fifth instar at control. The total feeding rate was 1.062 mg/mg/day during penultimate two instar at control. Increase in the concentration of ampicillin, chloromycetin, and ciproflaxocin resulted in increased feeding rate this exists a linear relationship between feeding rate and food intake.

The amount of food metabolized was more in the larvae fed leaf with different antibiotics than in the larvae fed leaf without antibiotics the oxidation in the larvae fed ampicillin, chloromycetin, ciproflaxocin. Leaf was considerably more and compare to control the oxidation increase as function of larval stage irrespective of concentration of antibiotics.
1.5 DISCUSSION

The effect of three different antibiotics on the food utilization budget in Eri silkworm *Samia cynthia ricini* has revealed some interesting aspects of feeding behavior in lepidopteran insects. The eri silkworm larvae were fed separately caster leaf *Ricinus communis* and the leaf with 0.2%, 0.4% and 0.6%. Ampicillin, chloromycetin, ciproflaxacin, Nutritional efficiency was studied during penultimate two instars as more than 97% of food is consumed during these two instars (Delvi and Pandian 1972) (Magadum et al, 1986, Kurinji 2002).

The amount of ingested food converted into the live tissue of the insect involves the different process of ingestion assimilation, digestion and synthesis. The resultant being growth. The energy from the assimilation is used up for the insects growth which is described separately in the present study. Ingestion, digestion, and utilization of food are mostly dependent upon the feeding levels and genotype of the hybrid (Singh *et al.*, 1976). Though growth and conversion are dependent, they are defined distinctly. Conversion refers to the amount of food converted into dry matter in an individual during its life stage expressed in mg dry weight per insect. Growth is the total gain in weight of the insects body expressed in mg live or wet weight per insect (Delvi, 1972, Naik, 1985).

Eri Silkworm *Samia cynthia ricini* displayed manifold increase in growth at each instar level both at control and also at three antibiotic feeding levels. The larvae continued to feed and grow on caster leaf with 0.2%, 0.4% and 0.6% of antibiotics, namely ampicillin, chloromycetin, ciproflaxacin. There were differences in the pattern of growth in the larvae fed with three different concentration of
antibiotics which displayed higher growth compared to growth at control. The highest growth was found in the larvae fed different concentration of ampicillin while the best next growth was found in the larvae fed chloromycetin. However, least growth was found in the larvae fed ciproflaxocin. Such differences in weight of the larvae may be due to the influence of antibiotics on metabolic activity of the larvae.

The duration of the larval period is a genetic feature. The variable larval duration is influenced by the type of food offered and environment factors like temperature, humidity (Delvi et al., 1988), pollutants (Khan, 2002) and antibiotics (present work). There were differences in the larval period depending on the type of food offered. The differences range from 12 hours to 24 hours. Extension of larval period during experimental feeding may be for accumulation of more food energy for completion of the non-feeding pupae and adult stages. Exposure to leaf with antibiotics has resulted in increased in food consumption by decrease in the larval period. It is known that in insects particularly lepidopteron insects it requires a certain amount of food to undergo moultling (Delvi 1972; Premaleela, 1986). The differences in the larvae period may be to accumulate minimum energy required for moulting. For instance in a study on different races of Bombyx mori with leaf raised on 5%, 10% and 15% concentration if zinc smelter resulted in significant reduction in food consumption and prolongation of larval period (Khan 2002). As such prolongation of larval period may be to accumulate minimum energy required for moulting. However extended period of moulting itself required energy for maintenance of body metabolism (Engelmann, 1965).
The rate and quality of food consumed by the larvae influenced growth rate, larval period and the final body weight (Slansky, 1986). Since about 97% of food was consumed in the penultimate two instars, food intake during the fourth and fifth instar play a major role in the development of the silkworm larvae which ultimately results in the quality of the cocoons. Higher value of ingesta for fourth and fifth instar was reported in different breeds (Jakshaw and Jenova, 1991). Thus in the present study the food intake was elucidated during the penultimate two instars. The eri silkworm *Samia cynthia ricini* fed controlled leaf and leaf with three different concentration of 0.2%, 0.4%, 0.6% antibiotics namely ampicillin, chloromycetin, ciproflaxocin, resulted in the following changes.

1) The larvae at all the antibiotics feeding levels increase their food intake when compared to intake at control.

2) Different amounts of food was consumed by the larvae at different concentrations.

3) The food intake increased as function of concentration of antibiotics.

4) The consumption in the larvae fed antibiotics increase not only as function of antibiotics but also as function of larval stage. The percent of difference in the consumption in the larvae fed different concentration of ampicillin, chloromycetin, and ciproflaxocin increased by 5.0% to 9.8% depending on the concentration.

The larvae consumed four to six times more food at fifth instar than at fourth instar at control and also at different concentration of antibiotics. Moulting involves formation or peeling off of the peritrophic membrane of the gut as well as the stress imposed by moulting (Muthukrishnan and Pandian 1987). The pre and
post moult fasting extending for a definite period have been demonstrated in many insects like *Schistocerca gregaria* (Davey, 1954), *Copelthus faciatus* (Beck *et al.*, 1958); *Poecilotherius pictus* (Delvi, 1972). At higher concentration of antibiotics (0.6%) the larval period reduced while the total amount of food intake increased when compared to consumption at control, 0.2% and 0.4% antibiotics. Probably the larvae must have reduced the larval period as sufficient food energy was required and extension of larval period by another 12 hours requires extra energy for maintenance of body metabolism and hence the reduction in the larval period. The larval duration in the silk worm depends on breed, quality of leaf and the environmental conditions like temperature and humidity (Kuringi 2002). Food intake reach the peak during the fourth and fifth instar and increase of each instar levels irrespective of the feeding category. The intake increase as function of life stage / age / body weight.

The food intake and utilization in the penultimate two instars of the eri silkworm *Samia cynthia ricini* fed *ad Libitum* castor leaf *Ricinus communis* and on different concentrations of antibiotics, resulted in the following observations.

1) Food intake during penultimate two instars was maximum during 0.6% ampicillin feeding and minimum during the control feeding.

2) The food intake increased with increase in concentration of all the three antibiotics namely ampicillin, chloromycetin and ciproflaxocin.

3) The oxidation of food reduced considerably at higher concentration of all the three antibiotics resulting in better conversion and growth.
4) It is extremely interesting to note that the maximum growth was achieved during the highest concentration of all the three antibiotics.

