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ANALYSIS OF THE MONOSODIUM GLUTAMATE ON NEUROTRANSMITTERS USING QUANTUM METHOD

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ABSTRACT

Monosodium glutamate (GMS) is a sodium salt used as enhancer additive flavor. This GMS is one of the chemicals responsible for maintaining the flavor of long-lasting food. According to studies carried out, consumption of this additive can cause various side effects. Among the most common side, effects of GMS are headaches, nausea, migraines and muscle spasms; in extreme cases may have epilepsy, and heart irregularities. The objective of the study is to determine, using the semi-empirical method of chemical quantum SE-ZINDO/1), which neurotransmitter has a higher affinity with the GMS. Hyperchem Professional software performed Molecular Modelling and analysis of the GMS and nine of the major neurotransmitters. (Hyperchem, Hypercube, Multi on for Windows, series 12-800-1501800080. Multi On, southern 1236-301 Tlacoquemecatl insurgent Col. del Valle, Mexico, Benito Juárez, CP 03200). The result of the simulations of the quantum poles reveals that this additive can oxidize Adrenaline, as well as cross bands related to this neurotransmitter.

KEYWORDS: Monosodium Glutamate, Neurotransmitters, Quantum Method, Hyperchem, SE-ZINDO/1.

INTRODUCTION

Glutamate is a nonessential amino acid that is producing the degradation and metabolism of glucose in the mitochondria inside. Today it is known to be a neuroexcitatory of the nervous system and the central mediator of sensory, motor, cognitive, and emotional information. In addition, it is present in 80-90% of the synapses of the brain.[1, 2]

In the industry, glutamate is used as salt in its form monosodium (monosodium glutamate "GMS"). The GMS is as conservative in many of products, mainly added in food canned or packaged soft drinks, medicines, sausages, sauces, among others.[3, 4] In the last five years has been discovered that the GMS has related the development of obesity, since it could influence the appetite regulation, favoring a high consumption of foods containing it.[5, 6]

Studies in monkeys in 1969, showed that GMS causes brain damage and acute neuronal death when it supplies him subcutaneously.[7] Other studies in Wistar rats showed that prolonged intake of GMS affects kidney functions.[8] As well as cause infertility by histological alterations of the seminiferous tubules, interstitial tissues, and exfoliation of the spermatocytes and the spermatids[9], as well as generate memory loss in rodents as many males as females in different ways.[10]

Other articles suggest that the GMS is a substance genotoxic for lymphocytes from peripheral blood human performed in vitro, causing damage to the DNA in different concentrations.[11] The GMS can produce injury "excitotoxic " that much resemble the neurodegenerative disorders that today suffer from many people around the world. Abnormally increased glutamatergic neurotransmission can cause cellular damage excitotoxic and lead to neuronal death associated with atrophy olivopontocerebellar, Huntington's disease, status epilepticus, hypoxia/ischemia and the Hypoglycemia.[12]

The objective of this study is to determine, using the semi-empirical method of quantum chemistry (SE-ZINDO/1), that neurotransmitter has a high affinity for the GMS. In this study were analyzed nine neurotransmitters which they are: adrenaline, serotonin, dopamine, GABA, glutamic acid, histamine, glycine, noradrenaline, and acetylcholine.

HyperChem is a program for molecular modeling graphic interface, which allows researchers to carry out chemical simulations that facilitate multiple data entry. Through the program, it is possible to analyze the transfer of electrons (ETC) of every interaction coefficient.

The theory of ETC is based on defining the band gap or Bandgap (BG), which is the energy difference between the valence band and the conduction band. In quantum theory, it is known as HOMO and LUMO, and in the old method known as E - and E +. On the other hand, the quantum well is defined as the area in which can drop the value of, etc. These areas are divided into 3 (figure. 1): 1) the area of high probability (zone I), 2) The area's average probability (ZONE II). 3) The area of low-probability (zone III).[13, 14]

