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Influence of different castor cultivars on consumption indices of Eri Chawki silkworm

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Abstract
In India, castor (*Ricinus communis*) is grown in various states using various cultivars chosen for the local conditions. Given that castor serves as eri silkworm's (*Phylosomia ricini* Boisd) major host plant for rearing eri silkworm as a secondary agriculture. In this view the study was planned and conducted in GKVK, UAS, Bangalore to find the effect of selected castor cultivars on consumption indices *viz.*, ingesta, digesta and efficiency parameters like ECI, ECD on FW and DW basis were recorded during the study of Eri Chawki silkworms and DCH-519, 48-1, DCS-9, GCH-4, DCH-177, GAUCH-1, JC-12, and Bangalore local were the castor cultivars that were employed. According to the experimental investigation, Eri silkworms fed on GAUCH-1 cultivar leaves varied significantly in their food intake on a fresh weight basis throughout the first, second, and third instars (0.15, 0.27, and 1.16 g/larva, respectively). Similarly for food digestion during first, second and third instar on fresh weight basis (0.24, 0.23 and 1.04 g/larva, respectively) So, by considering above parameters and results the castor cultivar GAUCH-1 was performed superior in overall rearing parameters compare to other castor cultivars. Hence GAUCH-1 castor cultivar is suitable for Eri Chawki silkworm rearing in southern region of the Karnataka.

Keywords: Castor cultivars, Eri silkworm, consumption indices, instars

Introduction
Phylosomia ricini Boisduval, a silkworm found in northeastern India, produces erei silk. Since pupae are not killed during the process, eri silk is also known as Ahimsa silk. Aside from *Bombyx mori* L., the eri silkworm is the only other domesticated silkworm. Eri silk cloth is a blessing for people who follow a strict nonviolent lifestyle. Because castor is widely available in rural areas, ericulture is a perfect activity for the development of secondary agriculture occupations in countries like India, which offer supplemental income to a large number of rural and tribal people. It is also ideal for sericulture (Saratchandra, 2003 and Suryanarayana, 2005) [9, 11].

India cultivates a large number of native, highly productive varieties and hybrids of castor due to its diverse varietal composition. An essential factor in the healthy growth and development of eri silkworms and their better productivity in terms of cocoon and progeny generation is the genotype selection of the castor. Additionally, it has been reported that the eri silkworm races and host plant types utilised for rearing affect the silk ratio (Dookia, 1980) [2]. Depending on the host plant cultivars, silkworm races, and environmental factors, the nutrients (proteins, carbohydrates, lipids, and minerals) in the diet are absorbed and digested at varying speeds (Richard and Lindroth, 1993) [6]. Food plants may have varying effects on food intake, food digesting efficiency, food conversion to body biomass, and ultimately insect performance (Waldbauer, 1964) [12]. In a larger sense, the efficiency of consumption, digestion, and conversion discloses aspects of insect life that are physiologic, behavioural, and ecological (Slansky and Scriber, 1985) [10]. By estimating the rate of ingestion, digestibility, food conversion efficiency, and organism growth rate, the appropriateness of the host is determined (Englemann, 1966) [3].

The process of turning leaves into silk depends critically on food consumption and conversion efficiency. Moreover, a variety of factors influence the silkworm's food intake, digestion, and conversion effectiveness. The nutrition and synthesis of silk in silkworms are affected when the same quantities of leaves are consumed under various feeding and nutritional circumstances (Reddy, 2011) [5]. An investigation of the connection between food absorption, digestion, and food conversion efficiency (FCE) has been conducted for this competition.

