ISSN 1009－3095 *Journal of Zhejiang University SCIENCE* V. 3, No. 3, P. 344－347, July－Aug., 2002
http://www.periodicals.com.cn; http://www.zju.edu.cn/English

http://www.zjupress.com; http://lib.zju.edu.cn/eindex.htm; jzu_s@mail.hz.zj.cn

Effect of vertebrate hormones and prostaglandins on growth, silk quality and metabolic activities of *Bombyx mori* L

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Received July. 28, 2001; revision accepted Oct. 6, 2001

Abstract: The economic importance of silkworm has moved biologists to explore various intricate mechanisms of the action of vertebrate hormones. The dietary administration of several vertebrate hormones and prostaglandins enhanced both developmental and metabolic processes of silkworm, *Bombyx mori* L. The main objective of sericulture research is to apply the results to achieve superior quality silk and greater output, to apply lab findings to achieve desirable ecenomic results.

Key words: *Bombyx mori* L, Vertebrate homones, Prostaglanding
Document code: **CLC number:**

INTRODUCTION

The presence of vertebrate hormone like compounds in insects and crustaceans had been reported (De loof, 1987 and Lafont, 1970). Vertebrate hormones stimulate growth, lipid metabolism, sugar uptake and cellular utilization in insects and other invertebrates (Kramer, 1983 and Magadum and Hooli, 1988). Effect of some vertebrate hormones on lipid mobilization of fat body was reported (Bhaktan and Gilbert, 1968). It is well known that vertebrate hormones accelerate vitellogenesis in insects which is due to Increased function of topocytes in the germanium (Landa, 1970). Hormones had been known to participate actively in reproduction and other physiological activities of silkworm, *Bombyx mori* L. (Pushpa Rani and Bharathi, 1998).

APPLICATION OF VERTEBRATE HORMONES AND PROSTAGLANDINS ON COCOON PRODUCTION, SILK QUALITY AND METABOLIC PROCESSES

1. Vertebrate pituitary extract

Effects of vertebrate pituitary extract on growth of larvae and biochemical composition of silk gland of silkworm was studied (Bhaskar et al., 1983a). Significant increase in growth rate of larva, increase in cocoon production and silk output, shortened larval duration and advance in eclosion period, were observed when larvae were exposed to rat vertebrate pituitary extract.

Pituitary treatment enhanced the organic constituents in the body and haemolymph of silkworm larva. The increase in biochemical constituents correlated with the increase in body weight, structural and dynamic levels of organization of silk gland, and with accelerated silk output (Bharathi et al., 1986). The effect of vertebrate pituitary extract on nitrogen turnover in faecal matter of silkworm was reported (Bharathi, 1995).

2. Prolactin

The growth rate of silkworm larva was enhanced significantly when it was treated with prolactin (Bhaskar et al., 1983b). Prolactin was used to improve the organic constituents of silkworm, *Bombyx mori* L. (Bharathi et al., 1984). Typical application of prolactin on different tissues of silkworm was reported (Reddy et al., 1992). Effect of prolactin on economic characters of *Bombyx*

mori was studied (Bhaskar et al., 1983b).

Prolactin has growth hormone like influence (Thomas et al., 1976), and accelerates biosynthetic activities (Grayhack Lobowitz, 1967). Prolactin mediated activation of synthetic activities at the cellular level lead to accumulation of structural and soluble protein components that form the structural units for the growth of the larva. The effect of prolactin on the pattern of nitrogenous end products of silkworm was studied (Bharathi et al., 1993). The prolactin, induces active turnover of larva free amino acids with increased nitrogen balance, the condition which highly favors the growth of the larva.

3. Thyroxine

Vertebrate thyroid hormone treatment brings about various physiological changes in insects in general (Bhaktan and Gilbert, 1968). There are reports on the effect of thyroxine on growth, quantitative characters and on the organic constituents of silkworm (Majumdar and Medda, 1975; Chaudhuri and Medda, 1986; Magadum and Hooli, 1988; Thyagaraja et al., 1991; Chaudhuri et al., 1992; Zhang et al., 1992; Pushpa Rani et al., 1999).

Thyroxine improved economic characters of silkworm (Pushpa et al., 1998). An increased level of oxygen uptake and consumption occurred in invertebrates when treated with thyroid extracts (Ashbel, 1935). Thyroxine regulates the basal metabolic rate, thus accelerating growth and development (Srinivasan et al., 1955; Bhaktan et al., 1968).

