PROTEIN AND TAURINE OF MATERNAL DIETS DURING THE MOUSE NEONATAL PERIOD:
Permanent Effects on Cerebellar-Brainstem Amino Acid Levels in Mature Offspring

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Neonatal malnutrition and/or undernutrition of limited duration appears to permanently influence steady state amino acid content of the adult mouse cerebellum and/or brainstem. Some of the changes seem related to the protein content of the milk (glutamine), whereas others reflect the taurine concentration in the milk during the neonatal period (glutamic acid and GABA). Adult levels of taurine, serine, and glycine in the cerebellum-brainstem may in part be influenced by the degree of growth retardation which occurred during the first 16 days of neonatal life. Provided the combined adult weight of the cerebellum and brainstem can be used as one criterion to determine growth retardation during the neonatal period, it appears justified to state that mice do not recover from malnutrition/undernutrition when subjected to such conditions during early infancy.

INTRODUCTION

In a previous communication (13) we reported on the physical development of mice, raised under varying nutritional conditions during a limited neonatal period. Such conditions were created by providing mothers with diets differing only in their casein content, combined with either an ab-
sence or presence of low amounts of taurine in the drinking water. These studies were initiated to provide information on whether taurine is an essential nutrient during maturation of the CNS and, if so, whether the presence of this amino acid in the maternal diets might offset some of the potentially adverse effects of supplying nursing animals with either excessive or insufficient quantities of protein.

As a first attempt by this laboratory to expand our understanding of how a limited period of inadequate nutritional conditions may permanently affect biochemical events in the CNS, a number of litters were subsequently allowed to reach maturity while on an ad libitum, nutritionally fully adequate diet. This article reports on the levels of certain amino acids in the adult cerebellum plus brainstem of these different groups of mice which during only the first 16 days of neonatal life had been submitted to circumstances causing either malnutrition, undernutrition, or both conditions in combination. The influence of a dietary presence of taurine during this period was also examined. The initial results obtained suggest that both the protein and taurine content of a maternal diet during the nursing period may permanently influence in a subtle manner the cerebellar-brainstem metabolism of certain amino acids in the offspring. Further and more detailed studies appear therefore warranted.

**EXPERIMENTAL PROCEDURE**

The details of the protocol followed to standardize nutritional procedures, the equilibration of litters 24 hrs after birth, and the elimination of other possible variable factors, has been fully described in the previous communication (13). Following this protocol, 6 different groups of mothers together with their litters of constant size can be distinguished and compared to each other (choice of litter size, litter sex, etc, see ref. 13).

I. (▽): Mothers on low (8%) protein diet—2 or 4 pups/litter.
   (▼): Same + 0.02% (w/v) taurine water—2 or 4 pups/litter.

II. (○): Mothers on normal (27%) protein diet—7 pups/litter.
   (●): Same + 0.02% taurine water—7 pups/litter.

III. (△): Mothers on high (64%) protein diet—7 pups/litter.
   (▲): Same + 0.02% taurine water—7 pups/litter.

At day 16 postnatal, all groups were placed on a normal diet (27% protein) and plain water. Thus, irrespective of whether or not the pups were still nursing or were already consuming some solid food, their subsequent maturation to 35 days while remaining in the presence of their mothers occurred under ordinary dietary conditions. This was evident from the growth curves of the litters in the different groups which began to parallel each other soon thereafter (indicating that malnourished litters which subsequently exhibited normal growth curves, nevertheless never caught up with the normal dietary groups; see Table I and ref. 13).