US 20120196300A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2012/0196300 A1

Myint et al.

(43) Pub. Date: Aug. 2, 2012

(54) **NEURODEGENERATIVE MARKERS FOR PSYCHIATRIC CONDITIONS**

(75) Inventors: **Aye Mu Myint**, Turnhout (BE); **Manfred Schawaller**, Cressier (CH); **Robert Verkerk**, Mortsel (BE); **Markus J. Schwarz**, Munchen (DE); **Harald Hampel**, Dublin (IE); **Norbert Müller**, Munchen (DE)

(73) Assignees: **Leopold Verstappen**, Duffel (BE); **DIAMED-EUROGEN N.V.**, Turnhout (BE); **Klinik und Poliklinik fur Psychiatrie und Psychotherapie**, Munchen (DE); **UNIVERSITY OF ANTWERP**, Wilrijk (BE); **UNIVERSITY OF MAASTRICHT**, Maastricht (NL)

(21) Appl. No.: **13/401,397**

(22) Filed: **Feb. 21, 2012**

Related U.S. Application Data

(63) Continuation of application No. 11/887,486, filed on Jan. 25, 2008, now abandoned, filed as application No. PCT/EP2006/002907 on Mar. 30, 2006.

(30) **Foreign Application Priority Data**

Apr. 6, 2005 (EP) 05 007 558.9

Publication Classification

(51) **Int. Cl.**

G01N 21/64	(2006.01)
G01N 21/17	(2006.01)
G01N 33/53	(2006.01)

(52) **U.S. Cl.** **435/7.9**; 436/501; 436/96

(57) **ABSTRACT**

The present invention relates to methods for detecting a psychiatric condition optionally associated with a depression comprising the steps of measuring the concentration of at least one in vivo degradation product of tryptophan. Further, the present invention relates to the use of said values as predictive markers for the detection of a psychiatric condition optionally associated with a depression and a kit containing means for detecting said values.

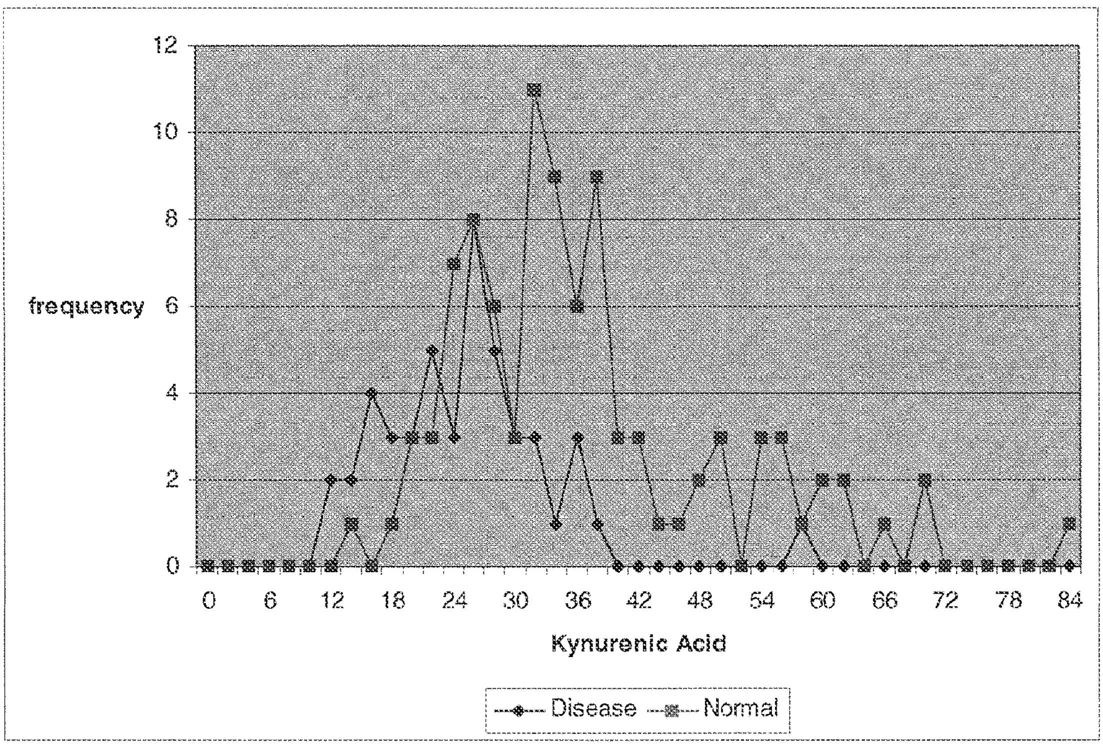

12
10
8
6
4
2
0
frequency
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
Kynurenic Acid
Disease
Normal

Figure 1

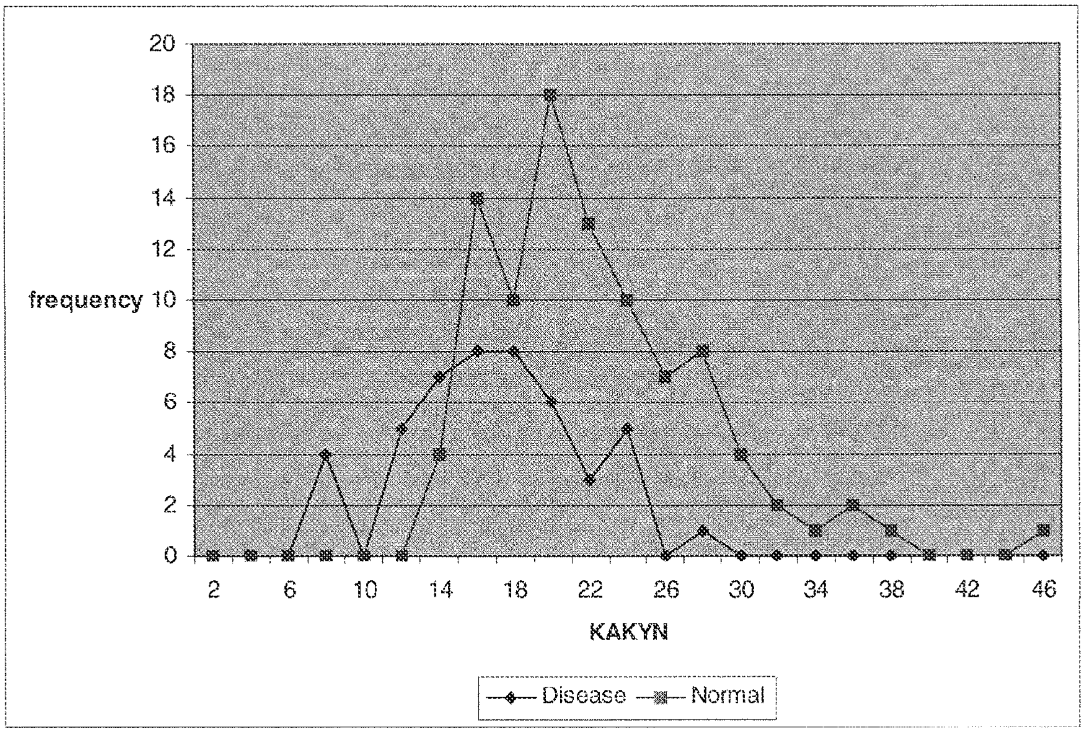
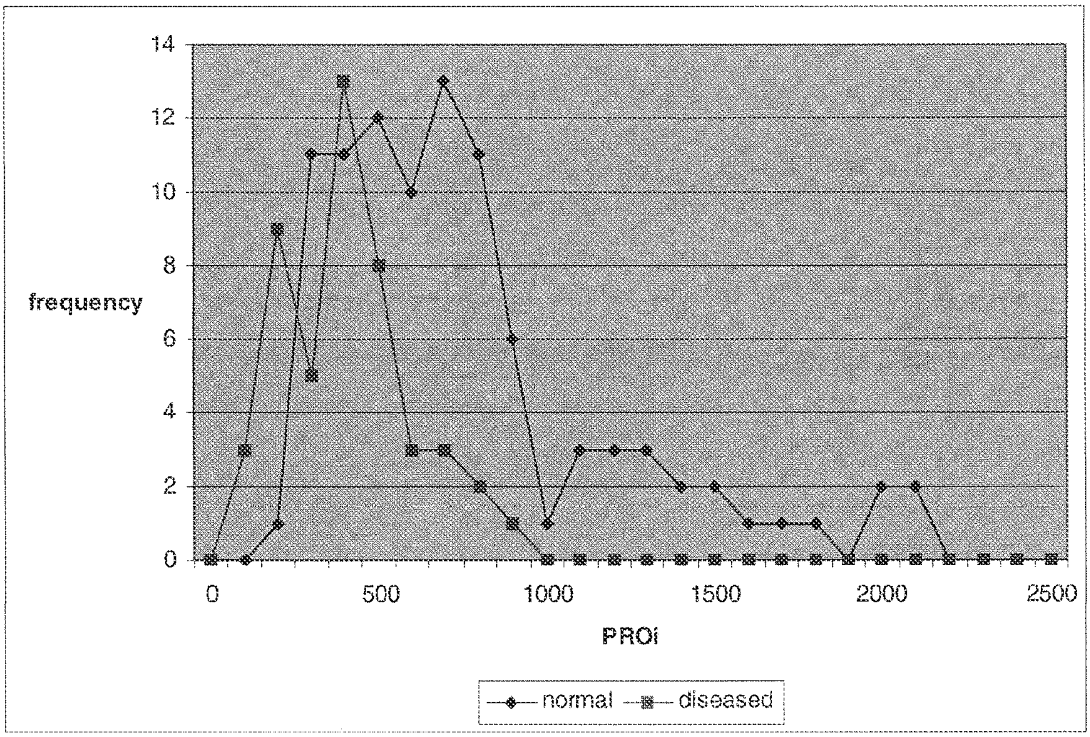

20
18
16
14
12
frequency 10
8
6
4
2
0
2
6
10
14
18
22
26
30
34
38
42
46
KAKYN
Disease
Normal