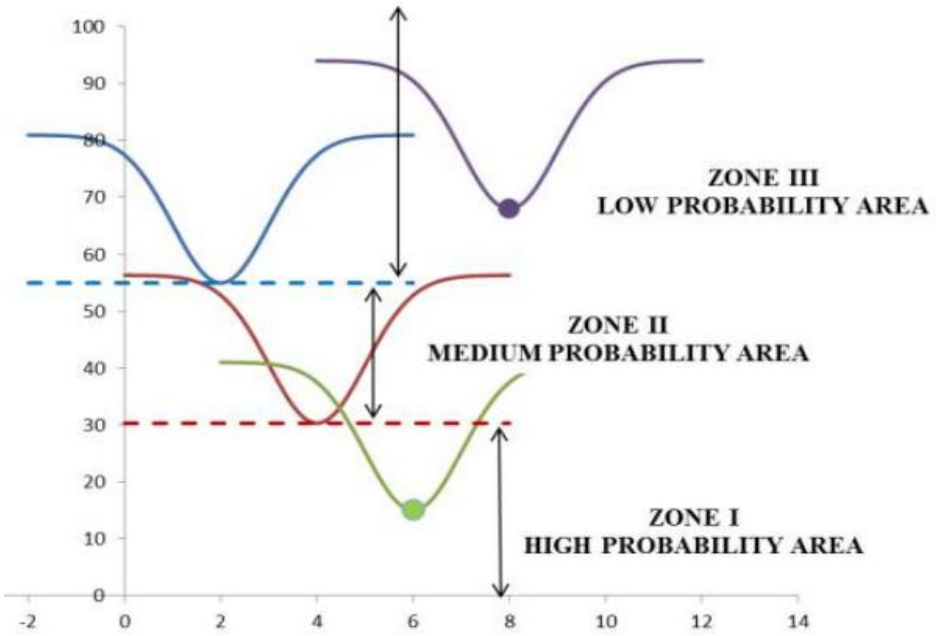


Figure 1. Areas of probability in quantum well, according to the theory of ETC´s.

MATERIALS AND METHODS

The simulation of the GMS molecule was carried out using the Hyperchem Software (Hypercube, Multi On for Windows, series 12-800-1501800080. Multi On, south 1236-301 Col. Insurgentes Tlacoquemecatl del Valle, Benito Juarez, Mexico City, Mexico CP 03200). We utilized the Semiempirical method to perform the BG calculation, the Electrostatic Potential (EP) and the ETC. When the complete molecule is drawn, the values of HOMO (-), LUMO (+), E- and E + are obtained, in the amount at zero and with a density of 0.015. The values that are recorded will be captured in an Excel sheet, and he will perform operations to obtain BG, EP, ETC. We get the cross band of the compounds; it is done taking the HOMO and E- the value of the first compound and the value of LUMO and E + the second compound. The lower ETC of the transverse band will be the value that will determine which compound will be most reactive. The lower value serves as the point that will be placed in the

quantum well graphs To set the limits of the charts, the highest ETC will be put in the upper limit and the ETC lower as, the lower limit of the compounds to be compared.[14, 15]

RESULTS AND DISCUSSION

Table 1 shows the interaction of the GMS against vital neurotransmitters with their respective ETC´s, stressing that the adrenaline has one minor for electrons hop energy.

Table 1. GMS vs Neurotransmisores

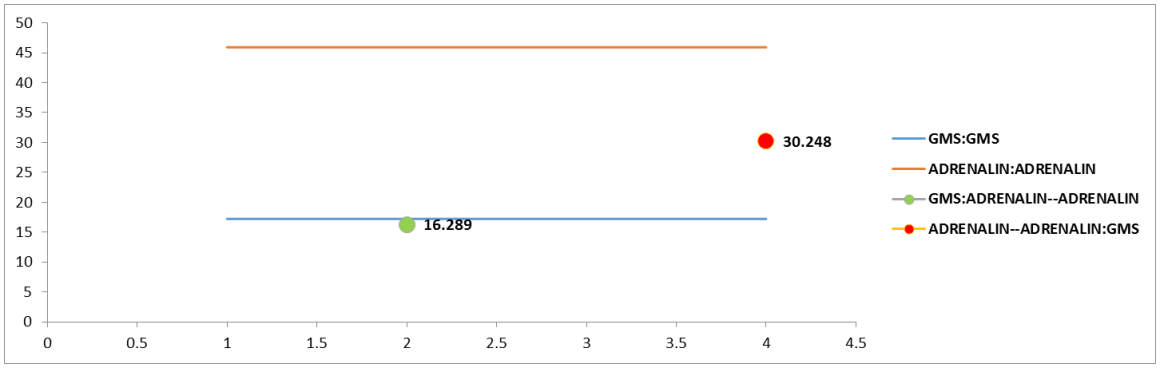
No.	Antioxidant	Oxidant	HOMO	LUMO	BG	E-	E+	EP	ETC
1	GMS	GMS	-5.674	0.288	5.962	-0.156	0.190	0.346	17.232
9	ADRENALIN	ADRENALIN	-8.998	0.092	9.090	-0.117	0.198	0.315	28.858
Option 1	*GMS*	*ADRENALIN*	*-5.674*	*0.092*	*5.766*	*-0.156*	*0.198*	*0.354*	*16.289*
Option 2	ADRENALIN	GMS	-8.998	0.288	9.286	-0.117	0.190	0.307	30.248

In the case of the crossbands, we found that all the neurotransmitters that interact with adrenalin, are oxidized by the GMS. I.e., have a 16.289 ETC, which means that the GMS has a high probability of oxidizing all neurotransmitters analyzed here. In Table 2, we can see the values of the ETC´s..

