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ASSESSMENT OF VARIATION IN QUALITY CHARACTERISTICS AND REELING PERFORMANCE OF TROPICAL TASAR COCOONS FOR DIFFERENT ECORACES IN CHHATTISGARH

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Abstract

The production of tasar silk, a valuable natural fiber obtained from the silkworms of the Antheraea genus, holds significant socio-economic importance in the state of Chhattisgarh, India. In this region, two prominent ecoraces of tasar cocoons, namely Daba and Raily, are extensively cultivated for silk production. However, variations in cocoon characteristics and reeling performance between these ecoraces have been observed, leading to differences in silk yield and quality. This research aims to comprehensively investigate and compare the quality characteristics and reeling performance of Daba and Raily tasar cocoons to understand their suitability for silk production in the Chhattisgarh region.

Keywords : *Tasar silk,Reeling Performance,Chhattisgarh,Ecoraces,Silk production,*

INTRODUCTION:

Tasar silk, renowned for its uniqueness and ecological sustainability, has served as a vital socio-economic commodity in India for centuries[1-2]. Among the various states known for tasar silk production, Chhattisgarh holds a prominent position. Here, the cultivation of two distinct ecoraces of tasar cocoons, namely Daba and Raily, plays a pivotal role in the silk industry. These ecoraces are distinguished by their unique cocoon characteristics and reeling behaviors, which have raised intriguing questions about their potential impact on silk production efficiency and quality.

The process of silk production involves several essential stages, including cocoon quality assessment, degumming, and reeling, each of which profoundly influences the final silk yarn's quality and productivity[3]. Therefore, a profound understanding of the inherent variations in these stages is crucial to enhance the overall silk production process. This research endeavors to bridge this knowledge gap by comprehensively investigating and comparing the quality characteristics and reeling performance of Daba and Raily tasar cocoons within the context of Chhattisgarh's silk industry. The study aims to shed light on key parameters influencing

cocoon quality, such as cocoon weight, shell weight, filament length, and non-broken filament length (NBFL).[4-5] .Additionally, it aims to assess the effectiveness of the newly developed Buniyad reeling machine in enhancing silk production compared to traditional natwa (thigh reeling) methods[6].

Daba (TV)

Daba (BV)

Raily Cocoon

MATERIALS AND METHODS:

Materials:

For a comprehensive comparative analysis, the research utilized reelable varieties of Raily cocoon and Daba cocoon, including Daba BV Crop and Daba TV Crop. Single cocoons with a standardized perimeter of 1.125 meters were selected for reeling trials. Additionally, the recently developed Buniyad reeling machine, a promising alternative to the traditional thigh reeling method, was employed for reeling assessments.

Methods:

The study entailed the assessment of critical single cocoon parameters, including cocoon weight, shell weight, and shell ratio, for both Daba and Raily tasar cocoons. The shell ratio, a significant indicator of cocoon quality, was calculated as a percentage using the formula (Shell weight / Cocoon weight) x 100 [7-8]. For cocoon degumming, standard procedures specific to each ecorace were followed.

$$\text{Shell Ratio (\%)} = \frac{\text{Shell weight (gm)}}{\text{Cocoon weight (gm)}} \times 100$$

Two replications were taken for each variety of cocoon and 20 observations of each replication

Degumming Procedure for Daba BV Crop, Daba TV Crop, and Raily Tasar Cocoons:

Sl. no.	Particulars	Daba BV Crop	Daba TV Crop	Raily
1	Sodium carbonate (Na_2Co_3)	6.0 gms /litre water	6.0 gms /litre water	6.0 gms /litre water
2	Sodium bi carbonate (Na2HCo3)	5.0 gms /litre water	5.0 gms /litre water	5.0 gms /litre water
3	Boiling time	25-30 minutes	15-20 minutes	45-60 minutes
4	Steaming time	20-25minutes	15-20 minutes	50-60 minutes
5	Rest time	15 minutes	10 minutes	30 minutes

Steps Of Degumming Solution :

1. Prepare the Degumming Solution:

- For Daba BV Crop: Dissolve 6.0 grams of sodium carbonate (Na2Co3) in one liter of water.

- For Daba TV Crop: Dissolve 6.0 grams of sodium carbonate (Na2Co3) in one liter of water.

- For Raily: Dissolve 6.0 grams of sodium carbonate (Na2Co3) in one liter of water.

2. Prepare the Sodium Bicarbonate Solution:

- For Daba BV Crop: Dissolve 5.0 grams of sodium bicarbonate (Na2HCo3) in one liter of water.

- For Daba TV Crop: Dissolve 5.0 grams of sodium bicarbonate (Na2HCo3) in one liter of water.

- For Raily: Dissolve 5.0 grams of sodium bicarbonate (Na2HCo3) in one liter of water.