Figure 2



frequency
14
12
10
8
6
4
2
0
0
500
1000
1500
2000
2500
PROi
normal
diseased

Figure 3

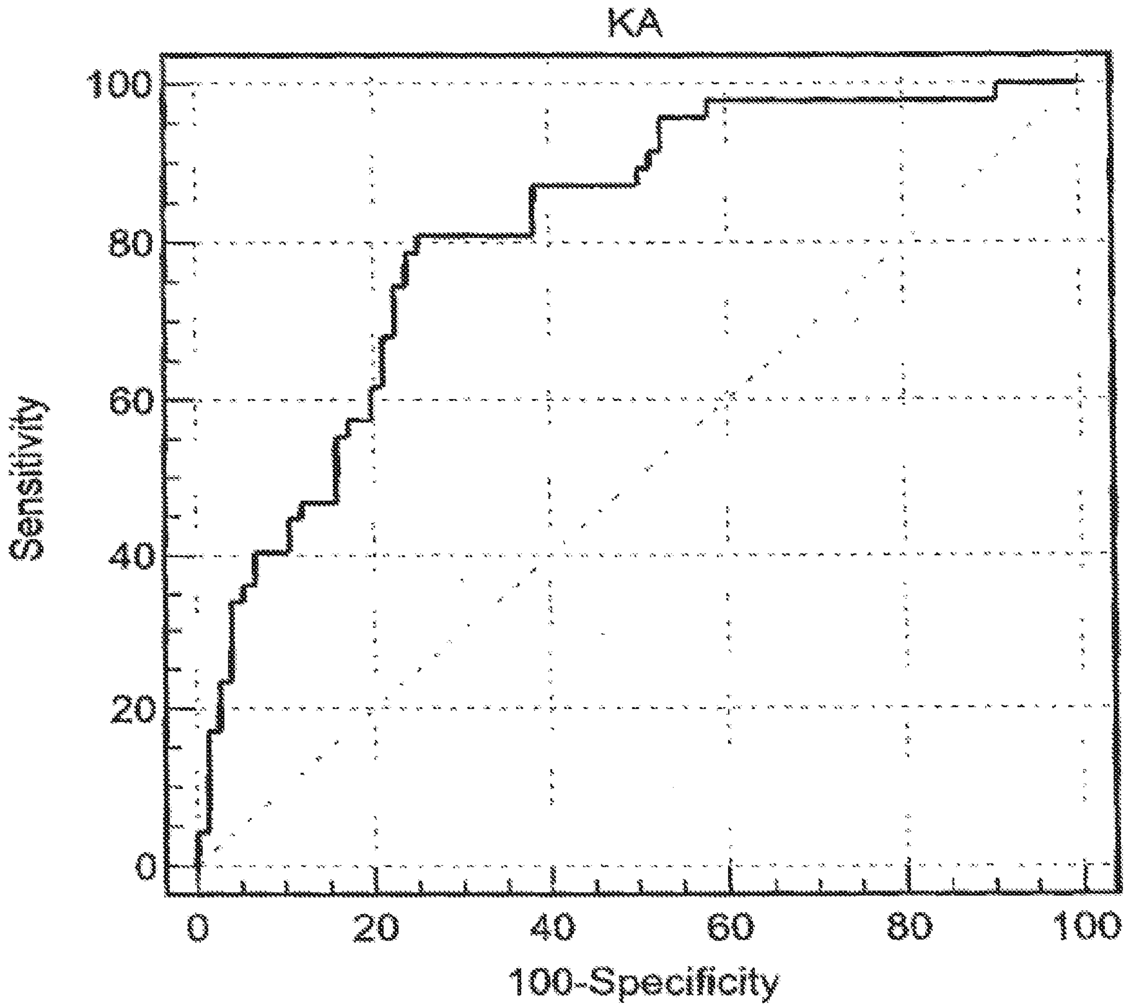

KA
Sensitivity
100
80
60
40
20
0
0
20
40
60
80
100
100-Specificity

Figure 4

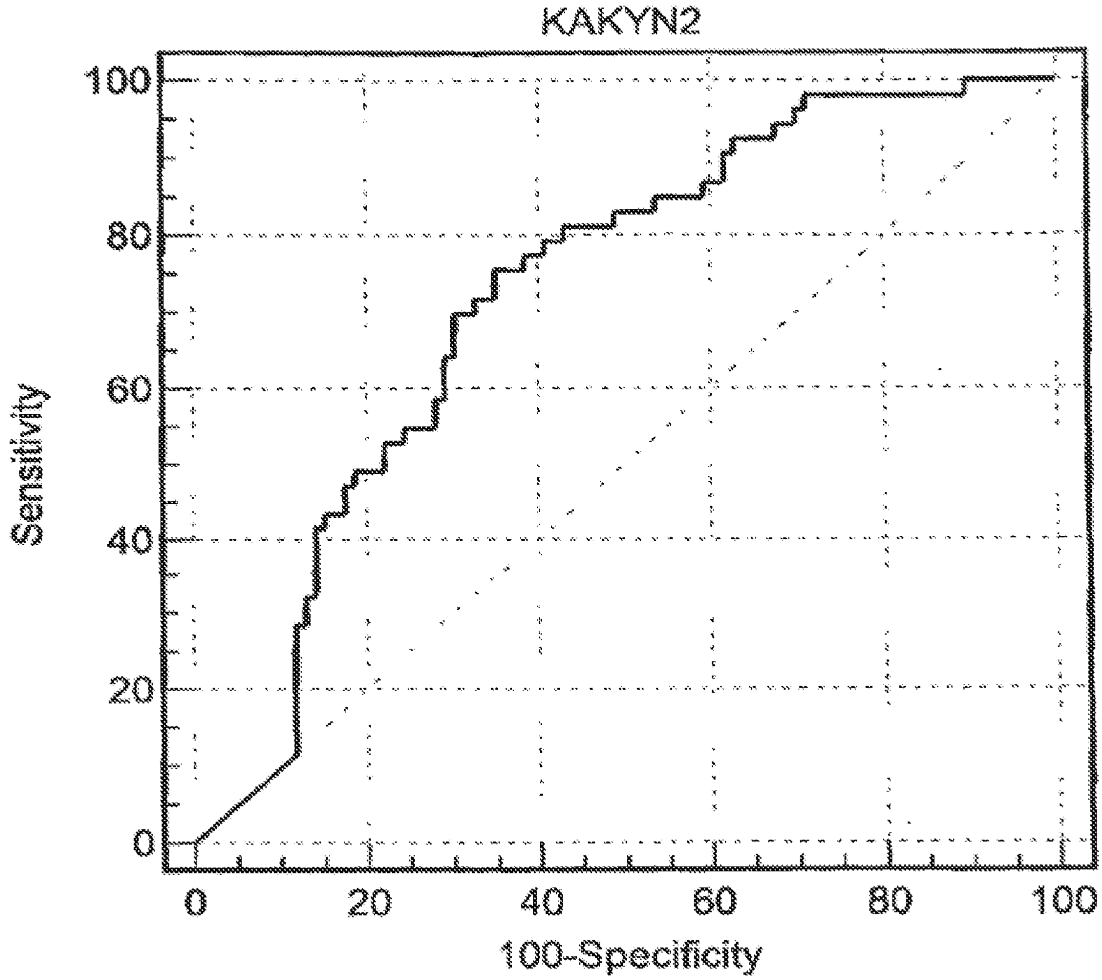

KAKYN2
100
80
60
40
20
0
Sensitivity
0
20
40
60
80
100
100-Specificity

Figure 5

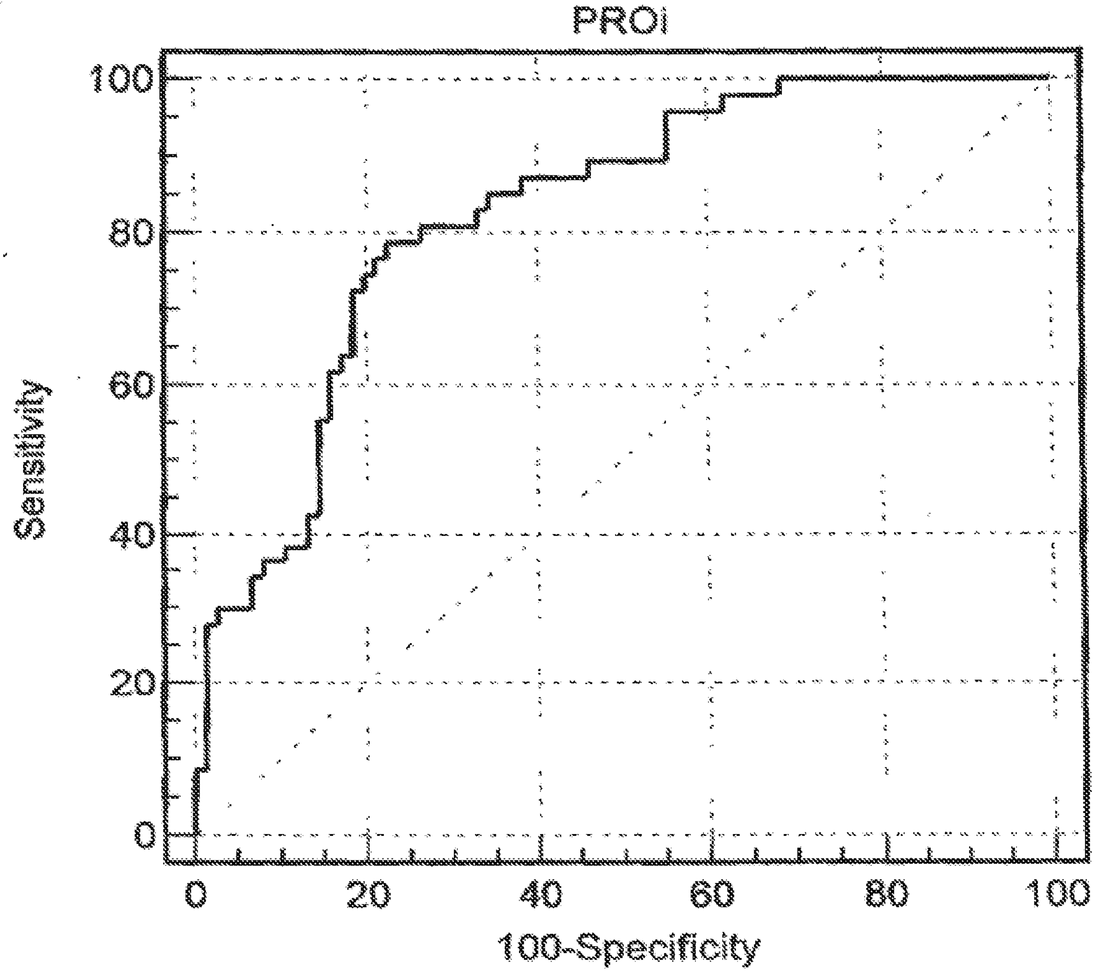

PROi
Sensitivity
100-Specificity
0
20
40
60
80
100
0
20
40
60
80
100

Figure 6

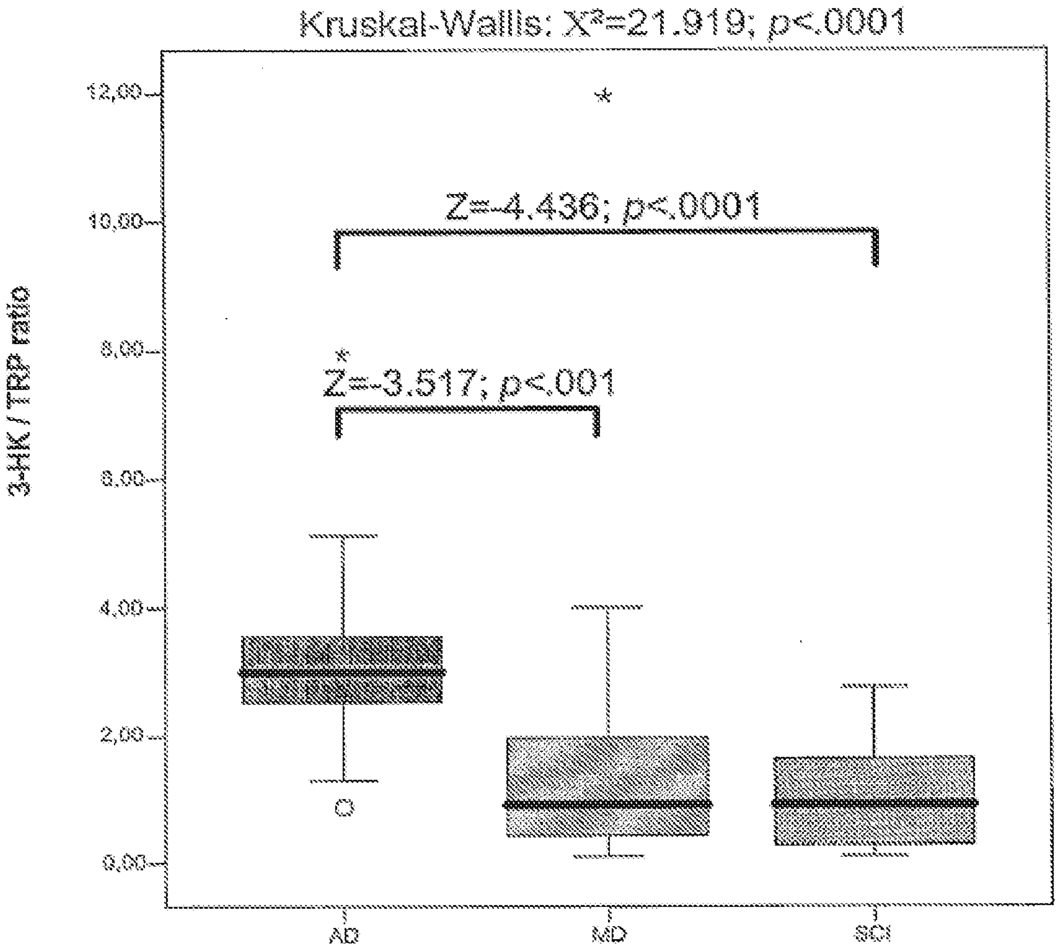

Kruskal-Wallis: X^2=21.919; p<.0001
12,00
10,00
8,00
6,00
4,00
2,00
0,00
3-HK / TRP ratio
Z=-4.436; p<.0001
Z=-3.517; p<.001
AD
MD
SCI

Figure 7

NEURODEGENERATIVE MARKERS FOR PSYCHIATRIC CONDITIONS

[0001] The present invention relates to methods for detecting a psychiatric condition optionally associated with a depression comprising the steps of measuring the concentration of at least one in vivo degradation product of tryptophan. Further, the present invention relates to the use of said values as predictive markers for the detection of a psychiatric condition optionally associated with a depression and a kit containing means for detecting said values.

