Bölüm

1

Besin - Zehir Algısı

Mono-sodyum-Glutamat; Buyon Konusu (MSG)*

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***Bir ailenin MSG gıda katkısı hakkında sorduklarına verdiğim cevaplar.*
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Akıl, öncelikle kendini sorgulamalı, benlik temelinde olmayan, altının ayarının saptandığı mihenk taşı gibi, İnsan Hakları ve Etik İlkeler ile İrfan konusundaki tanımlamalar, ölçekler temelinde yapılmalıdır.

Sizin konuşmanızı, sizin ne demek istediğini ben anlamam için, öncelikle yüreğinizin içindekini anlamak ve kavramam gerekir. Ayran bizim sık bildiğimiz ve içecek olarak kullandığımız bir içecek ise, bunu bilmeyen Amerikalıya nasıl anlatacaksınız? Çok zor dolduğunu bir deneyerek kavrayın. Balın tadını bile anlatmak olanaksızdır. Şeker, şekerli bir macun gibi bir yiyecek ise, çiçek balı ile çam balını nasıl tanımlayacaksınız.? Sadece tatmak ile ilk aşamada anlanır, ama kavranması için bir süreç gereklidir.

Datça'da kendisinin mühendis olduğunu söyleyen bir kişi, farklı bademlere bakarak, görünüşleri aynı, ama fiyatları çok farklı 50 liradan, 5 liraya kadar olan var dedi. Ben tadın dedim. En ucuzunu aldı ve yedi, hemen en pahalısını verin diyerek, bu yenilmez ki diyerek sonlandırdı.

Mukayese kayda değer ve gereklidir ama, mukayese ettiğiniz boyut anlam ve önem kazanır.

Özet

Mono-sodyum-Glutamat; Buyon Konusu (MSG)

Amaç: Monosodium Glutamat (MSG) bir amino asit olarak, sinirsel uyaranların iletilmesinde görev almaktadır. Bunun besinlere gıda katkısı olarak katılması ile bazı yan etkileri, zararları gündeme getirilmiştir. Bu konu geniş olarak irdelenmektedir.

Dayanaklar/Kaynaklar: Wikipedia, Google ve toxiline yolu ile konu ile ilgili dokümanlar gözden geçirilmiştir.

Genel Yaklaşım; Bir bilgi tüm olumlu ve olumsuz yayınlar ile birlikte irdelendikten sonra bir sonuca varılabilir. Bu açıdan MSG ile ilgili geniş bir literatür taraması yapılmıştır.

Yaklaşım: Bir maddenin etkisi var ise, bu etkinin görülmesi maddenin fizyolojik veya biyolojik gözlenen, beklenen reaksiyonlarıdır. Yan etki veya yan tesir ile istenmeyen zararlı etki/advers etki birbirinden farklıdır. Yüksek doz ile alınamayacak boyutlardaki çalışmalar ile zarar boyutu kullanıma göre

dengelenmelidir. Her ilacın bir toksik etkisi ile tedavi dozu karıştırılmamalıdır. Aradaki güvenlik boyutu, marjı, seviyesi de önemli parametredir. MSG bu açıdan irdelenmiştir.
Sonuç: Tüm değerlendirmeler yanında Bakanlık Kurumlarının FDA, Türk Tarım Gıda Bakanlığı dahil, uygulanmasında bir sakınca dahil vurgu olmadan, ruhsatlandırdıkları görülmektedir.
Yorum: Kahve içenin uykusuz kalması gibi bu katkı maddesinin de etkisinin olacağı algısı ile kullanılması tercihe bağlı olarak bilgilendirme ile yapılması uygundur.
Anahtar Kelimeler: Monosodium Glutamat (MSG), gıda katkısı

Outline
Mono-Sodium-Glutamat; for food additive (MSG)

AIM: Monosodium Glutamat (MSG), is a neurotransmitter functioning amino ascites compound. Thus, it is used as food additives, and some side effects are discussed, taken in notice. This fact is discussed.
Grounding Aspects: Wikipedia, Google ve toxiline is the basic grounding concepts, thus, nearly a wide range of references are taken in notice.
Introduction: The knowledge on MSG, from all aspects, positive and negative perspectives, must be evaluated, and later try to make a conclusion.
Notions: FDA and Turkish Food and Agriculture Minister and reports are also considered, they indicate some warning but, taken as safe food additives. This remarks as coffee effects on sleeping concept.
Conclusion: The MSG influences neuronal stimulus, thus, may case some reactions, personal perspectives are primum importance, but, not to consider all safe, for not taken great amount, may be side effects, especially individually. Personal demand, by information given.
Key Words: Monosodium Glutamat (MSG), food additives

Giriş

Yemeklerimize et suyu, tavuk suyu yerine, daha doğrusu bunların öğütülmüş ve kurutulmuş özleri ile yemeklerimizin daha lezzetli olması için koyduğumuz et-suyu/tavuk-suyu Bulyonları, buyon olarak okunan küpler hakkında farklı görüşler sunulmaktadır.

