155. *The Control of Growth and Development in Bombyx mori.* XXXV

Effect of Nutrition during Larval Development on the Release of Brain Hormone

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The author's previous reports have demonstrated that the secretion of brain hormone is controlled by sex-linked maturing genes (XXVII), temperature (XXVII) and light (XXXIV). The present paper reports that the secretion of brain hormone is also controlled by nutrition: the larvae reared with an artificial diet release less brain hormone (or less molting hormone), and the length of each instar is remarkably increased.

Materials and methods. Eggs derived from hybrids between J.106 and Daizo were incubated at 25°C in the light condition. Larvae developed from those eggs were reared with mulberry leaves (ML-series) and with the artificial diet (AD-series) prepared for earlier instar larvae by The Nihon Nosan-Kogyo Company. Both types of diet were given at 28°C in darkness except the leaf-supplying time. (1) The assessment for juvenile hormone (JH) was made with the brain-corpus allatum (Br-CA) complex or the corpus allatum (CA) alone from the 0-, 24-, 48-, and 60-hr-old 5th-instar-larvae which were implanted into the 24-hr-old 4th-instar-larvae allatectomized just after the 3rd larval ecdysis. It was necessary to use the recipients having no JH and the donors producing JH. (2) The assessment for brain hormone (BH) was done with the Br-CA complex or the CA alone from the 72-hr-old 5th-instar-larvae which were implanted into the allatectomized 36-hr-old 4th-instar-larvae or decapitated 36-hr-old 4th-instar-larvae. It was needed to use the recipients having JH and no BH, and the donors producing no JH and BH.

Results. 1. *Effect of the artificial diet on quantitative characters.* The length of each instar was longer in the AD-series than in the ML-series (Table I). However, the weight of pupa and cocoon-layer of the former was less than that of the latter.

2. *Activity of the Br-CA complex and of the CA alone in larvae*

Table I. Effect of the artificial diet on quantitative characters

Series	Each instar (hr) in larval duration						Pupal weight (g)	Cocoon-layer weight (g)	% of cocoon-layer weight
	I	II	III	IV	V	Total			
ML	73	56	64	81	182	456	1.335	0.240	15.24
AD	80	66	95	105	192	538	1.183	0.142	10.72

Table II. Effect of implantation of Br-CA complex or CA alone on the induction of L-L or L-P apolysis in larvae reared with ML and AD during all larval stage

Recipient	Donor		Transplantation					
	Series	Age (hr) in 5th-instar	Br-CA complex			CA alone		
			L-L apolysis	L-P apolysis	% of L-L apolysis	L-L apolysis	L-P apolysis	% of L-L apolysis
24-hr-old 4th-instar-larvae allatectomized just after 3rd larval ecdysis (containing on JH)	ML	0	8	1	88.9	8	2	80.0
		24	6	4	60.0	5	5	50.0
		48	2	8	20.0	1	9	10.0
		60	—	—	—	0	9	0.0
	AD	0	8	2	80.0	7	2	77.8
		24	5	4	55.6	4	6	40.0
		48	2	8	20.0	1	8	11.1
		60	1	9	10.0	1	9	10.0

reared with the artificial diet during all larval stage. The activity of the Br-CA complex and of the CA alone for L-L apolysis was somewhat stronger in the ML-series than in the AD-series (Table II). The activity of the CA alone was, however, maintained longer in the AD-series than in the ML-series. The activity of the Br-CA complex for L-L apolysis was stronger than that of the CA alone.

3. *Effect of the artificial diet on the release of brain hormone.* The 72-hr-old 5th-instar-larvae releasing no JH were used as donors, and the allatectomized 36-hr-old 4th-instar-larvae (ML-series) as recipients. Table III indicated that the allatectomized control series pupated on the 7th to 8th day after implantation, while the implantation of the Br-CA complex in the ML-series showed completely L-L apolysis during 2 to 4 days. The implantation of the Br-CA complex in the AD-series showed L-L apolysis in five-fifteenth of the test animals during 3 to 4 days, and L-P apolysis in remained ten animals during 6 to 8 days.