[0002] Depression is a major psychiatric disorder with an overall incidence of 12.3% with 14.1% for female and 8.6% for male in Europe (Copeland J R, Beekman A T, Dewey M E, Hooijer C, 1999, Depression in Europe. Geographical distribution among older people. Br. J. Psychiatry; 174:312-321). In the community and among employees, there are cases of undiagnosed depression. In America, at any time, 1 in 20 employees can experience depression and if it is left untreated, depression leads to a decrease of productivity and an increase of sick days. According to National Mental Health Association, American employees took around three million days off work every year due to untreated depression and that is more than employees used for other physical illnesses like diabetes, high blood pressure and arthritis (Burns H, Charleston Regional Business Journal, April, 2004).

[0003] To solve the problems with undiagnosed or under-diagnosed depression in the community, home care nurses were assigned to perform interviews using structured format such as PRIME-MD test or PDI-29 test, both of which are made to assess the psychological status of a person. The sensitivity of PRIME-MD is 41.7% and specificity is 83% whereas the PDI-29 test which is considered to be a better test reaches the sensitivity of 73.6% and the specificity of 59% (Preville M, Cote G, Boyer R, Hebert R (2004). Detection of depression and anxiety disorders by home care nurses. Aging Ment. Health; 8(5): 400-409).

[0004] There are theories regarding the roles of neurochemicals in depression. The group of neurochemicals found to be important in the pathophysiology of depression was monoamine and was proposed since 1960s (Coppen A, 1969, Defects in monoamine metabolism and their possible importance in the pathogenesis of depressive syndrome. Psychiatr. Neural Neurochir; 72(2): 173-180). Moreover, it was found that tryptophan gave added effect to monoamine-oxidase inhibitors, the antidepressants (Coppen A and Noguera R, 1970, L-tryptophan in depression. Lancet; 1(7656):1111). Few years later, the role of serotonin (5HT) was proposed in pathogenesis of affective disorders (Coppen A and Wook K, 1982, 5-Hydroxytryptamine in the pathogenesis of effective disorders. Adv. Biochem. Psychopharmacol. 34: 249-258).

[0005] Alzheimer's disease (AD) is the most frequent neurodegenerative disorder of the human brain. Especially in early stages of AD, it is important, but difficult to differentiate between depression accompanied with subjective cognitive impairment (so-called pseudodementia or dementia syndrome of depression) and AD (Tekin, S. and Cummings, J. L. (2001). Depression in dementia. Neurologist 7, 252-259). The prevalence of depression ranges between 15 and 50% in patients with AD (Rovner, B. W., Broadhead, J., Spencer, M., Carson, K., and Folstein, M. F. (1989). Depression and Alzheimer's disease. Am. J. Psychiatry 148, 350-353.; Migliorelli, R., Teson, A., Sabe, L., Petracchi, M., Leiguarda, R., and Starkstein, S. E. (1995). Prevalence and correlates of dysthymia and major depression among patients with Alzheimer's disease. Am. J. Psychiatry 152, 37-44) and several authors suggested that depressive symptoms are part of the preclinical phase of AD (Berger, A. K., Fratiglioni, L., Forsell, Y., Winblad, B., and Backman, L. (1999). The occurrence of depressive symptoms in the preclinical phase of AD: a population-based study. Neurology 53, 1998-2002.; Visser, P. J., Verhey, F. R., Ponds, R. W., Kester, A., and Jolles, J. (2000). Distinction between preclinical Alzheimer's disease and depression. J. Am. Geriatr. Soc. 48, 479-484.).

[0006] Serotonin is a neurochemical which is necessary for the brain for the good mood and growth factors for the brain, and which is synthesized from tryptophan. Tryptophan is an amino acid from the food and from the body amino acid pool. Tryptophan is partly broken down by an enzyme, indoleamine 2,3-dioxygenase, which is present in the lungs, white blood cells, placenta and the brain (Heyes M P, Satio K, Markey S P, 1992, Human macrophages convert L-tryptophan into the neurotoxin quinolinic acid. Biochem. J.; 283 (3):633-635; Mellor A L and Munn D H, 1999, Tryptophan catabolism and T-cell tolerance: immunosuppression by starvation. Immunol. Today; 20(10):469-473) and partly broken down by the tryptophan-dioxygenase in the liver. The tryptophan catabolic pathway or kynurenine pathway through indoleamine-2,3-dioxygenase exists both in the blood and in the brain and 60% of brain kynurenines come from the peripheral blood (Gal E M, Sherman A D, 1980, L-Kynurenine: synthesis and possible regulatory function in brain. Neurochem Res; 5(3): 223-239).

[0007] When tryptophan is degraded through the kynurenine pathway, the next product is kynurenine which is the first metabolite of tryptophan (Bender D A, 1989, The kynurenine pathway of tryptophan metabolism: In T W Stone (ed). Quinolinic acid and kynurenines. Boca Raton Fla.: CRC Press: 3-38). This kynurenine is again broken down into two pathways: (1) neuroprotective, kynurenic acid and (2) neurodegenerative 3-hydroxykynurenine (3-HK), hydroxyanthranilic acid and quinolinic acid (Chiarugi A, Calvani M, Meli E, Traggiai E, Moroni F, 2001, Synthesis and release of neurotoxic kynurenine metabolites by human monocyte derived macrophages. J Neuroimmunol; 120(1-2):190-198). Normally, formation of quinolinic acid is faster and kynurenic acid has a counteractive protective role against quinolinic acid (Perkins M N and Stone T W, 1982, An iontophoretic investigation of the action of convulsant kynurenines and their interaction with the endogenous excitant quinolinic acid. Brain Res.; 247(1):184-187). Based on the above evidences, a hypothesis was proposed that the imbalance in neurodegenerative neuroprotective pathways bring a person to chronically depressed state (Myint A M and Kim Y K, 2003, Cytokine-serotonin interaction through IDO: a neurodegeneration hypothesis of depression. Medical Hypothesis; 61 (5-6): 519-525).

[0008] Though scientists in the area of neuroscience tried to find out the aetiological factor for major depression, no single factor was found and depression is considered as a disease caused by both genetic or congenital and environmental factors such as psychological stress and certain chronic diseases such as cancer. In addition, biochemical diagnostic markers have been searched but no efficient biomarker was found.

[0009] Thus, the problem underlying the present invention is to provide a new method for detecting a psychiatric condition using low molecular weight biochemical markers.

[0010] The solution to the above technical problem is achieved by the embodiments characterized in the claims.

[0011] In particular, the present invention relates to a method for detecting a psychiatric condition optionally associated with a depression comprising the step of measuring the concentration of at least one in vivo degradation product of tryptophan, preferably 3-hydroxykynurenine, quinolinic acid, melatonin, serotonin, 5-hydroxyindoleacetic acid, kynurenic acid and/or kynurenine, in a blood plasma sample obtained from the individuum being examined, and assessing the psychiatric condition.

[0012] The term "degradation product of tryptophan" as used herein also includes tryptophan. The blood plasma sample can be obtained by any method known in the art. In a preferred embodiment of the present invention an overnight-fasting early morning blood sample of a patient is collected in a heparinised tube. The blood plasma is obtained via centrifugation of said heparinised tube which results in a separation of the plasma fraction which forms the supernatant. In a more preferred embodiment the plasma is frozen, most preferably at −70° C., before measuring the concentration of at least one in vivo degradation product of tryptophan. Instead of blood plasma any other sources of body fluids such as whole blood, serum, urine, saliva and cerebrospinal fluid (CSF) can also be used in the present invention. These body fluids can be obtained by methods known in the art.

[0013] In a preferred embodiment of the present invention the above method further comprises the step of measuring the concentration of kynurenine in the blood plasma sample.

[0014] In another preferred embodiment of the present invention the above method further comprises the step of measuring the concentration of 3-hydroxykynurenine in the blood plasma sample.

[0015] The measurement of the concentration of tryptophan and/or degradation products such as 3-hydroxykynurenine and/or kynurenic acid and/or kynurenine in a body fluid such as a blood plasma sample can be carried out by any method known in the art. In a preferred embodiment of the present invention the measurement of the concentration of the analytes, especially the degradation products of tryptophan, is carried out using High Performance Liquid Chromatography, in a more preferred embodiment using a UV detector and/or a fluorescent detector, and/or an immunoassay and/or a ligand binding assay. In a preferred embodiment of the present invention the analytes are determined by a ligand binding assay, for example an immunoassay based on antibodies or a receptor binding assay or an enzyme binding assay or competitive versions of one or more of those assays.

[0016] In another embodiment of the present invention, the samples are for example substantially deproteinated (all proteins are removed) before measuring the concentration of at least one in vivo degradation product of tryptophan, preferably 3-hydroxykynurenine, kynurenic acid, and/or kynurenine.

[0017] After measuring the concentrations of kynurenic acid and kynurenine in a blood sample the neuroprotective ratio may be determined by dividing the value of the concentration of kynurenic acid by the value of the concentration of kynurenine in said blood plasma sample (kynurenic acid value/kynurenine value).

[0018] In a preferred embodiment of the present invention an individuum having a psychiatric condition optionally associated with a depression is characterized by a neuroprotective ratio in the blood plasma of about 0 to about 18, more preferably about 3 to about 17, and most preferably about 6 to about 16.3.

[0019] Further, after measuring the concentrations of kynurenic acid and kynurenine in a blood sample the neuroprotective index may be determined by dividing the square value of the concentration of kynurenic acid by the value of the concentration of kynurenine in said blood plasma sample (kynurenic acid value^2/kynurenine value).

[0020] In a preferred embodiment of the present invention an individuum having a psychiatric condition optionally associated with a depression is characterized by a neuroprotective index in the blood plasma of about 0 to about 700, more preferably about 100 to about 600, and most preferably about 200 to about 473.

[0021] In another embodiment of the present invention, after measuring the concentrations of kynurenic acid and 3-hydroxykynurenine in a blood sample the ratio ("neurodegenerative ratio") may be determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid or of tryptophan (3-hydroxykynurenine value/kynurenic acid value or 3-hydroxykynurenine value/tryptophan value).

[0022] In a preferred embodiment of the present invention the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid is significantly increased when compared to healthy individuals and preferably the psychiatric condition optionally associated with a depression is Alzheimer's disease (AD).

[0023] In another preferred embodiment of the present invention an individuum having a psychiatric condition optionally associated with a depression is characterized by a ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid or of tryptophan in the blood plasma. For example, if the ratio is about two or higher, provided that the analytes are given in the same unit, this is considered as an indication of Alzheimer's disease. The same applies to the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine multiplied by the factor 1000 by the value of the concentration of tryptophan in the blood plasma; i.e. 3-HK is multiplied by the factor 1000, provided that the analytes are given in the same unit (3-HK×1000/TRP).

[0024] Any mathematical formula known in the art that uses e.g. tryptophan, 3-hydroxykynurenine, kynurenine and kynurenic acid as input values and yields in the same result of interpretation may be used according to the present invention.

[0025] The present invention further relates to a method for detecting a psychiatric condition optionally associated with a depression comprising the step of combining at least two values selected from the group consisting of the concentration of kynurenic acid, the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of tryptophan and the neuroprotective index of a blood plasma sample in order to improve the specificity and/or sensitivity of the detection of said psychiatric condition.

[0026] Methods for detecting a psychiatric condition optionally associated with a depression comprising the measurement of at least one other neurodegenerative, neuroprotective, or neurotrophic marker(s) in combination with the measurement of the concentration of at least one in vivo degradation product of tryptophan are also part of the present invention.

