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Growth hormone secretory response to thyrotropin-releasing hormone in normal and dwarf chickens

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Summary. The effect of the dw-genotype on *in vivo* growth hormone (GH) release after a single thyrotrophin-releasing hormone (TRH) injection (2 µg/kg) was investigated in the present study. Young, growing chickens of different ages (3, 5 and 7 weeks old) were used to determine whether differences in GH levels, with increasing age, might influence the response to TRH within one genotype. In both the sex-linked dwarf (SLD) and control strain plasma GH concentration increased rapidly following TRH injection. This increase was greater in the dwarf birds and the response lasted longer. No effect of pretreatment levels of GH on TRH response were observed throughout the study. Two mechanisms may be responsible for the observed differences : increased pituitary responsiveness to TRH and a lower degradation rate of GH in dwarf chickens.

Introduction.

Thyrotrophin-releasing hormone (TRH) stimulates growth hormone (GH) secretion in domestic fowl (Harvey *et al.*, 1978). This effect is age-related, being high in young, fast-growing birds (Scanes *et al.*, 1981 ; Harvey *et al.*, 1981) and low in adult birds (Scanes *et al.*, 1984). Although TRH is a potent GH secretagogue in post-hatching chickens, it has no effect on GH secretion during the prenatal period (Decuypere and Scanes, 1983).

Growth deficiency in the sex-linked dwarf (SLD) is not due to low GH levels (Scanes *et al.*, 1983 ; Hoshino *et al.*, 1982). The latter authors found no differences in GH concentration between the two strains, while Scanes *et al.* (1983) and Stewart *et al.* (1984) found significantly higher GH levels in the SLD strain at 12, 15 and 18 weeks of age.

The present study examined the possible effect of the dw genotype on *in vivo* GH release after TRH injection ; the experiment was carried out at different

ages in order to determine whether different pretreatment plasma concentrations of GH would influence the response to TRH.

Material and methods.

The offspring from the mating of heterozygous sires (Dwdw) to dwarf females (dw-) were used in this study. This resulted in genotypically heterozygous male control birds and homozygous (dwdw) dwarf birds.

All birds were maintained under a long-day photoperiod of 16 hours of light and 8 hours of darkness (16L:8D) ; food and water were available *ad libitum* prior to experimentation. Before the experiment began, dwarfism was verified by body weight and shank length. Because of the reported difference in triiodothyronine (T3) levels in dwarf and normal birds (Scanes *et al.,* 1983), the dwarfs having low T3 levels, a concentration of T3 was used as a control for correct pooling. T3 was measured using a commercial radioimmunoassay kit (Wellcome, T3 DAC-CEL) with a good parallelism between chicken plasma dilution curves and the standard curve of the commercial kit.

In the control strain, groups of 7 birds were used for each treatment. In the SLD strain 7 birds were taken at 3 weeks and thereafter 5 birds per treatment were used. Using heparine as an anticoagulant, a pretreatment blood sample was obtained, and TRH (2 μg/kg body weight) or saline was injected into the brachial vein. Another blood sample (0.5 ml) was taken from the contralateral vein of 3, 5 or 7-week old chickens 5, 15, 30, 60 and 120 min after injection. The plasma was separated and stored at − 20 °C until assay. GH concentration was measured using an homologous radioimmunoassay (Harvey and Scanes, 1977). All the samples were assayed in duplicate and in a single radioimmunoassay. The data were analysed using the analysis of variance within a genotype and across times.

Results and discussion.

The plasma GH concentration increased maximally 5 to 15 min after injection (fig. 1, 2, 3). This rapid effect of TRH on GH secretion has been reported previously (Harvey *et al.,* 1978 ; Scanes *et al.,* 1981 ; Decuypere and Scanes, 1983). In normal birds, plasma GH concentrations returned to pretreatment levels within 30 min after injection. However, circulating GH concentrations in dwarf birds remained significantly elevated 30 min after the injection.

The two genotypes responded differently at both 5 and 7 weeks. At these ages, circulating GH concentrations were significantly different 15 and 30 min after injection. These differences between the two strains can be explained by two mechanisms. Dwarf birds may be more sensitive to TRH stimulation and therefore show a greater GH release than normal birds. This is expressed by the differences in plasma GH concentration observed 5 and 15 min after injection. The effect of TRH injection was prolonged in the dwarf birds (30 min sampling time) and might be due to a difference in clearance. At the earliest age studied

(3 weeks), there was no significant difference between the two strains ; a difference in TRH response only became evident when the birds were older. This discrepancy between the two lines has also been reported in older birds (Hoshino *et al.*, 1984 ; Harvey and Scanes, 1984).