1908 yılından bu yana kullanılan bu madde konusunda bir değerlendirme yapılmaktadır. Bu bir gıda katkısı olup, Kanıta Dayalı Tıp kavramı içinde irdelenmesi yapılmaktadır. Ruhsatlı bir ürün olduğu da irdeleme öncesi belirtilmelidir.

Asya Çin orijinli olduğu için, Batı Dünyası için bir bağımlılık yaratan ve istenmeyen bir tabu olarak görüldüğü de ifade edildiğinden, benimsenme boyutunda zorlamalar gözlenmektedir.

Et Suyu Bulyon üstünde, *Daha Lezzetli Yemekler* vurgusu ile yazılanlar:

- Bulyonlarımızda kemik veya sakatat eklenmemiş lezzetli etler kullanılır.
- Etlerimiz haşlanıp kurutulur, özenle seçilen baharat ve sebzelerle lezzetlendirilir.
- Enerji ve besin öğeleri, 100gram Bulyon içinde: Enerji: 280kkal, Yağ: 19g, doymuş yağ: 14g, karbonhidrat: 15g, Lif: 3g, Protein 8g, Sodyum 19.8g
- İçindekiler: iyotlu tuz, bitkisel hurma yağı, aroma arttırıcılar (monosodium Glutamat, Disodyum inosinat, Disodyum guanilat), nişastalar, kıvam arttırıcı (ksantam gam), aroma vericiler, şeker, sirke tozu, soğan tozu, kurutulmuş öğütülmüş havuç, kurutulmuş öğütülmüş sığır eti, kurutulmuş öğütülmüş kereviz
- 1 litreye bir tablet

1) Monosodium glutamate (Wikipedia)

Monosodium glutamate (**MSG**, also known as **sodium glutamate**) is the sodium salt of glutamic acid, one of the most abundant naturally occurring non-essential amino acids.[2] Monosodium glutamate is found naturally in tomatoes, cheese and other foods.[3]
MSG is used in the food industry as a flavor enhancer with an umami taste that intensifies the meaty, savory flavor of food, as naturally occurring glutamate does in foods such as stews and meat soups.[4][5] It was first prepared in 1908 by Japanese biochemist Kikunae Ikeda, who was trying to isolate and duplicate the savory taste of *kombu*, an edible seaweed used as a base for many Japanese soups. MSG as a flavor enhancer balances, blends, and rounds the perception of other tastes.[6][7]
The U.S. Food and Drug Administration has given MSG its generally recognized as safe (GRAS) designation.[8] A popular belief is that large doses of MSG can cause headaches and other feelings of discomfort, known as "Chinese restaurant syndrome," but double-blind tests fail to find evidence of such a reaction.[8][9][10] The European Union classifies it as a food additive permitted in certain foods and subject to quantitative limits. MSG has the HS code 29224220 and the E number E621.[11]

Yorum

Burada öncelikle Lethal/zehirleme dozu ilk planda belirtilmelidir. 15800mg/kg'dır. Kilo başına 15 gram alınmalıdır, bir tablette tüm buyon 10gram, sodyum ise 19,8 gramdır. Bir tablet 10 gramdır. Na %20 civarındadır.

Gıda katkısının konulmaması, doğal olanın kullanılması önerilebilir. Ancak benimki güzel, seninki ise zehirdir yaklaşımı kültür çatışmalarını akla getirmektedir.

Karadeniz sahilinde kime sorarsanız, farklı çay demlenmesini ve farklı usuller belirtir. Diğer usuller ile çayın içilmeyeceğini ve güzel olamayacağını vurgular. Bu bir aile geleneği ve usullerinin devamlılığı anlamındadır. Kabile zihniyetinde başkasının simgesi düşman, kendi simgesi ile dosttur. Futbol takımlarında bu boyut çok belirgindir. Sarı-kırmız ve sarı-lacivert karıştırılmamalıdır.