[0027] Additionally, the present invention relates to (i) the use of kynurenic acid as a predictive marker for the detection of a psychiatric condition optionally associated with a depression, and/or (ii) the use of a neuroprotective ratio determined by dividing the value of the concentration of kynurenic acid by the value of the concentration of kynurenine in a blood plasma sample as a predictive marker for the detection of a psychiatric condition optionally associated with a depression, and/or (iii) the use of a ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid for the detection of a psychiatric condition optionally associated with a depression, and/or (iv) the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of tryptophan and/or (v) the use of a neuroprotective index determined by dividing the square value of the concentration of kynurenic acid by the value of the concentration of kynurenine in a blood plasma sample as a predictive marker for the detection of a psychiatric condition optionally associated with a depression.

[0028] The present invention also relates to the use of a combination of at least two values selected from the group consisting of the concentration of kynurenic acid, the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of tryptophan, and the neuroprotective index of a blood plasma as predictive markers for the detection of a psychiatric condition optionally associated with a depression.

[0029] The present invention also relates to the use of a combination of the concentration of kynurenic acid, the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid, the neuroprotective index of a blood plasma, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of tryptophan, and/or at least one other neuroprotective, neurodegenerative or neurotrophic marker(s) as predictive markers for the detection of a psychiatric condition optionally associated with a depression.

[0030] The terms "predictive marker" or "biological marker" as used herein means that the factor used as a biological or predictive marker, preferably the concentration of kynurenic acid in blood plasma, the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid, the neuroprotective index, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of tryptophan, or a combination thereof, is indicative regarding the question whether an individuum has a psychiatric condition optionally associated with a depression or not.

[0031] The present invention also relates to a kit for detecting a psychiatric condition containing means for detecting the concentration of a tryptophan degeneration product in a body fluid such as whole blood, serum, plasma; urine, saliva and CSF can also be used in the present invention.

[0032] In a preferred embodiment of the present invention the kit contains means for detecting the concentration of kynurenic acid and/or kynurenine and/or 3-hydroxykynurenine and/or tryptophan in said blood plasma sample.

[0033] The present invention also relates to therapeutic interventions that change any of the above mentioned biomarkers.

[0034] The figures show:

[0035] FIG. **1** shows the frequency of the kynurenic acid concentrations in nanomole/litre as obtained in Example 1.

[0036] FIG. **2** shows the frequency of the neuroprotective ratio (KAKYN) as obtained in Example 1.

[0037] FIG. **3** shows the frequency of the neuroprotective index (PROi) as obtained in Example 1.

[0038] FIG. **4** shows the Receiver Operating Characteristic (ROC) curve for kynurenic acid (KA) as obtained in Example 1.

[0039] FIG. **5** shows the ROC curve for the neuroprotective ratio (KAKYN) as obtained in Example 1.

[0040] FIG. **6** shows the ROC curve for the neuroprotective index (PROi) as obtained in Example 1.

[0041] FIG. **7** shows ratios between serum levels of 3-HK and TRP in patients with Alzheimer's disease (AD), patients with major depression (MD), and healthy persons with subjective cognitive impairment (SCI). Kruskal-Wallis test revealed a significant difference between the three investigated groups, and Mann-Whitney test confirmed the significant difference between AD patients and the two comparison groups.

[0042] Table 1 shows the results of Example 1 (Gender, M=male, F=female; Age (years); TYR (tyrosine in micromole/litre); VAL (valine in micromole/litre); TRP (tryptophan in micromole/litre); PHE (phenylalanine in micromole/litre); ILE (isoleucine in micromole/litre); LEU (leucine in micromole/litre); Kyn (Kynurenine in micromole/litre); KA (Kynurenic acid in nanomole/litre); TRPi (tryptophan index=100×tryptophan/{TYR+VAL+PHE+ILE+LEU}); KYN/TRP (Tryptophan breakdown index=Kynurenine value/Tryptophan value); KAKYN (Neuroprotective ratio=1000×Kynurenic acid value (micromole/litre)/Kynurenine value (micromole/litre)); PROi (Neuroprotective index=1,000,000 kynurenic acid value (micromole/litre)×kynurenic acid value (micromole/litre)/kynurenine value (micromole/litre)))

[0043] Table 2 shows group characteristics of patients and control subjects. AD=Patients with Alzheimer's disease; MD=Patients with major depression; SCI: Healthy persons with subjective cognitive impairment; MMSE=Mini-Mental State Examination.

[0044] Table 3 shows mobile phases and gradient conditions. Solvent A: 50 mM sodium acetate, pH 4.8; solvent B: 50 mM sodium acetate, pH 3.56; solvent C: 100% acetonitrile; solvent D: 100% methanol.

[0045] Table 4 shows serum levels of tryptophan (TRP), kynurenine (KYN), kynurenic acid (KYNA), and 3-hydroxykynurenine (3-HK) in patients with Alzheimer's disease (AD), patients with major depression (MD), and healthy persons with subjective cognitive impairment (SCI). The nonparametric Kruskal-Wallis test was used to test for differences between the three investigated groups. The significant differences regarding 3-HK levels and 3-HK/TRP ratio was confirmed by Mann-Whitney test.

[0046] The present invention will now be further illustrated in the following examples without being limited thereto.

EXAMPLES

Example 1

Measurement of Neuroprotective Index, Neuroprotective Ratio and Plasma Kynurenine Concentrations in Human Blood Plasma

Subjects

[0047] A total of 48 depressed patients (age of 44.277±11.42 years) who were drug naïve at the time of admission to the psychiatric department of the general hospital were recruited. A total of 95 normal healthy persons (age of 31.63±8.5 years) who came to the same general hospital for regular check-up during the same period of time were recruited as controls. Informed consent was taken from all the subjects.

[0048] All the patients were interviewed by a qualified psychiatrist and diagnosed as major depression according to DSM-IV criteria (American Psychiatric Association, 1994, Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM IV). Am. Psy. Asso. Washington D.C.). All those patients with co-morbidity of other psychiatric disorders including alcoholism and other acute or chronic diseases were excluded. Presence of other diseases were checked by both clinically and biochemically.

[0049] All the controls were checked for being free of chronic and acute diseases in the same way as patients. The interview was done by a qualified psychiatrist, to confirm whether they were free from psychiatric and related disorders.

Sample Collection

[0050] A total of 10 ml of overnight-fasting early morning blood samples were collected in heparinised tubes and plasma samples were collected and stored at −70° C. for analyses at a later date. For the patients, another samplings were done at the time of discharge.

Sample and Data Analysis

[0051] Samples were analysed for (1) tryptophan (2) competing amino acids: tyrosine, valine, phenylalanine, isoleucine; leucine, taurine, a-amino-n-butyric acid, and methionine (μmol/l), (3) kynurenine (μmol/l), hydroxy-anthranilic acid (nmol/l), and (4) kyrenic acid (nmol/l), using High Performance Liquid Chromatography using UV detector and the fluorescent detectors (Nerve C, Beyne P, Jamault H, Delacoux E, 1996, Determination of tryptophan and its kynurenine pathway metabolites in human serum by high-performance liquid chromatography. J. Chromatography B: Biomedical applications; (675):157-161.).

[0052] The tryptophan index (TRPi) which represents the tryptophan availability in the blood (100×tryptophan value/sum of competing amino acids values), tryptophan breakdown index (KYN/TRP) which represents the tryptophan breakdown (kynurenine value/tryptophan value), and neuroprotective ratio (KAKYN) (kynurenic acid value/kynurenine value) and neuroprotective index (PROi) (kynurenic acid value^2/kynurenine value) which represent the strength of neuroprotection against quinolinic excitotoxic effect were calculated (Table 1).

[0053] Statistical analysis was done using SPSS version 11.0.

Results

[0054] (1) On admission, the tryptophan index in the patients were significantly but not strongly lower ($p<0.05$) than the normal controls (9.99±0.26 vs 10.88±0.14).

[0055] (2) On admission, the tryptophan breakdown index in the patients were significantly but not strongly lower ($p<0.04$) than the normal controls (0.03±0.002 vs 0.05±0.02).

[0056] (3) On admission, the hydroxy-anthranilic acid (a step before formation of quinolinic acid in the catabolism) which indicates the toxic effect on the neurons showed no difference ($p=0.1$) between patients (25.265±2.437) and normal controls (25.182±0.768).

[0057] (4) On admission, the plasma kynurenic acid concentrations in the patients were significantly and strongly lower ($p<0.0001$) than the normal controls (24.29±1.18 vs 35.96±1.37) (FIG. **1**).

[0058] (5) The ROC curve analysis showed that the kynurenic acid value 29.3 nmol/l is the cut-off point between depressed and normal with sensitivity of 80.9% and specificity of 75% (FIG. **4**).

[0059] (6) On admission, the neuroprotective ratio in the patients were significantly and strongly lower ($p<0.0001$) than the normal controls (14.08±0.64 vs 19.36±0.61) (FIG. **2**).

[0060] (7) The ROC curve analysis showed that the neuroprotective index 16.3 is the cut-off point between depressed and normal with sensitivity of 75.5% and specificity of 65% (FIG. **5**).

[0061] (8) On admission, the neuroprotective index in the patients were significantly lower ($p<0.04$) than the normal controls (358.77±52.93 vs 757.7±86.22) (FIG. **3**).

[0062] (9) The ROC curve analysis showed that the neuroprotective index 473 is the cut-off point between depressed and normal with sensitivity of 78.7% and specificity of 77.6% (FIG. **6**).

[0063] (10) The univariate analysis showed that the above three markers were not influenced by age or gender.

Conclusion

[0064] The neuroprotective index, neuroprotective ratio and plasma kynurenic acid concentrations are biological markers to be used to differentiate between normal and depressed persons.

Example 2

Determination of Kynurenine and Kynurenic Acid Using High Performance Liquid Chromatography

1. Introduction:

[0065] Combined measurement of kynurenine and kynurenic acid by HPLC with external standardisation. Kynurenine is detected by UV and kynurenic acid by its enhanced fluorescence in a Zn containing elution solvent.

2. Sample Preparation:

[0066] Samples (serum, whole blood, plasma) need to be deproteinated.

[0067] Add 20 μl of perchloric acid to 180 μl of sample.

[0068] Leave for 10 minutes, then centrifuge for 5 minutes at 14000 g. The 100 µl of the supernatant is transferred to a Gilson injection vial, capped and centrifuged for 5 minutes an 6000 g.

3. Instrumentation: Configuration System 2

3.1 Gilson 305 HPLC Pump

3.2 Gilson 231 Autoinjector:

[0069] check dilutor reservoir. 20% ACN/AD.
Program file 1.
ANAL. TIME=4 minutes
SAMPLE NUMBER=number of injections

INJECTION VOLUME=40 µl

3.3 Fluorescence Detector Shimadzu 10A(xl):

Excitation: 334 nm

Emission: 388 nm

SENS: 1

GAIN: 3

3.4 Gilson 117 Detector

Wavelength: 365 nm

Sensitivity 1: 0.01

Sensitivity 2: 0.1

[0070] Min. peak width: 8 sec

3.5 Gilson Unipoint Software:

Method File: KYNS2.GCT.

[0071] Stop file: STOPKA2.GCT

Analysis File: KAS2.GAN and KYNS2.G

4. Chromatography:

[0072] column: Chromolith Performance 4.6×100 mm with a Chromolith guard cartridge.

[0073] Buffer: 250 mM Zn-acetate in AD (27.4 g in 500 ml). pH is brought to 5.8 with acetic acid and made up to a volume of 455 ml with water in a measuring cylinder. To this 45 ml ACN (for gradient chromatography) is added.

[0074] Solvent is degassed by ultrasonification during 20 minutes.

5. Preparation of Standards:

[0075] 5.1 Kynurenine stock standard is prepared by weighing off 20 mg of kynurenine (MW 208.2) and dissolving in water in a 100 ml measuring flask. Standard is stored as 1 ml aliquots in Eppendorf cups at −20° C.

[0076] 5.2 Kynurenic acid stock standard is prepared by weighing off 20 mg of kynurenic acid (MW 189.2) and dissolving on EtOH with 1 ml of HCl 12 N in a 100 ml measuring flask. Standard is stored at −20° C.

