

Chrononutrition: Improving Infant Sleep with Tryptophan in Food Matrices

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Abstract

It is known beneficial effect of essential tryptophan on nocturnal sleep. Its application in the field of infant nutrition is utilized to improve the rest of children with sleep problems. The development of infants' cereals enriched with essential amino acid tryptophan this mainly for making dinner, have shown satisfactory results in tests with such children. We cannot forget that besides the amino sedative also added to infant cereals nucleotides with a notable sleep facilitator. These nucleotides with neuroactive function of sleep phases are adenosine 5P and uridine 5P.

Introduction

The ingestion of a cereal facilitator of sleep before being put to bed led to an improvement in the sleep of children with sleep problems, with them staying asleep throughout the night period. In other words, the ingestion of these cereals helps regulate problems of adjustment of the sleep/wake cycle to the environment, allowing these children to synchronize themselves both with the natural light/dark cycle and with their family environment. Our investigations support the idea that the intake of food should be concordant with the organism's chronobiology, supporting the concept of chrononutrition [1,2]. We would stress the fact that the improvement in the sleep of these children who took a cereal facilitator of sleep was obtained by an intake of appropriate nutrients during the night, and not by any pharmacological component.

Improving Infant Sleep with Tryptophan in Food Matrices

Some 30% of infants present sleep problems during the first year of life. [3]. This represents a serious disorder in that it may affect brain development since sleep in the newborn is decisive for correct brain maturation [4] and for the correct synthesis of different hormones, such as growth hormone [5]. In addition, infant sleep problems constitute a major source of distress in many families. It is known that the quality and quantity of sleep can be influenced through diet. Feeding-induced sleep modulation probably results from an alteration in the availability of various neuromediators. Among the components of food, amino acids serve as precursors for the synthesis of different neurotransmitters [6]. This is particularly the case for tryptophan which, when taken in the diet, increases the circulating levels of serotonin (5-hydroxytryptamine, 5-HT) and the hormone melatonin, [7,8] both of which are neurotransmitters involved in the regulatory processes of sleep [9]. Thus, the 5-HT synthesized through tryptophan gives rise in the pineal gland to melatonin, a neurohormone secreted during the night which serves as the organism's signal for darkness [10]. For this reason, the intake of tryptophan in the first few months of life is fundamental because of its action on the hypnotic function [1,11,12]. The perfect food for a baby is breast-milk. This presents circadian changes in some of its components, in particular those involved in sleep/wakefulness. Thus, the levels of tryptophan in breast-milk have been observed to change during the course of the day. The acrophase (time of maximum concentration) occurs at night, with tryptophan possibly acting as a promoting substance in the anabolism of the biogenic amines serotonin and melatonin—both sleep inducers [13].

Chrononutrition Applied To Formula Milks and Cereals to Consolidate Infants' Sleep/Wake Cycle

For this reason, in a preliminary study we designed formula milks with high tryptophan content (3.4% tryptophan) which were taken during the night by infants with sleep problems. The results showed improvements in the sleep parameters studied [12]. Other non-protein nitrogenous nutrients such as nucleotides may also present circadian changes in breast milk. Among these are adenosine-5'-monophosphate (5'-AMP), guanosine-5'-monophosphate (5'-GMP), cytidine-5'-monophosphate (5'-CMP), uridine-5'-monophosphate (5'-UMP), and inosine-5'-monophosphate (5'-IMP). Thus, 5'-AMP is a molecule that acts on the A2A receptors located in the neurons of the ventrolateral nuclei, signaling for sleep to begin [14]. It has been found that administration of 5'-AMP, whether locally or systemically, induces sleep and reduces the periods of wakefulness [15]. 5'-AMP has its acrophase in breast-milk at 20:19 h [16]. Similarly, 5'-UMP shows increased levels in breast milk during the night (at 02:00 h), but without any circadian rhythm [16]. 5'-UMP is involved in the regulation of sleep as a sleep-promoting substance, interacting with gamma aminobenzoic acid (GABA) receptors in the central nervous system [17]. When 5'-UMP is administered during the nocturnal phase, it leads to an increase in REM and NREM sleep. However, when it is administered during the day, it has no sleep-inducing effect [18]. Based on the foregoing, and in order to mimic the circadian changes in tryptophan, 5'-AMP, and 5'-UMP in breast-milk during the night, infant initiation and continuation formula milks were designed and marketed which included a greater contribution of tryptophan, 5'-AMP, and 5'-UMP at night than during the day, helping to establish a robust circadian sleep/wake rhythm in infants with nocturnal sleep problems [1,11]. As each nutrient acts on different sleep regulating mechanisms, the aim with the mixture of them all in the food was to achieve greater improvement in sleep quality and quantity in children with difficulty in sleeping.

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Nonetheless, the problem of sleep at night in older children is more critical since, if they have not attained circadian sleep habits in the first months of infancy, this complicates their entrainment towards the normal sleep pattern of about 13.5 h on average described for children between 6–10 months of life [19]. Given this context and the favorable results on improving infant sleep with the aid of formula milks dissociated into day and night values of tryptophan with the addition of adenosine-5'-P and uridine-5'-P to the night formula, we thought of applying these nutrients to the broader infant population that has a high proportion of nocturnal awakenings, in particular, children of around 1 year of age. To this end, we designed for the infant with complementary feeding a night cereal containing 225 mg tryptophan, 5.3 mg adenosine-5'-P, and 6.3 mg uridine-5'-P, per 100 g product.

In conclusion, the ingestion of a cereal facilitator of sleep before being put to bed led to an improvement in the sleep of children with sleep problems, with them staying asleep throughout the night period. Finally, we would note the potential of these foods for other groups of people who have sleep problems. Indeed, menopausal women, adults in situations of stress, children and adults with neurodegenerative diseases, and the elderly, are populations with severe sleep problems, a feature of these groups being that they present a decline in the circulating levels of serotonin and melatonin.

Others Possibility in Food Matrices with Chrononutrition

Expanding research and development in chrononutrition baby food, it is interesting to test other essential and neuroactive amino acids in the initial stages of life. To do this we know that amino acids such as histidine, glutamate, methionine have a marked tendency to facilitate and promote locomotor activity during the day period and therefore do not facilitate sleep [20].

The idea to develop would be to add these amino acids induce activity in the footage only by day, and avoid them in the shots of the night which would be enriched with tryptophan. Also with the action of these amino acids and neuroactive nucleotides on the sleep / wake, you could add the use of herbs with proven pharmacological effect on sleep [21] such as valerian (*Valeriana officinalis L*) and hops (*Humulus lupulus L*), both hypnotic functions.

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