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CHEMICAL DIFFERENCES OF SILKWORM *Bombyx mori* L. PRODUCTS AS INDEX OF RACES

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ABSTRACT

The present study aims to study the by-product components of silkworm, *Bombyx mori* races especially those concerning faeces, eggs, and cocoons. It also, deals with the differences which occur among local races (Novi M, Novi P, 380 M and EJP) in chlorophyll consumption.

The highest amount of faeces were produced by 4th and 5th larval instars EJP race, followed by 380 M then Novi P and lastly Novi M race. The highest amount of total chlorophyll during Spring and Autumn were recorded for 380 M and EJP races, respectively. While 380 M and Novi M races showed the highest concentration of carotene during Spring and Autumn. EJP and Novi M races showed the highest AD % of total chlorophyll during Spring and Autumn, respectively.

Novi P and Novi M races showed the highest concentration of fibroin during Spring and Autumn. While EJP race showed the highest concentration of sericin during two rearing seasons. Novi P race showed the highest concentration of wax layer in egg chorion during Spring and Autumn.

INTRODUCTION

Recently, new concept is worked out to introduce new technologies which can make full utilization of mulberry silkworm wastes as a valuable by-product industry. Proper utilization of sericulture and silk waste adds a value up to 40% to silk industry (Raju, 1996). Silkworm faeces acts as raw material for variety of materials viz., chlorophyll A & B, are obtained from silkworm litter and used in medicines and cosmetics in China and Japan. Ping et al., (1994) reported that, the latest progress in multi-purpose utilization of sericulture by product focus on silkworm faces, pupae, cocoon, moths and mulberries. From silkworm faeces are extracted pigments such as chlorophylls and carotenoids and from the pupae an oil. Hormones and antibacterial peptides of the adults are used, and also the cellulose and fruit juice of the mulberry fruits. Rajiv and Vijayakumar (1996), reported that phytol extracted from silkworm faeces is used in preparation of vitamin E & K and carotene as a source of vitamin A.

Eggs, larvae, pupae and faeces find their use in medicinal, pharmaceuticals, cosmetics, paper and leather industry (Jayasomu and Singh, 1999). Paste chlorophyll, pectin, phytol, carotene, triacontanol and solanesol, etc., extracted from silkworm faeces are used in the treatment of various diseases such as hepatitis, acute pancreatitis, chronic nephritis, stomach and gastric disorders, leukocytopenia, blood cholesterol, as mentioned by many authors (Babu, 1994; Chung et al, 1997; Hiraki et at,

1997; Majumder 1997; Revannasiddiah and Bai, 2000; Ahn *et al*, 2001& 2002; Cui *et al*, 2002; Promboon *et al*, 2002 and Gui *et al* 2003).

Besides, faeces of silkworm are used in manuring (Ries and Wert,1982; Ries and Houtz,1983; Gunasekaran and Shanmugavelu, 1983 and Mishra *et al* 1983). The application of dried silkworm faeces was effective in reducing mung bean damage caused by *Meloidogyne javanica* in potexperimants (Toida *et al* 1991, 1992 and 1994). It is used in producing biogas (Kalimuthu and Rajasekaran, 1992) and producing much rooms (Sun and Yu, 1989), also in feeding poultry birds (Hussain *et al* 1995) and milking cattle's (Sivasankar and Ashoka,1997).

Fibroin and sericin of silkworms are race dependent (Huang, 1988; Zhang and Zhang, 1998) and are being developed and utilized for purposes besides traditional textile material.

In the light of the fact that the production of one ton of cocoons gives 83 tons of faeces and others of side products, the present work was planned to study the race dependent variation of these products.

MATERIALS AND METHODS

The present study aims to study the by-product components of silkworm, *Bombyx mori* races especially those concerning faeces and eggs. It also, deals with the differences which occur among local races (Novi M, Novi P, 380 M and EJP) in chlorophyll consumption.

Insect resources :

Stock cultures of *Bombyx mori* eggs, Novi M and Novi P (Italian monovoltine races), 380 M (a Chinese monovoltine race) and EJP (a Japanese bivoltine race) were obtained from the Sericulture Research Department of the Agriculture Research Center, Giza, Egypt.

Rearing silkworms and experimental techniques were carried out under laboratory conditions (25Ċ ± 2 and R.H. 65 – 75%) at the Sericulture Research Department.

Rearing technique :

Six replicates (120 larvae) of each race were reared on fresh mulberry leaves of *Morus alba* var. Kukuso-27 from hatching to pupation. They were fed four times daily.

Larvae of each race were reared in wooden boxes (30 x 20 x 15 cm.) in diameter, twenty larvae per box were used. Regular cleaning of rearing beds were carried out to remaining leaves and faeces to avoid disease infection.

