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SCAN ME

Research Paper

QUANTIFICATION OF BOIL OFF LOSS IN THE COCOON SHELLS OF THE SILKWORM BREEDS AS INFLUENCED BY SEX

M. N. Anil Kumar

Department of Studies in Sericulture Science,
University of Mysore,
Manasagangotri, Mysuru-570006,
India.

Abstract

The process of removal of sericin is known as boil off loss ratio (B.O.R). This trait differs among silkworm breeds and tt is considered as one of the important economic parameter during the course of silkworm breeding programme. The current investigation was carried out to record influence of sex (male and female) in the silkworm, *Bombyx mori* L on the cocoon parameters such as cocoon weight, shell weight, shell ratio, and boil off loss ratio in multivoltine breeds *viz*., Hosa Mysore, Nistari, MU303, MU1 and Pure Mysore and bivoltine breeds *viz*., CSR2, CSR6, NB4D2, Zebra and Ursa. The results of the data of the present study revealed that the male larvae of Hosa Mysore excelled over other multivoltine breeds for shell weight and shell percentage. However, for the trait boil off ratio male larvae of MU1 recorded better over remaining breeds. Among bivoltine breeds, CSR2, CSR6 and Zebra of male larvae exhibited higher cocoon weight, shell weight and shell ratio than NB4D2 and Ursa. Further, male larvae of both multivoltine and bivoltine breeds scored better for boil off loss ratio when compared to female.

Key words: Bivoltine breeds, Boil off loss ratio, *Bombyx mori,* Cocoon characters, Multivoltine breeds, Sex.

INTRODUCTION

The silk is an animal fiber, produced by lepidopteran insect belonging to the genus *Bombyx* and is made up of two principle protein *viz*., fibroin and sericin. The fibroin forms inner core of silk bave and accounts for about 70 to 80 % of cocoon weight which is warped by sericin contributing 20 to 30 % of its weight. In addition to this little quantity of fat, wax, colouring and mineral matters of the silk bave not exceeding 2-3 % [1]. The main silk protein fibroin is insoluble in alkaline hot water, whereas the sericin is easily soluble in boiling alkaline soap solution [2]. Without degumming, the silk

cannot be called as "Queen of Textile". Degumming (boil off loss) is the process of removal of sericin. The cocoon shell has more boil-off loss percentage when compared to the raw silk. The percentage of boil-off loss has got paramount importance in reeling and weaving activities [3]. Low boil-off ratio content improves cocoon reeling qualities and is manifested by dominant genes, while recessive genes act towards the opposite direction [4]. The boil-off ratio varies according to seasons and also influenced by diverse environment [5].In sericulturally advanced countries like, China and Japan silkworm breeders have successfully bred productive hybrids with high quality raw silk. During the course of breeding, boil-off loss is considered as one of the important qualitative trait. The degumming loss percentage was higher in multivoltines than bivoltines due to genetic constitution [6]. Good number of reports available on boil off loss ratio in the hybrids of silkworm. In multivoltine x bivoltine hybrids, boil off loss ratio is intermediate between parents [7]. Similar trend was also observed in bivoltine hybrids by [8, 9,10]. The silk degumming is necessary process which make the silk lustrous, soft feel and to enable the penetration of chemicals and dye stuff substances easily. After the removal of sericin the silk is used in weaving process. Foregoing literature, adequate information is available on boil off loss ratio with respect to silkworm breeds and their hybrids. However, influence of sex in silkworm breeds in relation to boil off loss ratio is meager. In this context, the present study was undertaken to know the influence of sex on boil off loss ratio in multivoltine and bivoltine breeds.

MATERIALS AND METHODS

In the present study, five multivoltine races / breeds *viz*., Nistari, Hosa Mysore, Pure Mysore, MU1, and MU_{303} and five bivoltine breeds *viz*., CSR2, CSR26, NB4D2, Zebra and Ursa were drawn from the Department of Studies in Sericulture Science, University of Mysore, Manasagangotri, Mysuru. The larvae were reared by following the standard rearing techniques of [11]. After rearing, 10 cocoons spun by male and female larvae (three replications each) were selected from respective breeds and were subjected to record cocoon parameters which includes cocoon weight, shell weight and shell ratio. In addition to this, degumming of cocoon shells was carried out by adopting modified procedure outlined by [5].

Degumming

The initial weight of 10 cocoon shells of multivoltine and bivoltine breeds (male and female) were recorded before degumming process. Afterwards, cocoon shells were subjected to liquor bath consisting mixture of neutral soap and sodium carbonate. The amount of soap and sodium carbonate required for degumming for 1gram of cocoon shell are as below;

70 ml of liquor solution (Water)

Soap 7 gram per liter

Soda ash 1 gram per 1 liter

The cocoon shells of respective breeds were immersed in the beaker containing liquor bath where the temperature was maintained at 90 to 95^0 C. for about 1 hour. The material was turned up and down for uniform and effective degumming. Afterwards the material was boiled in distilled water for about half an hour. Finally, the material was washed in cold tap water and then dried. The final weight of the material was recorded.