The amount of food consumed per unit weight (g or cal) of insect per instar is termed as feeding rate. In the present study the feeding rate is expressed per day (mg / mg / day). The food consumed by an insect is related to the live body weight following the feeding rate expressed by Delvi (1972), Delvi and Pandian (1972), Naik (1985), Kurinji (2002). Nutritionally the feeding rate measures the rate at which nutrients enter the digestive system. The rate of feeding in the larvae fed controlled caster leaf decreased as function of life stage / age / body weight. The feeding rate decreased with increase in body weight in individual of orthoptera, dictyoptera, lepidoptera and coleoptera (MutuKrishnan and Pandian, 1987). This decrease depends on the weight of the insect and its duration of larval period. Though the rate decreased in the final instar larvae the total amount of food intake increased both at control and at all feeding levels. Such increase in he consumption allows the larvae to accumulate sufficient energy required to spin the cocoon and meet the energy requirements of the non-feeding pupal and adult stages (Delvi and Pandian, 1972)

The feeding rate in the present study decreased as function of body weight/age at all the feeding levels. The larvae displayed a unique trend by faster rate of feeding when fed different concentrations of all the three antibiotics. The total rate increased as function of concentration of antibiotics. Increase in the concentration of antibiotics resulted in the increase in feeding rate. However the rate at each instar level decreased as function of body weight but total feeding rate
was higher in the larvae fed antibiotics when compared to larvae fed control leaf. The highest feeding rate was found in the penultimate two instars during 0.6% antibiotic feeding. Feeding the larvae with 0.6%, ampicillin increased the feeding rate by 18.8%. Such increase in the feeding was also found in the larvae fed Chloromycetin and Ciproflaxocin. The increase may be due to the presence of antibiotics in the leaf which promoted the feeding by increasing the feeding rate. The consumption of the food is regulated by the concentration of nutrients in the Haemolymph (Dadd, 1970; Barton and Browne, 1975; Bernays and Simpson, 1982). Nitrogen, and water and energy content of the food are some of the limiting factors that significantly influence the feeding rate (Scriber, 1977; M. Neil and South wood, 1978; Slansky, 1982 a and b). It may be that insecticide present in the food might have been accumulated in the haemolymph, resulting in the decrease feeding rate. The rate of feeding in *Bombyx mori* has been shown to depend on the body weight/age (Delvi and Pandian, 1972; Asiya Nuzhat, 1993; Hanifa Banu, 1997; Kurinji, 2002). Feeding rate in the silkworm *B. mori* decreased with increase in the body weight or age, irrespective of the factors like food quality, scotoperiod or photoperiod Asiya Nuzhat, 1993; Hanifa Banu, 1997). Feeding rate can be modified by the larvae depending on the amount of food consumed in *B.mori* (Radhakrishnan, 1992). Diseased mulberry (Powdery Mildew, leaf spot) can also alter the feeding rate (Aftab Ahmed, 1994). Hence it may be concluded that the antibiotics have altered the feeding rate in *Samia cynthia ricini* (present study).

In spite of differences in feeding rate the assimilation efficiency altered a little and was not related to each other Khan (2002) found that the assimilation rate was proportion to feeding rate in different races of *B. mori* except P.M. race where
efficiency did not alter. Such modifications may be genetical characters but alter in some races if *B. mori* depending on the quality of food. Negligible amount of dead cell of the gut and its secretions as well as nitrogenous product are found in the faces of insect. The amount of faeces defecated is specific to instars and depends on the amount of food consumed and efficiency of digestion. The least amount of faces was produced were found in the larval fed control leaf which increased in the larvae fed antibiotics. The defecation is not only increase as function of larval period but also as function of concentration of antibiotics. Faeces on quantification results in the net metabolisable energy. Assimilation depends on the efficiency of digestion and absorption, which results in faeces. The quantity and activity of digestive enzymes determines the amount of food consumed in few insects (Langley, 1966; Vonk, 1964; Muralidharan and Prabhu, 1978, 1981). Similar observations were made in *B. mori* by previous workers (Aftab Ahmed, 1994; Premaleela, 1986: Khan, 1994: Asiya Nuzhut, 1993; Hanifa Banu, 1997; Misbhauddin Khan, 1998; Kurinji, 2002). Assimilation efficiency as a function of age depends on temperature in *Poecilocerus Pictus* (Delvi, 1972) and in mullipede *Xenopus carnifex* (Alagesan, 2002). The efficiency decreased with increase in temperature and age. However, in some insects the efficiency increased with age alone (Larson and Tenow, 1972). The decrease in assimilation efficiency may be due to increase in surface area. A two fold increase in the volume and weight of an organism is followed by a 1.8 fold increase in the area of the gut (Gordon, 1959). Thus resulting in the decline in the efficiency, Hussain *et al.*, (1946), Alagesan, (2002) observed that assimilation efficiency decreased from the highest level at the first instar to the lowest level at the fifth instar. Assimilation efficiency is temperature dependent (Delvi, 1972; Hanumappa and Delvi, 1989; Alagesan,
Decrease in assimilation efficiency was observed by Smalley (1960), Wigert (1965), Slansky and Scriber (1982), Calow (1979).

The assimilation efficiency changes among the insects belonging to the same group and also among those which occupy the same trophic level (Walcott, 1924; Soo Hoo and Fraenkel, 1966; Muthukrishnan and Delvi 1973; Woodland et al., 1968). Herbivore insects exhibit lower assimilation efficiency, which decreases with age. (Hiratsuka, 1920; Waldbauer, 1968; Stockner, 1971; Mc Neil, 1972). The efficiency depends not only on the species but also on different races of the same species (Hiratsuka, 1920; Horie et al., 1976; Soo Hoo and Fraenkel, 1966; Radhakrishna 1989; Asiya Nuzhat 1993; Aftab Ahmed 1994; Khan, 1994; Mispahuddin Khan 1998; Kurinji, 2002).

Assimilation efficiency depends on feeding rate. Its differs depending on the presence of egg albumin and agar agar in the food (Hanifa Banu, 1997). The efficiency also changes depending on the presence of distillery effluence in the leaf (Kurinji, 2002). Welch (1968) obtained a linear regression for a plot of net growth against assimilation efficiency in aquatic primary and secondary consumers. Inverse relation exhists between the feeding rate and age (Evans, 1939; Misra, 1962; Carne, 1966; Delvi and Pandian, 1972). Assimilation efficiency differs according to the feeding rate. However, the efficiency is also race specific in *B. mori* (Somashekar, 2002).