5.3 Working Standard:

[0077] Dilute stock standards till concentrations of 5 µM for kynurenine (500 µl) and 100 nM for kynurenic acid (10.0 µl) in AD (till 100 ml). Stable for one day at room temperature.

6. Reagents:

[0078] Perchloric acid (2.4 M): 7 ml of perchloric acid+13 ml AD.

7. Quality Control:

[0079] Commercial drug free plasma (TRP, KYN, KA)

8. Procedure:

[0080] Prepare solvents, reagents, thaw Working Standard

Solution and Control Plasma.

[0081] Stabilize column
[0082] Check plumbery
[0083] Fluorescence detector
[0084] Sample preparation
[0085] adapt Operation File to number of standard injections, samples and controls.
[0086] Program autoinjector—Start run
[0087] System shut-down.

9. Normal Values:

[0088] 9.1 Clin Chem 44:4, 858-62 (1992):

[0089] KYN: 1.98 (median) range 1.86-2.10 µM n=72

[0090] 9.2 J Chrom B, 675 (1996), 157-61:

KYN:	1.35	0.7-3.0 µM	n = 35
KA:	23	6-54 nM	

[0091] 9.3 Anal Bloch 172, 518-25 (1988):

KYN:	2.21	1.30-3.32 µM	n = 20M + 20F

[0092] 9.4 Roseneck studio (project 11/01)

KYN:	1.66	1.04-2.28 µM	n = 36

Example 3

Determination of Tryptophan and Competing Amino Acids Using High Performance Liquid Chromatography

1. Introduction:

[0093] Simultaneous measurement of: Tyrosine (TYR), Valine (VAL), Tryptophan (TRY), Phenylalanine (PHE), Isoleucine (ILE), Leucine (LEU)
Other amino acids which elute: Taurine (TAU), a-Amino-n-butyric acid (ABA), Ethanolamine, Methionine (MET)

2. Sample Preparation:

[0094] 25 µl of sample is diluted with 25 µl of Internal Standard solution (IS) in a Gilson Sample vial.

3. Instrumentation:

3.1 Gilson System 1

3.2 ASTED:

[0095] Install 20 ul injection loop and dialyser block. Use Prime Solution for Dilutor 0 and Dialyser Solution for Dilutor 1. Place Borate Buffer in vial positions A and B of Rack 50. Place OPA derivatisation reagent in position C.

3.3 Shimadzu RF-A Fluorescence Detector.

Excitation: 330

Emission: 450

SENS: 1

GAIN: 2

3.4 Gilson Unipoint Software:

[0096] Control method: AZP
Analysis method: AZP

4. Chromatography:

[0097] Column: Econospher C18, 3 μm, 4.7×50 mm

[0098] Solvent A: 57.2 g Na_2HPO_4.12$H_2$0 or 22.6 9 Na_2HPO_4.anh. is dissolved in 400 ml of water by stirring and gently heating. The pH is brought to 6.5 with phosphoric acid and made up to a volume of 1840 ml with water in a measuring cylinder. To this is added 160 ml acetonitrile for chromatography.

[0099] Solvent B: 420 water/280 ACN/320 MeOH (all Spectrograde).

[0100] Both solvents are degassed by ultrasonification during 20 minutes.

5. Preparation of Standards:

[0101] Separate amino acid standards are prepared by weighing off 100 mg of each compound and dissolving in water in a 100 ml measuring flask.

[0102] Working Standard solution: 5 ml of the following separate amino acid standards are dissolved in 250 ml of water in a measuring flask: TYR, VAL, TRY, PHE, ILE, LEU.

[0103] Check Standard Solution: same as Working Standard Solution but with these additional compounds: TAU, ABA, MET. This solution is not used for standardisation but for checking chromatogram.

[0104] Both standards are stored as 1 ml aliquots in Eppendorf cups at −20° C.

[0105] Working solution's actual concentrations (in microM): see Peak Table

6. Reagents:

[0106] 6.1 Prime Solvent (1 week): 8.6 g NaCl is dissolved in 1 l of water. 500 μl of Triton X 100 is added. Mix well and ultrasonicate during 10 minutes.

[0107] 6.2 Dialysis solution (1 week): 0.2 M KH2PO4 with NaN3 (a spoon's tip)

[0108] 6.3 Internal Standard Stock Solution: 100 mg Norvaline is dissolved in 100 ml of water. 1.5 ml aliquots are stored in Eppendorf cups at −20° C. (2 years).

[0109] 6.4 Internal Standard (IS): 1 ml of Internal Standard Stock Solution is diluted with 20 ml of 2 g/l Na_2-EDTA (Kestranal 2S) in a scintillation vial (1 month).

[0110] 6.5 Borate buffer: 3.1 g of boric acid is dissolved in 400 ml of water, brought to pH 9.5 with NaOH conc. and diluted till 500 ml (1 month).

[0111] 6.6 OPA: 500 mg of orthophtalicdialdehyde (OPA) is dissolved by short ultrasonification in 10 ml of methanol spectrograde in a 100 ml Erlenmeyer flask. 90 ml of Borate Buffer and 500 μl of mercaptoethanol are added. This reagent is stable during 1 month but 50 μl of mercaptoethanol is added every 2 days.

7. Quality Control:

[0112] A pool of EDTA plasma is stored in Eppendorf tubes at −20° C.

8. System Shut-Down:

[0113] Rinse column with solvent B

[0114] Prime ASTED with water

9. Procedure:

[0115] Prepare solvents, reagents, IS, thaw Working Standard Solution and Control Plasma.

[0116] Stabilize column by running gradient 3 times: first power on pump 1, pump 2, (eventually prime pumps with column disconnected), Qata Master, Ditutors, ASTED, printer, computer screen, computer. Select method AZP2 and run three times (click "Continue"). Check gradient at least once with and without sample preparation.

[0117] Prepare ASTED for dialyzing (if changing configuration first run FILE 181): place reagents and solvents, Prime. Run File 150 (ELUT. TIME=50)

[0118] Fluorescence detector

[0119] start stabilizing column

[0120] check plumbery

[0121] program ASTED for check sample (Working Standard)

[0122] If the check sample is not OK, try remedying and start again.

[0123] In case of doubt, run Control Standard and/or Quality Control Plasma.

[0124] Sample preparation

[0125] adapt Gilson Program according to number of standard injections, samples and controls.

[0126] Program ASTED.

[0127] Start run.

[0128] System shut-down.

Example 4

Determination of Hydroxy-Anthranilic Acid Using High Performance Liquid Chromatography

1. Introduction:

[0129] KYN may be detected by UV and HAA by its fluorescence.

2. Sample Preparation:

[0130] Samples (serum, EDTA whole blood, EDTA plasma, heparinised or citrated plasma) are first centrifuged at 4000 g to remove particulates. They need to be deproteinated.

[0131] Add 20 μl of perchloric acid (6.3) to 180 μl of sample.

[0132] Leave for 5 minutes, then centrifuge for 5 minutes at 14000 g. Then 100 μl of the supernatant is transferred to a Gilson injection vial, capped and centrifuged for 5 minutes at 6000 g.

3. Instrumentation:

Configuration System 2

[0133] 3.1 Gilson 305 HPLC pump.

3.2 Gilson 234 Autoinjector:

[0134] Check dilutor reservoir: 20% ACN/AD.

[0135] Program file 3.

[0136] ANAL. TIME=12 minutes,
[0137] sample number=number of injections,
[0138] INJECTION VOLUME=45 μl.

3.3 Fluorescence Detector Shimadzu 10A(xl):

[0139] Excitation: 316 nm,
[0140] Emission: 420 nm,
[0141] SENS: 1,
[0142] GAIN: 3.

3.5 Gilson Unipoint Software:

[0143] Method File: HAAS2.GCT,
[0144] Stop file: STOPSYS2.GCT,
[0145] Analysis File: HAAS2.GAN and HAAS2.GAN.

4. Chromatography:

[0146] Column: Prevail select C18 3μ 4.6×100 mm (Altech 99302).
[0147] Buffer: 20 mM acetic acid (1.2 ml in 900 ml) is brought to pH 5.8 with KOH and made up to a volume of 1000 ml with water in a measuring cylinder. To this is added 20 ml MeOH (for gradient chromatography). The solvent is degassed by ultrasonification for 10 minutes.

5. Preparation of Standards:

[0148] 5.2 Hydroxyanthranilic acid stock standard is prepared by weighing off 20 mg of anthranylic acid (MW) and dissolving with 40 mM acetate citrate pH 4.5 in a 100 ml measuring flask. Standard is stored at −80.
[0149] 5.3 Working standard: Dilute stock standards till concentration of 100 nM for hydroxyanthranylic acid (10.0 μl) in AD (till 100 ml).

6. Reagents:

[0150] 6.3 Perchloric acid (2.4 M): 7 ml of perchloric acid+13 ml AD
[0151] 6.4 Internal standard working solution: 5× dilution of 6.4 in 6.3)

7. Procedure:

[0152] Prepare solvents, reagents, thaw Working Standard Solution and Control Plasma,
[0153] Stabilize column,
[0154] Check plumbery,
[0155] Fluorescence detector,
[0156] Sample preparation,
[0157] adapt Operation File to number of standard injections, samples and controls,
[0158] Program autoinjector—Start run,
[0159] System shut-down.

8. Normal Values:

[0160] 8.1 J Chrom B, 675 (1996), 157-61: serum

KYN:	1.35	0.7-3.0 μM	n = 35
HAA:	79	15-209 nM	

Example 5

Determination of Elevated 3-Hydroxykynurenine Serum Levels in Alzheimer's Disease

Methods

Patients and Control Subjects

[0161] Serum levels of TRP, KYN, KYNA, and 3-HK in 20 patients with the diagnosis of clinical probable Alzheimer's disease (AD), 20 patients with late-onset major depression (MD), and 20 healthy elderly subjects with subjective memory complaints (SCI) in whom a neurodegenerative disorder had been ruled out by medical examination and neuropsychological testing were investigated.
[0162] For subjects' characteristics, see Table 2. The clinical diagnosis of probable AD is made according to the National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association criteria (McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., and Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology 34, 939-944.). The diagnosis of major depression is made according to the criteria of ICD-10 and DSM-IV (American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision. (Washington, D.C.: American Psychiatric Association)). Mean duration of illness in the AD group is 2.20 years (0-5 years). All AD patients are free of antidementive treatment, and have no actual treatment with NSAIDs (Non-Steroidal Anti-Inflammatory Drugs). One of the AD patients had a previous history of remitting-relapsing major depression, but is admitted to the hospital without any depressive symptoms and free of anti-depressive medication. On admission three of the MD patients are treated with selective serotonin reuptake inhibitors, one with a tricyclic antidepressant and one with a combination of antidepressants; the remaining MD patients are free of antidepressant medication at the time of blood sampling. One SCI subject suffers from a mild depressive episode and is treated with reboxetine, while another SCI subject is sporadically taking NSAIDs due to ankylosing spondylarthritis.
[0163] There is a significant between group difference in age (Kruskal-Wallis test X^2=18.223, p<0.001), gender (X^2=6.667, p=0.036), and Mini-Mental State Examination (MMSE) score (X^2=31.944, p<0.001, see Table 2). Patients with AD are older than patients with MD (Mann-Whitney test Z=−2.654, p=0.008) and SCI subjects (Z=−3.998, p<0.001), and MD patients are older than the SCI subjects (Z=−2.072, p=0.038).
[0164] Serum samples are collected in vacucontainers without further additives. After 0.5 hours of coagulation, samples are centrifuged and the supernatant is aliquoted into Eppendorf cups (Eppendorf, Hamburg, Germany) and immediately frozen at −80° C.

Laboratory Analyses

[0165] We established a gradient high-performance liquid chromatographic (HPLC) method with ultraviolet (UV) and fluorescence detection.