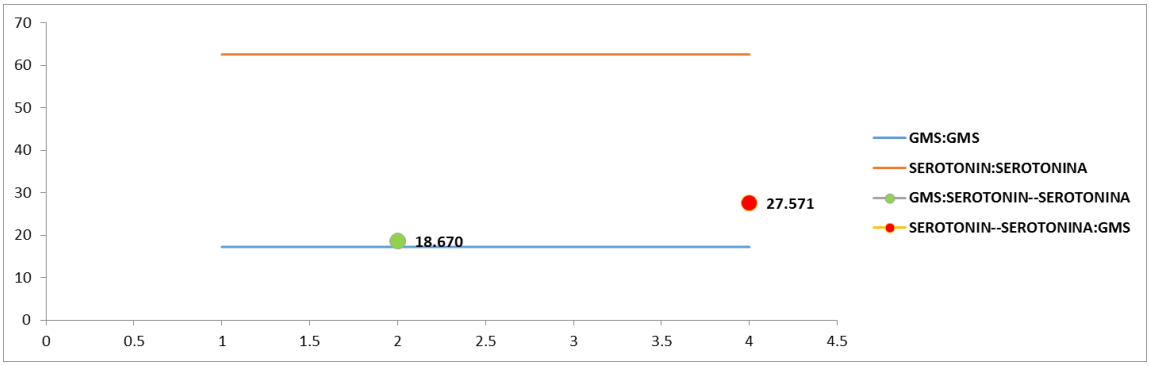
Table 2. Crossed bands vs GMS

No.	Antioxidant	Oxidant	HOMO	LUMO	BG	E-	E+	EP	ETC
1	GMS	SEROTONIN--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
2	GMS	DOPAMINE--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
3	GMS	GABA--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
4	GMS	GLUTAMIC ACID--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
5	GMS	GLYCINE--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
6	GMS	HISTAMINE--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
7	GMS	NORADRENALINE--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
8	GMS	ACETYLCHOLINE--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289
9	GMS	ADRENALIN--ADRENALIN	-5.674	0.092	5.766	-0.156	0.198	0.354	16.289

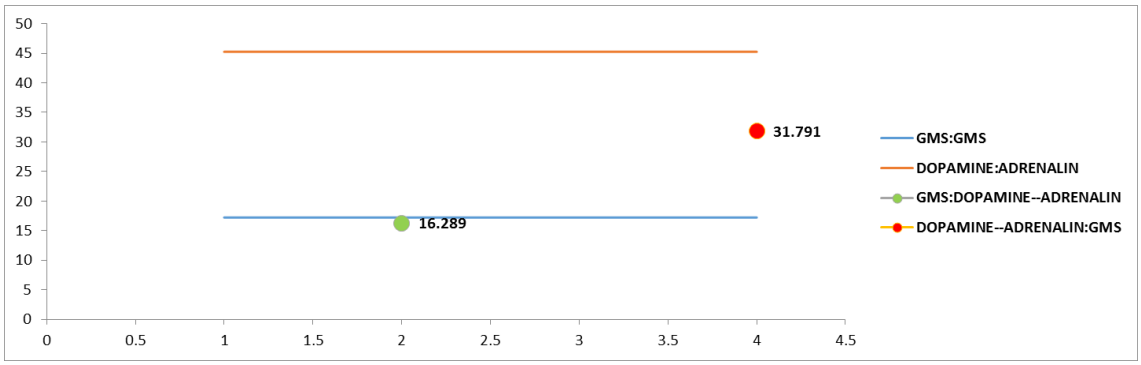
Below we can see the interactions of neurotransmitters in the quantum wells. In these graphs show all cross bands and the area of high probability.