Materials and Methods

Phylosomia ricini Boisduval, an eri silkworm, was studied for its nutritional effectiveness on eight different castor cultivars, including DCH-519, 48-1, DCS-9, GCH-4, DCH-177, GAUCH-1, JC-12, and Bangalore local. Following Poonia's (1978) [4] rearing technique, three replications of each cultivar, consisting of twenty larvae per instar, were used to grow the silkworms on each cultivar independently under controlled conditions from the first to the fifth instar. The freshly hatched larvae were chosen at random and individually moved to the rearing tray of each replication of the cultivars under discourse, using feathers as support. Before a leaf was provided, the initial weight of the larvae in each replicate was noted in order to track their rate of growth. Succulent leaves were provided to the larvae in their first and second instars, medium-aged leaves to the larvae in their third instar, and mature leaves to the larvae in their fourth and fifth instars. The larvae were fed twice a day during their first and second in stars and four times during their later instars.

With the development of the larval stage, the amount of food was increased to meet their nutritional needs. Every day, the same amount of food was fed to each duplicate in their feeding. Following each feeding instar, the faces and leftover food were gathered and weighed. Every instar, or before and after moult, saw the weight of the larvae recorded. The fresh weight gain of the larva during the feeding time was determined by comparing the weight of the larva before and after eating. To determine the evaporation loss from the leaves provided as food, an equivalent amount of the same castor leaf was maintained in a different tray as a blank under the same testing conditions. Using Waldbauer's formula (1968) [13], the various nutritional indices of food consumption and utilisation were evaluated on a fresh weight basis.

FC (Food consumption) (g) = Weight of fresh food offered to larvae – Weight of fresh remnants

FD (Food digestion) (g) = weight of fresh food offered to larvae - Weight of fresh excreta voided

$$\text{ECI (Efficiency of conversion of ingested food) (\%): } = \frac{\text{Increase in weight of larva}}{\text{Weight of food ingested}} \times 100$$

$$\text{ECD (Efficiency of conversion of digested food) (\%): } = \frac{\text{Increase in weight of larva}}{\text{Weight of food digested}} \times 100$$

Result and Discussion

The next section discusses the findings on consumption indices among several eri silkworm instars on a fresh weight (FW) and dry weight (DW) basis as influenced by feeding leaves of specific castor varieties.

Food Consumption

When reared on GAUCH-1 leaves during the first, second, third, and fourth instars, eri silkworms consumed significantly more food on a fresh weight basis (0.15, 0.27, 1.16, and 3.95 g/larva); in contrast, cultivar JC-12 found the highest food consumption during the fifth instar, as well as the highest total food consumption of 26.97 and 31.35 g/larva, respectively. GCH-4 recorded the highest total food intake of 13.97 g/larva, but cultivar GAUCH-1 reported the superior food consumption in the first, second, third, fourth, and fifth instars (0.10, 0.09, 0.23, 0.75, and 6.60 g/larva) on a DW basis (Table 1). According to Poonia (1985) [14], as the eri silkworm grows from the first to the fifth instar, it consumes a growing amount of castor leaves. When calculated on an FW and DW basis, the castor cultivars had an impact on the larvae's food consumption, according to Sannappa *et al*. (2000) [7]. Insect eating rate may be influenced by phagostimulants, temperature, food type, relative humidity, and leaf moisture content.

Food Digestion

When leaf was fed to eri silkworms, there were noticeable differences between the castor kinds in terms of food digestion on a fresh weight basis. In the first and second instars, GAUCH-1 shown the highest digestibility (0.24 and 0.23 g/larva); in the third and fourth instars, as well as for total food digestion (1.04, 3.48, and 22.65 g/larva), JC-12 demonstrated the best; in the fifth instar, DCH-519 demonstrated the highest (18.62 g/larva). When the leaf was fed to the eri silkworm on a DW basis. In terms of total food digestion, the variety GAUCH-1 recorded the maximum digestibility of 0.09, 0.06, 0.12, 0.40, 3.88, and 4.55 g/larva, as well as during the first, second, third, fourth, and fifth instars (Table 2). The castor cultivars had a significant impact on food digestion on both an FW and DW basis (Sannappa *et al.*, 2002) [8]. Castor variants have been found to cause a substantial variation in the pace of digestion, as the digestion process may be regulated by the leaf composition, namely the fibre content and the accompanying enzyme activity in eri silkworms.