Collection of faeces :

Newly molted fourth instar larvae of silkworm, *Bombyx mori* were prepared in four treatments, each contain 60 larvae in three replicates. They were fed on mulberry leaves (4 times daily) till pupation. Faeces of each group (380 M, EJP, Novi M and Novi P races) were collected daily from the rearing bed of the fourth and fifth larval instars. They were dried in open trays for two days

in the laboratory and are then dried in a hot air oven at 70 Ċ, till constant weight is reached and kept for biochemical analysis.

Leaves biochemical analysis :

Mulberry leaves (tender, medium and coarse) 10 leaves / level are collected for recording the biochemical parameters. They were dried in open trays for two days in the laboratory and were then dried in hot air oven at 70 °C, till constant weight was reached, then kept for analysis of chlorophyll A, B and carotene. The determination was carried out according to the method reported by Holden (1965).

Determination of chlorophyll A, B and carotene in faeces :

The chlorophyll A, B and carotene were extracted from dried faeces by using 85% acetone according to Fadeels method (1962).

The optical densities were measured Spectrophotometrically with "Spectronic 21D" at 622, 644 and 440nm. The pigments concentrations were calculated using Wettstains formula (Wettstain, 1957).

Consumption and digestion of food by different races as biochemical parameter:

To estimate the mean weight of both chlorophyll and consequently fresh food consumed by each larval instar of the different races, the method adopted by Waldbauer, (1964) was used.

Determination of fibroin and sericin :

The fibroin and sericin protein quantities were determined in cocoon shell of the four races. Twenty cocoon shells of each race were collected and dried in the oven for 4 hours at 70 Ċ to eliminate the water content, then weighted separately. The cocoon shell were cooked in boiling water (95 Ċ) to eliminate the sericin . Each cocoon shell were reeled by withdrawing the silk filament by hand then the silk were dried for 4 hours at 70 Ċ till constant weight was reached . the silk filament (fibroin) was weighted and the sericin content was estimated as follow :

Weight of sericin=weight of dried cocoon shell-Weight of dried silk filament (fibroin)

Sericin and fibroin content / 100 gm of cocoon were calculated.

Determination of wax in egg shell :

Quantitative assessment of wax was determined in egg shell of each race. The wax was determined according to A.O.A.C. (1984) as follows: The thoroughly grinned dried sample (about 0.5 gm) was accurately weighted, then extracted in a soxhlet apparatus with petroleum ether (40 – 60 Ċ) for several times. The solvent was removed by evaporation under reduced pressure and the percentage of total wax was calculated.

$$\text{Percentage of wax (\%)} = \frac{\text{Weight of wax extracted}}{\text{Weight of sample}} \times 100$$

RESULTS AND DISCUSSIONS

1- Chlorophylls and carotene of the used mulberry leaves:

Results in (Table, 1) show that, the mean weight of chlorophyll A, B, total chlorophyll and carotene in mulberry leaves were 2.274, 1.376, 3.650 and 1.030 mg/g leaf, respectively during Spring. While they were 2.768, 1.515, 4.283 and 1.455 mg/g leaf, respectively during Autumn.

Also, results in Table (1) show that, the mean weight of chlorophyll A, B, total chlorophyll and carotene in mulberry leaves differ according to the rearing season. The amount of chlorophyll A, B, total chlorophyll and carotene in Autumn are higher than that of Spring one.

Table (1) show significant differences between the amount of chlorophyll A, B, total chlorophyll and carotene in mulberry leaves during Spring and Autumn.

These finding were confirmed by several authors as they showed that, the content of chlorophyll A is higher than chlorophyll B in different mulberry varieties. (Thangamani and Vivekanandan, 1984; Bongale and Chaluvachari, 1995; Cappelozza et al, 1995; Shankar et al, 1999 and Patil et al, 2001) reported that, the results of biochemical analyses of mulberry leaves differ according to variety.

Table (1): Mean Weight (mg/g dry w.) of Chlorophyll A,B and Caro tene in Mulberry Leaves During Spring and Autamn .

Seasons / Parametars	Spring	Autumn
	Mean ± S.E.	
Chl.A (mg/g)	2.274 ± 0.602	2.768 ± 0.662
Chl.B (mg/g)	1.376 ± 0.094	1.515 ± 0.346
Total Chl. (mg/g)	3.650 ± 0.698	4.283 ±1.016
carotene (mg/g)	1.030 ± 0.248	1.455 ± 0.363
F.Value	11.846 *	8.159 *
L.S.D. at 5%	1.108	1.513

Chl. = Chlorophyll
*** = Significant**
S.E. = Standerd Error

2- Amount of chlorophyll and carotene in faeces of the different races :

Tables (2 and 3) show the amount of faeces produced from 1000 larvae of *Bombyx mori* races under study from 4th and 5th larval instars during Spring and Autumn.

