102. The Control of Growth and Development in *Bombyx mori*. XL

Inhibition of the Corpus Cardiacum Activity by the Hormone from Tritocerebrum Neurosecretory Cells Occurring in the Hindbrain

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In Rep. XXXIX of this series, it was suggested that the hormone from 3 neurosecretory cells of group IV situating in the hindbrain appeared to control the corpus cardiacum (CC) activity through the externi commissures, ncc-IV. Here, a hormonal relationship between the 3 neurosecretory cells of group IV and the corpus cardiacum was investigated. It was newly demonstrated that the hormone from 3 cells of group IV floating on the externi commissures inhibits the activity of the corpus cardiacum which is not related to hormones floating on the interni commissures.

Materials and methods. The eggs of two strains, multivoltine N_4 and bivoltine hybrids between J. 106 and Daizo, were used for this study. The eggs of N_4 were incubated at 17°C in the dark condition, and the eggs of hybrids between J. 106 and Daizo were incubated at 17°C (L) under the dark condition to obtain non-diapause eggs, and at 25°C (H) in the light condition to obtain diapause eggs.

The 4th day females of pupae fated to lay non-diapause eggs were used as hosts, and the implanted organs were taken from the full grown female larvae fated to lay diapause eggs. In the implantation of brain-corpora cardiaca (Br-CC) complex, the corpora allata were

Table I. Effect of implantation of Br-CC complex and CC alone
on voltinism in J. 106×Daizo crossing

Implant	No. treated	No. of adults			Sum of laid eggs		
		Non-diap. eggs	Diap. eggs	Mixed eggs	Non-diap. eggs	Diap. eggs	% of diap. eggs
Br-CC (3)	5	0	0	4	961	450	31.9
CC (3)	5	0	0	4	942	898	48.8
Control	5	5	0	0	2295	0	0.0

Hosts: 4 days female pupae fated to lay non-diapause eggs. Implants: Full grown female larvae fated to lay diapause eggs. (3): 3 pairs of organs.

eliminated.

Results. The individuals which implanted Br-CC (3 pairs) and CC (3 pairs) produced the mixed egg batches corresponding to the non-mixed egg batches of the control.

The Br-CC-implanted individuals produced obviously less diapause eggs than the CC-implanted individuals did, though experimental batches were few in number (Tables I–II).

Similar experiments were repeated at the same time but with different races as shown in Tables III–IV. The individuals which implanted with Br-CC complex obviously produced less diapause eggs than the individuals which implanted with CC alone did.

Table II. Content of mixed egg batches by implantation of Br-CC complex or CC alone of Table I

Implant	Br-CC complex (3)		CC alone (3)	
	No. of batch	No. of non-diap. eggs	No. of non-diap. eggs	No. of diap. eggs
1		254	184	253
2		519	333	120
3		153	194	216
4		35	231	309
Total		961	942	898
% of diap. eggs		31.9		48.8

Table III. Implantation of Br-CC complex or CC alone taken from individuals of J.106×Daizo (H) into individuals of N₄(L)

Implant	No. treated	No. of adults		
		No. laid non-diap. eggs	No. laid diap. eggs	No. laid mixed eggs
Br-CC (3)	8	0	0	8
CC (3)	8	0	0	8
Control	8	8	0	0

Discussion. It has been demonstrated in *Calliphora erythrocephala* and *Periplaneta americana*, that the corpus cardiacum produces a hyperglycaemic hormone (Normann and Duve, 1969) and a hypolipemic hormone (Downer and Steele, 1972). While Takeda and Ogura (1976) have demonstrated that both of the corpus cardiacum and corpus allatum have an ability to produce diapause eggs as the suboesophageal ganglion shows. However, a correlation between the brain and the corpus cardiacum or the corpus allatum had not been well demonstrated. Fraser and Pipa (1977) noted an inhibiting function due to brain hormones on the corpus allatum in *Periplaneta*

Table IV. Content of mixed egg batches by implantation of Br-CC complex or CC alone of Table III

Donor	Recipient	No. of batches	No. of non-diap. eggs	No. of diap. eggs	Total	% of diap. eggs
N ₄	Br-CC (3)	1	335	26	361	7.2
		2	307	69	376	18.4
		3	283	66	349	18.9
		4	236	65	301	21.6
		5	268	83	351	23.6
		6	211	98	309	31.7
		7	244	121	365	33.2
		8	167	123	290	42.4
Total and mean			2051	651	2702	24.1
N ₄	CC (3)	1	287	68	355	19.2
		2	263	72	335	21.5
		3	209	88	297	29.6
		4	215	93	308	30.2
		5	225	128	353	36.3
		6	236	145	381	38.1
		7	115	192	307	62.5
		8	100	207	307	67.4
Total and mean			1650	993	2643	37.6

americana.

The implantation of 3 pairs of corpora cardiaca taken from hibernating individuals into pupae fated to produce non-diapause eggs resulted in the formation of a higher diapause egg than the implantation of 3 pairs of brain-corpora cardiaca complex did. This seems to be due to the inhibition of the corpora cardiaca by the hormone from 3 cells (group IV) existing in hindbrain. The corpora cardiaca are connected with the externi commissures from these 3 cells (group IV) as shown in Fig. 1. Since these 3 cells are in contact with the head antennae, certain external environments exert some influence on their functions.

While it has been demonstrated that the function of the corpus allatum is inhibited by the hormones from three kinds of neuro-hormone-secreting cells (groups I, II, and III), the function of the prothoracic gland is promoted by these brain hormones. It is needless to say that two neurosecretory cell bodies of group III are under immediate influence of environmental factors.

It has been demonstrated (Reps. VII-IX, 1971) that the corpus cardiacum have a function for carbohydrate- and fat-metabolism as mentioned above, and the corpus allatum for protein metabolism, and that both organs deals with the determination of voltinism. The

function of the corpus cardiacum and that of the corpus allatum mutually are thus independent (Rep. XXVII, 1975).

Fig. 1. Diagram of the endocrine system of *Bombyx mori*. Br: Brain. CC: Corpus cardiacum. CA: Corpus allatum. PG: Prothoracic gland. I: Central nervous cells. II: Lateral nervous cells. III: Apical two cells. IV: Hindbrain three cells.

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