

Nutritive Quality Assessment of Two Mulberry Varieties including Kokosa and Local on Some Biological Parameters and Economical Characters of Silkworm *Bombyx mori* L.

Rouhollah Radjabi

Plant Protection Department, Dezful Branch, Islamic Azad University, Dezful, Iran.

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ABSTRACT

An investigation was carried out on the effects of silkworm larval feeding by leaves of two different mulberry varieties on some biological parameters and economical characters of silkworm *Bombyx mori* L. in Natanz of Isfahan. Silkworm larvae hybrid 31×32 fed on Kokosa variety during first 3rd instar and Kokosa & Isfahan local varieties during 4th and 5th instars. The data of studied characters such as average weight of 5th instar larva (in during 1, 3, 5 and 7 days), silk glands average weight of 5th instar larva (in during 2, 4 and 6 days), effective rearing rate percentage, male cocoon weight, male shell cocoon weight, male shell cocoon percentage, male pupae weight, female cocoon weight, female shell cocoon weight, female shell cocoon percentage, female pupa weight and no. egg laid by each moth were measured and analyzed. The results showed that silkworm larvae feeding on different mulberry varieties had not significant effect on cocoon and pupa parameters in two male & female groups ($P<0.05$). Average weight of 5th instar larva and no. egg laid by each moth in treatment that larvae fed by Kokosa mulberry was higher in comparison to Isfahan local mulberry ($P<0.05$). Effective rearing rate percentage in treatment fed by Isfahan local mulberry was higher in comparison to Kokosa mulberry ($P<0.05$).

Key words: Variety, Mulberry, Biological Parameters, Economic Traits, Silkworm

Introduction

The silkworm is an of economic insect used for silk production and Sericulture or silkworm rearing depends on mulberry leaves as the sole natural food of the silkworm *Bombyx mori* L., the quality of the mulberry leaves has a direct bearing on the normal growth of the larvae and the quality of the cocoon [1,8,15]. The composition of mulberry leaves plays an important role in the growth and development of silkworms and other traits important to the economic production of these animals [25]. Significant seasonal variations occur in the nutritional value and composition of mulberry leaves depending on factors such as the weather, pests and diseases as well as

agricultural practices such as fertilization, irrigation and other current practices [11]. This variation impacts both qualitatively and quantitatively upon the silkworm cocoon production. Weakness of nutritive value of mulberry leaves will lead to significant decrease of silk production [15].

Mulberry varieties regarded as one of important factors that affects on number of laid eggs, fecundity, hatchability, larval period and weight in local strains and obtained hybrids in silkworms. This variation will lead to various physiological state and cocoon production [5,15].

Maximum of larval growth and uniform cocoon production determined by mulberry leaves varieties and caused that long silk fiber in silkworm fed on

Corresponding Author

Rouhollah Radjabi, Plant Protection Department, Dezful Branch, Islamic Azad University, Dezful, Iran.
E-mail: roholla_radjabi@yahoo.com

foreign variety compared with local varieties [27]. Das *et al.* evaluated seven mulberry cultivars for their performance in rearing *B. mori* bivoltine hybrids and found that C763 was the best, followed by S1630 and C1730 [4]. Difference in growth and development, cocoon and silk shell production among various strains related to difference in mulberry varieties used for rearing [9]. It is recorded that S-1 mulberry varieties is better than others for bivoltine silkworm rearing in Uttar Pradesh of India in quantitative characteristics. Nutritive effects studies of mulberry leaves variation on economic, biological and biochemical characteristics in Isfahan region showed that kokosa variety increased catabolic activities during larval feeding. It caused better larval and cocoon characteristics [6]. At present, a large number of mulberry varieties are being cultivated in north and center of Iran especially Guilan, Mazandaran, Golestan, Yazd and Isfahan provinces that mainly differ in tolerance to biotic and abiotic stresses. Successful sericulture depends on increased production of mulberry leaves with high nutritive values [12].

Generally accepted importance of silkworm larval feeding and mulberry leaves quality on increase of performance in sericulture [4,7,9,21]. Features of mulberry plants vary according to the variety [2]. In this direction, main goals of this investigation is determination of effects of silkworm larval feeding on two varieties including Kokosa and local mulberry varieties on biological and economic parameters in Natanza (Isfahan province) weather condition of Iran.

Methods and materials:

Silkworm Rearing and Treatments:

The eggs of bivoltine Japanese-Chinese hybrid silkworms (31×32) were obtained from the Iran Silkworm Research Center (Rasht, Iran), and reared in the Natanz Sericultural Center (Natanz, Isfahan, Iran) under standard conditions of 25°C with a RH of 75 ± 5% and a photoperiod of 16L:8D as described by Lim *et al.*, [16]. Silkworm larvae fed on Kokosa during first third instars but its food changed during 4th and 5th instars. Fresh leaves of the Kokosa and local varieties of mulberry (*Morus alba*) were used for feeding the larval silkworms during 4th and 5th instars three times a day. 100 silkworm larvae for each box treated with mentioned mulberry leaves varieties in three replications in complete random design.