These highest amount of faeces produced by 4th and 5th larval instar were recorded for EJP and 380 M race during Spring and Autumn, respectively (Tables 2 and 3).

Also, the highest amount of chlorophyll A leaked to faeces of 1000 larvae in 4th larval instar during Spring and Autumn were recorded for 380 M and EJP race (Tables 2 and 3). While in 5th larval instar the highest amount of chlorophyll A were recorded for 380 M (10.802 gm/1000 larvae) and Novi P (15.124 gm/1000 larvae) race.

TabLe (2): Mean Weight of Faeces, Chlorophyll A,B and Carotene /1000 Larvae of Bombyx mori Races During Spring rearing .

Parametars / Races	Faeces (gm)		Chl.A (gm)		Chl.B (gm)		Total Chl. (gm)		carotene (gm)	
	Larval Instars									
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.									
380m	322.520± 12.107	2283± 0.010	1.185± 0.044	10.802± 0.049	0.737± 0.027	7.056± 0.032	2.093± 0.047	17.859± 0.082	0.370± 0.013	3.197± 0.014
EJP	326.611± 12.715	2273± 0.012	0.970± 0.037	7.349± 0.380	0.597± 0.023	6.366± 0.038	0.908± 0.035	13.596± 0.083	0.137± 0.038	2.910± 0.017
Novim	270.833± 13.792	2224± 0.013	0.907± 0.016	9.120± 0.054	0.644± 0.032	6.428± 0.038	1.551± 0.079	15.548± 0.092	0.219± 0.011	3.180± 0.018
Novip	278.237± 10.686	2229± 0.010	1.037± 0.039	8.360± 0.040	0.548± 0.021	7.334± 0.035	1.585± 0.060	15.695± 0.075	0.244± 0.009	3.299± 0.015
F.Value	46.700*	230.194*	46.300*	248.530*	44.850*	466.620*	54.080*	245.344*	13.200*	103.491*
L.S.D. at 5%	5.907	0.060	0.196	0.269	0.122	0.157	0.268	0.488	0.084	0.075

TabLe (3): Mean Weight of Faeces, Chlorophyll A,B and Carotene /1000 Larvae of Bombyx mori Races During Autumn rearing .

Parametars / Races	Faeces (gm)		Chl.A (gm)		Chl.B (gm)		Total Chl. (gm)		carotene (gm)	
	Larval Instars									
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.									
380m	270.158± 14.883	2224± 0.012	1.294± 0.071	10.765± 0.060	0.905± 0.049	8.007± 0.044	2.199± 0.121	18.772± 0.105	0.340± 0.018	3.291± 0.018
EJP	274.882± 16.221	2233± 0.012	1.396± 0.082	13.179± 0.074	0.937± 0.055	11.526± 0.065	2.333± 0.137	24.706± 0.139	0.291± 0.017	2.479± 0.014
Novim	219.666± 12.866	2167± 0.013	0.902± 0.052	10.901± 0.066	0.619± 0.036	10.360± 0.063	1.522± 0.089	21.263± 0.129	0.325± 0.019	3.706± 0.022
Novip	224.408± 13.836	2173± 0.011	0.875± 0.053	15.124± 0.102	0.747± 0.046	9.561± 0.065	1.622± 0.100	24.685± 0.168	0.150± 0.009	2.455± 0.017
F.Value	28.269*	206.420*	46.910*	205.220*	53.158*	305.560*	50.104*	209.980*	28.493*	281.720*
L.S.D. at 5%	16.362	0.063	0.378	0.458	0.269	0.231	0.646	0.635	0.011	0.079

ChL. --▶ Chlorophyll
* --▶ Significant
S.E. --▶ Standerd Error

The amount of chlorophyll B outflowed to faeces of 1000 larvae during 4th larval instar recorded 0.737- 0.937 gm/1000 larvae, during Spring and Autumn these highest amount were recorded for 380 M and EJP race (Tables 2 and 3). While in 5th larval instar the amount of chlorophyll B recorded 7.334 - 11.526 gm/1000 larvae, during Spring and Autumn these highest amount were recorded for Novi P and EJP race (Tables 2 and 3).

380 M and EJP race showed the highest amount of total chlorophyll infiltrated to faeces of 1000 larvae of Bombyx mori races under study from 4th and 5th larval instars during Spring and Autumn, respectively (Tables 2 and 3).

At the 4th and 5th larval instar 380 M and Novi M race showed the highest concentration of carotene during Spring and Autumn. While EJP and Novi P race showed the lowest one for the same season.

Statistical analysis in (Tables 2 and 3) show significant differences among the races under study and the rearing seasons in amount of faeces, chlorophyll A, B, total chlorophyll and carotene leaked from 1000 larvae during 4th and 5th larval instars.