Efficiency of Conversion of Ingested Food (ECI)

The ECI of eri silkworms fed with leaves of several castor kinds was greatly influenced throughout all instars, including the mean ECI, with the exception of the third instar. The ECI was significantly higher (10.11%) when eri worms were fed DCS-9 leaves during their first instar. In the fourth instar, DCH-519's leaves had the greatest ECI (33.48%). The variety DCH-177 had a higher mean ECI of 18.69%, while the eri worms fed GAUCH-1 leaves recorded the greatest ECI of 34.51 percent during the fifth instar. The ECI of eri silkworms fed with leaves from several castor cultivars was greatly affected throughout every instar, including the mean ECI.

The ECI was significantly greater (4.20%) when eri worms were fed DCH-177 leaves during their first instar. In GAUCH-1 leaves, the ECI recorded at the second and fifth instars was higher at 21.56% and 22.07%, respectively. In the third instar, the DCH-519 leaves had the highest ECI (33.48%). The cultivar DCS-9 (17.01%) had the greatest percentage during the fourth instar (table 3). The total sugar content of the castor variety's leaves exhibited a strong, positive correlation with ECI. These findings were in line with those of Poonia (1985) [14], who observed a declining tendency in ECI as eri worm ages. Variations in castor cultivars were observed by the ECI (Sanappa *et al.*, 2002 and Chandrappa, 2003) [8, 1].

Efficiency of Conversion of Digested Food (ECD)

With the exception of the first instar, the eri silkworm fed leaves of several castor cultivars on an FW basis showed a superior difference in ECD (table 4). When the worms were fed GCH-4 leaves, it reached its peak during the second instar (31.97%). Bangalore local was found to have the highest mean ECD during the third quarter (33.83 and 39.03%). The fourth instar of the variety DCH-519 recorded a high ECD of

70.58%, while the variety GAUCH-1 recorded a high ECD of 58.63% in the fifth instar. When leaves were fed on eri silkworms, notable and substantial differences were seen between the various types of castor with regard to ECD in DW basis. In the first and second instars of the DCH-177 variety, it performed better (5.09 and 26.84%). The variety GAUCH-1 had the greatest values in the third, fifth, and mean ECD periods (24.87, 35.36, and 20.72 percent, respectively). The variety DCS-9 had the highest recorded percentage (19.65%) during the fourth instar. According to studies by Sannappa *et al*. (2002) [8] and Chandrappa (2003) [1], different castor cultivars showed different reverse trends in ECD on both FW and DW bases. This could be because leaf moisture plays a crucial role in these processes.

Table1: Food consumption by eri silkworms reared on leaves of selected castor cultivars

Sl. No.	Cultivars	Young-age (g/larva)						Late-age (g/larva)				Total	
		I Instar		II Instar		III Instar		IV Instar		V Instar			
		FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB
1	DCH-177	0.05	0.02	0.17	0.06	0.92	0.14	3.22	0.53	23.28	5.57	28.32	11.10
2	DCH-519	0.08	0.02	0.19	0.06	0.89	0.14	3.26	0.46	26.44	5.67	31.04	11.11
3	GAUCH-1	0.15	0.10	0.27	0.09	1.16	0.23	3.95	0.75	23.75	6.60	29.55	10.59
4	GCH-4	0.10	0.03	0.17	0.06	0.97	0.14	3.88	0.64	24.25	5.05	29.33	13.97
5	DCS-9	0.07	0.02	0.25	0.07	1.01	0.15	3.19	0.47	23.50	5.37	28.41	12.02
6	JC-12	0.11	0.06	0.24	0.06	1.14	0.15	3.91	0.65	26.97	6.30	31.35	10.41
7	48-1	0.08	0.02	0.24	0.07	1.03	0.14	3.70	0.55	22.47	4.85	27.58	11.88
8	B-LOCAL	0.08	0.01	0.20	0.05	0.81	0.13	2.69	0.38	22.30	4.93	26.33	13.84
F-test		*	*	*	*	*	*	*	*	*	*	*	NS
S.Em±		0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.01	0.17	0.06	0.52	4.26
CD at 5%		0.06	0.04	0.06	0.11	0.10	0.03	0.09	0.04	0.53	0.19	1.61	-