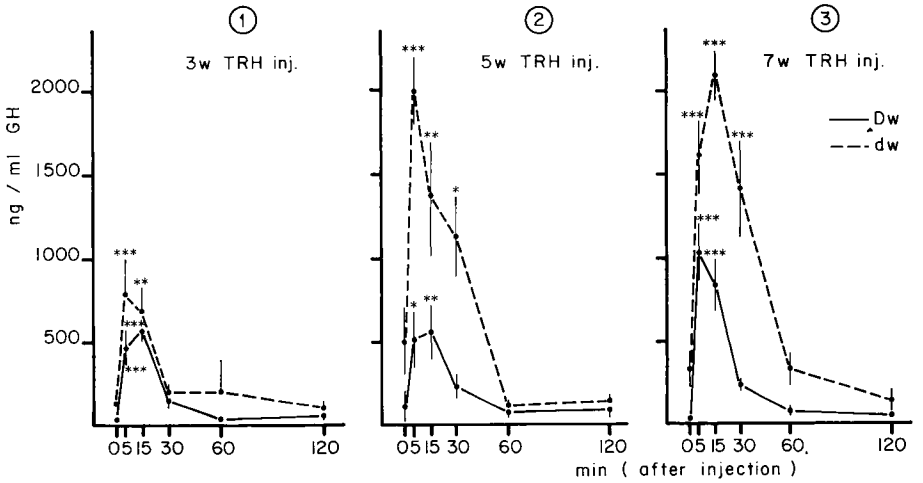

FIG. 1, 2, 3. — *The effect of a single TRH injection on GH concentrations in control and sex-linked dwarf chickens at 3 weeks of age* (FIG. 1), *at 5 weeks of age* (FIG. 2), *at 7 weeks of age* (FIG. 3). Significant intra-genotype differences from the pretreatment level (time O). FIG. 1 : Dw, N = 7 ; dw, N = 7. FIG. 2 : Dw, N = 7 ; dw, N = 5. FIG. 3 : Dw, N = 7 ; dw, N = 5. * : $P < 0.05$, ** : $P < 0.01$, *** : $P < 0.001$ (ANOVA).

At most time points, the dwarf chickens had higher GH levels than the control animals (table 1). Pretreatment plasma concentration of GH appeared to have no effect on the response to TRH. Harvey *et al.* (1978) reported a negative correlation between pretreatment levels and both the incremental increase and the changes in the percentage of plasma GH concentration after TRH injection of birds at various ages. In the present study, incremental increase was not inversely correlated with the pretreatment levels. However, when the results were expressed in percentage of change, a non-significant negative correlation was found. This may be due to the use of genotypically heterozygous males. It has

TABLE 1

Growth hormone concentration in the control animals of both strains.
Mean ± SEM (N).

Age	Genotype	0 min	5 min	15 min	30 min
3	Dw	63.7 ± 15.3 (7)	49.0 ± 28.0 (7)	40.0 ± 11.1 (7)	70.6 ± 33.2 (7)
3	dw	181.0 ± 79.0 (7)	348.5 ± 115.0 (7)	307.6 ± 109.8 (7)	89.8 ± 32.6 (7)
5	Dw	76.2 ± 28.6 (7)	90.3 ± 35.1 (7)	116.9 ± 51.8 (7)	59.7 ± 13.7 (7)
5	dw	119.4 ± 14.3 (5)	184.5 ± 62.9 (5)	197.5 ± 81.5 (5)	524.5 ± 214.9 (5)
7	Dw	77.4 ± 24.1 (7)	153.2 ± 73.6 (7)	76.0 ± 20.6 (7)	64.5 ± 9.8 (7)
7	dw	—	58.6 ± 13.2 (5)	33.6 ± 10.2 (5)	588.1 ± 253.7 (5)

been reported that heterozygous male broilers, compared to homozygous males, show a somewhat different GH pattern during growth, the GH levels being higher in the heterozygous birds during the first 4 to 5 weeks of age (Stewart *et al.*, 1984).

This study demonstrates that a single TRH injection results in higher plasma GH concentrations in sex-linked dwarf chickens than in the controls and that the return to the respective control levels is also slower in the dwarfs. Although these observations may indicate a lower rate of GH degradation in the SLD strain, the possibility of a change in pituitary responsiveness cannot be discarded. Further research combined with the *in vitro* approach is needed to elucidate the mechanisms of the observed changes in GH response.

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Résumé. *Réponse sécrétoire de l'hormone de croissance* (GH) *à l'injection d'hormone stimulant la sécrétion de thyrotropine* (TRH) *chez des poussins normaux et nains.*

L'effet d'une seule injection d'hormone stimulant la sécrétion de thyrotropine sur la sécrétion de l'hormone de croissance *in vivo* a été examiné chez des poussins normaux et nains (gène lié au sexe) à l'âge de 3, 5 et 7 semaines après l'éclosion. Dans les deux cas on a constaté un accroissement rapide de la concentration en GH dans le plasma après l'injection de TRH, cet accroissement étant toutefois plus élevé chez les nains. Chez ces derniers, la durée de la réponse fut également plus prolongée. Deux mécanismes entrent en ligne de compte pour expliquer les différences observées : soit une réactivité hypophysaire envers TRH plus élevée, soit un taux de dégradation de GH plus bas, en faveur des poussins de type nain.

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