The above results are in accordance with some investigators, (Raju, 1996; Rajiv and Vijayakumar, 1996 and Gui et al 2003) about the observation confirmed the exist of chlorophyll in the silkworm faeces. They recorded that, the silkworm faeces acts as raw material for variety of products viz., paste chlorophyll, sodium copper chlorophyllin. At least types of chlorophyll A and B are obtained from silkworm litter in the ratio 3:1 are used in medicines and cosmetics in China and Japan. The carotene extracted from silkworm faeces used as a source of vitamin A.

3- Participation of chlorophylls and carotene of mulberry leaves in weight gain of *Bombyx mori* L. larvae:

The silkworm can utilize different nutrients in the leaves through digestion and absorption. The nutrients are used to build up body weight and to produce energy to maintain the life of the worm.

a- Chlorophylls:

Tables 4 and 5, represent the average quantity of total chlorophyll consumed, digest AD and digestibility AD % during the 4th and 5th larval instars in Spring and Autumn. The average of total chlorophyll consumed by an individual larva in the 4th and 5th larval instars ranged between 11.059 - 11.219 and 54.303 - 54.489 mg/ larva during Spring, respectively (Table, 4). While in the Autumn it ranged between 12.700 - 12.982 and 73.762 - 74.033 mg/ larva, respectively (Table, 5). In Autumn 380 M race showed the highest amount of total chlorophyll consumed in the 4th and 5th larval instars, while Novi P race showed the lowest one.

At the 4th and 5th larval instars 380 M race showed the lowest amount of approximate weight of total chlorophyll digest AD while EIP and Novi M race showed the highest amount of approximate weight of total chlorophyll digest AD during Spring, respectively (Table, 4). While EIP and Novi P race showed the lowest amount of approximate weight of total chlorophyll digest AD and Novi M race showed the highest amount of approximate weight of total chlorophyll digest AD for 4th and 5th larval instars, respectively (Table, 5).

Table (4) : Consumption Efficiency of Total Chlorophyll Per Larva (mg) Utilized By Bombyx mori Races During Spring rearing

Parametars \ Races	380m		EJP		Novim		Novip		F value		L.S.D. at 5%	
	Larval Instars											
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.											
Chl. Consumed (mg)	11.200± 0.013	54.489± 0.007	11.219± 0.022	54.469± 0.001	11.086± 0.005	54.313± 0.027	11.059± 0.008	54.303± 0.006	116.000*	609.044*	0.029	0.029
A.D. (mg)	2.608± 0.218	6.768± 0.216	4.249± 0.148	8.993± 0.193	4.144± 0.242	10.999± 0.330	3.964± 0.090	9.434± 0.068	34.302*	123.474*	0.426	0.513
A.D. (%)	23.283± 1.923	12.420± 0.395	37.872± 1.243	16.511± 0.353	37.381± 2.191	20.251± 0.601	35.846± 0.839	17.372± 0.126	35.716*	127.129*	3.780	0.935

Table (5) : Consumption Efficiency of Total Chlorophyll Per Larva (mg) Utilized By Bombyx mori Races During Autumn rearing .

Parametars \ Races	380m		EJP		Novim		Novip		F value		L.S.D. at 5%	
	Larval Instars											
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.											
Chl. Consumed (mg)	12.982± 0.011	74.033± 0.008	12.962± 0.004	73.990± 0.024	12.768± 0.017	73.799± 0.011	12.700± 0.028	73.762± 0.009	136.000*	413.330*	0.042	0.036
A.D. (mg)	3.278± 0.231	10.307± 0.190	2.665± 0.142	8.801± 0.147	6.051± 0.098	13.965± 0.289	5.541± 0.145	8.666± 0.606	212.846*	95.659*	0.371	0.823
A.D. (%)	25.253± 1.788	13.921± 0.257	20.560± 1.107	11.895± 0.203	47.397± 0.833	18.924± 0.389	43.632± 1.212	11.748± 0.821	214.162*	102.007*	2.959	1.082

ChL . ——▶ Chlorophyll
* ——▶ Significant
S.E. ——▶ Standerd Error
A.D. ——▶ Approximate digest
A.D.% ——▶ Approximate digestibility

The approximate digestibility AD %, recorded differences among the different races. At the 4th and 5th larval instars 380 M race showed the lowest of approximate digestibility AD % of total chlorophyll while EIP and Novi M race showed the highest digestibility AD % of total chlorophyll during Spring, respectively (Table, 4). While during Autumn EIP and Novi P race showed the lowest of approximate digestibility AD % of total chlorophyll but Novi M race showed the highest digestibility AD % of total chlorophyll during Autumn, respectively (Table, 5).