FWB: Fresh weight basis DWB: Dry weight basis NS: Non-Significant * Significant
B- Bangalore Local FC: Food consumption ( ): % food consumption to the total

Table 2: Food digestion by eri silkworms reared on leaves of selected castor cultivars

Sl. No.	Cultivars	Young-age (g/larva)						Late-age (g/larva)				Total FD	
		I Instar		II Instar		III Instar		IV Instar		V Instar			
		FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB
1	DCH-177	0.05 (0.27)	0.01 (0.29)	0.14 (0.76)	0.01 (0.58)	0.81 (4.41)	0.07 (2.03)	2.79 (15.20)	0.27 (7.85)	14.57 (79.40)	3.06 (88.95)	18.35	3.44
2	DCH-519	0.07 (0.31)	0.02 (0.52)	0.16 (0.71)	0.02 (0.52)	0.78 (3.47)	0.08 (2.10)	2.82 (12.56)	0.17 (4.46)	18.62 (82.94)	3.52 (92.39)	22.45	3.81
3	GAUCH-1	0.24 (1.22)	0.09 (1.98)	0.23 (1.17)	0.06 (1.32)	1.01 (5.12)	0.12 (2.64)	3.41 (17.29)	0.40 (8.79)	14.83 (75.20)	3.88 (85.27)	19.72	4.55
4	GCH-4	0.10 (0.50)	0.02 (0.64)	0.14 (0.64)	0.02 (0.64)	0.84 (4.17)	0.06 (1.92)	3.44 (17.06)	0.38 (12.14)	15.65 (77.63)	2.65 (84.66)	20.16	3.13
5	DCS-9	0.06 (0.32)	0.02 (0.29)	0.22 (1.16)	0.04 (1.16)	0.89 (4.69)	0.09 (2.62)	2.76 (14.56)	0.20 (5.81)	15.03 (79.27)	3.10 (90.12)	18.96	3.44
6	JC-12	0.19 (0.84)	0.05 (1.15)	0.21 (0.93)	0.04 (0.92)	1.04 (4.59)	0.10 (2.29)	3.48 (15.36)	0.39 (8.94)	17.73 (78.28)	3.79 (86.93)	22.65	4.36
7	48-1	0.07 (0.38)	0.02 (0.62)	0.21 (1.13)	0.04 (1.24)	0.89 (4.77)	0.06 (1.86)	3.25 (17.42)	0.30 (9.29)	14.23 (76.26)	2.82 (90.12)	18.66	3.23
8	B-LOCAL	0.07 (0.41)	0.02 (0.66)	0.17 (0.99)	0.02 (0.66)	0.70 (4.07)	0.05 (2.31)	2.28 (13.27)	0.13 (4.29)	13.97 (81.32)	2.80 (86.93)	17.18	3.03
F-test		*	*	*	*	*	*	*	*	*	*	*	*
S.EM±		0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.02	0.18	0.08	0.19	0.09
CD at 5%		0.07	0.03	0.07	0.04	0.10	0.03	0.10	0.07	0.58	0.26	0.61	0.29

FWB: Fresh weight basis DWB: Dry weight basis NS: Non-Significant * Significant
B- Bangalore Local FC: Food digestion ( ): % food consumption to the total

Table 3: Efficiency of conversion of ingested food (ECI) in eri silkworms reared on leaves of selected castor cultivars