Larval weight:

To study the effect of feeding mulberry leaves

on the larval growth, the weight of the silkworm larvae were weighed on days 1, 3, 5, and 7 of the fifth instar using a digital balance (± 0.01g). Thirty larvae from every replication were randomly selected and their mass recorded from which the average larval weight was then derived.

Silk Glands Weight:

Three silkworm larvae in 2nd, 4th and 6th day of fifth instar were picked from each replication and were chilled in a refrigerator for a few minutes. With one longitudinal cut on the dorsal surface the larvae were cut open and their silk glands were isolated in 9% NaCl. The mass of the three silk glands was determined in a digital balance (± 0.01) and the average was recorded.

Cocoon, Pupa and Cocoon Shell Weights:

One week after pupation, the cocoons were harvested and thirty cocoons in good condition were cut open from each batch. Male and female pupae were separated and cocoon, pupa and shell weights were recorded.

Cocoon Shell Percentage:

The shell percentage of each cocoon was calculated as: Cocoon shell percentage = (shell weight/cocoon weight) x 100

Egg Number and its Hatchability:

Mated female transferred to paper including amylase and covered with plastic container. After 24 hours female removed and egg number calculated and weight of 50 eggs measured by digital balance (±0.001gr). This experiment including 5 replication for each treatment. Egg hatchability obtained by storage of eggs until next year.

Statistical Analysis:

The data were subjected to analysis of variance (ANOVA) to determine if the differences found between treatments and the differences between treatments and the controls were significant. For analysis of variance, Duncan's multiple range function in SAS was used [23].

Results and discussion

Recorded data analysis showed that larval weight of silkworm in 1st, 2nd and 3rd days of 5th instar did not increased in two groups significantly while it increased in 7th day of last instar significantly in

silkworm larvae fed on Kokosa variety ($P < 0.05$).

The study of feeding effects with various varieties on silk glands weight showed that silk glands weight increased in larvae fed on Kokosa at early 5th stage but local varieties had better condition at the end stage. Of course this increase was not significant and cocoon shell weight and males and females shell ratio did not increase.

The study of economic characteristics such as cocoon weight, pupa weight, shell weight and cocoon shell weight in both sexes showed that KK treatment had better condition but there were not significant statistically compared to KL treatment (table 2). The parameter of effective rate of rearing recorded 76% and 58% for KK and KL respectively, then KK showed better performance statistically ($P < 0.05$).

Table 1: the effect of larval feeding on various mulberry varieties on larval weight of during 5th instar

Treatment	Larval weight during 5 th instar (gr)			
	1 st day	3 rd day	5 th day	7 th day
KK	1.169a	1.745a	2.585a	3.991a
KL	1.098a	1.513a	2.378a	3.246b

Means with the same letter in the columns are not significantly different at $p > 0.05$.
 KK=Kokosa-Kokosa and KL=Kokosa-Local

Table 2: the effects of silkworm larvae fed on two groups on economic characteristics of males and females cocoon

Treatments	Female				Male			
	Cocoon weight (gr)	Pupa weight (gr)	Cocoon shell weight (gr)	Cocoon Shell ratio (%)	Cocoon weight (gr)	Pupa weight (gr)	Cocoon shell weight (gr)	Cocoon Shell ratio (%)
KK	1.306a	0.954a	0.352a	26.95a	1.625a	1.283a	0.342a	21.06a
KL	1.264a	0.924a	0.332a	26.88a	1.535a	1.199a	0.335a	21.83a

Means with the same letter in the columns are not significantly different at $p > 0.05$.
 KK=Kokosa-Kokosa and KL=Kokosa-Local

Table 3: the effects of silkworm larval feeding on various varieties on females fecundity

Standard Error	Minimum	Maximum	Egg number	Treatments
11.34	530	567	552.33a	KK
23.18	408	479	432.67b	KL

Means with the same letter in the columns are not significantly different at $p > 0.05$.
 KK=Kokosa-Kokosa and KL=Kokosa-Local

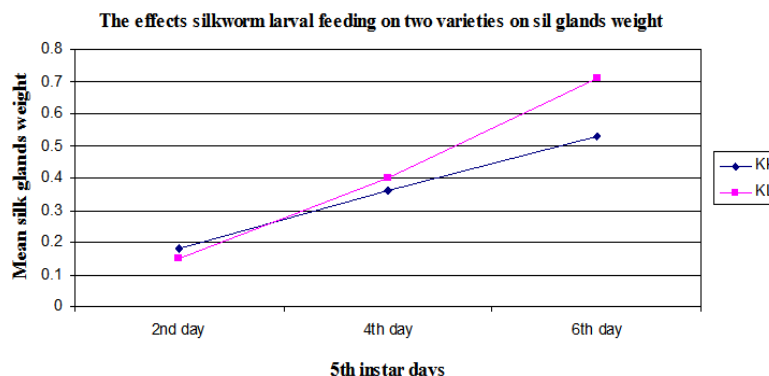


Fig. 1: The effects of mulberry leaves varieties on silk glands weight

Females of silkworm larvae fed on KK laid more eggs compared to KL significantly and mean eggs laid by KL treatment group (432.67 mean eggs per female) recorded less than minimum of KK treatment group (530 mean eggs per female).