Tables (4 and 5) show significant differences between the races under study and the rearing seasons in amount of total chlorophyll consumed, approximate weight digest AD and approximate digestibility AD % to 4th and 5th larval instars during Spring and Autumn seasons.

b- Carotene:

Tables 6 and 7, represent the average quantity of carotene consumed, digest AD and digestibility AD % during the 4th and 5th larval instars in Spring and Autumn rearing. It is evident from these Tables that, the average carotene consumed by an individual larva in the 4th and 5th larval instars ranged between 3.087 - 3.165 and 15.324 - 15.375 mg/ larva during Spring for Novi P, EJP, Novi P and 380 M race, respectively (Table, 6). While in the Autumn it ranged between 4.314 - 4.410 and 25.058 -25.150 mg/ larva, respectively (Table, 7) for Novi P and 380 M, races, respectively.

The approximate weight of carotene digest AD ranged between 1.502 - 2.553 and 2.357 - 3.520 mg/ larva, at the 4th and 5th larval instars during Spring for 380 M and EJP race, respectively (Table, 6). While in the Autumn it ranged between 2.903 - 3.651 and 3.540 - 5.768 mg/ larva, for Novi M , Novi P and 380 M race, respectively (Table, 7).

The approximate digestibility AD %, recorded differences among the different races. They ranged between 47.546 - 80.655 and 15.330 - 22.901 % at the 4th and 5th larval instars during Spring for 380 M and EJP race, respectively (Table, 12).

While the approximate digestibility AD %, of carotene during Autumn to 4th and 5th larval instars ranged between 65.941 - 84.624 and 14.120 - 21.743 % for 380 M, Novi P, Novi M and 380 M, respectively (Table ,13).

Statistical analysis in (Tables 6 and 7) show significant differences among the races under study and the rearing seasons in amount of carotene consumed, approximate weight digest AD and approximate digestibility AD % to 4th and 5th larval instars during Spring and Autumn seasons.

4- Race dependent variation of silk components:

Insects produce a wide range of organic compounds for many of which they have found biological uses and some of which have become articles of commerce. Prominent among of these are silk from the commercial silkworm, *Bombyx mori* L. consisting of 70 - 75 % of a tough elastic protein fibroin and 20 - 25 % of a gelatinous protein sericin as a covering layer.

Table (6) : Consumption Efficiency of Carotene Per Larva (mg) Utilized By Bombyx mori Races During Spring rearing .

Parametars \ Races	380m		EJP		Novim		Novip		F value		L.S.D. at 5%	
	Larval Instars											
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.											
Chl. Consumed (mg)	3.160± 0.003	15.375± 0.002	3.165± 0.006	15.370± 0.000	3.128± 0.001	15.326± 0.007	3.087± 0.045	15.324± 0.001	8.380*	226.389*	0.055	0.021
A.D. (mg)	1.502± 0.041	2.357± 0.039	2.553± 0.017	3.520± 0.017	2.147± 0.034	3.374± 0.507	1.992± 0.052	2.859± 0.010	252.296*	8.621*	0.089	0.588
A.D. (%)	47.546± 1.256	15.330± 0.255	80.655± 0.387	22.901± 0.110	68.636± 1.094	22.014± 0.400	64.512± 0.835	18.657± 0.223	414.168*	764.890*	2.194	0.582

Table(7) : Consumption Efficiency of Carotene Per Larva (mg) Utilized By Bombyx mori Races During Autumn rearing .

Parametars \ Races	380m		EJP		Novim		Novip		F value		L.S.D. at 5%	
	Larval Instars											
	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th	4 th	5 th
	Mean ± S.E.											
Chl. Consumed (mg)	4.410± 0.003	25.150± 0.002	4.403± 0.001	25.135± 0.008	4.337± 0.006	25.070± 0.003	4.314± 0.009	25.058± 0.003	117.333*	232.000*	0.021	0.006
A.D. (mg)	2.908± 0.035	5.768± 0.033	3.117± 0.016	4.076± 0.009	2.903± 0.018	3.540± 0.052	3.651± 0.010	4.106± 0.061	428.952*	697.826*	0.055	0.101
A.D. (%)	65.941± 0.814	21.743± 0.134	70.804± 0.407	16.219± 0.043	66.930± 0.523	14.120± 0.206	84.624± 0.330	16.387± 0.245	405.106*	686.491*	1.396	0.404

* ——— ▶ Significant

S.E. ——— ▶ Standerd Error

A.D. ——— ▶ Approximate digest

A.D.% ——— ▶ Approximate digestibility

Quantities of fibroin and sericin contents in the cocoon shell of the different races under study has been estimated and are illustrated in (Tables 8 and 9).

a- Amount of fibroin in cocoon shell :

EJP race registered the lowest concentration of fibroin during Spring and Autumn, they were 74.232 and 71.278 gm/100gm of cocoon shell, respectively. While Novi P and Novi M races showed the highest concentration of fibroin during Spring and Autumn rearing seasons and recorded 77.678 and 72.965 gm/100gm of cocoon shell, respectively (Tables 8 and 9).