Çin tadı olduğu için, Batıyı bağımlı hale getiren bir katkı olarak görüldüğü ve bu açıdan da Çin Restoran Sendromu denildiği gözlenmektedir.

Endüstri kültüründe de bir kesin CocaCola içerken, diğer kesim de PepsiCola içmektedirler. Bunlar farklı açıdan birbirlerinin kolalarını tenkit ederler.

Bazı kişilerde, genellikle yaşlılarda kanser ve bazı toksik madde korkusu ile bunu yansıtmaktadırlar. Bu bir fobi boyutuna çıkmaktadır.

Kanıta Dayalı Tıp Kavramında zarar kavramı soyut değil somut olarak ortaya konulmalıdır. Nitekim Amerika'da Gıda Tarım ve İlaç Bakanlığı "The U.S. Food and Drug Administration has given MSG its generally recognized as safe (GRAS) designation" olarak güvenli tanımlaması yapmaktadır.

Use

Pure MSG is reported to not have a pleasant taste until it is combined with a savory aroma.[12] The basic sensory function of MSG is attributed to its ability to enhance savory taste-active compounds when added in the proper concentration.[6] The optimum concentration varies by food; in clear soup, the pleasure score rapidly falls with the addition of more than one gram of MSG per 100 mL.[13]
The sodium content (in mass percent) of MSG, 12%, is about one-third of that in sodium chloride (39%), due to the greater mass of the glutamate counterion.[14] Although other salts of glutamate have been used in low-salt soups, they are less palatable than MSG.[15]

Yorum

MSG içine tuzlu ve özellikle baharatlı, acılı lezzet arttırıcıların konması ile acı tadı olacağı belirtilmektedir. İçinde tuz olması ve bunun iyotlu tuz olması ile, ayrıca çorbaya tuz konulması gereksiz olmaktadır. Ayrıca eşitli baharatların da bulunması ile ek katkı gerekmemektedir. Bu durumda dengeleme sağlanmış olacaktır.

Safety

A popular belief is that MSG can cause headaches and other feelings of discomfort but double-blind tests have found no good evidence to support this.[9] MSG has been used for more than 100 years to season food, with a number of studies conducted on its safety. Consumption and manufacture of high-salt and high-glutamate foods, which contain both sodium and glutamate, stretch back far longer, with evidence of cheese manufacture as early as 5,500 BC.[16] International and national bodies governing food additives currently consider MSG safe for human consumption as a flavor enhancer.[17] Under normal conditions, humans can metabolize relatively large quantities of glutamate, which is naturally produced in the gut in the course of protein hydrolysis. The median lethal dose (LD_{50}) is between 15 and 18 g/kg body weight in rats and mice, respectively, five times greater than the LD_{50} of salt (3 g/kg in rats). The use of MSG as a food additive and the natural level of glutamic acid in foods are not toxicological concerns in humans.[17]

A 1995 report from the Federation of American Societies for Experimental Biology (FASEB) for the United States Food and Drug Administration (FDA) concluded that MSG is safe when "eaten at customary levels" and, although a subgroup of otherwise-healthy individuals develop an MSG symptom complex when exposed to 3 g of MSG in the absence of food, MSG as a cause has not been established because the symptom reports are anecdotal.[18]
According to the report, no data support the role of glutamate in chronic disease. A controlled, double-blind, multiple-location clinical trial failed to demonstrate a relationship between the MSG symptom complex and actual MSG consumption. No statistical association has been demonstrated, and the few responses were inconsistent. No symptoms were observed when MSG was administered with food.[19][20][21][22]
Adequately controlling for experimental bias includes a double-blind, placebo-controlled experimental design (DBPC) and administration by capsule, because of the unique aftertaste of glutamates.[21] In a study by Tarasoff and Kelly (1993), 71 fasting participants were given 5 g of MSG and then a standard breakfast. One reaction (to the placebo, in a self-identified MSG-sensitive individual) occurred.[19] A study by Geha *et al.* (2000) tested the reaction of 130 subjects with a reported sensitivity to MSG. Multiple DBPC trials were performed, with subjects exhibiting at least two symptoms continuing. Two people out of the 130 responded to all four challenges. Because of the low prevalence, the researchers concluded that a response to MSG was not reproducible.[23]
Studies exploring MSG's role in obesity have yielded mixed results.[24][25]
Although several studies have investigated anecdotal links between MSG and asthma, current evidence does not support a causal association.[26] Since glutamates are important neurotransmitters in the human brain, playing a key role in learning and memory, ongoing neurological studies indicate a need for further research.[27]