Assimilation rate increased in *S. ricini* as a result of feeding leaf with different antibiotics in different concentrations. The assimilation rate indicates the
metabolic levels and the production rate in insects. The rates increased during penultimate two instars from the maximum during fourth instar. Highest rate of assimilation was found in 0.6% ampicillin treatment, (present study) and then in 0.4% and 0.2% chloromycetin and ciproflaxocin. Increase in assimilation rates from fourth instar to fifth instar larvae of pure Mysore and MH¹ and MH² have been reported (Maribashetty et al., 1999).

A co-relation exists between the rates of assimilation and consumption in a few herbivours, carnivours, aquatic detrivour and granivour insects (Mothukrishnan and Pandian, 1987). This resulted in a significant correlation coefficient between two parameters, which indicate that the assimilation rate is dependent on the consumption rate, other factors on which the assimilation rate differs are the life stage, food quality, and availability of food and temperature.

Assimilation efficiency in the present investigation did not differ in the S.ricini as a function of life stage and at different feeding levels. The assimilation efficiency was related to feeding rate (Asiya Nuzhut, 1993). It was found to be linear in S.ricini. The efficiency inversely increases with the increase in the feeding rate conversely few workers observed decrease in the assimilation efficiency with increase in the feeding rate (Radhakrishna, 1992) which could be because of the presence of insecticides in the offered food. Differences in the relationship may be due to quality of food or due to specific characters of S.ricini.

Assimilation efficiency decreases with increase in age or body weight (Smalley, 1960; Slansky and Scriber, 1982; Calow, 1977). The digestive efficiency
was expected to decline with growth since an animal increases its weight and volume more than the surface area of its digestive tract (Gordon, 1959). The efficiency decreased from highest level at first instar to the lowest at the fifth instar (Hussain et al., 1946; Delvi and Pandian, 1971). The assimilation efficiency changes in insects under same trophic level (Walcott, 1924; Soo Hoo and Fraenkel, 1966; Muthukrishnan and Delvi, 1973; woodland et al., 1968). Welch (1968) obtained a linear plot of net growth against the assimilation efficiency in primary and secondary consumers. Assimilation efficiency in *S. ricini* did not change appreciably when fed leaf with Antibiotics. ampicillin, chloromycetin, ciproflaxocin. The total amount of food intake and utilization in *S. ricini* fed caster leaf (*Ricinus communis*) in different concentration 0.2%, 0.4% and 0.6% of ampicillin, chloromycetin, and ciproflaxocin and normal (control) leaf resulted in alteration in the amount of food intake and utilization. The antibiotics must have acted positively in the larvae resulting in alteration in intake and utilizations of food energy. The antibiotics ampicillin, chloromycetin and ciproflaxocin in different concentration have first acted positively by increasing the food intake and feeding rate (Table 1 to 12). The larvae increase food consumption at all feeding levels than control. This suggest that the composition or nutrients in the leaf must have changed which leads to higher consumption. The moulting occurs only after a certain amount of food is accumulated in the body to tide over the non feeding pupal and adult stages. The larval period reduced by about 12 hours in the larvae fed 0.6% ampicillin. The presence of antibiotics has altered food intake and utilization in *S. ricini*. This is a positive response of the larvae to the change in the environment. Information is available on the bioenergetics of silkworm fed mulberry treated with insecticides in PM, CB, NB4D2 races of the silkworm (Naik and Delvi, 1987; Delvi et al., 1988; Naik, 1985; Radhakrishna, 1989; Radhakrishnan, 1992; Noorpasha,
Though there exist information of the effect of distillery effluent on food intake in *B. mori* (Kurinji, 2002) there is a paucity of information of effect of antibiotics on food and water utilization. Conversion efficiency has been considered as an important economic index in China in evolving new breeds (XU and WU, 1992). A larva utilizes the food to the maximum extent for self gain is considered to be more efficient (Ramadevi et al., 1992). Silkworm with higher rate of conversion of food into cocoon shell would be of more commercial value (Chandrakala et al., 1999)

