
Abstract
Aromatic amino acids in the brain function as precursors for the monoamine neurotransmitters serotonin (substrate tryptophan) and the catecholamines [dopamine, norepinephrine, epinephrine; substrate tyrosine (Tyr)]. Unlike almost all other neurotransmitter biosynthetic pathways, the rates of synthesis of serotonin and catecholamines in the brain are sensitive to local substrate concentrations, particularly in the ranges normally found in vivo. As a consequence, physiologic factors that influence brain pools of these amino acids, notably diet, influence their rates of conversion to neurotransmitter products, with functional consequences. This review focuses on Tyr and phenylalanine (Phe). Elevating brain Tyr concentrations stimulates catecholamine production, an effect exclusive to actively firing neurons. Increasing the amount of protein ingested, acutely (single meal) or chronically (intake over several days), raises brain Tyr concentrations and stimulates catecholamine synthesis. Phe, like Tyr, is a substrate for Tyr hydroxylase, the enzyme catalyzing the rate-limiting step in catecholamine synthesis. Tyr is the preferred substrate; consequently, unless Tyr concentrations are abnormally low, variations in Phe concentration do not affect catecholamine synthesis. Unlike Tyr, Phe does not demonstrate substrate inhibition. Hence, high concentrations of Phe do not inhibit catecholamine synthesis and probably are not responsible for the low production of catecholamines in subjects with phenylketonuria. Whereas neuronal catecholamine release varies directly with Tyr-induced changes in catecholamine synthesis, and brain functions linked pharmacologically to catecholamine neurons are predictably altered, the physiologic functions that utilize the link between Tyr supply and catecholamine synthesis/release are presently unknown. An attractive candidate is the passive monitoring of protein intake to influence protein-seeking behavior.