Sl. No.	Cultivars	Young age (g/larva)						Late age (g/larva)				Mean ECI	
		I Instar		II Instar		III Instar		IV Instar		V Instar			
		FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB
1	DCH-177	8.01	4.20	15.49	15.43	12.03	25.92	25.92	13.80	32.01	19.92	18.69	14.42
2	DCH-519	6.93	3.26	12.25	15.39	9.95	33.48	33.48	14.06	17.59	13.08	16.04	11.87
3	GAUCH-1	6.11	1.62	7.31	21.56	9.55	20.78	20.78	15.24	34.51	22.07	15.05	13.20
4	GCH-4	8.00	3.08	15.95	17.82	10.10	22.40	22.40	13.73	23.62	15.35	16.01	15.06
5	DCS-9	10.11	3.96	9.17	16.75	12.25	26.99	26.99	17.01	30.08	17.09	17.72	13.11
6	JC-12	4.37	1.84	9.32	17.00	12.25	21.85	21.85	12.66	27.78	16.85	15.11	13.41
7	48-1	9.25	3.75	8.37	13.65	9.19	23.41	23.41	7.78	24.80	20.86	15.00	11.36
8	B-LOCAL	6.12	3.01	14.29	19.38	18.02	28.78	28.78	15.73	19.25	15.03	17.29	13.94
F-test		*	*	*	*	NS	*	*	*	*	*	*	*
S.EM±		1.18	0.34	1.39	0.88	1.48	1.23	1.23	0.72	0.58	0.46	0.51	0.57
CD at 5%		3.77	1.08	4.43	2.85	-	3.98	3.94	2.33	1.87	1.49	1.65	1.86

FWB: Fresh weight basis DWB: Dry weight basis NS: Non-Significant
*: Significant ECI: Efficiency of conversion of ingested food

Table 4: Efficiency of conversion of digested food (ECD) in eri silkworms reared on leaves of selected castor cultivars

Sl. No.	Cultivars	Young age (g/larva)						Late age (g/larva)				Mean ECD	
		I Instar		II Instar		III Instar		IV Instar		V Instar			
		FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB	FWB	DWB
1	DCH-177	17.01	5.09	23.27	26.84	22.35	17.58	50.13	15.95	58.27	31.85	37.39	18.75
2	DCH-519	9.22	3.55	16.44	12.53	19.48	16.48	70.58	16.29	28.30	18.94	34.72	14.53
3	GAUCH-1	3.44	1.71	24.22	21.94	17.67	24.87	40.02	17.46	58.63	35.36	26.37	20.72
4	GCH-4	10.54	3.34	31.97	25.56	25.25	20.65	37.18	15.49	45.15	23.81	32.50	19.05
5	DCS-9	20.46	4.85	12.48	10.08	21.29	18.86	65.56	19.65	52.23	26.72	35.08	16.51
6	JC-12	5.15	1.98	22.06	18.58	19.33	18.74	36.93	14.23	46.14	25.12	24.89	16.42
7	48-1	13.83	4.26	12.54	9.50	22.37	15.71	43.13	8.83	42.70	32.93	27.23	14.85
8	B-LOCAL	8.61	3.30	19.86	17.30	33.83	22.46	68.45	18.57	33.98	24.01	39.03	17.64
F-test		NS	*`	*	*	*	*	*	*	*	*	*	*
S.EM±		3.56	0.47	3.09	0.57	2.41	1.05	4.05	0.84	1.07	0.80	1.88	0.78
CD at 5%		-	1.55	10.20	1.88	7.95	3.47	13.37	2.77	3.53	2.64	6.20	2.57

FWB : Fresh weight basis DWB : Dry weight basis NS : Non-Significant
* : Significant ECD : Efficiency of conversion of digested food

Conclusion

The results of the study demonstrated that there was a considerable variance in the food consumption, digestion, and nutritional indicators of silkworms fed on leaves of the GAUCH-1 type. Considering the above parameters and results the castor cultivar GAUCH-1 was performed superior in chawki rearing and subsequent rearing parameters compare to other castor cultivars. Hence GAUCH-1 castor cultivar is suitable for eri chawki silkworm rearing in southern region of the Karnataka.

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