Yorum

Bazı çalışmalarda gıda içine katkı olarak değil, doğrudan toz olarak içilmesini gündeme getirerek, baş ağrısı yaptığı ifade edilmektedir. 3 gram MSG olması, Bir seferde 2 tabletin doğrudan yenilmesidir, kısaca 2 litre suya/çorbaya atılan maddenin bir kişinin, bir defa yemesi anlamındadır. Tuzlu olduğu için bir seferde yenilmesi olanaklı görülmemektedir.

Chinese restaurant syndrome
A hypothetical MSG symptom complex, named "Chinese restaurant syndrome", attracted attention in the period after 1968, when Robert Ho Man Kwok reported symptoms he felt after an American-Chinese meal. Kwok suggested possible reasons for his symptoms, including alcohol (from cooking with wine), sodium, and MSG; however, a number of symptoms have become associated with MSG.[19]
Food Standards Australia New Zealand (FSANZ) MSG technical report concludes, "There is no convincing evidence that MSG is a significant factor in causing systemic reactions resulting in severe illness or mortality. The studies conducted to date on Chinese restaurant syndrome (CRS) have largely failed to demonstrate a causal association with MSG. Symptoms resembling those of CRS may be provoked in a clinical setting in small numbers of individuals by the administration of large doses of MSG without food. However, such effects are neither persistent nor serious and are likely to be attenuated when MSG is consumed with food. In terms of more serious adverse effects such as the triggering of bronchospasm in asthmatic individuals, the evidence does not indicate that MSG is a significant trigger factor."[28][29]
However, the FSANZ MSG report says that although no data are available on average MSG consumption in Australia and New Zealand, "data from the United Kingdom indicates an average intake of 590 mg/day, with extreme users (97.5th percentile consumers) consuming 2330 mg/day" (Rhodes *et al.* 1991). In a highly seasoned restaurant meal, intakes as high as 5000 mg or more may be possible (Yang *et al.* 1997). When very large doses of MSG (>5 g MSG in a bolus dose) are ingested, plasma glutamate concentration will significantly increase. However, the concentration typically returns to normal within two hours. In general, foods providing metabolizable carbohydrate significantly attenuate peak plasma glutamate levels at doses up to 150 mg/kg body weight. Two earlier studies—the 1987 Joint FAO/WHO Expert Committee on Food Additives (JECFA) and the 1995 Federation of American Societies for Experimental Biology (FASEB)—concluded, "there may be a small number of unstable asthmatics who respond to doses of 1.5 – 2.5g of MSG in the absence of food". The FASEB evaluation concluded, "sufficient evidence exists to indicate some individuals may experience manifestations of CRS when exposed to a ≥3g bolus dose of MSG in the absence of food".[28]

Yorum

Glutamat metabolizmada olan bir aminoasit olup, zararlı etkisi beklenilmemektedir. Aminoasit alınması ile metabolizmada yıkıma giderek, enerji olarak kullanılabilir, kapsadığı azot ta renal solüt yükü yapabilir. Sodium yüksek oranda olması söz konusu olmadığı için, belirtilen zehirlenmenin mekanizmasını açıklamak zor olmaktadır.

Production

MSG has been produced by three methods: hydrolysis of vegetable proteins with hydrochloric acid to disrupt peptide bonds (1909–1962); direct chemical synthesis with acrylonitrile (1962–1973), and bacterial fermentation (the current method).[30] Wheat gluten was originally used for hydrolysis because it contains more than 30 g of glutamate and glutamine in 100 g of protein. As demand for MSG increased, chemical synthesis and fermentation were studied. The polyacrylic fiber industry began in Japan during the mid-1950s, and acrylonitrile was adopted as a base material to synthesize MSG.[31]
Currently (2016), most global MSG is produced by bacterial fermentation in a process similar to making vinegar or yogurt. Sodium is added later, for neutralization. During fermentation, *Corynebacterium* species, cultured with ammonia and carbohydrates from sugar beets, sugar cane, tapioca or molasses, excrete amino acids into a culture broth from which L-glutamate is isolated. The Kyowa Hakko Kogyo Company developed industrial fermentation to produce L-glutamate.[32]
The conversion yield and production rate (from sugars to glutamate) continues to improve in the industrial production of MSG, keeping up with demand.[30] The product, after filtration, concentration, acidification, and crystallization, is glutamate, sodium, and water.