The boil-off loss percentage was calculated by using the formula:

$$B.O.R = \frac{\text{Initial dry weight-Final weight after degumming}}{\text{Initial dry weight}} \times 100$$

The fibroin percentage was calculated by using a formula;

Fibroin percentage = 100-Final weight of degummed material.

The data obtained were analyzed by standard deviation (±) method and mean values were expressed.

RESULTS AND DISCUSSION

Cocoon weight is an important attribute for the yield as this characters mainly depends on the race / breed and its ability to convert mulberry leaf into cocoon. The cocoon weight in respect of sex differing in multivoltine breeds ranging from 0.751 to 0.963g with highest being in Hoas Mysore (0.963g) and it was lowest in Pure Mysore (0.573g) of female (Table.1). These results are in conformity with those of previous workers [12,13] who have reported that the multivoltine races are characterized with low

cocoon weight as their potentiality is poor and its poor efficiency to build a better cocoon even in favorable climatic conditions. Similar trend was also observed by [14,15].

Among the bivoltine breeds, CSR2, CSR26, and Zebra exhibited higher cocoon weight (ranging from 0.722 to 1.012g) than NB4D2 and Ursa of female (Table.2). Similarly, CSR2, CSR26 and NB4D2 expressed maximum cocoon weight than Zebra and Ursa of male. It clear indicates that the silkworm breeds differ genetically for the expression of this trait even it is provided with same quantum of feed. The present findings are in conformity with the observations of earlier workers [12,13,16,17,18]. Cocoon spun by the both breeds of female registered higher cocoon weight than male which is attribute by higher female pupal weight.

Shell weight

Shell weight is an important economic character which indicates the silk content. It varies from rearing condition and quality of mulberry leaf. The shell weight in respect of sex expressed notable variations in multivoltine breeds ranging from 0.081 to 0.127g with highest being in Hosa Mysore (0.127) and lowest in Pure Mysore (0.081g) of male (Table.1). These results are in agreement with earlier findings of [6] who have opined that increased shell weight of 1.648g in P2D1and 1.710g in KA over control batch 1.613g (Pure Mysore). Similar results were also documented by [16, 18]. Among the bivoltine breeds, maximum shell weight of 0.172 recorded in CSR2 of male and it was minimum in Ursa (0.064g) (Table.2). Similarly, highest shell weight of 0.172g registered in CSR2 of female and it was minimum in Ursa (0.064g). CSR2 excel over other bivoltine breeds for this trait which indicates its genetic superiority. These results are supported by the observation of previous workers [12,13]. Similar trend was also noticed by [16]. Cocoon shells formed by the males of the both breeds registered higher shell weight than females. It is due to better conversion of mulberry nutrients into silk protein by the male larvae and in female, though cocoon weight is higher but shell weight is lower is due to most of the nutrients are utilized for the synthesis organic substances which is required for the egg production.

Shell ratio

Cocoon shell percentage is one of the important parameter for silk productivity. This trait also vary in different breeds. Among multivoltine breeds highest shell percentage was expressed in Hosa Mysore (15.73%) of male, while it was lowest in MU_{303} (13.92%)

(Table.1). However cocoon spun by the female larvae of Hosa Mysore registered maximum shell percentage of 12.80 % and it was minimum in Pure Mysore (10.03%). The variations within multivoltine breeds is due to genetic variability for this trait. These results are conformity with those of previous workers [12,13]. Similar trend was also reported in other multivoltine breeds by [15,16, 19].

The cocoon shell percentage also differ among bivoltine breeds with being maximum in NB4D2 (21.38%) of male and minimum was registered in Ursa (14.04%) (Table.2). Similar trend was also observed for this trait in case of female. The present findings are in conformity with the observations of earlier researchers [12,13,16]. Irrespective of the breeds, cocoon formed by male larvae recorded, highest shell percentage than female. The variation within the sex is due to genetic variability for this trait. Hence male larvae can be reared economically and exploited for commercial raering program.

Boil off loss ratio

The cocoon shell has more boil-off loss ratio when compared to raw silk and lower value is preferred for this trait in reeling and weaving sector [3]. Among males of multivoltine breeds, lowest boil of ratio (BOR) was recorded in MU1 (21.72 %) and MU303 (22.62%) (Table.1). In general, male expressed lowest boil off ratio than the female in all the breeds might be due to less synthesis sericin. Moreover this trait differ genetically among the breeds. These results are also supported by the observations of earlier researchers [13,6] who have reported that the boil off loss ratio was relatively higher in multivoltine than bivoltine breeds is due to inferior flossy cocoon and it is genetically controlled.