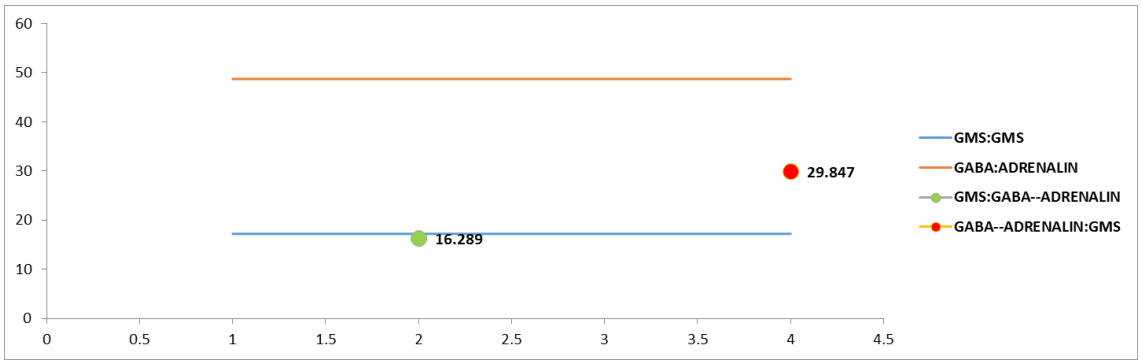
Graph 1. Interaction of the GMS against Adrenalin-Adrenalin.



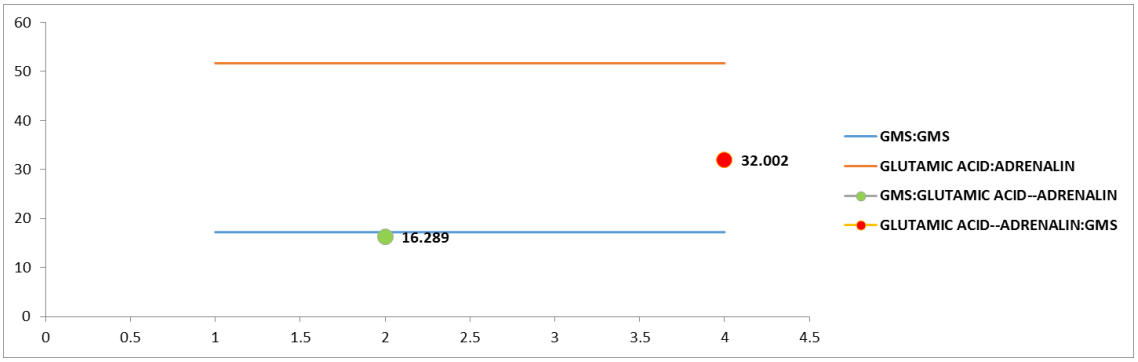
Graph 2. Interaction of the GMS against Serotonin-Adrenalin.



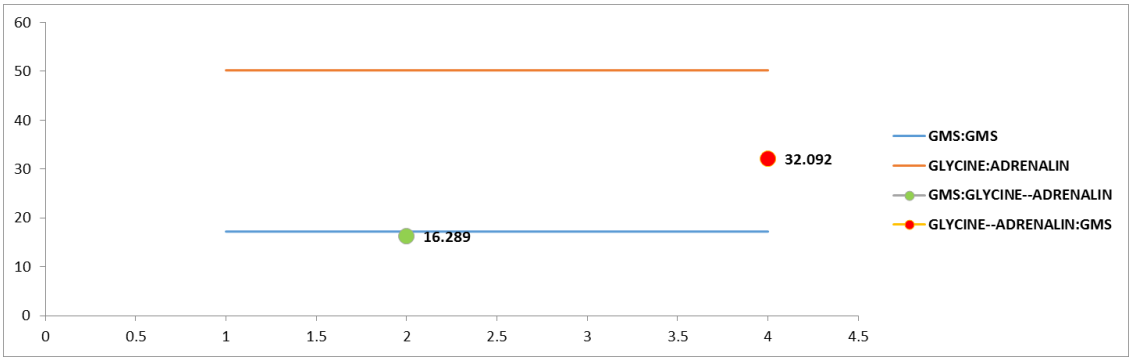
Graph 3. Interaction of the GMS against Dopamine-Adrenalin.