Though total food converted into body substance was higher in the larvae fed different concentration of all the three antibiotics. The net conversion efficiency also increased in the larvae with antibiotics than in the larvae at control. The efficiency decreased with increase the concentration of antibiotics at all feeding levels. The efficiency of silkworm to convert ingested and / or digested food to body substance is an over all indicator of the larvae’s ability to utilize the ingested or digested food for growth (Assal et al., 1994). Variations in food intake, assimilation and conversion may be due to different reasons like presence of antibiotics in the food (present study) presence of pollutants like zinc smelter effluent (Khan 2002) or presence of distillery effluent (Sunitha 2001) or it may be genetic race specificity. The variations observed in the present investigation may be due to presence of antibiotics in the food. Change in the intakes leads to variations in digestion and assimilation which reflects on metabolism affecting the conversion and cocoon formation. As such it may be that food provided for the silkworms / insects play a vital role not only in the metabolism but also in the products like silk etc.
Table 1: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciprofloxacin) on food intake in Sesia Cynthia ricini fed ad libitum on caster leaf Ricinus communis at 26 ± 2°C and 80 ± 10% R.H. The values are expressed in mg dry weight per insect.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>998.6*</td>
<td>5392.7*</td>
<td>6391.4</td>
<td>1150.4*</td>
</tr>
<tr>
<td>V</td>
<td>± 46.1</td>
<td>± 122.1</td>
<td>± 168.15</td>
<td>± 45.75</td>
</tr>
<tr>
<td>Total</td>
<td>998.5*</td>
<td>5392.7*</td>
<td>6391.3</td>
<td>1050.2*</td>
</tr>
<tr>
<td>± 46.05</td>
<td>± 122.1</td>
<td>± 128.15</td>
<td>± 75.17</td>
<td>± 125.37</td>
</tr>
<tr>
<td>IV</td>
<td>998.5*</td>
<td>5392.7*</td>
<td>6391.3</td>
<td>1024.9*</td>
</tr>
<tr>
<td>± 46.1</td>
<td>± 22.1</td>
<td>± 168.15</td>
<td>± 64.87</td>
<td>± 185.51</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table 2: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxacin) on faeces defeated in Samsia Cynzia ricini fed ad libitum on castor leaf Ricinus communis at 26 ± 2º c and 80 ± 10% R.H. The values are expressed in mg dry weight per insect.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>±24.6</td>
<td>±107.0</td>
<td>±131.6</td>
<td>±22.5</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>284.3*</td>
<td>2196.7*</td>
<td>2483.0</td>
<td>302.8*</td>
</tr>
<tr>
<td>±24.6</td>
<td>±107.0</td>
<td>±131.6</td>
<td>±29.1</td>
<td>±71.4</td>
</tr>
<tr>
<td>Ciproflaxacin</td>
<td>284.3*</td>
<td>2196.7*</td>
<td>2483.0</td>
<td>293.0*</td>
</tr>
<tr>
<td>±24.6</td>
<td>±107.0</td>
<td>±131.6</td>
<td>±18.4</td>
<td>±85.2</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table 3: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on food assimilation in Samia Cynthia ricini fed ad libitum on caster leaf Ricinus communis at 26 ± 2°c and 80 ± 10% R.H. The values are expressed in mg dry weight per insect.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>714.2*</td>
<td>3194.0*</td>
<td>3908.3</td>
<td>924.0*</td>
</tr>
<tr>
<td></td>
<td>±29.01</td>
<td>±18.1</td>
<td>±47.1</td>
<td>±17.4</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>714.2*</td>
<td>3194.0*</td>
<td>3908.3</td>
<td>895.9*</td>
</tr>
<tr>
<td></td>
<td>±29.0</td>
<td>±18.1</td>
<td>±47.1</td>
<td>±1.00</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>714.2*</td>
<td>3194.0*</td>
<td>3908.3</td>
<td>879.2*</td>
</tr>
<tr>
<td></td>
<td>±29.0</td>
<td>±18.1</td>
<td>±47.1</td>
<td>±30.0</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table-4: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on food conversion in Samia Cynthia ricini fed ad libitum on caster leaf Ricinus communis at 26 ± 2° c and 80 ± 10% R.H. The values are expressed in mg dry weight per insect.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>105.6*</td>
<td>874.2*</td>
<td>979.7</td>
<td>108.1*</td>
</tr>
<tr>
<td></td>
<td>±3.7</td>
<td>±7.3</td>
<td>±1.0</td>
<td>±2.8</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>105.6*</td>
<td>874.2*</td>
<td>979.7</td>
<td>104.2*</td>
</tr>
<tr>
<td></td>
<td>±3.8</td>
<td>±7.3</td>
<td>±11.0</td>
<td>±2.8</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>105.6*</td>
<td>874.2*</td>
<td>979.7</td>
<td>95.4*</td>
</tr>
<tr>
<td></td>
<td>±3.8</td>
<td>±7.3</td>
<td>±1.0</td>
<td>±18.6</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table 5: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciprofloxacin) on feeding oxidation in *Spodoptera frugiperda* fed ad libitum on castor leaf *Ricinus communis* at 26 ± 2°C and 80 ± 10% R.H. The values are expressed in mg dry weight per insect.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>608.7*</td>
<td>2319.9*</td>
<td>2928.6</td>
<td>745.8*</td>
</tr>
<tr>
<td>V</td>
<td>±2.7</td>
<td>±8.5</td>
<td>±11.2</td>
<td>±2.5</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>608.7*</td>
<td>2319.9*</td>
<td>2928.6</td>
<td>791.8*</td>
</tr>
<tr>
<td>V</td>
<td>±27.7</td>
<td>±8.5</td>
<td>±11.2</td>
<td>±2.8</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>608.7*</td>
<td>2319.9*</td>
<td>2928.6</td>
<td>783.9*</td>
</tr>
<tr>
<td>V</td>
<td>±27.7</td>
<td>±8.5</td>
<td>±11.2</td>
<td>±8.6</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table-6: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciprofloxacin) on feeding rate in *Samia Cynthia ricini* fed ad libitum on caster leaf *Ricinus communis* at 26 ± 2° c and 80 ± 10% R.H. The values are expressed in dry weight per mg wet weight of insect per day.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>0.7139*</td>
<td>0.3490*</td>
<td>1.0629</td>
<td>0.657.8*</td>
</tr>
<tr>
<td></td>
<td>±0.30</td>
<td>±0.01</td>
<td>±0.31</td>
<td>±0.33</td>
</tr>
<tr>
<td>V</td>
<td>0.7139*</td>
<td>0.3490*</td>
<td>1.0629</td>
<td>0.6142*</td>
</tr>
<tr>
<td></td>
<td>±0.30</td>
<td>±0.01</td>
<td>±0.31</td>
<td>±0.81</td>
</tr>
<tr>
<td>V</td>
<td>0.7139*</td>
<td>0.3490*</td>
<td>1.0629</td>
<td>0.61408*</td>
</tr>
<tr>
<td></td>
<td>±0.30</td>
<td>±0.01</td>
<td>±0.31</td>
<td>±0.613</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table-7: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxacin) on food conversion rate in Samia Cynthia ricini fed ad libitum on caster leaf Ricinus communis at 26 ± 2°C and 80 ± 10% R.H. The values are expressed in mg dry weight per mg wet weight of insect per day.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
<th>0.8%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
<td>V</td>
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<tr>
<td>Larval Stages</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>0.5904*</td>
<td>0.7852*</td>
<td>0.13756</td>
<td>0.06104*</td>
<td>0.07915*</td>
</tr>
<tr>
<td>±0.0024</td>
<td>±0.008</td>
<td>±0.0104</td>
<td>±0.0021</td>
<td>±0.008</td>
<td>±0.0101</td>
</tr>
<tr>
<td>V</td>
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<td>0.07852*</td>
<td>0.13756</td>
<td>0.06001*</td>
<td>0.07951*</td>
</tr>
<tr>
<td>±0.0024</td>
<td>±0.008</td>
<td>±0.0104</td>
<td>±0.0012</td>
<td>±0.008</td>
<td>±0.0092</td>
</tr>
<tr>
<td>Total</td>
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<td></td>
<td>0.14019</td>
<td>0.12911</td>
<td>0.06236*</td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>0.05904*</td>
<td>0.07852*</td>
<td>0.13756</td>
<td>0.06000*</td>
<td>0.07981*</td>
</tr>
<tr>
<td>±0.0024</td>
<td>±0.008</td>
<td>±0.0104</td>
<td>±0.0015</td>
<td>±0.0025</td>
<td>±0.0021</td>
</tr>
<tr>
<td>Ciproflaxacin</td>
<td>0.05904*</td>
<td>0.07852*</td>
<td>0.13756</td>
<td>0.06000*</td>
<td>0.07981*</td>
</tr>
<tr>
<td>±0.0024</td>
<td>±0.008</td>
<td>±0.0104</td>
<td>±0.0015</td>
<td>±0.0025</td>
<td>±0.0021</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table 8: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on assimilation rate in *Samia Cynthis ricini* fed *ad libitum* on easter leaf *Ricinus communis* at 26 ± 2°C and 80 ± 10 of R.H. The values are expressed in mg dry weight per mg wet weight of insect per day.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td><strong>Larval Stages</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>±0.016</td>
<td>±0.0028</td>
<td>±0.0188</td>
<td>±0.0015</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>±0.016</td>
<td>±0.0028</td>
<td>±0.0188</td>
<td>±0.0015</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>±0.016</td>
<td>±0.0018</td>
<td>±0.0188</td>
<td>±0.018</td>
</tr>
</tbody>
</table>