Discussion. One (XXVII) of our papers has reported that the

Table III. Effect of implantation of Br-CA complex of larvae reared with ML and AD on the induction of apolysis in allatectomized 36-hr-old 4th-instar-larvae

Recipient	Donor (from 72-hr-old 5th-instar-larvae)		Resulting	Time (day) after implantation in recipients							
				2	3	4	5	6	7	8	Total
Allatectomized 36-hr-old 4th-instar-larvae (containing JH)	ML	Br-CA	L-L	4	7	2					13
			L-P								0
		Allatectomized control	L-L								0
			L-P						2	7	9
	AD	Br-CA	L-L	4	1						5
			L-P					1	5	4	10
		Allatectomized control	L-L								0
			L-P						3	7	10

Table IV. Influence of environments during incubation and reciprocal crossing on larval development (reared at 20°C)

Reciprocal crossing and environments during incubation	Each instar (hr)					Cocoon weight (larval and pupal hours) (g)	% of trimolters	% of non-diapause moths
	I	II	III	IV	V			
E. 606×c (<i>Lm</i> × <i>Lm</i> ^e / <i>Lm</i> ^e)	77	136	227	342	477	♀ 1.35 (755) ♂ 1.51 (785)	33.0 0.0	68.2 —
c×E. 606 (<i>Lm</i> ^e × <i>Lm</i> / <i>Lm</i>)	83	141	235	354	502	♀ 1.79 (832) ♂ 1.50 (796)	0.0 0.0	0.0 —
17°C in darkness (J. No. 107)	106	199	310	453	591	♀ 1.44 ♂ 1.08	2.8 8.0	93.1 —
25°C in light	115	214	341	492	645	♀ 1.58 ♂ 1.16	0.0 0.0	0.0 —

brain does not release the brain hormone from the brain itself, but release it from the CA through axons from neurosecretory cells, and that the brain hormone is controlled by a series of multiple allelomorphs of the sex-linked maturing gene (XXVII), as well as by temperature (XXVII) and light (XXXIV). The present study showed that the secretion of BH was highly controlled by nutrition.

The larvae reared with AD showed a delay of larval development, being especially less in weight of the cocoon-layer than those reared with ML. However, the activity of the CA of the 5th-instar-larvae was not particularly different in both the AD- and ML-series. It seems that the delayed larval development in the AD-series is attributable to the reduced secretion of BH, since the AD-series-larvae produced less BH than the ML-series-larvae. The reduced secretion of BH may lead the reduced production of molting hormone (MH)

from the prothoracic glands, following the delay of larval development.

The female larvae from the cross of tetramolting univoltine E. 606 (Z^{Lm}/W) X tetramolting multivoltine c (Z^{Lm^e}/Z^{Lm^e}) showed shorter instar-duration and lighter cocoon weight than those from the reciprocal cross as shown in Table IV (XV). While both parents were tetramoltings, some trimolters or "non-diapause moths" appeared in the F_1 females of the former, but not in those carrying the Lm gene (Table IV). The similar features were shown in the larvae developed from "bivoltine eggs" which were incubated at low and high temperature (Table IV). Probably this is due to the functional conversion of the $+Lm$ gene to that of the Lm^e gene under the low temperature-incubation, as well as to that of the Lm gene under the high temperature-incubation. The shortening of larval duration was dependent on the increased secretion of BH (XXVII), and the delayed larval duration resulted from the decreased secretion of BH was the finding of the present study.

The larvae carrying the Lm^e gene and those developed from "bivoltine eggs" incubated at 17°C in the dark condition showed an increased release of BH, in contrast to the larvae having the Lm gene and those developed from "bivoltine eggs" incubated at 25°C in the light. Probably, the larvae of the former series strongly inhibit the CA activity and apparently promote the activity of the prothoracic gland as compared with the larvae of the latter, and the former larvae produce less JH and more MH than the latter larvae. The larvae of the former were shorter in the instar duration than those of the latter.

The larvae rearing with AD release less BH than those rearing with ML. The larval development of each instar was delayed in the former in comparison with the latter, but the weight of pupa and cocoon-layer was lighter in the former than in the latter.

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