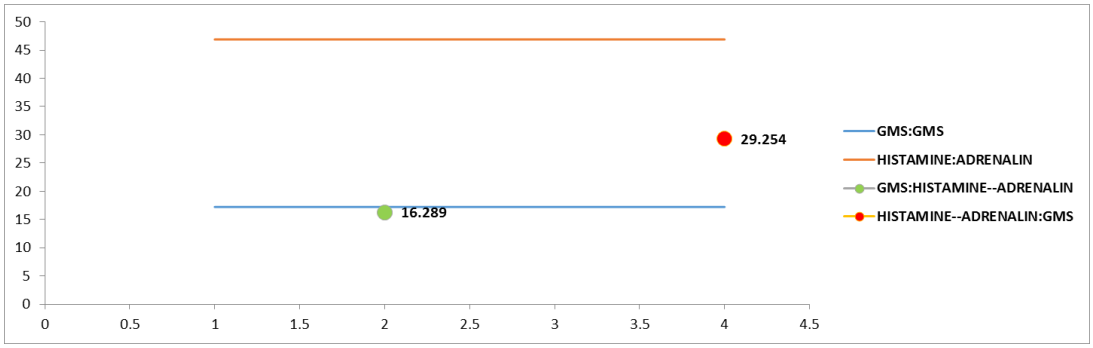
Graph 4. Interaction of the GMS against GABA-Adrenalin.



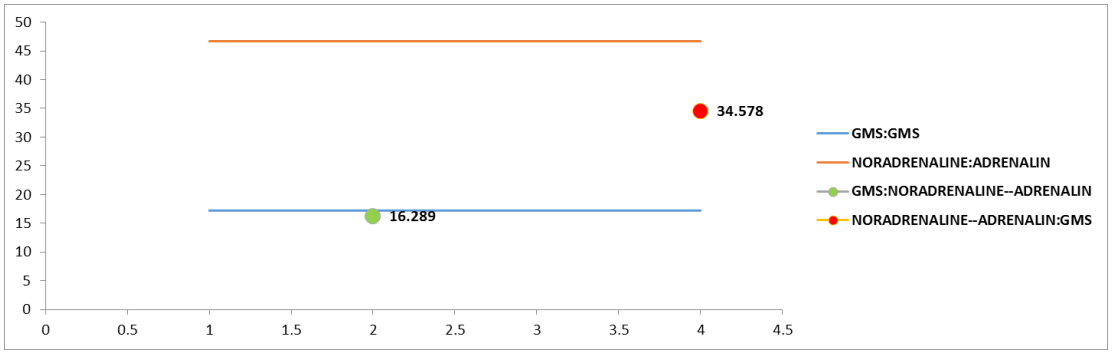
Graph 5. Interaction of the GMS against Acid Glutamic-Adrenalin.



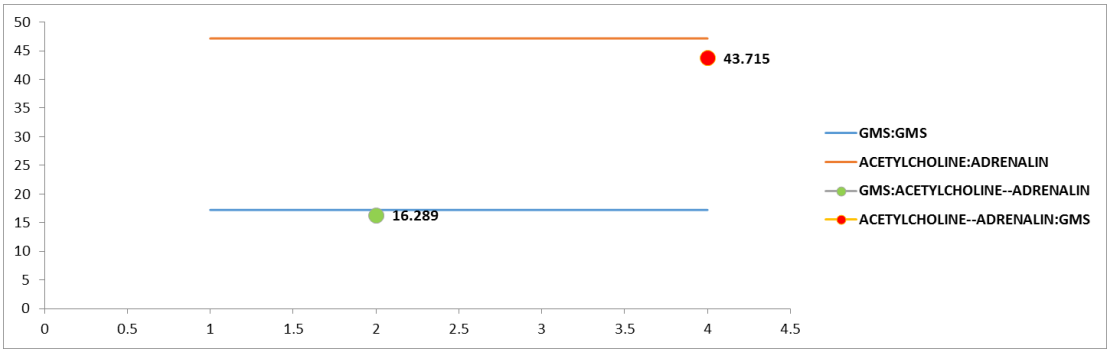
Graph 6. Interaction of the GMS against Glycine-Adrenalin.



Graph 7. Interaction of the GMS against Histamine-Adrenalin.



Graph 8. Interaction of the GMS against Noradrenaline-Adrenalin



Graph 9. Interaction of the GMS against Acetylcholine-Adrenalin

CONCLUSIONS

In the analysis of quantum wells and the interaction of the ETC´s, tells us there is an excellent probability of oxidation the neurotransmitters by the presence of GMS. Both concepts may suggest that this additive may be associated with neurological disorders that lurk in our society. There is a growing amount of experimental evidence that oxidative stress is a causal factor in the neuropathology of several neurodegenerative diseases in adults, as well as stroke, trauma, and seizure disorders. Note that this type of quantum analysis-based probabilistic systems.