Similar trend was also noticed in bivoltine breeds with lowest being in Zebra (20.37%) of male and it was highest (22.95 %) in female (Table.2). These results are on par with earlier observations of previous workers [21] who have reported that the boil off loss ratio genetically differ among bivoltine breeds. Similar to multivoltine males, bivoltine males also exhibited lower boil off ratio. It clearly indicates that this trait genetically differing with in sex and breeds.

Fibroin percentage

Fibroin is actual silk in the fabric which absorbs coloured dyes. This trait varies with in the sex and breeds. Among multivoltine breeds, highest fibroin percentage was recorded in MU1 (78.27 and 75.35%) of male and female, respectively (Table.1). While it was lowest in Pure Mysore and Hosa Mysore. Among bivoltine breeds highest fibroin

percentage of 79.62 % was noticed in Zebra of male and 78.35 % in female of CSR2 (Table.2). This corroborates the earlier worker [20] who have reported that the additive effect gene was higher than the dominance effect on the amount of sericin and fibroin in male and female and boil off loss ratio in female. The direction of dominanace in the amounts of sericin and fibroin in male and female was positive and that in boil off loss ratio was negative.

Table.1: Influence of sex on cocoon parameters and boil off loss ratio in multivoltine breeds.

Traits / Breeds	Cocoon weight (g)		Shell weight (g)		Shell ratio (%)		Sericin (%)		Fibroin (%)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Hosa Mysore	0.809 ± 0.003	0.963 ± 0.003	0.127 ± 0.003	0.123 ± 0.003	15.73 ± 0.26	12.80 ± 0.23	25.07 ± 0.722	26.15 ± 0.450	74.92 ± 0.722	73.85 ± 0.450
Nistari	0.631 ± 0.003	0.859 ± 0.003	0.099 ± 0.004	0.087 ± 0.003	15.63 ± 0.50	10.16 ± 0.26	24.17 ± 0.531	25.02 ± 0.478	75.82 ± 0.531	74.97 ± 0.478
MU303	0.663 ± 0.003	0.810 ± 0.003	0.092 ± 0.003	0.088 ± 0.003	13.92 ± 0.33	10.90 ± 0.28	22.62 ± 0.607	25.07 ± 0.512	77.37 ± 0.607	74.92 ± 0.512
MU1	0.673 ± 0.003	0.886 ± 0.003	0.101 ± 0.003	0.090 ± 0.003	15.05 ± 0.32	10.19 ± 0.25	21.72 ± 0.464	24.65 ± 0.519	78.27 ± 0.464	75.35 ± 0.519
PM	0.573 ± 0.003	0.751 ± 0.003	0.081 ± 0.003	0.075 ± 0.003	14.18 ± 0.38	10.03 ± 0.30	25.12 ± 0.434	26.10 ± 0.294	74.87 ± 0.434	73.90 ± 0.294

Table.2: Influence of sex on cocoon parameters and boil off loss ratio in bivoltine breeds.

Traits/Breeds	Cocoon weight (g)		Shell weight (g)		Shell ratio (%)		Sericin (%)		Fibroin (%)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
CSR2	0.973 ± 0.002	1.012 ± 0.003	0.175 ± 0.002	0.172 ± 0.004	17.99 ± 0.17	17.00 ± 0.35	20.57 ± 1.312	21.65 ± 1.178	79.42 ± 1.312	78.35 ± 1.178
CSR26	0.759 ± 0.005	0.770 ± 0.001	0.151 ± 0.006	0.146 ± 0.014	19.89 ± 0.66	18.96 ± 1.79	20.92 ± 0.981	22.07 ± 0.987	79.07 ± 0.981	77.92 ± 0.987
NB4D2	0.745 ± 0.007	0.753 ± 0.004	0.159 ± 0.008	0.158 ± 0.002	21.34 ± 0.87	20.98 ± 0.15	20.42 ± 0.573	21.62 ± 0.340	79.57 ± 0.573	78.37 ± 0.340
Zebra	0.715 ± 0.003	0.722 ± 0.005	0.119 ± 0.004	0.115 ± 0.005	16.64 ± 0.50	15.93 ± 0.58	20.37 ± 0.754	22.92 ± 0.386	79.62 ± 0.754	77.07 ± 0.386
Ursa	0.465 ± 0.011	0.468 ± 0.010	0.065 ± 0.008	0.064 ± 0.001	13.98 ± 1.39	13.68 ± 0.08	22.10 ± 0.139	22.52 ± 0.386	77.90 ± 0.739	77.47 ± 0.386

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