* Means in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table-9: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciprofloxacin) on metabolic rate in *Samia Cynthia ricini* fed *ad libitum* on caster leaf *Ricinus communis* at 26 ± 2°c and 80 ± 10% R.H. The values are expressed in mg dry weight per mg wet weight of insect per day.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
<td>V</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Larval Stages</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>0.6540*</td>
<td>0.2119*</td>
<td>0.8659</td>
<td>0.664*</td>
<td>0.2312*</td>
<td>0.8952</td>
<td>0.665*</td>
<td>0.2315*</td>
<td>0.8965</td>
<td>0.695*</td>
<td>0.2375*</td>
<td>0.9325</td>
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<tr>
<td></td>
<td>±0.004</td>
<td>±0.07</td>
<td>±0.41</td>
<td>±0.577</td>
<td>±0.001</td>
<td>±0.578</td>
<td>±0.56</td>
<td>±0.021</td>
<td>±0.581</td>
<td>±0.125</td>
<td>±0.255</td>
<td>±0.038</td>
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<tr>
<td>Chloromycetin</td>
<td>0.6540*</td>
<td>0.2119*</td>
<td>0.8659</td>
<td>0.661*</td>
<td>0.2310*</td>
<td>0.892</td>
<td>0.662*</td>
<td>0.2312*</td>
<td>0.8932</td>
<td>0.691*</td>
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<tr>
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<td>±0.000</td>
<td>±0.07</td>
<td>±0.41</td>
<td>±0.51</td>
<td>±0.012</td>
<td>±0.63</td>
<td>±0.35</td>
<td>±0.016</td>
<td>±0.366</td>
<td>±0.02*</td>
<td>±0.175</td>
<td>±0.387</td>
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<tr>
<td>Ciprofloxacin</td>
<td>0.6540*</td>
<td>0.2119*</td>
<td>0.8659</td>
<td>0.659*</td>
<td>0.2305*</td>
<td>0.8895</td>
<td>0.660*</td>
<td>0.2310*</td>
<td>0.891</td>
<td>0.681*</td>
<td>0.2365*</td>
<td>0.9175</td>
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<tr>
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<td>±0.004</td>
<td>±0.07</td>
<td>±0.41</td>
<td>±0.65</td>
<td>±0.014</td>
<td>±0.79</td>
<td>±0.15</td>
<td>±0.015</td>
<td>±0.165</td>
<td>±0.121</td>
<td>±0.433</td>
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</tr>
</tbody>
</table>

* Mean in a column are significantly different at p<0.1%; two-way student-Newman-Kuels (SNK) test.
Table-10: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on assimilation efficiency in *Samia Cynthia ricini* fed ad libitum on caster leaf *Ricinus communis* at 26 ± 2°C and 80 ± 10% R.H. The values are expressed in percent.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td><em>Larval Stages</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>62.5</td>
<td>59.2</td>
<td>61.3</td>
<td>61.0</td>
</tr>
<tr>
<td>±6.0</td>
<td>±2.7</td>
<td>±8.6</td>
<td>±6.5</td>
<td>±3.1</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>62.5</td>
<td>59.2</td>
<td>61.4</td>
<td>60.4</td>
</tr>
<tr>
<td>±6.0</td>
<td>±2.7</td>
<td>±8.6</td>
<td>±2.3</td>
<td>±2.1</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>62.5</td>
<td>59.2</td>
<td>61.4</td>
<td>63.4</td>
</tr>
<tr>
<td>±6.0</td>
<td>±2.7</td>
<td>±8.6</td>
<td>±2.2</td>
<td>±1.2</td>
</tr>
</tbody>
</table>
Table-11: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on gross conversion efficiency (Kt) in *Samia Cynthia ricini* fed ad libitum on caster leaf *Ricinus communis* at 26 ± 2°C and 80 ± 10% R.H. The values are expressed in percent.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>10.63</td>
<td>16.2</td>
<td>13.4</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>±1.45</td>
<td>±3.04</td>
<td>±4.54</td>
<td>±2.63</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>10.6</td>
<td>16.2</td>
<td>13.4</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>±1.45</td>
<td>±3.09</td>
<td>±4.54</td>
<td>±2.13</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>10.6</td>
<td>16.2</td>
<td>13.4</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>±1.45</td>
<td>±3.09</td>
<td>±4.54</td>
<td>±1.35</td>
</tr>
</tbody>
</table>
Table-12: Effect of different dilutions of Antibiotics (Ampicillin, Chloromycetin and Ciproflaxocin) on net conversion efficiency (Kd) in *Samia Cynthia ricini* fed ad libitum on caster leaf *Ricinus communis* at 26 ± 2° c and 80 ± 10% R.H. The values are expressed in percent.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>Larval Stages</td>
<td>IV</td>
<td>V</td>
<td>Total</td>
<td>IV</td>
</tr>
<tr>
<td>IV</td>
<td>14.8</td>
<td>21.1</td>
<td>27.4</td>
<td>14.8</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
<tr>
<td>V</td>
<td>27.4</td>
<td>21.1</td>
<td>27.4</td>
<td>27.4</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
<tr>
<td>Total</td>
<td>21.1</td>
<td>27.4</td>
<td>48.5</td>
<td>21.1</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
<tr>
<td>Ampicillin</td>
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<td>21.1</td>
<td>42.2</td>
<td>21.1</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>21.1</td>
<td>21.1</td>
<td>42.2</td>
<td>21.1</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>21.1</td>
<td>21.1</td>
<td>42.2</td>
<td>21.1</td>
</tr>
<tr>
<td>±0.78</td>
<td>±1.20</td>
<td>±1.98</td>
<td>±1.38</td>
<td>±1.20</td>
</tr>
</tbody>
</table>