Chemical properties

The compound is usually available as the monohydrate, a white, odorless, crystalline powder. The solid contains separate sodium cations Na+ and glutamate anions in zwitterionic form, $^{-}$OOC-CH(NH+ 3)-(CH 2)$_2$-COO^{-}.[33] In solution it dissociates into glutamate and sodium ions.
MSG is freely soluble in water, but it is not hygroscopic and is insoluble in common organic solvents (such as ether).[34] It is generally stable under food-processing conditions. MSG does not break down during cooking and, like other amino acids, will exhibit a Maillard reaction (browning) in the presence of sugars at very high temperatures.[35]

Yorum

MSG temini başlıca üç yol ile olmaktadır; a) bitkisel proteinlerin HCl asit, mide asiti ile parçalanmasıyla, b) doğrudan sentez ve c) bakteriyel fermantasyon ile oluşturulabilmektedir. 100 gram buğday proteininde 30 gram Glutamin/Glutamat bulunmaktadır.

History

Glutamic acid was discovered and identified in 1866 by the German chemist Karl Heinrich Ritthausen, who treated wheat gluten (for which it was named) with sulfuric acid.[36] Kikunae Ikeda of Tokyo Imperial University isolated glutamic acid as a taste substance in 1908 from the seaweed *Laminaria japonica* (*kombu*) by aqueous extraction and crystallization, calling its taste *umami*.[37] Ikeda noticed that *dashi*, the Japanese broth of *katsuobushi* and *kombu*, had a unique taste not yet scientifically described (not sweet, salty, sour, or bitter).[37] To verify that ionized glutamate was responsible for *umami*, he studied the taste properties of glutamate salts: calcium, potassium, ammonium, and magnesium glutamate. All these salts elicited *umami* and a metallic taste due to the other minerals. Of them, sodium glutamate was the most soluble, most palatable, and easiest to crystallize.[*citation needed*] Ikeda called his product "monosodium glutamate", and submitted a patent to produce MSG;[38] the Suzuki brothers began commercial production of MSG in 1909 as *Aji-no-moto* (味の素, "essence of taste").[30][35][39]

Society and culture

It has been suggested that a fear of MSG may reflect anti-Asian racism, with MSG being seen as an "Oriental", alien arrival in Western cooking, likely to be dangerous.[40][41][42] Food critic Jeffrey Steingarten argued that fear of MSG should be seen as a Western-centric mindset, lacking awareness of its common use in Far Eastern cooking without apparent problems: "If MSG is a problem, why doesn't everyone in China have a headache?"[43][44]

Yorum

Burada bir önyargı olduğu, neden Çin'de restoranlarda sorun yok iken, bunun Batı da olması da bir soru yaratmaktadır. Bazı Avrupa ilaçları Amerika'da yaygınlığı olmamıştır. Aspirin bile çok sonra kabul edilmiştir.

Regulations

United States

MSG is one of several forms of glutamic acid found in foods, in large part because glutamic acid (an amino acid) is pervasive in nature. Glutamic acid and its salts may be present in a variety of other additives, including hydrolyzed vegetable protein, autolyzed yeast, hydrolyzed yeast, yeast extract, soy extracts, and protein isolate, which must be specifically labeled. Since 1998, MSG cannot be included in the term "spices and flavorings". The ribonucleotide food additives disodium inosinate and disodium guanylate are usually used with monosodium glutamate-containing ingredients. However, the term "natural flavor" is used by the food industry for glutamic acid (chemically similar to MSG, lacking only the sodium ion). The Food and Drug Administration does not require disclosure of components and amounts of "natural flavor."[45]
The FDA considers labels such as "no MSG" or "no added MSG" misleading if the food has ingredients which are sources of free glutamate, such as hydrolyzed protein. In 1993, it proposed adding "contains glutamate" to the common names of certain hydrolyzed proteins with substantial amounts of glutamate.[*citation needed*]

Australia and New Zealand

Standard 1.2.4 of the Australia and New Zealand Food Standards Code requires MSG to be labeled in packaged foods. The label must have the food-additive class name (e.g. "flavour enhancer"), followed by the name of the additive ("MSG") or its International Numbering System (INS) number, 621.[46]

Pakistan

Punjab Food Authority banned MSG from being used in food products in January 2018 on it being detrimental to general, and particularly cardiovascular, health.[47]

2) Nutrition and healthy eating

https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/expert-answers/monosodium-glutamate/faq-20058196

Healthy Lifestyle

What is MSG? Is it bad for you?