Table (8) : Mean Weight of Fibroin and Sericin (gm/100 gm) In Cocoon of Bombyx mori L. Races During Spring Rearing.

parametars / races	Wt.Fib. / 100 gm)	Wt.Seri. / 100 gm)
	Mean ± S.E.	
380m	74.271± 0.123	25.728± 0.013
EJP	74.232± 0.105	25.767± 0.014
Novim	77.387± 0.124	22.612± 0.026
Novip	77.678± 0.130	22.321± 0.008
F.value	3.094*	3.120*
L.S.D	0.016	0.007

Table (9) : Mean Weight of Fibroin and Sericin (gm/100 gm) In Cocoon of Bombyx mori L. Races During Autumn Rearing.

Parametars / Races	Wt.Fib. / 100 gm)	Wt.Seri. / 100 gm)
	Mean ± S.E.	
380m	72.339± 0.153	27.660± 0.023
EJP	71.278± 0.158	28.721± 0.158
Novim	72.965± 0.025	27.034± 0.012
Novip	71.520± 0.114	28.479± 0.162
F.value	5.549*	12.391*
L.S.D	0.020	0.011

b- Amount of sericin in cocoon shell :

The pooled data revealed that, sericin, it was more concentrated in the cocoon shell during Autumn season than Spring one for the 380 M, EJP, Novi M and Novi P races.

Novi M race showed the lowest concentration (22.321 gm /100gm of cocoon shell) of sericin during Spring rearing season. While EJP race showed the highest one (25.767 gm /100gm of cocoon shell) for the same season (Tables 8). As for Autumn rearing season, Novi M race showed the lowest concentration (27.034 gm /100gm of cocoon shell) of sericin. While the highest amount (28.721 gm /100gm of cocoon shell) was in the cocoon shell of EJP race (Tables 9).

The results clear that, weights of fibroin and sericin differ significantly in the different races. The above results revealed that, amounts of sericin and fibroin differ according to the silkworm races and also according to the rearing seasons.

Almost similar findings have been reported by (Islam et al, 1997 and Gupta & Gupta, 1998). They confirmed these results as they reported that, the sericin protein contents varied significantly among the races and in different larval developmental stages. The silk is secreted by silkworm *Bombyx mori* L larvae to form cocoon. It is a proteinous fibre and protein of silk bave is known as fibroin. In cocoon shell, the ratio of fibroin and sericin is 75: 25.

5- Wax of egg chorion in different races:

As far as the writer is a ware, no references concerning the wax in egg chorion could be found. Therefore a trial has been conducted to differentiate the different races through the differences in the wax in egg chorion contents.

Quantities of wax in the egg chorion of the different races under study are illustrated in (Table, 10). The amount of wax in egg chorion of the 380 M, EJP, Novi M and Novi P race, were 2.407, 2.248, 2.122 and 2.593 mg /100gm, of egg chorion during Spring season, respectively. While it recorded 1.450, 1.920, 1.820 and 2.100 mg/100 gm, of egg chorion during Autumn, respectively.

Table (10) : Mean Weight of Wax in Egg

Parametars / Races	Wax (in gm/100gm) Chorions	
	Spring	Autumn
	Mean ± S.E.	
380 m	2.407± 0.675	1.475± 0.693
E J P	2.248± 1.354	1.920± 0.643
Novim	2.122± 0.571	1.820±0.250
Novip	2.593±1.268	2.1± 0.792
F.Value	0.102	0.240
L.S.D. at 5%	N.S	N.S

From the above results, it is clear that, amount of wax in egg chorion differ according to the silkworm race and also according to the rearing season, this could be due to artificial hatching processing.

Novi M race showed the lowest concentration of wax in egg chorion during Spring rearing season. While Novi P race showed the highest one for the same season. As for Autumn rearing season, 380 M race showed the lowest concentration of wax in egg chorion, while Novi P race showed the highest one for the same rearing season.

The results also indicate that, the differences in amount of wax in egg chorion between races of Bombyx mori during Spring and Autumn were not mostly significant.

REFERENCES

Ahn, M. Y.; Ryu, K. S.; Kim, I.; Kim, S. Y.; Lee, H. S.; Kim, J. W. and Lee, Y. K. (2001): Cytotoxicity of the ethanol extracts of mulberry leaves, branches and silkworm faeces. Korean J. Seric. Sci., 43 : 26-28.