The in vivo distribution and metabolism of thyroxine in various tissues of insects was studied ((Majumdar et al., 1975). Thyroxine induced various physiological changes in insects (Karlson et al., 1963). Stimulating effect of thyroxine on various physiological parameters including enhancement of protein, DNA and lipid contents of silkworm (Hoch, 1962; Ghosh et al., 1969; Singh, 1972; Medda et al., 1980; Chaudhuri et al., 1985).

4. Insulin

The effect of insulin on silk gland, fat body and gonads of silkworm was studied (Reddy et al., 1992). Insulin accelerates growth and cocoon production, and enhances quality of silk which are practical advantages in sericulture. The increase in biochemical constituents of silk gland, fat body and gonads were correlated with the growth and quantitative characters of silkworm. Insulin regulates the basal metabolic rate, and can accelerate improvement of the economic characters of silkworm.

5. Pregnant mare serum gonadotropin (PMSG)

Our previous results and those of Rajasekhar (1993) and Pushpa Rani and Bahrati (1998) showed improvement in economic. Administration of PMSG significantly improved the commercial characters of silkworm *Bombyx mori* L.

6. Testosterone proprionate:

Administration of testosterone proprionate improved the economic characters and biochemical constituents of silk gland, fat body and gonads (Reddy et al., 1992). Magadum and Magadum (1993) studied the effect of testosterone proprionate on the economic traits of silkworm, *Bombyx mori* L. Testosterone played an important role in stimulating growth, cocoon production and post-cocoon characters of silkworm. The increase in organic constituents of tissues can be utilized as energy sources for the function of these tissues. The silk gland is the organ responsible for the biosynthesis and secretion of proteins. Testosterone played an important role in biosynthesis of proteins that form the structural units for the growth of the larva. Active accumulation of proteins, carbohydrates and lipids in the silk gland can increase its weight (Reddy et al., 1992).

7. Prostaglandin $F_{2\alpha}$

Prostaglandins are powerful, hormone like molecules produced in most mammalian tissues; and are arachidonic acid derivatives, Which are of two types: (1)E-series; (2) F-series of prostaglandins. Prostaglandins with particular reference to $PGF_{2\alpha}$, had been known to participate actively in reproduction, digestion and other physiological activities of vertebrates (Pharris et al., 1969; Mc Kee et al., 2000). Hence it will be worthwhile to

understand the possible role of $PGF_{2\alpha}$ on the growth and reproduction of silkworm.

The effect of $PGF_{2\alpha}$ on excretory pattern and, organic constituents of haemolymph and silk gland was reported. The increase in organic constituents was correlated with the observed increase in body weight and silk output. The effects of administration of $PGF_{2\alpha}$ on silk quality, biosynthesis of silk proteins, carbohydrate metabolism of gonads and lipid profiles of silk gland were reported (Bharathi, 1993a; 1993b; Bharathi et al., 1996).

Their results suggested that $PGF_{2\alpha}$ induced active turnover of silk gland protein molecules with increased nitrogen balance in the form of amino acids which are highly favorable for the the silkworm's growth and silk production. The increase in the organic composition of the gonads revealed that accumulation of carbohydrates denotes higher extent of utility of these energy sources for the function of gonads. The increase in lipid profiles suggested increase in silk gland biosynthetic activities which might reflect active spinning of silkworm larva.

CONCLUSIONS

Application of vertebrate hormones and prostaglandin $F_{2\alpha}$ have stimulatory effect on cocoon production and silk quality which is of much economic importance in the reeling industry. However, its efficacy and final suitability is to be tested and research towards this direction is highly focused on apply lab findings to achieve desired acmomic goals. Various hormones such as vertebrate pituitary extract, prolactin, thyroxine, insulin, PMSG, testosterone and prostaglandin $F_{2\alpha}$ are known to participate actively in growth, reproduction, cocoon production, silk quality and other physiological activities of silkworm, *Bombyx mori* L.

The ambition of the authors is to improve the economic characters of silkworm through substances which are easy to handle and within the reach of common sericulturist. The economic importance of silkworms motivated biologists to explore various intricate mechanisms of the action of vertebrate hormones. Effect of hormones and prostaglandin $F_{2\alpha}$ have significant effects on the development of the silk industry in terms of productivity and quality right from the cocoon production to the processing of silk.

This review work on vertebrate hormones and prostaglandin $F_{2\alpha}$ was aimed at collating background information on silkworm growth, cocoon production, silk quality and reproduction, for possible application to the improvement of silk industry, and has research and development importance.

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