Chemicals

[0166] Reagents for solid phase extraction and chromatography are purchased from Merck (Darmstadt, Germany) in gradient grade purity for liquid chromatography. Ultra pure water is produced by a Millipore Milli-Q system (Millipore, Milford, Miss.). Phosphate buffered saline (PBS) capsules (Sigma, St. Louis, Mo.) are used to generate a 0.05 M PBS. Tryptophan, kynurenine, kynurenic acid, and 3-hydroxykynurenine are purchased in high purity from Sigma (St. Louis, Mo.).

[0167] Calibrators and controls are established by adding defined concentrations of the analytes to a 0.05 M PBS solution. The following concentrations are used for five-point calibration: TRP: 0.313, 0.625, 1.25, 2.5, 5.0, 10.0, 20.0 μg/ml; KYN: 12.5, 25.0, 50.0, 100, 200, 400, 800 ng/ml; KYNA: 4.688, 9.375, 18.75, 37.5, 75.0, 150, 300 ng/ml; 3-HK: 1.563, 3.125, 6.25, 12.5, 25.0, 50.0, 100 ng/ml.

Sample Extraction

[0168] Analytes are extracted from samples and calibrators/controls using Waters Oasis MCX 1cc (30 mg) extraction cartridges (Waters, Milford, Miss.) as follows (all extractions are conducted with a manual vacuum-manifold system): (1) the cartridge is preconditioned by rinsing with 1 ml of methanol followed by 1 ml water; (2) 1 ml sample and 100 μl 1M H_3PO_4 are applied to the cartridge and pulled through under a light vacuum (2 minutes); (3) the cartridge is washed with 1 ml of 0.1 M HCl followed by 1 ml 100% methanol; and finally, (4) the analytes are eluted by rinsing the cartridge with 1.5 ml of acetonitrile containing 6% NaOH. The eluent is then evaporated under nitrogen to dryness and reconstituted with 150 μl 0.1 M PBS. The reconstituted sample/calibrator/control is then transferred to a microinjection vial (Waters).

HPLC Equipment and Chromatographic Conditions

[0169] Analyses are carried out on a Waters 2695 chromatograph connected to a Waters Model 2487 dual-X UV detector and a 2475 fluorescence detector.

[0170] For the determination of KYN, KYNA, and 3-HK, 100 μl of the samples are loaded onto an 250 mm×4 mm Supersphere 60 RP-select B, C8 column (Merck, Darmstadt, Germany). Due to the relatively higher concentration, a second injection with a volume of 10 μl is performed for the determination of TRP. In order to ensure optimal peak resolution in the chromatograms, and hence efficient separation of the analytes in a reasonably short time (30 minutes), elution is carried out in the gradient mode using a mobile phase consisting of a mixture of 0.050 M sodium acetate (solvent A: pH 4.80; solvent B: pH 3.65); acetonitrile (solvent C), and methanol (solvent D) at distinct proportions (see Table 3).

[0171] Flow rate is set at 0.80 ml/minute, column temperature is set at 35.0° C., while the samples are cooled at 4.0° C. TRP is measured by fluorescence detection (λex: 300 nm; λem: 350 nm), KYN (365 nm), KYNA (330 nm), and 3-HK (365 nm) are measured by UV detection. Approximate run time after injection until detection of the compounds is about 20.4 minutes for TRP, 13.4 minutes for KYN, 22.5 minutes for KYNA, and 7.0 minutes for 3-HK.

[0172] Data are processed using EMPOWER for Windows 2000 software (Waters). The concentrations are established through comparison of peak heights of the single analytes with the peak heights of the respective calibration curves.

Statistics

[0173] Statistical analysis is performed with SPSS (version 12.0.1; SPSS, Chicago, Ill.) with nonparametric procedures (Kruskal-Wallis-Test—Mann-Whitney-Test—Spearman-Rank correlation). Level of significance is set at $p<0.050$. To control significant between group effects for differences in age, a linear mode with diagnosis as independent factor and age as covariate is used. Because the outcome variables are not normally distributed by visual inspection of the regression residuals and Kolmogorov Smirnov tests ($p<0.05$), bootstrapping applied to a multiple regression model with diagnosis and age as independent predictor variables for a distribution free significance test is used. Specifically, the multiple regression model for each pair of diagnoses on the basis of 999 samples is iteratively computed. To assess whether a marker showing significant differences between the AD and the comparison groups might also be useful as a potential diagnostic test, sensitivity of the marker when specificity is set at >80% and specificity when sensitivity is set at >80% using ROC analysis is determined. The level of 80% is chosen based on the consensus criteria for a clinically useful biomarker in AD (The Ronald and Nancy Reagan Research Institute of the Alzheimer's Association and the National Institute on Aging Working Group (1998). Consensus report of the Working Group on: "Molecular and Biochemical Markers of Alzheimer's Disease". The Ronald and Nancy Reagan Research Institute of the Alzheimer's Association and the National Institute on Aging Working Group. Neurobiol. Aging 19, 109-116.).

Results

[0174] Mean serum levels of tryptophan (TRP), kynurenine (KYN), kynurenic acid (KYNA), and 3-hydroxykynurenine (3-HK) in patients with Alzheimer's disease (AD), patients with major depression (MD), and healthy persons with subjective cognitive impairment (SCI) are given in Table 4. There is a non-significant difference of TRP levels between the three groups (Kruskal-Wallis: $X^2=5.507$; $p=0.064$) with AD patients showing lower TRP levels than healthy control persons (Mann-Whitney $Z=-2.288$; $p=0.022$). The serum levels of KYN ($X^2=1.536$; $p=0.464$) and KYNA ($X^2=0.033$; $p=0.984$) are not different between the groups. In contrast, 3-HK levels are significantly different between the three groups ($X^2=20.281$; $p<0.0001$), with higher serum 3-HK levels in AD patients compared to the patients with major depression ($Z=-3.571$; $p<0.001$) and SCI controls ($Z=-4.139$; $p<0.0001$). In contrast, serum 3-HK levels did not differ between patients with MD and SCI controls ($Z=-0.541$; $p=0.602$). Since availability of the essential amino acid TRP is a limiting factor for the production of its metabolites, the ratio between 3-HK and TRP levels is also calculated. Again, there is a highly significant difference between the groups ($X^2=21.911$; $p<0.0001$) with a much higher mean ratio (3-HK/TRP) in AD patients than in MD patients ($Z=-3.517$; $p<0.001$) and healthy controls ($Z=-4.436$; $p<0.0001$), but with no difference between the two comparison groups ($Z=-0.757$; $p=0.449$). Accordingly, the ratio between neurotoxic 3-HK and neuroprotective KYNA is significantly increased in AD patients ($X^2=18.016$, $p=0.0001$; AD vs. MD; $Z=-3.219$, $p=0.001$; AD vs. SCI: $Z=-4.003$, $p=0.00002$; MD vs. SCI: $Z=-0.649$, $p=0.529$).

[0175] When the significant between group differences in 3-HK and 3-HK/TRP are controlled for age using bootstrapping for determination of the sampling distribution, 3-HK levels are significantly different between AD patients and SCI controls (partial correlation coefficient −0.42, $p<0.05$) and between AD and MD patients (partial correlation coefficient −0.35, $p<0.05$). The ratio of 3-HK to TRP is significantly different between AD patients and SCI controls (partial correlation coefficient −0.47, $p<0.05$), but not between AD and MD patients (partial correlation coefficient −0.2).

[0176] Using ROC analysis of the AD group compared with the combined MD and SCI group, for 3-HK sensitivity is 75% when specificity is set at 85%, and specificity is 70% when sensitivity is set at 90%. For the ratio of 3-HK to TRP sensitivity is 80% when specificity is set at 82.5%, and specificity is 77.5% when sensitivity is set at 85%.