3. Boiling Time:

- For Daba BV Crop: Place the Daba BV Crop tasar cocoons in the degumming solution and boil for 25-30 minutes.

- For Daba TV Crop: Place the Daba TV Crop tasar cocoons in the degumming solution and boil for 15-20 minutes.

- For Raily: Place the Raily tasar cocoons in the degumming solution and boil for 45-60 minutes.

4. Steaming Time:

- For Daba BV Crop: After the boiling process, steam the tasar cocoons for 20-25 minutes.

- For Daba TV Crop: After the boiling process, steam the tasar cocoons for 15-20 minutes.

- For Raily: After the boiling process, steam the tasar cocoons for 50-60 minutes.

5. Rest Time:

- For Daba BV Crop: Allow the tasar cocoons to rest for 15 minutes after steaming.

- For Daba TV Crop: Allow the tasar cocoons to rest for 10 minutes after steaming.

- For Raily: Allow the tasar cocoons to rest for 30 minutes after steaming.

The degumming process involves boiling the tasar cocoons in the respective degumming solution, followed by steaming and resting[9-10]. It is important to follow the specified boiling, steaming, and resting times for each variety to achieve the desired degumming results. Proper degumming is crucial to remove the sericin, the silk gum, from the cocoons and prepare them for the reeling process, ensuring the production of high-quality tasar silk yarn. Regarding

reeling, single cocoon filaments were meticulously reeled using the Epprouvette method for both ecoraces. The total filament length from a single cocoon was accurately estimated by multiplying the number of revolutions (noted from the revolution counter meter) by a factor of 1.125. The number of breaks during the reeling process was carefully recorded for each cocoon. Subsequently, yarn weight was measured after drying, and filament denier was calculated using the formula .

$$\text{Yarn denier (filament)} = \frac{\text{Filament weight (gm)}}{\text{Yarn length in meter (No. of Rev. x 1.125)}} \times 9000$$

$$\text{Non-Broken Filament Length (NBFL) (filament)} = \frac{\text{Filament length in meter}}{\text{No of cocoons + No. of breaks}}$$

$$\text{i.e.for single cocoon} = \frac{\text{Filament length in meter}}{\text{1 + No. of breaks}}$$

Additionally, the innovative Buniyad reeling machine was employed to evaluate the reeling performance of multiple cocoons[11-12]. For this purpose, a sample of one hundred cocoons was used, with six cocoons being reeled simultaneously to achieve a target denier of approximately 60. Various parameters, including the number of breaks, unreelable cocoons, and carry (thick, middle, and thin), were meticulously noted. Furthermore, yarn and waste weight were measured after drying, and reelability (%), raw silk recovery (%), and waste (%) were calculated based on specific expressions.Here is the information presented in a tabular form:

Reeling Performance of Buniyad Reeling Machine for Tasar Cocoons

Parameters	Calculation
a) No. of Cocoons taken	a = 100 (total cocoons for reeling
b)Total Breaks	b = (total breaks during reeling)
c)Total Castings made	c = (total unreelable cocoons)
d)Unreeled cocoons	d = (total cocoons - total breaks)
e)Carry over Cocoons	e = (thick + middle + thin cocoons
i)Thick	Thick t = (percentage of thick cocoons)

ii)Middle	Middle m = (percentage of middle cocoons)
iii)Thin	Thin th = (percentage of thin cocoons)
i)Converted carry over cocoons	f = (0.58t + 0.24m + 0.06th)
j)No. of Reeling cocoons	g = (a - d - f)
k)No. of feeding ends	h = (c + e - f)
Reeliability (%)	Reeliability = (g / h) x 100%
a)Weight of Silk Reeled (gm)	a = (weight of silk reeled in grams)
b) Converted Carry over cocoons	b = (0.43t + 0.14m + 0.03th)
c) Weight of Waste (gm)	c = (weight of waste in grams)
Raw Silk %	Raw Silk % = ((a + b) / (a + b + c)) x 100
Waste %	Waste % = (c / (a + c)) x 100
Denier	Denier = (a / b) x 9000
a) Yarn weight (in gms	a = (weight of yarn in grams)
b) Yarn length (in mts)	b = (yarn length in meters)

The Buniyad Reeling Machine was used for reeling tasar cocoons. For multiple cocoons, a total of 100 cocoons were taken, and for a single end, 6 cocoons were taken to achieve a target denier of approximately 60. The reeling process involved noting the number of breaks, unreelable cocoons, and carry (thick, middle, and thin cocoons)[13]. After reeling, yarn and waste weight were measured, and three replications were taken for reeling performance assessments.

The following parameters were estimated using the given expressions:

- Reeliability (%): The percentage of reeling cocoons to feeding ends.

