THE ACTIVITY OF MONOAMINE OXIDASE IN THE INTERSCAPULAR BROWN ADIPOSE TISSUE AND DOPAMINE-β-HYDROXYLASE IN THE SERUM DEPENDS ON THE RAT THYROID STATUS. Nataša Petrović, Gordana Cvijić and Vukosava Davidović, Institute of Physiology and Biochemistry, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia and Montenegro

Brown adipose tissue (BAT) is an effector organ of non-shivering thermogenesis (Lowell and Flier 1997). The inner membrane of BAT mitochondria contains uncoupling protein-1 (UCP1) which uncouples the electron transport chain from ATP synthesis, dissipating the proton-electrochemical gradient as heat (Nicholls and Locke 1984). Noradrenaline (NA) directly controls UCP1 synthesis (Ricquier and Casssard-Doulcier 1993) and stimulates BAT thermogenesis (Girardier and Seydoux 1986). However, the role of thyroid hormones on the BAT thermogenesis is still being disputed although it is known that these hormones are involved in cold-induced thermogenesis. Namely, thyroid hormones increase obligatory thermogenesis and also play a role in the facultative thermogenesis affecting BAT activity directly or interacting with the sympathetic nervous system (SNS) (Silva 1995). Several important facts support the view that SNS activity is increased in hypothyroid and decreased in hyperthyroid state (Premel-Cabic et al. 1986; Silva 1995). Thus, the activity of rate-limiting enzyme for NA synthesis, tyrosine hydroxylase (Zenker et al. 1976), as well as that of NA-metabolizing enzymes (Gripois et al. 1980) is increased in the BAT of hypothyroid rats. Hence, the aim of this study was to investigate the effects of chemically-induced hypothyroidism and provoked hyperthyroidism, either by thyroxine (T4) or triiodothyronine (T3), on the activities of serum dopamine-β-hydroxylase (DBH), a terminal enzyme in NA biosynthesis, reaching circulation together with NA during its secretion, as well as monoamine oxidase (MAO), a catecholamine-degrading enzyme, in the rat interscapular brown adipose tissue (IBAT).

Adult male rats of Wistar strain (Rattus norvegicus) were used for the experiments. The animals, previously acclimated to 21±1 °C, were maintained under 12 h light/dark cycle and given food and tap water ad libitum. Hypothyroidism was induced by 0.02% methimazole (MMI) (Sigma, St. Louis, MO, USA), which was added to drinking water for three weeks. Hyperthyroidism was provoked by daily administration of either T4 (Sigma, St. Louis, MO, USA) (300 μg/kg body mass, i.p., for five days) or T3 (Sigma, St. Louis, MO, USA) (200 μg/kg body mass, i.p., for five days), dissolved in 9 mM NaOH. Control rats received vehicle in the same manner. MMI- and T4- or T3-treated animals were killed by decapitation on days 21 and 6 of the treatment, respectively. Blood was then collected from the trunk and the serum for DBH determination, while the IBAT was rapidly excised, dissected (4°C), weighed and stored in a deep freezer at -20°C prior to the measurement of MAO activity. DBH activity in the serum was determined by the method of Kato et al. (1974, 1978) while that of MAO in the IBAT was determined by the method of Wurtman and Axelrod (1963). The results were analyzed by Student's t-test, accepting p<0.05 as significant.

Our present results clearly show that chemically induced hypothyroidism markedly increased (p<0.001) DBH activity in the serum (Fig. 1a), as well as that of MAO (p<0.01) in the IBAT (Fig. 1b), indicating that under hypothyroid condition...
NA release from sympathetic terminals is markedly increased and so is catecholamine deamination in the IBAT. These findings correlate well with the results concerning an increased NA turnover in the IBAT of hypothyroid rats (Young et al. 1982) and confirm the well known fact that under hypothyroid condition the SNS activity is increased compensatorily. Otherwise, our present results demonstrate that under hyperthyroid state the activities of serum DBH and IBAT MAO are changed differently depending on whether, T4 or T3 was used, for provoking hyperthyroidism. Thus, T4 administration significantly decreased (p<0.05) DBH activity in the serum (Fig. 1a) while T3 treatment caused a marked attenuation (p<0.05) of MAO activity in the IBAT (Fig. 1b). Lowered activity of these enzymes indicates that the SNS activity of hyperthyroid rats is most probably depressed, supporting similar findings of Premel-Cabic et al. (1986), as well as those of Silva (1995). However, it is important to emphasize that T4 and T3 influence DBH and MAO activities in different ways, but the explanation requires additional investigations.

In conclusion, our present results confirm the view that SNS activity, as estimated by serum DBH and IBAT MAO activities, is increased under hypothyroid and decreased under hyperthyroid conditions. Besides, they clearly show that thyroid hormones play an important role in the regulation of the activities of both enzymes studied.