TABLE 1

Group	Gender	Age	TYR	VAL	TRP	PHE	ILE	LEU	Kyn	KA	TRPi	KYN/TRP	KAKYN	PROi
Disease	M	68	87.14	263.7	55.31	96.47	66.66	129.95	2.99	31.84	8.59	0.0540	10.67	339.61
Disease	M	44	79.93	376.89	88.94	87.77	137.2	226.64	2.51	29.33	9.79	0.0282	11.71	343.30
Disease	F	35	92.87	260.05	62.23	82.86	96.06	156.65	2.06	24.96	9.04	0.0331	12.11	302.29
Disease	M	31	63.29	230.9	62.43	68.38	76.53	125.46	1.85	17.87	11.06	0.0296	9.66	172.63
Disease	F	52	63.12	246.49	84.73	81.67	82.9	141.06	1.49	14.34	13.77	0.0176	9.62	137.98
Disease	F	68	105.1	376.3	101.54	110.33	140.93	198.4	1.90	26.81	10.91	0.0188	14.08	377.39
Disease	M	20	68.26	300.6	89.45	110.23	96.08	192.06	1.80	33.71	11.66	0.0201	18.70	630.54
Disease	F	34	57.66	210.25	47.97	69.85	89.7	125	1.63	11.60	8.68	0.0339	7.13	82.70
Disease	M	61	57.29	241.99	58	65.2	78.73	117	1.33	13.79	10.35	0.0229	10.38	143.18
Disease	F	67	52.67	251.93	59.7	76.58	74.52	128.63	1.93	28.16	10.22	0.0324	14.56	409.90
Disease	F	30	66.08	245.14	75.71	94.63	83.71	154.31	1.43	16.71	11.76	0.0189	11.68	195.18
Disease	M	40	48.34	193.21	53.76	61.03	55.14	94.44	1.52	24.85	11.89	0.0283	16.35	406.26
Disease	F	23	62	317	51.3	80	80	191	1.44	21.87	7.03	0.0281	15.19	332.15
Disease	M	46	90.82	318.26	104.36	102.49	106.22	188.57	2.46	21.47	12.94	0.0236	8.73	187.38
Disease	M	33	72.31	418.11	86.75	104.43	112.24	195.43	3.94	56.29	9.61	0.0454	14.29	804.20
Disease	F	51	52.06	215.4	54.45	74.58	92.56	134.33	1.81	35.54	9.57	0.0332	19.64	697.84
Disease	F	50	106.3	357.06	84.05	95.28	127.88	204.96	1.82	35.21	9.43	0.0217	19.35	681.18
Disease	M	20	72.26	343.18	85.84	96.24	128.5	220.42	1.91	25.86	9.97	0.0222	13.54	350.12
Disease	M	37	53.39	257.99	64.99	64.92	86.14	143.17	2.91	19.80	10.73	0.0448	6.80	134.58
Disease	F	52	80.22	267.89	77.55	83.11	90.69	169.15	1.85	14.81	11.22	0.0239	8.01	118.56
Disease	F	61	78.16	237.18	49.78	103.12	95	135.81	1.98	25.47	7.67	0.0398	12.86	327.64
Disease	F	41	71.59	309.87	54.17	114.52	97.29	216.86	1.06	27.26	6.69	0.0196	25.72	701.04
Disease	M	39	79.65	278.68	66.04	89.76	98.05	183.32	1.92	28.56	9.05	0.0291	14.88	424.83
Disease	M	45	54.56	295.44	42.61	78.96	123.37	208.21	1.20	25.59	5.60	0.0282	21.33	545.71
Disease	M	36	59.25	276.07	61.44	79.84	82.34	155.45	1.46	26.28	9.41	0.0238	18.00	473.04
Disease	F	38	96.4	306	79.9	94.2	93.2	166	1.42	19.00	10.57	0.0178	13.38	254.23
Disease	F	35	53.12	188.28	46.91	56.48	57.41	101.99	0.75	15.94	10.26	0.0160	21.25	338.78
Disease	M	20	71.83	276.7	88.19	93.49	78.02	178.17	1.77	36.26	12.63	0.0201	20.49	742.82
Disease	M	32	82.7	306.59	57.24	86.81	10'.51	198.25	1.72	24.70	7.38	0.0300	14.36	354.70
Disease	F	21	62.45	232.87	69.74	88.74	75.78	154.07	2.14	20.09	11.36	0.0307	9.39	188.60
Disease	M	63	65.45	344.26	57.84	92.89	127.58	223.23	2.25	31.35	6.78	0.0389	13.93	436.81
Disease	M	67	66.36	282.86	59.19	82.04	72.61	152.41	2.06	26.97	9.02	0.0348	13.09	353.10
Disease	F	40	63.58	244.54	70.29	72.7	72.23	141.26	1.01	20.36	11.83	0.0144	20.16	410.43
Disease	M	60	69.79	316.34	35.02	85	106.15	187.38	1.22	24.47	4.58	0.0348	20.06	490.80
Disease	F	42	64.29	243.52	60.87	69.42	72.54	142.77	1.42	23.05	10.27	0.0233	16.23	374.16
Disease	M	41	60.03	225.76	48.89	66.74	69.3	123.49	2.01	22.78	8.97	0.0411	11.33	258.17
Disease	M	42	66.65	270.91	72.22	74.28	92.07	169.43	1.79	31.10	10.73	0.0248	17.37	540.34
Disease	F	60	64.52	227.57	50.73	60.26	71.34	113.87	1.79	21.82	9.44	0.0353	12.19	265.98
Disease	M	52	47.94	207.97	52.33	65.94	114.84	57.91	1.84	19.90	10.58	0.0352	10.82	215.22
Disease	M	49	64.68	283.25	62.09	59.75	79.29	148.15	1.39	17.80	9.78	0.0224	12.81	227.94
Disease	M	66	50.5	207.19	38.14	62.38	65.21	117.37	1.35	10.78	7.59	0.0354	7.99	86.08
Disease	F	48	70.79	313.1	74.21	67.66	85.85	154.31	1.71	24.61	10.73	0.0230	14.39	354.18
Disease	F	43	70.55	210.41	70.69	78.76	65.47	123.65	1.63	26.04	12.88	0.0231	15.98	416.00
Disease	M	43	42.96	204.91	55.37	55.74	76.35	125.37	1.88	13.61	10.96	0.0340	7.24	98.53
Disease	F	43	84.69	212.39	57.9	68.17	55.94	117.44	1.41	23.44	10.75	0.0244	16.62	389.67
Disease	F	24	56.28	264.5	66.27	73.73	78.58	167.06	1.42	15.56	10.35	0.0214	10.96	170.50
Disease	F	68	73.73	257.95	69.25	78.04	82.88	140.21	2.02	34.10	10.94	0.0292	16.88	575.65
average		44.277	68.587	270.584	65.242	80.967	89.204	156.172	1.791	24.291	9.894	0.028	14.082	358.765
average dev		11.424	11.28	41.924	12.803	12.545	16.759	30.543	0.3677	5.8735	1.4505	0.0068	3.4879	142.69
Normal	M	26	85.92	280.85	66.2	80.74	81.71	155.62	2.60	35.93	9.67	0.0393	13.81	496.23
Normal	M	33	63.48	256.2	71.5	84.52	82.38	156.44	1.23	16.66	11.12	0.0171	13.59	226.35
Normal	F	38	50.86	257.27	74.66	64.11	76.45	135.14	2.10	55.74	12.79	0.0281	26.54	1479.50
Normal	F	25	50.52	226.25	47.26	64.66	60.52	114.16	1.74	32.69	9.16	0.0368	18.79	614.16
Normal	F	26	57.18	272.04	69.04	79.9	78.33	141.88	1.74	30.81	10.97	0.0252	17.71	545.55
Normal	M	31	77.22	295.32	64.78	86.19	95.89	170.89	1.66	53.85	8.93	0.0256	32.44	1746.88
Normal	F	23	75.91	235.17	65.24	60.12	65.54	122.87	1.41	36.05	11.66	0.0216	25.57	921.70
Normal	F	24	75.28	306.84	89.74	85.65	104.99	188.73	2.92	48.31	11.78	0.0325	16.54	799.27
Normal	F	43	81.76	364.43	82.47	99.37	132.87	217.79	2.64	36.53	9.20	0.0320	13.84	505.47
Normal	F	22	66.59	232.12	59.67	72.02	69.32	126.1	1.70	20.62	10.54	0.0285	12.13	250.11
Normal	F	39	98.54	389.11	88.22	85.16	151.75	243.89	1.46	26.57	9.11	0.0165	18.20	483.54
Normal	M	32	73.14	223.15	75.48	80.12	73.22	129.57	1.58	22.35	13.03	0.0209	14.15	316.15
Normal	F	38	42.31	174.21	53	69.31	54.98	98.29	1.43	22.51	12.07	0.0270	15.74	354.29
Normal	F	14	88.22	238.34	91.17	87.04	66.5	117.3	2.49	61.06	15.26	0.0273	24.52	1497.32
Normal	M	60	64.28	289.74	63.71	80.74	85.93	165.58	1.84	23.63	9.28	0.0289	12.84	303.47
Normal	M	35	45.61	217.82	48.39	54.85	46.58	94.08	1.51	25.13	10.54	0.0312	16.64	418.22
Normal	M	29	61.03	231.44	63.57	67.57	69.5	104.66	1.44	30.70	11.90	0.0227	21.32	654.51
Normal	M	49	77.08	208.37	73.35	68.73	65.18	121.83	2.05	65.47	13.55	0.0279	31.94	2090.89
Normal	M	18	70.9	308.78	75.86	78.37	81.05	172.04	1.48	30.15	10.67	0.0195	20.37	614.20
Normal	F	22	49.46	206.08	61.21	61.94	58.98	116.05	1.42	33.82	12.43	0.0232	23.82	805.49
Normal	M	27	125.39	512.88	136.14	128.46	161.38	272.7	2.34	56.99	11.34	0.0172	24.35	1387.97
Normal	F	21	79.65	340.52	83	76.15	99.53	185.28	1.67	41.63	10.63	0.0201	24.93	1037.76
Normal	M	34	74.22	289.78	84.62	82.71	102.22	175.94	1.22	29.44	11.67	0.0144	24.13	710.42
Normal	M	24	52.4	252	50	57.3	77.2	124	2.14	28.86	8.88	0.0429	13.46	388.33

TABLE 1-continued

Group	Gender	Age	TYR	VAL	TRP	PHE	ILE	LEU	Kyn	KA	TRPi	KYN/TRP	KAKYN	PROi
Normal	F	24	70.59	333.52	57.99	70.88	94.83	155.29	2.19	35.85	8.00	0.0378	16.37	586.86
Normal	M	32	56.72	252.22	59.14	62.77	71.3	122.58	1.20	12.13	10.46	0.0203	10.11	122.61
Normal	F	22	103.82	319.45	80.37	86.42	125.75	203.7	0.98	25.15	9.58	0.0122	25.66	645.43
Normal	M	31	72.57	210.37	53.19	64.8	58.92	129.02	1.96	25.65	9.93	0.0368	13.09	335.67
Normal	F	40	47.52	236.7	58.23	65.74	115.79	72.11	1.73	43.77	10.83	0.0297	25.30	1107.41
Normal	M	23	50.62	230.92	57.6	66.21	119.85	81.02	1.75	32.98	10.50	0.0304	18.85	621.53
Normal	M	52	56.79	252.36	59.25	67.99	74.41	141.64	1.40	31.97	9.99	0.0236	22.84	730.06
Normal	M	24	54.4	250.4	75.91	69.38	75.96	139.54	2.14	30.91	12.87	0.0282	14.44	446.46
Normal	M	28	68.96	261.15	79.83	91.84	86.16	148.51	1.83	37.31	12.16	0.0229	20.39	760.68
Normal	M	33	62.44	254.3	65.66	79.68	92.25	148.38	1.87	39.17	10.31	0.0285	20.95	820.48
Normal	F	26	81.28	299.3	70.25	79.27	100.58	152.51	2.00	38.01	9.85	0.0285	19.00	722.27
Normal	F	21	73.79	387.97	71.24	88.14	131.4	197.62	1.79	36.61	8.11	0.0251	20.45	748.77
Normal	M	27	70.53	289.96	47.2	94.29	92.02	177.07	1.69	46.32	6.52	0.0358	27.41	1269.55
Normal	F	43	75.06	273.9	65.31	79.62	94.29	174.42	1.71	48.33	9.37	0.0262	28.26	1365.96
Normal	F	26	73.25	267.69	66.38	85.83	73.75	162.15	2.11	37.49	10.02	0.0318	17.77	666.11
Normal	F	13	67.48	228.24	89.84	75.04	60.82	117.82	2.87	55.93	16.35	0.0319	19.49	1089.95
Normal	M	45	73.78	256.3	59.38	74.66	97.42	152.32	1.31	24.92	9.07	0.0221	19.02	474.05
Normal	F	40	69.2	308.36	71.35	77.85	94.6	173.05	1.82	32.54	9.87	0.0255	17.88	581.79
Normal	F	48	47.69	230.78	74.85	81.22	68.3	125.92	1.64	35.70	13.51	0.0219	21.77	777.13
Normal	F	33	76.68	395.14	78.84	105.78	148.92	245.64	2.15	46.40	8.11	0.0273	21.58	1001.38
Normal	M	41	72.17	241.48	60.83	69.24	71.42	117.68	2.07	36.98	10.63	0.0340	17.89	661.67
Normal	F	18	88.52	295.21	74.86	115.75	107.42	176.77	2.29	53.20	9.55	0.0306	23.23	1235.91
Normal	M	21	87.65	342.55	79.53	106.66	116.75	222.82	1.62	37.09	9.07	0.0204	22.90	849.18
Normal	F	26	70.02	260.83	62.68	80.95	81.65	163.44	1.42	18.28	9.54	0.0227	12.87	235.32
Normal	F	19	65.12	342.15	72.42	89.35	104.28	159.65	2.12	36.98	9.52	0.0293	17.44	645.06
Normal	F	37	48.27	208.26	62.53	67.99	62.8	127.45	1.79	21.62	12.15	0.0286	12.08	261.13
Normal	F	50	109.86	365.58	112.91	107.94	98.64	202.86	1.98	31.98	12.76	0.0175	16.18	517.34
Normal	F	26	92	265.49	75.53	79.26	85.52	154.04	2.34	52.98	11.17	0.0309	22.67	1201.25
Normal	F	31	42.1	206	70.4	59.1	59.1	104	1.44	23.91	14.97	0.0205	16.58	396.43
Normal	F	18	71.59	259.86	61.03	67.87	82.68	122.82	1.62	29.86	10.09	0.0265	18.48	551.71
Normal	F	37	82.3	354.52	91.04	91.48	124.62	196.72	1.95	33.09	10.72	0.0214	17.00	562.67
Normal	F	49	78.7	282.09	79.83	76.4	82.1	156.04	4.06	69.31	11.82	0.0508	17.09	1184.49
Normal	F	22	105.24	350.8	89.12	89.9	129.96	216.99	1.58	30.51	9.98	0.0177	19.31	589.14
Normal	M	27	78.65	297.28	80.17	76.28	94.43	147.39	2.40	40.40	11.55	0.0299	16.85	680.78
Normal	M	34	89.01	336.88	87.05	106.2	128.22	229.63	2.01	24.39	9.78	0.0231	12.16	296.49
Normal	M	31	76.95	272.3	97.91	86.12	96.04	169.29	2.05	41.36	13.97	0.0209	20.18	834.46
Normal	M	26	98.99	356.51	83.67	90.85	139.19	217.67	1.56	37.37	9.26	0.0186	23.96	895.20
Normal	F	32	66.15	298.79	85.58	66.99	100.93	165.82	1.73	33.47	12.25	0.0202	19.35	647.54
Normal	M	37	63.65	247.58	80.1	82.73	64.41	134.1	1.66	30.32	13.52	0.0207	18.27	553.80
Normal	F	26	74.7	274.84	73.85	95.5	98.19	154.64	1.95	54.55	10.58	0.0264	27.97	1526.00
Normal	M	43	63.45	242.48	63.4	63.36	75.36	126.95	1.96	39.45	11.09	0.0310	20.08	792.06
Normal	M	39	48.92	246.31	68.5	68.91	67.12	130.77	1.88	30.30	12.19	0.0274	16.12	488.35
Normal	M	31	102.3	337.23	79.85	88.71	109.58	184.2	2.15	23.19	9.71	0.0269	10.79	250.13
Normal	M	29	65.05	294.12	78.39	80.25	87.29	159.73	1.88	61.03	11.42	0.0240	32.46	1981.20
Normal	F	46	86.14	291.2	56.99	78.41	84.89	145.01	2.23	59.94	8.31	0.0391	26.88	1611.12
Normal	M	19	65.77	316.33	80.69	72.82	115.68	175.47	2.55	33.29	10.82	0.0316	13.05	434.60
Normal	F	23	67.44	286.77	66.49	61.21	69.58	126.92	1.65	22.22	10.87	0.0248	13.47	299.23
Normal	F	19	57.39	248.82	55.97	70.29	63.96	135.13	2.38	68.78	9.72	0.0425	28.90	1987.68
Normal	F	34	49.96	171.17	51.75	75.47	52.99	97.59	1.52	27.51	11.57	0.0294	18.10	497.89
Normal	M	26	86.4	188	52.7	74.8	54.1	117	1.69	34.72	10.13	0.0321	20.54	713.30
Normal	F	33	46.46	203.96	59.74	66.81	62.2	108.33	1.27	30.27	12.25	0.0213	23.83	721.47
Normal	F	30	48.56	186.41	51.33	50.63	48.96	78.35	2.17	32.99	12.43	0.0423	15.21	501.95
Normal	M	28	62.42	189.75	60.42	80.6	59.2	98.86	1.73	58.87	12.31	0.0286	34.03	2003.28
Normal	F	32	54.7	266.7	65.5	64.5	83.1	138.8	2.03	26.47	10.77	0.0310	13.04	345.15
Normal	F	23	43.1	220.9	56.9	89.9	60.2	114.9	1.92	83.79	10.76	0.0337	43.64	3656.65
Normal	M	31	51.0	257.1	58.2	75.9	78.2	139.1	1.54	18.87	9.69	0.0264	12.25	231.22
Normal	M	47	71.14	317.02	75.23	85.47	95	182.33	1.94	48.08	10.02	0.0258	24.78	1191.59
Normal	M	33	61.89	334.76	70.1	66.31	98.9	174.95	1.94	30.19	9.51	0.0277	15.56	469.81
Normal	M	67	73.12	287.99	87.47	82.46	98.67	159.65	1.37	20.10	12.46	0.0157	14.67	294.90
Normal	M	21	69.26	294.2	77.84	67.53	90.06	161.12	1.82	35.00	11.41	0.0234	19.23	673.08
Normal	M	24	84.05	275.82	73.74	71.44	84.53	155.9	2.22	26.46	10.98	0.0301	11.92	315.37
Normal	M	20	69.79	359.13	79.53	105.21	111.28	203.68	1.90	33.78	9.37	0.0239	17.78	600.57
Normal	F	53	72.71	221.39	69.4	101.25	66.02	129.85	2.16	22.44	11.74	0.0311	10.40	233.49
Normal	M	34	76.2	298.56	71.03	85.26	90.65	155.15	1.91	34.31	10.06	0.0269	17.96	616.32
Normal	M	20	79.68	306.32	73.96	92.73	87.98	170.59	1.91	26.98	10.03	0.0258	14.13	381.11
Normal	F	20	55.33	212.5	60.85	67.5	56.86	131.09	1.63	25.51	11.63	0.0268	15.65	399.24
Normal	F	41	52.09	185.33	72.79	67.14	55.3	87.19	1.57	27.74	16.28	0.0216	17.67	490.13
Normal	M	69	47.92	220.64	71.21	70.24	65.09	111.4	2.30	44.41	13.82	0.0323	19.30	857.32
Normal	M	42	50.25	200.96	58.8	83.13	56.8	108.07	1.23	18.01	11.78	0.0208	14.69	264.54
Normal	M	35	63.85	218.86	66.85	73	70.92	118.73	1.62	25.81	12.26	0.0242	15.97	412.16