Discussion:

It is demonstrated that there is different yield in silk production among silkworm larvae fed on various varieties [8,17]. It is showed that larval weight related to environmental factors such as

feeding and culture area [11]. Definite relationship between larval weight and economic characteristics such as cocoon weight, pupa weight and cocoon shell weight in various strains were reported [6]. Studies of many researchers reveal relationship between mulberry leaves content and different in larval feeding behavior and its yield for cocoon production [10,13,14,15]. Studies on the influence of mulberry leaf of different varieties on larval behavior and cocoon traits of silkworm was studied in tropical climatic zones of India [13,14,18. Many researcher emphasized on direct effects of mulberry quality on

food consumption ratio, daily larval growth, digestive coefficient and food absorption [15,19,20]. Results of this investigation showed brilliant difference in yield of silkworm fed on two mulberry Kokosa and local varieties, thus larval weight parameters of 5th instar of silkworm larvae fed on Kokosa was better than other group which fed on local varieties. Same result reported due to little humidity and unsuitable physical texture of local variety. Kokosa mulberry leaves have soft, fresh and suitable humidity content for silkworm larval acceptance for feeding.

A research emphasized on the effects of different varieties role on silk glands growth, cocoon characteristics and disease outbreak in larval stage [10]. Generally, higher larval weight will produce higher silk glands in mature stage and their cocoon production will improve directly. However, our findings did not show such a relationship. The silk glands weight and larval weight did not increase in tandem. Silkworm larvae fed on Kokosa during 4th and 5th instar with maximum larval weight did not reflect in silk glands weight. It is due to different in measurement time and better mulberry quality of local varieties for mature larvae in condition of studies area (Natanz, Isfahan).

It is reported that significant interaction effects between season and variety for better larval growth and its weight, then season of rearing is one of main factor for silkworm rearing [5]. It is showed that local variety had best yield for cocoon production in April and March [26]. A research on season and mulberry varieties for silkworm rearing, they proved that season and mulberry varieties affect on effective rate of rearing, cocoon weight and silk shell ratio significantly [13]. The observation of low performance associated with feeding on best quality mulberry leaves reported by other researcher [24]. It related to high evaporation from mulberry surface in weather condition. In this investigation, Kokosa mulberry variety with best mulberry leaves quality did not showed positive effects on economic characteristics, effective rate of rearing and silk glands weight ($P < 0.05$).

Moisture content of Kokosa leaves is higher in early season but it decrease gradually to end season [6,22]. Decrease of effective rate of rearing related to moisture content of Kokosa which can cause disease outbreak in silkworm larvae. Results of Girdhar *et al.*, 1990 proved performance decrease due to disease spread related to rearing season, mulberry varieties and silkworm strains [10]. Leaf moisture content and water retention positively influence the silkworm larval growth and development [15]. Ashiru (2002) evaluated eight elite mulberry cultivars in Nigeria and highlighted the relationship between leaf moisture content and cocoon yields [3].

Silkworm fecundity is also affected by feeding quality and mulberry varieties [15]. Number of laid

eggs of KK treatment significantly increase compared to KL treatment due to better Kokosa condition for reproductive goal. It is reported the effect of mulberry varieties on fecundity, silk glands and cocoon characteristics [13,14]. Mulberry local varieties is dominant variety in Natanz of Isfahan, therefore it is better that it use for first third instar. The 4th and 5th instar can feed on Local and Kokosa varieties alternatively with respect to our goals. Due to the old cultivated trees and the low performance of variety Kokosa for 4th and 5th instars of silkworm larvae, it is essential to introduce adapted improved variety for environmental condition of this area.

According to Nagaraju *et al.*, 1981 results that state high correlation between cocoon weight and shell weight, we can results that cocoon weight regarded as suitable character for assessment of mulberry leaves for its food nutritive value [17]. Our experiment showed no significant difference between treatments in economic traits. Results of this investigation showed that selection of suitable varieties had important effects on larval weight, silk glands weight and reproductive characteristics of silkworm hybrid 31×32 but it did not affect on cocoon weight, cocoon shell weight, pupa weight and cocoon shell ratio. It can indirectly relate to season and time of study in weather condition of Natanz area possibly.

Conclusion:

In general, best varieties for 4th and 5th instars was local variety which cultivated in this area, therefore it is suggested that local and Kokosa varieties integrated usage for silkworm rearing during first third instars and 4th and 5th instars respectively.

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