----------; Ryu, K. S.; Kim, I.; Kim, J. W.; Lee, H. S.; Lee, Y. K. and Kim, E. S. (2002): Pheophytin content and fibrinolytic activity of silkworm faeces in the different larval stages of silkworms. Int. J. Indust. Entomol., 5 (2): 195-199.

A.O.A.C. (1984): Official methods of analytical chemist. 14th ed Washington, D.C.

Babu, G. R. (1994): Drugs from silkworms and their faeces too. Sci. Rep., 31 (11): 51.

Bongale, U. D. and Chaluvachari (1995): Evaluation of eight mulberry germplasm varieties by leaf biochemical and bioassay moulting studies. Sericologia, 35 (1): 83-94.

Cappelozza, L.; Coradazzi and Tornadore N. (1995): Studies on the phenotypic variability of seven cultivars of Morus alba l. and three of Morus monticules P. (Moraceae) - Part 1. Sericologia 35 (2): 257-270.

Chung, S. H.; Kim, M. S. and Ryu, K. S. (1997): Effect of silkworm extract on intestinal glycosidase activity in mice administered with a high carbohydrate containing diet. Korean J. Seric. Sci., 39 : 86-92.

Cui, Z.; Ahn, M. Y.; Lee, Y. B. and Ryu, K. S. (2002): Materia medica from insects. PP. 150, Shinilbooks, Seoul.

Fadeels, A. A. (1962): Location and properties of chloroplasts and pigment determination in roots. Physiol. Plant., 15 : 130-147.

Gui, Z.; Xijie, G. and Jianyi, D. (2003): The current status and prospect of Sericultural by-products industry in China. Int. J. Induste. Entomol., (7): 1-4.

Gunasekaran, N. and Shanmugavelu, K. G. (1983): Studies on the effect of triacontanol on tomato. In: Proc. National Seminar on the Production Tech. Of Tomato and Chillis, Coimbatore, PP. 75- 85.

Gupta, B. K. and Gupta, Y. K. (1998): Amino acids and synthesis of silk. Indian Silk, (5): 14-18.

Hiraki, A.; Yukawa, M.; Kim, J.; Ueda, S. and Kim, J. M. (1997): Antiviral substance from silkworm faeces: Purification and it's chemical characterization. Biological and Pharmaceutical Bulletin, 20 (5): 547-555.

Holden, (1965): Chlorophylls in chemistry and biochemistry of plant pigmented. Goo. Win. T. W., PP. 462-488, Academic Press, London.

Huang, L. Q. (1988): Genetic study on cocoon shell sericin content of silkworm. Acta Sericologica Sinica, 14 (2): 68-71.

Hussain, M. G.; Ali, M. H.; Ali, M. M.; Chowdhury, M. F. K. N.; Rahman, M. L.; Khaleque, M. A.; Jalil, M. A. and Uddin, M. M. (1995): Utilization of industrial wastes. Part I : Preparation of poultry feeds from waste silk pupa (Bombyx mori L.), a silk industrial waste. Bangladesh J. of Scientific and Industrial Research, 30 (4): 71-76.

Islam, S.; Haque, T.; Qader, M. A.; Khan, A.R. and Haque, R. (1997): Sericin protein contents in different larval developmental stages in some race of Bombyx mori L. Pak. J. Zool., 29 (1): 89-91.

Jayasomu, R. S; and Singh, K. P. (1999): Bombyx mori – A potential medicinal insect. Proceeding of International Sericultural Commission Congress Cairo, Egypt pp 303-309.

Kalimuthu, K. and Rajasekaran, P. (1992): Biodigestion of silkworm litter for biogas production. Indian J. Seric., 31 (1): 17-22.

Majumder, S. K. (1997): Scope for new commercial products from sericulture. Indian Silk, 35 (12): 13-18.

Mishra, R. K.; Shukla, P.; Choudhury, P. C.; Das, P. K.; Singh, G. B.; Bajpai, A. K. and Datta, R. K. (1983): Studies on the effect of commercial formulations of triacontanol on quality and yield of mulberry (Morus indica L. var. Kanava 2). Indian J. Seric., 32 (2): 156-161.

Patil, S. V.; Mallikarjunappa, R. S.; Dandin, S. B. and Eswara Rao, M. S. (2001): Evaluation of improved genotypes of mulberry through leaf chemical analysis and bioassay with silkworm races NB4D2. Sericologia 41 (2): 219-226.

Ping, X. J. I.; Huang, Z.; Ji, P. and Huang, Z. R. (1994): The multipurpose utilization of Sericultural resources in China. J. of South China Agric. University, 15 (4): 127-131.