TABLE 1-continued

Group	Gender	Age	TYR	VAL	TRP	PHE	ILE	LEU	Kyn	KA	TRPi	KYN/TRP	KAKYN	PROi
Normal	F	21	64.88	248.28	76.83	76.07	86.05	144.91	1.51	25.19	12.39	0.0197	16.64	419.18
average		31.632	69.400	273.009	71.090	78.811	86.675	150.345	1.865	35.958	10.971	0.027	19.360	757.701
average dev		8.494	12.658	45.118	10.490	10.633	19.504	30.568	0.322	10.086	1.366	0.005	4.500	368.848

Tables

[0177]

TABLE 2

Group	Age (y) Mean ± SD (Range)	Gender (n) Female/ Male)	MMSE Score Mean ± SD (Range)
AD (n = 20)	74.0 ± 7.6 (55-84)	16/4	19.6 ± 6.4 (7-28)
MD (n = 20)	67.7 ± 7.2 (57-82)	12/8	27.2 ± 2.0 (21-30)
SCI (n = 20)	60.2 ± 10.4 (40-74)	8/12	28.7 ± 1.3 (25-30)

TABLE 3

Gradient step	Time (minutes)	% A	% B	% C	% D
1	0.0	99.0	0.0	0.0	1.0
2	6.0	98.0	0.0	0.0	2.0
3	8.0	90.0	6.0	2.0	2.0
4	12.0	80.0	14.0	3.0	3.0
5	18.0	20.0	74.0	3.0	3.0
6	19.0	20.0	74.0	3.0	3.0
7	20.0	95.0	0.0	2.0	3.0
8	22.0	99.0	0.0	0.0	1.0
9	30.0	99.0	0.0	0.0	1.0

TABLE 4

	AD	MD	SCI	Kruskal-Wallis
TRP [μg/ml]	10.7 ± 2.1	10.9 ± 2.4	12.6 ± 3.0	X^2 = 5.507 p = 0.064
KYN [ng/ml]	550.5 ± 232.6	466.2 ± 120.2	487.3 ± 123.3	X^2 = 1.536 p = 0.464
KYNA [ng/ml]	11.1 ± 5.6	11.2 ± 6.0	10.8 ± 3.8	X^2 = 0.033 p = 0.984
3-HK [ng/ml]	32.6 ± 13.0	16.9 ± 17.5	13.3 ± 10.5	X^2 = 20.281 p < 0.0001
3-HK:TRP ratio	3.16 ± 1.54	1.81 ± 2.61	1.11 ± 0.90	X^2 = 21.919 P < 0.0001

1-17. (canceled)

18. A method for detecting Alzheimer's disease comprising the steps of measuring the concentration of tryptophan and/or at least one in vivo degradation product of tryptophan in a body fluid selected from the group consisting of whole blood, serum, plasma, urine, saliva and CSF, obtained from an individuum, and assessing Alzheimer's disease.

19. The method according to claim **18**, wherein the degradation product of tryptophan is selected from the group consisting of 3-hydroxykynurenine, quinolinic acid, melatonin, serotonin, 5-hydroxyindoleacetic acid, kynurenic acid and kynurenine.

20. The method according to claim **19**, further comprising the step of determining the neuroprotective ratio by dividing the value of the concentration of kynurenic acid by the value of the concentration of kynurenine in said body fluid.

21. The method according to claim **20**, wherein an individuum having Alzheimer's disease is characterized by a neuroprotective ratio in the body fluid of about 0 to about 18.

22. The method according to claim **19**, further comprising the step of determining the neuroprotective index by dividing the square value of the concentration of kynurenic acid by the value of the concentration of kynurenine in said body fluid.

23. The method according to claim **22**, wherein an individuum having Alzheimer's disease is characterized by a neuroprotective index of about 0 to about 700.

24. The method according to claim **19**, further comprising the step of determining the ratio by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid in said body fluid.

25. A method according to claim **24**, wherein an individuum having Alzheimer's disease is characterized by a ratio which is about two or higher.

26. The method according to claim **19**, further comprising the step of determining the ratio by dividing the value of the concentration of 3-hydroxykynurenine×1000 by the value of the concentration of tryptophan in said body fluid.

27. The method according to claim **26**, wherein an individuum having Alzheimer's disease is characterized by a ratio which is about two or higher.

28. A method for detecting Alzheimer's disease comprising the step of combining at least two values selected from the group consisting of the concentration of kynurenic acid, the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid or of tryptophan in a body fluid, and the neuroprotective index of a body fluid.

29. A predictive marker for the detection of Alzheimer's disease which is selected from the group consisting of:

(a) a neuroprotective ratio determined by dividing the value of the concentration of kynurenic acid by the value of the concentration of kynurenine in a body fluid;

(b) a neuroprotective index determined by dividing the square value of the concentration of kynurenic acid by the value of the concentration of kynurenine in a body fluid; and

(c) a ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid or of tryptophan in a body fluid.

30. A predictive marker for the detection of Alzheimer's disease which is a combination of at least two values selected from the group consisting of:

(a) the concentration of kynurenic acid;

(b) the neuroprotective ratio, the ratio determined by dividing the value of the concentration of 3-hydroxykynurenine by the value of the concentration of kynurenic acid or tryptophan; and

(c) the neuroprotective index of a body fluid, the neuroprotective index determined by the value of the concentration of kynurenine in a body fluid.

31. A kit containing means for performing a method as defined in claim **18**.

32. A kit containing means for performing a method as defined in claim **28**.

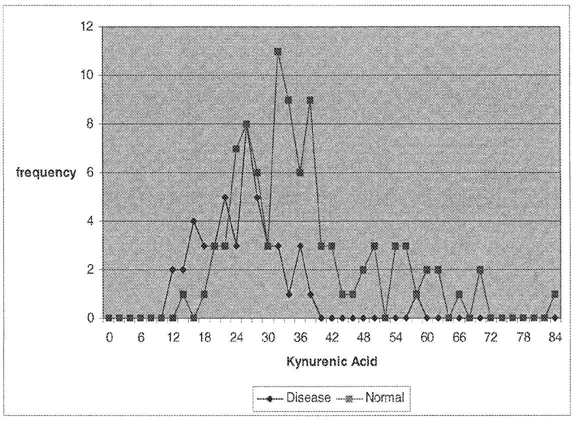
33. A kit for detecting Alzheimer's disease containing means for detecting the concentration of kynurenic acid and/or kynurenine and/or 3-hydroxykynurenine and/or tryptophan in a body fluid.

* * * * *

专利名称(译)	精神疾病的神经退行性标志物		
公开(公告)号	US20120196300A1	公开(公告)日	2012-08-02
申请号	US13/401397	申请日	2012-02-21
[标]申请(专利权)人(译)	维斯塔潘LEOPOLD DIAMED EUROGEN KLINIK & POLIKLINIK毛皮精神病学和PSYCHOTHERAPIE 安特卫普大学 UNIV马斯特里赫特		
申请(专利权)人(译)	维斯塔潘，利奥波德 DIAMED-EUROGEN N.V. KLINIK UND POLIKLINIK毛皮精神病学UND PSYCHOTHERAPIE 安特卫普大学 马斯特里赫特大学		
当前申请(专利权)人(译)	维斯塔潘，利奥波德 DIAMED-EUROGEN N.V. KLINIK UND POLIKLINIK毛皮精神病学UND PSYCHOTHERAPIE 安特卫普大学 马斯特里赫特大学		
[标]发明人	MYINT AYE MU SCHAWALLER MANFRED VERKERK ROBERT SCHWARZ MARKUS J HAMPEL HARALD MULLER NORBERT		
发明人	MYINT, AYE MU SCHAWALLER, MANFRED VERKERK, ROBERT SCHWARZ, MARKUS J. HAMPEL, HARALD MULLER, NORBERT		
IPC分类号	G01N21/64 G01N21/17 G01N33/53		
CPC分类号	G01N33/6896 Y10T436/145555 G01N2800/2821 G01N33/942		
优先权	2005007558 2005-04-06 EP 11/887486 2008-01-25 US PCT/EP2006/002907 2006-03-30 WO		
外部链接	Espacenet USPTO		

摘要(译)

本发明涉及检测任选与抑郁症相关的精神病症的方法，包括测量至少一种色氨酸体内降解产物浓度的步骤。此外，本发明涉及所述值作为预测标志物的用途，所述预测标志物用于检测任选地与抑郁症相关的精神病症和包含用于检测所述值的装置的试剂盒。



frequency
Kynurenic Acid
Disease
Normal
0
2
4
6
8
10
12
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84

Figure 1