Note: The values are expressed in percent.
Table-13: Effect of different dilutions of antibiotics Ampicillin, Chloromycetin, Ciproflaxocin) on growth in *Samia Cynthia ricini*

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>IV Instar After 3&lt;sup&gt;rd&lt;/sup&gt; Moult</th>
<th>V Instar After 4&lt;sup&gt;th&lt;/sup&gt; Moult</th>
<th>Prior to population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>21.88 ± 4.29</td>
<td>159.98 ± 7.14</td>
<td>1616.51 ± 12.4</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>29.18 ± 2.89</td>
<td>198.07 ± 4.83</td>
<td>2015.59 ± 12.65</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>24.66 ± 3.67</td>
<td>186.21 ± 2.51</td>
<td>1832.68 ± 7.16</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>22.67 ± 3.02</td>
<td>172.53 ± 5.33</td>
<td>1446.17 ± 13.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>IV Instar After 3&lt;sup&gt;rd&lt;/sup&gt; Moult</th>
<th>V Instar After 4&lt;sup&gt;th&lt;/sup&gt; Moult</th>
<th>Prior to population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>21.75 ± 4.29</td>
<td>159.86 ± 7.14</td>
<td>1616.51 ± 12.11</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>32.17 ± 3.35</td>
<td>255.18 ± 9.25</td>
<td>2324.55 ± 14.56</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>28.31 ± 2.15</td>
<td>215.12 ± 4.25</td>
<td>2115.22 ± 2.38</td>
</tr>
<tr>
<td>Ciproflaxocin</td>
<td>24.45 ± 3.45</td>
<td>198.36 ± 3.36</td>
<td>1811.88 ± 4.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>IV Instar After 3&lt;sup&gt;rd&lt;/sup&gt; Moult</th>
<th>V Instar After 4&lt;sup&gt;th&lt;/sup&gt; Moult</th>
<th>Prior to population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>21.75 ± 4.29</td>
<td>159.86 ± 7.14</td>
<td>1616.51 ± 12.11</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>41.36 ± 6.15</td>
<td>286.65 ± 3.25</td>
<td>2398.22 ± 16.55</td>
</tr>
<tr>
<td>Chloromycetin</td>
<td>36.22 ± 4.56</td>
<td>256.39 ± 3.5</td>
<td>2240.66 ± 8.56</td>
</tr>
</tbody>
</table>
Table-14: Food Utilization budgets in Eri silkworm *Samia cynthia ricini* fed ad libitum treated in 0.2% concentrations of Ampicillin, Chloromycetin Ciproflaxacin) the values are expressed in mg. Rates in mg/mg/day and efficiencies alone are expressed in percent.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Control</th>
<th>Ampicillin</th>
<th>Chloromycetin</th>
<th>Ciproflaxacin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Larval period days</td>
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<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>2.</td>
<td>Food intake</td>
<td>6391.3</td>
<td>6946.82</td>
<td>6825.87</td>
<td>6720.22</td>
</tr>
<tr>
<td></td>
<td>± 168.15</td>
<td>± 172.51</td>
<td>± 200.54</td>
<td>± 250.38</td>
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</tr>
<tr>
<td>3.</td>
<td>Faces defecated</td>
<td>2482.97</td>
<td>2601.3</td>
<td>2531.21</td>
<td>2488.70</td>
</tr>
<tr>
<td></td>
<td>± 131.57</td>
<td>± 121.23</td>
<td>± 100.49</td>
<td>± 103.5</td>
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</tr>
<tr>
<td>4.</td>
<td>Food assimilated</td>
<td>3908.27</td>
<td>4345.51</td>
<td>4294.80</td>
<td>4231.60</td>
</tr>
<tr>
<td></td>
<td>± 47.07</td>
<td>± 33.87</td>
<td>± 6.17</td>
<td>± 69.0</td>
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</tr>
<tr>
<td>5.</td>
<td>Food converted</td>
<td>979.72</td>
<td>1221.57</td>
<td>1110.11</td>
<td>876.47</td>
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<tr>
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<td>± 10.97</td>
<td>± 11.70</td>
<td>± 6.40</td>
<td>± 31.96</td>
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</tr>
<tr>
<td>6.</td>
<td>Food oxidized</td>
<td>2928.55</td>
<td>3123.94</td>
<td>3184.69</td>
<td>3355.13</td>
</tr>
<tr>
<td></td>
<td>± 11.19</td>
<td>± 11.70</td>
<td>± 6.31</td>
<td>± 13.14</td>
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</tr>
<tr>
<td>7.</td>
<td>Feeding rate</td>
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<td>0.9789</td>
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<td>± 0.63</td>
<td>± 0.932</td>
<td>± 0.212</td>
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<tr>
<td>8.</td>
<td>Conversion rate</td>
<td>0.13756</td>
<td>0.14019</td>
<td>0.1395</td>
<td>0.13981</td>
</tr>
<tr>
<td></td>
<td>± 0.010</td>
<td>± 0.010</td>
<td>± 0.0092</td>
<td>± 0.0025</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Assimilation rate</td>
<td>0.7826</td>
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<td>0.7924</td>
<td>0.7885</td>
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<tr>
<td></td>
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<td>± 0.016</td>
<td>± 0.0171</td>
<td>± 0.03</td>
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</tr>
<tr>
<td>10.</td>
<td>Metabolic rate</td>
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<td>0.8952</td>
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<td>0.889</td>
</tr>
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<td>± 4.011</td>
<td>± 0.578</td>
<td>± 0.63</td>
<td>± 0.79</td>
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</tr>
<tr>
<td>11.</td>
<td>Assimilation efficiency</td>
<td>61.35</td>
<td>62.55</td>
<td>63.00</td>
<td>62.96</td>
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<td></td>
<td>± 8.64</td>
<td>± 9.67</td>
<td>± 4.48</td>
<td>± 3.40</td>
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</tr>
<tr>
<td>12.</td>
<td>Grass conversion efficiency</td>
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<td>17.6</td>
<td>16.3</td>
<td>13.00</td>
</tr>
<tr>
<td></td>
<td>± 1.98</td>
<td>± 5.65</td>
<td>± 5.49</td>
<td>± 3.24</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Net conversion efficiency</td>
<td>25.97</td>
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<td>25.8</td>
<td>20.71</td>
</tr>
<tr>
<td></td>
<td>± 4.54</td>
<td>± 4.75</td>
<td>± 4.29</td>
<td>± 3.16</td>
<td></td>
</tr>
</tbody>
</table>
Table-15