The product of the oxidation of adrenaline is also called Adrenochrome and is responsible for various mental disorders, including Alzheimer's disease[18, 19] and schizophrenia.[16,17] Also, high doses of MSG can cause Neurodegeneration in the brain most vulnerable regions such as the hypothalamic arcuate nucleus and generate acute cerebral disorders such as cardiac arrest and hypoxia pre/perinatal.[20]

In the case of Serotonin, we can say it is a monoaminergic neurotransmitter participates in a plethora of physiological processes and behavior, including emotionality, dream, locomotion, perception, cognition, aggression, sexual behavior, and appetite. Most essential disorders of the degradation of serotonin are associated with depression, addictions to substances, attention deficit, irregular sexual cycles, inflammation and dysfunction of gastrointestinal tract, disorders of sleep cycles, anxiety, Fibromyalgia, dizziness, nausea, obesity, chills, tremors, confusion, delirium and tachycardia or fluctuations of blood pressure.[21, 22]

The oxidation of dopamine at high concentrations is correlated with the specific loss of dopaminergic terminals. This oxidation may be related to Parkinson's disease disorder.[23, 24] Other findings suggest that the product of the oxidation of dopamine can change transport of

glutamate function, which may have implications for neurodegenerative processes as ischemia, induced toxicity by methamphetamine and disease of Parkinson.[25]

The neurotransmitter GABA deficiency is rare but can be very serious when it is experienced. This neurotransmitter performs a variety of activities that are strictly related to the operation of the parasympathetic nervous system. Some authors have reported that inhibition or oxidation of the neurotransmitter GABA, may be linked to the regulation of overweight, obesity, hypertension, and hyperglycemia.[26] GABA deficiency can make a person more susceptible to several other diseases. Epilepsy, Huntington's disease, disease, Cushing, meningitis, and psycho-organic syndrome are affected by levels of GABA.[27]

Glutamic acid oxidation also brings severe consequences for health. In 1987, the Academy of Neurology American reported that patients who had amyotrophic lateral sclerosis showed a low concentration of this neurotransmitter in the region of the brain and cervical cord. Brain glutamate deficiency is not explained, but the production or insufficient release of this neurotransmitter Exciter could have significant effects on motor neurons.[28]

Glycine is a neurotransmitter that performs several functions as a transmitter in the central nervous system. As an inhibitory neurotransmitter participates in the processing of motor and sensory information that allows movement, vision, and hearing. Also, the glycine modulates excitatory neurotransmission to potentiate the action of glutamate in N-methyl-D-aspartate receptors.[29] As we see this neurotransmitter, it is vital for the brain, and the oxidation of the same could affect some related functions.

In the case of the histamine, studies have revealed that there are alterations in the histaminergic system in neurological and psychiatric diseases. Brain histamine levels decrease in patients with Alzheimer's disease, while abnormally high concentrations of histamine are found in the brains of Parkinson's disease and schizophrenic patients. Low histamine levels are associated with seizures.[30]

It has been shown that the low level of the neurotransmitter norepinephrine in the central and peripheral, nervous system cause a defective hydroxylation of dopamine. This low level suggests that it provoked a primary genetic defect in the enzyme dopamine-β-hydroxylase or the presence of a highly specific inhibitor of this enzyme. Associated with this deficiency of noradrenaline are an increase in the activity of tyrosine hydroxylase in the central nervous

system and an increase in the active absorption of tyrosine and other amino acids that share a common mechanism of absorption with Tyrosine) through the blood-brain barrier.[31] Finally, it is well known that this neurotransmitter deficiency is closely related to Parkinson's disease.

The significant deterioration of the neurotransmitter acetylcholine is associated with dementia cases, usually caused by Parkinson's disease and Alzheimer's disease.[32] Also, this neurotransmitter is responsible for regulates the vasodilation of the smooth muscles, which its oxidation can be linked with various disorders of the structures related to the autonomic nervous system.

In conclusion, we can say that the oxidation of these neurotransmitters may be the origin of any pathology. The proper functioning of our neurotransmitters gives us a healthy balance in all of our functions of the nervous system. Now, either by our genes or the environment, production or erroneous processing of various neurotransmitters can lead to disorders or physical and psychological disorders.

The study of the quantum grounds between substances and chemicals created by the human body gives us the possibility to study and analyze the interactions among these. In the particular case of the oxidation of neurotransmitters by the oxaloacetic monosodium (Graphics 1 to 9), we can conclude that such alteration is correlated with the side effects of such additive, giving rise to future research.

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