- Raw Silk %: The percentage of raw silk produced compared to the total weight of silk reeled and waste.

- Waste %: The percentage of waste produced compared to the total weight of silk reeled and waste.

- Denier: The denier of the yarn calculated using the weight of silk reeled and the converted carry over cocoons.

- Yarn weight (in grams): The weight of the yarn produced after reeling.

- Yarn length (in meters): The length of the yarn produced in meters.

These calculations provide valuable insights into the reeling performance of the Buniyad Reeling Machine for tasar cocoons, helping to optimize silk production efficiency and quality[13].

RESULT AND DISCUSSION:

Single Cocoon Parameters:

The research yielded essential insights into the single cocoon parameters for Daba TV Crop, Daba BV Crop, and Raily tasar cocoons. Notably, Raily tasar cocoons displayed the highest shell ratio (21.75%), followed by Daba BV Crop (14.55%) and Daba TV Crop (12.44%). These findings indicate that Raily tasar cocoon exhibits a relatively higher shell weight compared to its cocoon weight, potentially impacting silk yield and quality.

The single cocoon parameters for tasar cocoons (Daba BV & Daba TV) and Raily cocoons are given in Table-1

Table1: Quality parameters of single cocoon

Sl.no.	Type of cocoon	Quality Parameters		
		Cocoon Weight (gm)	Shell Weight (gm)	Shell Rato (%)
1	Daba TV	8.52	1.06	12.44
2	Daba BV	10.58	1.54	14.55
3	Raily	12.86	2.80	21.75

The maximum shell ratio (%) was observed Raily cocoon (Table -1) followed by Daba BV Crop & Daba TV Crop.

Single Cocoon Reeling Parameters:

The reeling performance of Daba and Raily tasar cocoons was rigorously analyzed based on filament length, non-broken filament length (NBFL), and filament denier. Impressively, Raily tasar cocoons demonstrated the maximum filament length (1251.56 meters), while Daba TV Crop exhibited the highest NBFL (208.55 meters). Moreover, Daba BV Crop and Daba TV Crop produced finer filaments compared to Raily tasar cocoon, suggesting a potential advantage in silk quality.

The quality parameters estimated by following single cocoon reeling are given in Table-2

Table 2: Quality parameters by single cocoon reeling process

Sl.no.	Type of cocoon	Quality Parameters		
		Filament Length (m)	Non-Broken Filament (m)	Filament Denier
1	Daba TV	604.69	208.55	9.89
2	Daba BV	666.96	267.92	10.94
3	Raily	1251.56	191.53	12.81

From Table 2: It can depicted that raily tasar cocoon has maximum filament length followed by Daba BV Crop & Daba TV Crop. But Non-broken filament length (NBFL) parameter being considered the NBFL Daba TV Crop higher as compared to raily tasar cocoon . The study the single filament of raily cocoon is higher compared to Daba BV Crop & Daba TV .

Reeling Performance of Silk Cocoons:

The research encompassed a meticulous evaluation of the reeling performance of Daba and Raily tasar cocoons using the Buniyad reeling machine, focusing on reelability (%), raw silk recovery (%), and productivity. Remarkably, Daba BV Crop emerged as the ecorace with the highest reelability (35.71%), followed closely by Raily tasar cocoon (31.55%) and Daba TV Crop (27.40%). Furthermore, raw silk recovery showed comparable percentages for all ecoraces, with Daba TV Crop (59.52%) marginally surpassing Raily tasar cocoon (59.63%). Notably, the estimated

raw silk production for an 8-hour period was projected to be between 175-200 grams for both Daba ecoraces and 150-175 grams for Raily tasar cocoon. These findings hold critical implications for selecting the appropriate ecorace to meet specific silk production requirements while optimizing raw silk recovery and productivity.

Table 3: Reeling Performance of different cocoons

Sl. no.	Parameters	Race of Tasar Cocoons		
		Daba TV	Daba BV	Raily
1	Reelability (%)	27.40	35.71	31.55
2	Raw Silk (%)	59.52	60.79	59.63
3	Raw Silk (Denier)	60.63	64.12	76.86
5	Raw silk Production (gms)/8hrs	175-200	175-200	150-175

CONCLUSION:

In conclusion, this research has shed light on the variations in quality characteristics and reeling performance observed between Daba and Raily tasar cocoons cultivated in Chhattisgarh. Raily tasar cocoon displays a higher shell ratio and filament length, showcasing its unique attributes. On the other hand, Daba BV Crop and Daba TV Crop exhibit finer filaments and higher NBFL, rendering them more suitable for silk quality. The introduction of the Buniyad reeling machine has shown promising results in improving productivity and efficiency, offering valuable insights for silk reelers and the industry at large.

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