Food Utilization budgets in Eri silkworm *Samia cynthia ricini* fed ad *libitum* treated in 0.4% concentrations of Ampicillin, Chloromycetin (Ciproflaxocin) the values are expressed in mg. Rates in mg/mg/day and efficiencies alone are expressed in percent.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Control</th>
<th>Ampicillin</th>
<th>Chloromycetin</th>
<th>Ciproflaxocin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Larval period days</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>2.</td>
<td>Food intake</td>
<td>6391.3</td>
<td>6984.31</td>
<td>6870.21</td>
<td>6769.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 168.15</td>
<td>± 187.49</td>
<td>± 171.2</td>
<td>± 185.79</td>
</tr>
<tr>
<td>3.</td>
<td>Faces defecated</td>
<td>2482.97</td>
<td>2628.20</td>
<td>2591.16</td>
<td>2534.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 131.57</td>
<td>± 124.32</td>
<td>± 36.78</td>
<td>± 35.67</td>
</tr>
<tr>
<td>4.</td>
<td>Food assimilated</td>
<td>3908.27</td>
<td>4356.11</td>
<td>4279.05</td>
<td>4235.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 47.07</td>
<td>± 40.42</td>
<td>± 3.75</td>
<td>± 60.96</td>
</tr>
<tr>
<td>5.</td>
<td>Food converted</td>
<td>979.72</td>
<td>1408.82</td>
<td>1281.99</td>
<td>1098.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 10.97</td>
<td>± 11.8</td>
<td>± 9.86</td>
<td>± 7.40</td>
</tr>
<tr>
<td>6.</td>
<td>Food oxidized</td>
<td>2928.55</td>
<td>2947.29</td>
<td>2997.05</td>
<td>3136.97</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>± 10.70</td>
<td>± 10.68</td>
<td>± 8.10</td>
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<td>7.</td>
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<td>1.1621</td>
<td>1.034</td>
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<td>± 0.354</td>
<td>± 0.285</td>
<td>± 0.346</td>
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<td>8.</td>
<td>Conversion rate</td>
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<td>0.12818</td>
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<tr>
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<td>± 0.0072</td>
<td>± 0.0063</td>
<td>± 0.0043</td>
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<tr>
<td>9.</td>
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<tr>
<td></td>
<td></td>
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<td>± 0.126</td>
<td>± 0.119</td>
<td>± 0.121</td>
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<tr>
<td>10.</td>
<td>Metabolic rate</td>
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<td>0.8965</td>
<td>0.8932</td>
<td>0.891</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 4.011</td>
<td>± 0.581</td>
<td>± 0.366</td>
<td>± 0.165</td>
</tr>
<tr>
<td>11.</td>
<td>Assimilation efficiency</td>
<td>61.35</td>
<td>62.36</td>
<td>62.28</td>
<td>62.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 8.64</td>
<td>± 1.27</td>
<td>± 3.34</td>
<td>± 3.51</td>
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<tr>
<td>12.</td>
<td>Grass conversion efficiency</td>
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<td>20.2</td>
<td>18.7</td>
<td>16.2</td>
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<td>± 1.98</td>
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<td>± 2.57</td>
<td>± 2.23</td>
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<td>29.95</td>
<td>25.92</td>
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<td></td>
<td>± 4.54</td>
<td>± 4.25</td>
<td>± 6.25</td>
<td>± 4.36</td>
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</table>
**Table-16**

Food Utilization budgets in Eri silkworm *Samia cynthia ricini* fed ad *libitum* treated in 0.6% concentrations of Ampicillin, Chloromycetin (Ciprofloxacin) the values are expressed in mg. Rates in mg/mg/day and efficiencies alone are expressed in percent.

<table>
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<tr>
<th>Sl. No.</th>
<th>Parameters</th>
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<th>Chloromycetin</th>
<th>Ciprofloxacin</th>
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<tr>
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<td>2686.91</td>
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<td>± 90.30</td>
<td>± 147.90</td>
<td>± 60.50</td>
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<td>4.</td>
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<td>4167.69</td>
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<td>± 24.49</td>
<td>± 24.90</td>
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<tr>
<td>5.</td>
<td>Food converted</td>
<td>979.72</td>
<td>1453.47</td>
<td>1357.98</td>
<td>1181.31</td>
</tr>
<tr>
<td></td>
<td>± 10.97</td>
<td>± 3.35</td>
<td>± 5.80</td>
<td>± 10.87</td>
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<td>6.</td>
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<td></td>
<td>± 11.19</td>
<td>± 5.35</td>
<td>± 5.98</td>
<td>± 11.50</td>
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<td>Feeding rate</td>
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<td>1.080</td>
<td>1.086</td>
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<td>± 0.31</td>
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<td>0.14341</td>
<td>0.14213</td>
</tr>
<tr>
<td></td>
<td>± 0.010</td>
<td>± 0.0214</td>
<td>± 0.0238</td>
<td>± 0.0224</td>
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<tr>
<td>9.</td>
<td>Assimilation rate</td>
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<td>0.83263</td>
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<tr>
<td></td>
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<td>08659</td>
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<td>± 4.011</td>
<td>± 3.80</td>
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<td>± 4.50</td>
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<td>28.3</td>
</tr>
<tr>
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<td>± 4.54</td>
<td>± 0.83</td>
<td>± 6.00</td>
<td>± 7.36</td>
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</tr>
</tbody>
</table>
Figure 1: Food intake in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed ad libitum on castor leaf at different dilutions.

Food intake in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fourth instar.

