

Mechanism in brain protein synthesis caused by the different quality and quantity of dietary proteins

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For the effect of age on tissue protein synthesis, many investigations suggested that that protein synthesis declined in specific tissues (e.g., liver or muscle). Recently, we have shown that the protein synthesis in the brain depended on the quantity and quality of dietary protein in aged rats. The purpose of this study was to determine whether the regulation of brain protein synthesis was mediated through changes in the phosphorylation of proteins that represent important control points in translation initiation including eukaryotic initiation factor (eIF) 4E-binding protein 1 (4E-BP1) and ribosomal protein S6 kinase (S6K1) regulate the brain protein synthesis when the quantity and quality of dietary protein is manipulated. The important example of regulation in translation initiation is the reversible sequestration of eIF 4E into an inactive complex with 4E-BP1. Hyperphosphorylation of 4E-BP1 prevents the binding of eIF 4E to 4E-BP1 while hypophosphorylation is permissive for binding. Phosphorylation of ribosomal protein S6 which is mediated by S6K1 is another mechanism for the regulation of translation initiation. S6K1 is also activated by phosphorylation. Two experiments were done on three groups of aged male rats (24 wk) given diets containing 20% casein, 5% casein or 0% casein (Experiment 1) and 20% casein, 20% gluten or 20% gelatin (Experiment 2) for 1d (only one 5-h period) after all rats were fed the 20% casein diet for 10d (only 5-h feeding per day). The aggregation of brain ribosomes, the concentration in plasma GH, the branched chain amino acids in the plasma and cerebral cortex, and the phosphorylation of S6K1 in the cerebral cortex declined with a decrease of quantity and quality of dietary protein. The phosphorylation of 4E-BP1 in the brains did not differ among groups. The result suggests that the ingestion of a higher quality and quantity of dietary protein increases the phosphorylation of S6K1 in the brain of aged rats, and that the concentration GH and amino acids, and the phosphorylation of S6K1 are at least partly related to the mechanism by which the dietary protein affects brain protein synthesis in aged rats.