Promboon, A.; Tanpraseritkit, S.; Opaswacharanon, U.; Somboonnak, J.; Pornchaichareon, K.; Patharakorn, T.;Saksoong, P. and Ratanapo, S. (2002): A simple purification of phospholipids from Bombyx mori wastes. The Proceeding of XIX Congress of the International Sericultural Commission 21st 25th Sep. (2002).

Rajiv, S. and Vijayakumar (1996): Sericulture by products of China. Indian Silk, 34 (9): 19.

Raju, S. (1996): Utilization of Sericultural by products a Chines exsample. Indian Silk, 35 (7&8): 19-20.

Revannasiddiah, H. M. and Bai, S. Y. (2000): Paste chlorophyll extracted from the faeces of multivoltine Pure Mysore (P M) race of silkworm, Bombyx mori L. Himalayan J. Environ. Zool., 14 (1): 89-92.

Ries, S. K. and Houtz, R. (1983): Triacontanol as a plant growth regulator. Hortic. Sci., 18 (5): 654-662.

---------- and Wert, V. F. (1982): Rapid in vivo and in vitro effect of triacontanol. J. Plant Growth Regul., (1) : 117-127.

Shankar, M. A.; Jayaramaiah, M.; Antha Peter and Rangaswamy, B. T. (1999 a): Impact of intercropping vegetables on growth and yield of mulberry. The Proceeding of the XVIII International Sericultural Commission Congress Cairo Egypt 12-16 Oct. (1999), 3-7.

Sivasankar, N. and Ashoka, J. (1997): Use of silkworm rearing waste in fresh water prawn culture. Indian J. Seric., 36 (2): 161-163.

Sun, P. J. and yu, J. J. (1989): The cultivation of pleurotus mushrooms on unsterilized substrates in the field. Mushroom Science. Part II. Proceedings of the Twelfth International Congress on the Science and Cultivation of Edible Fungi September 1987, Braunschweig, Germany, (1989): 219-228.

Thangamani, R. and Vivekanandan, M. (1984): Physiological studies and leaf nutrient analysis in the evaluation of best mulberry variety. Sericologia, 24 (3): 317-324.

Toida, Y.; Keereewan, S. and Murakami, T. (1991): Cultural control of java root knot nematode attacking mungbean in Thailand. TARC Newsletter Tropical Agricultural Research center, 2 (2): 5.

----------; ---------- and Puttirut, N. (1992): Cultural control of the root knot nematode, Meloidogyne javanica, attacking mungbean in Thailand. Research Highlights, Tropical Agricultural Research center, No 1992 : 16-19.

----------; ---------- and Tangjitsomkid, N. (1994): Effect of addition of organic materials on population density of Meloidogyne javanica, attacking mungbean in Thailand. Japanese J. of Nematology, 23 (2): 90-94.

Waldbauer, C. P. (1964): The consumption, digestion and utilization of solanaceous and non solanaceous plants by larvae of tobacco horn worm, Protoparce Sexta John (Lep. : Sphin.). Entomol. Ext. Appl., (7): 253-269.

Wettstain, D. (1957): Chlorophyll, letal und der submikro svopische formmech sallder plastiden. Exptl. Cell. Rec. (12): 427-433.

Zhang, Y. Q. and Zhang, Y. Q. (1998): Natural silk fibroin as a support for enzyme immobilization. Biotechnology Advances, 16 (5-6): 961-971.

بعض القياسات الكيماوية كدليل لسلالات دودة القز التوتية

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وتهدف هذه الدراسة إلى إمكانية استخدام بعض النواتج الجانبية الناتجة من تربية بعض سلالات ديدان الحرير المحلية (Novi M, Novi P, 380 M and EJP) ذات القيمة الاقتصادية العالية و هي (البراز – الشرانق – البيض) و دراسة معدل استهلاك الغذاء كدليل لتمييز بين سلالات ديدان الحرير.

فقد وجد من الدراسة أن السلالة EJP أعلى السلالات في إنتاجها بكمية البراز واقلهم هي السلالة Novi M . كما سجلت السلالتين 380 M و EJP أعلى كمية من الكلوروفيل المستخلص من البراز خلال موسمي الربيع والخريف . بينما سجلت السلالتين 380 M و Novi M أعلى تركيز للكاروتين المستخلص من البراز خلال موسمي الربيع والخريف . كما سجلت السلالتين EJP و Novi M أعلى نسبة لهضم الكلوروفيل بالمقارنة بالسلالات الأخرى خلال موسمي التربية . كما أظهرت السلالتين Novi P و Novi M أعلى تركيز لنسبة بروتين الفبروين في حين أن السلالة EJP كانت أعلى السلالات في نسبة بروتين السريسين خلال موسمي التربية . بينما سجلت السلالة Novi P أعلى كمية في نسبه تكوين الطبقة الشمعية المحيطة بغلاف البيض خلال موسمي التربية.