Food intake in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fifth instar.
Figure-3: Food assimilated in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciproflaxocin) fed *ad libitum* castor leaf on *S. cynthia ricini* at different dilutions during fourth instar.
in three antibiotics
(Ampicillin, Chloromycetin, Ciproflaxacin) fed ad libitum on caster leaf on

Food converted in three different antibiotic fed on Samia cynthia ricini at
different dilutions during fourth instar

<table>
<thead>
<tr>
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<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
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<td>Ampicillin</td>
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<td></td>
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</tr>
<tr>
<td>Chloromycetin</td>
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<td></td>
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<td></td>
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<tr>
<td>Ciproflaxacin</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Food converted in three different antibiotic fed on Samia cynthia ricini at
different dilutions during fifth instar

<table>
<thead>
<tr>
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<th>Control</th>
<th>0.2%</th>
<th>0.4%</th>
<th>0.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloromycetin</td>
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<td></td>
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<td></td>
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<tr>
<td>Ciproflaxacin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 8: Food oxidized in Samia cynthia ricini in three antibiotics (Ampicillin, Chloromycetin, Ciproflaxacin) fed ad libitum castor leaf on Samia cynthia ricini at different dilutions during fourth instar.

- Control
- 0.2%
- 0.4%
- 0.6%
Figure 3: Feeding rate in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed ad libitum castor leaf on different dilutions.
Figure-7: Conversion rate in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed *ad libitum* caster leaf on different dilutions during fourth and fifth instar.
Figure 8: Assimilation rate in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromyocetin, Ciproflaxacin) fed *ad libitum* on castor leaf on different dilutions during fourth instar.

Assimilation rate in three different antibiotic fed on *Samia cynthia ricini* at different dilutions during fourth instar.

Assimilation rate in three different antibiotic fed on *Samia cynthia ricini* at different dilutions during fifth instar.
Figure-9: Metabolic rate in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed *ad libitum* castor leaf on

Metabolic rate in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fourth instar

![Graph showing metabolic rate during fourth instar](image)

Metabolic rate in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fifth instar

![Graph showing metabolic rate during fifth instar](image)

73
Figure-10: Assimilation efficiency in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed *ad libitum* caster leaf on

Assimilation efficiency in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fourth instar

Assimilation efficiency in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fifth instar
Figure-11: Gross conversion efficiency ($K_I$) in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed *ad libitum* caster leaf on different dilutions during fourth and fifth instar.
Figure 12: Net conversion efficiency ($K_3$) in *Samia cynthia ricini* in three antibiotics (Ampicillin, Chloromycetin, Ciprofloxacin) fed ad libitum castor leaf on different dilutions during fourth and fifth instar.

Net conversion efficiency ($K_3$) in three different antibiotics fed on *Samia cynthia ricini* at different dilutions during fourth instar.

- **Ampicillin**
- **Chloromycetin**
- **Ciprofloxacin**

Legend:
- Control
- 0.2%
- 0.4%
- 0.6%
Figure 13: Allocation of consumed food energy in *Samia cynthia ricini* fed *ad libitum* caster leaf (*Ricinus communis*) on different Antibiotics (ampicillin, chloromycetin, ciproflaxocin), at 0.2% concentration.

### Food Intake (mg 100 %)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
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<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>6946.8</td>
<td></td>
</tr>
<tr>
<td>Chloromycetin</td>
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</tr>
<tr>
<td>Ciproflaxocin</td>
<td>6720.2</td>
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### Assimilation

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<tbody>
<tr>
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<td>Ciproflaxocin</td>
<td>4231.6</td>
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### Conversion

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<td>Ciproflaxocin</td>
<td>876.5</td>
<td>3355.1</td>
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### Respiration

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<tbody>
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<td>Control</td>
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<tr>
<td>Ciproflaxocin</td>
<td>876.5</td>
<td>3355.1</td>
</tr>
</tbody>
</table>
Figure-14: Allocation of consumed food energy in *Samia cynthia ricini* fed *ad libitum* caster leaf (*Ricinus communis*) on different Antibiotics (ampicillin, chloromycetin, ciproflaxocin), at 0.4% concentration.

### Food Intake (mg 100 %)

- **Control**: 6391.3
- **Ampicillin**: 6984.31
- **Chloromycetin**: 6870.21
- **Ciproflaxocin**: 6769.39

### Assimilation

- **Control**: 3908.3 (61.1%)
- **Ampicillin**: 4356.1 (62.3%)
- **Chloromycetin**: 4279.0 (62.2%)
- **Ciproflaxocin**: 4235.0 (62.5%)

### Faeces

- **Control**: 2483.0 (38.8%)
- **Ampicillin**: 2628.2 (37.6%)
- **Chloromycetin**: 2591.1 (37.7%)
- **Ciproflaxocin**: 2534.3 (37.4%)

### Conversion

- **Control**: 979.8 (25.0%)
- **Ampicillin**: 1408.8 (32.3%)
- **Chloromycetin**: 1281.9 (29.9%)
- **Ciproflaxocin**: 1098.1 (25.9%)

### Respiration

- **Control**: 2928.6 (74.9%)
- **Ampicillin**: 2947.2 (67.6%)
- **Chloromycetin**: 2997.0 (70.0%)
- **Ciproflaxocin**: 5136.9 (74.0%)
Figure-15: Allocation of consumed food energy in *Samia cynthia ricini* fed *ad libitum* caster leaf (*Ricinus communis*) on different Antibiotics (Ampicillin, Chloromycetin, Ciproflaxacin), at 0.6% concentration.

Food Intake (mg 100 %)

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<th>Chloromycetin</th>
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<td>6391.3</td>
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**Assimilation**

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<tr>
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<td>(61.1%)</td>
<td>(61.3%)</td>
<td>(61.2%)</td>
<td>(61.1%)</td>
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**Faeces**

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<th>Chloromycetin</th>
<th>Ciproflaxacin</th>
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<td>2482.9</td>
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<td>2686.9</td>
<td>2645.9</td>
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<td>(38.9)</td>
<td>(38.6)</td>
<td>(38.8)</td>
<td>(38.9)</td>
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**Conversion**

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<th>Chloromycetin</th>
<th>Ciproflaxacin</th>
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<td>979.7</td>
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<td>(25.0%)</td>
<td>(33.7%)</td>
<td>(31.9%)</td>
<td>(28.3%)</td>
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**Respiration**

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<tbody>
<tr>
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<td>2853.2</td>
<td>2886.3</td>
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<tr>
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<td>(74.9%)</td>
<td>(66.7%)</td>
<td>(68.0%)</td>
<td>(71.6%)</td>
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