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The effects of dietary tryptophan metabolism on the "vigor" and "confusion" factor of mood

Reiko Yonekura[a,b,*], Yasuhiro Itoh[c], Masami Asayama[b], Katsumi Shibata[d]

[a] *Institute of Biochemisty and food Chemistry, Department of Food Chemistry, University of Hamburg, Germany*
[b] *Department of Health Science, Chukyo Women's University, Aichi, Japan*
[c] *Department of Clinical Physiology, School of Health Sciences, Fujita Health University, Aichi, Japan*
[d] *Department of Life style Studies, School of Human Cultures, University of Shiga Prefecture, Hikone, Japan*

Abstract. Previously, we reported that tryptophan metabolites affect mood. According to research conducted using the Profile of Mood States (POMS) test, kynurenin and serotonin, which are intermediary metabolites of tryptophan, appear to be correlated with some factors of mood. The present study examined one of the tryptophan metabolites that affects mood using a nutritional method. According to the results of the POMS-test and the nutrition survey, the "vigor" and "confusion" factors of mood were correlated with the intake of tryptophan and niacin. In contrast, serum tryptophan and kynurenin were correlated resting conditions ($r=0.872$). Furthermore, correlations were observed between "vigor" and serum kynurenin ($r=0.597$) and between "confusion" and serum kynurenin ($r=0.681$). These findings indicate a positive relationship between the intake of tryptophan and niacin and emotional state. Therefore, we investigated the relationship between intake values of tryptophan, niacin and each mood. The observed intake of tryptophan was 610±134 mg/day, while the intake of niacin was 13±4 mg/day. Correlations were observed between intake of tryptophan and "confusion"($r=-0.602$) and "vigor"($r=0.727$), and between the intake of niacin and "confusion" ($r=-0.786$) and "vigor"($r=0.585$). These results suggest that dietary intake of tryptophan and niacin is correlated to tryptophan metabolites and mood. In particular, we suggest that the correlation between serum tryptophan, kynurenin and observed resting conditions of "vigor" and "confusion" resulted from dietary intake of tryptophan.

Keywords: Dietary tryptophan; Niacin intake; Profile of mood states

* Corresponding author. Institute of Biochemisty and food Chemistry, Department of Food Chemistry, University of Hamburg, D-20146 Hamburg, Germany. Tel.: +49 40 42838 4347; fax: +49 40 42838 4342.
E-mail address: reiko.yonekura@uni-hamburg.de (R. Yonekura).

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1. Introduction

Metabolites of tryptophan such as serotonin, kynurenic acid, quinolinic acid and NAD generally have physiological activity. Among these, serotonin induces central fatigue [1]. We previously reported that serum L-kynurenine, which is a tryptophan metabolite, is associated with mood (vigor and confusion) [2]. The present study determines how metabolites of dietary tryptophan affect mood.

L-kynurenine is an intermediary metabolite in the pathway of tryptophan-NAD conversion, and the most niacin is derived from tryptophan [3]. Tryptophan which is an essential amino acid is a precursor of kynurenine. Thus, blood kynurenine originates in dietary tryptophan. Japanese males usually take daily nicotinamide from dietary tryptophan [4]. We found that although circulating kynurenine temporarily increased, NAD did not increase [2,5,6]. Regular exercise tends to induce a high concentration of blood kynurenine. Cortisol and H_2O_2 are induced by exercise stress, indicating that tryptophan 2,3-dioxygenase (TDO), which catalyzes between tryptophan to kynurenine, is activated [2,7,8]. We examined the correlation between tryptophan and dietary niacin among individuals who regularly exercise, and mood (vigor and confusion).

This is a first description of the relationship between metabolites of tryptophan-NAD conversion and mood.

2. Materials and methods

Subjects were healthy female ($n=14$, 18–22 years old) volunteers who regularly exercise at the same level and participated in nutrition surveys. A nationally registered dietician analyzed the average dietary intake of tryptophan and niacin using the software for nourishment evaluation, Microsoft Excel Eiyou–Kun (Kenpakusha, Tokyo, Japan). The Profile of Mood States (POMS) [9] was also tested. We then searched for correlations between "vigor" and "confusion" determined by the POMS-test and intake of tryptophan, niacin and niacin equivalent.

Blood samples were collected during rest to analyze serum kynurenine as described by Saito et al. [10] and the POMS-test was administered. Correlations between "vigor" and

Table 1
Correlation coefficients between "vigor", "confusion" and each component

Serum					Kynurenine
"vigor"					0.597*
"confusion"					−0.681**
Intakes form diet	Tryptophan	Niacin	Niacin equivalent	Energy (kcal)	Protein (g)
"vigor"	0.721*	0.585*	0.581*	0.195 ns	0.293 ns
"confusion"	−0.602*	−0.886**	−0.805**	−0.229 ns	−0.607*

**: $p<0.01$, *: $p<0.05$, ns: not significant.