Answers from Katherine Zeratsky, R.D., L.D.

Monosodium glutamate (MSG) is a flavor enhancer commonly added to Chinese food, canned vegetables, soups and processed meats. The Food and Drug Administration (FDA) has classified MSG as a food ingredient that's "generally recognized as safe," but its use remains controversial. For this reason, when MSG is added to food, the FDA requires that it be listed on the label.
MSG has been used as a food additive for decades. Over the years, the FDA has received many anecdotal reports of adverse reactions to foods containing MSG. These reactions — known as MSG symptom complex — include:

- Headache
- Flushing
- Sweating
- Facial pressure or tightness

- Numbness, tingling or burning in the face, neck and other areas
- Rapid, fluttering heartbeats (heart palpitations)
- Chest pain
- Nausea
- Weakness

However, researchers have found no definitive evidence of a link between MSG and these symptoms. Researchers acknowledge, though, that a small percentage of people may have short-term reactions to MSG. Symptoms are usually mild and don't require treatment. The only way to prevent a reaction is to avoid foods containing MSG.

Yorum

Bu yorumu yapanların hekim olmadıkları görülmektedir. Bu sorunların Çin'de gözlenmemesi de ilginçtir. Tüketenlerde görülme oranı ve görülen olguların bile belirtilmemesi, sadece internet kaynaklı bilgi aktarımı olması, bilimsel kaynak ve dayanaklarının olmaması da ilginçtir. Bir metabolize edilen ve buğdayda 100 gramda 30 gram gibi oranda Glutamat olması ile aynı bulguları buğday yedikten sonra da gözlenmesi gerektiğinden dolayı, neden olmadığı da bir soru işaretidir.

3) LEZZET ARTTIRICI MSG'NİN KORKUNÇ ZARARLARI!

http://hastaliktasagliktagelismelerhaberler.blogspot.com.tr/2013/01/lezzet-arttirici-msgnin-korkunc.html

"Monosodyum Gulutamat" (E621)

Çin ve Japon mutfaklarının vazgeçilmez aroması Monosodyum Glutamat, hazır gıdalarda Türkiye de dahil bir çok ülkede yaygın bir şekilde kullanılıyor. Uzmanlar, hazır gıdalardaki bu lezzet arttırıcının, özellikle çocukların gelişiminde önemli bir risk oluşturduğunu ve sıkça kullanıldığında birçok hastalığı da beraberinde getirdiğini söylüyor.

Özellikle Çin ve Japon mutfaklarında lezzet arttırıcı olarak kullanılan MSG- Monosodyum Glutamat (E621) artık Türk mutfağında da sıklıkla kullanılıyor. Uzmanlar Türk mutfaklarında da sıklıkla kullanılan Monosodyum Glutamatın pek çok zararı olduğunu söylüyor. Oluşan zararlı reaksiyonlar nedeniyle özellikle çocukların etkilendiği söyleyen uzmanlar, bu lezzet arttırıcının, "alzheimer'dan parkinson'a göz hasarından çocuklarda büyüme hormonunun baskılanmasına" kadar pek çok rahatsızlığa neden olduğunu bildiriyor. MSG'nin reaksiyonlarına "Çin Restoranı Sendromu" da deniyor.

MSG (E621) Glukom'a neden olabiliyor

Yapılan araştırmalar, Monosodyum Glutamat'ın (E621) retinadaki hücrelere saldırdığını gösteriyor...

Japon bilim adamları, birçok hazır gıda da lezzet verici olarak kullanılan monosodyum glutamat (E621) maddesinin gözlere zarar verdiğini gözlemledi. Hirosaki Üniversitesi'nde görevli bilim adamı Hiroşi Ohguro ve ekibi tarafından yapılan deneylerde, farelere çeşitli miktarda monosodyum glutamat verildi. Japon bilim adamları, Glutamat maddesinin retinadaki (ağtabaka) hücrelere saldırdığını ve bu nedenle farelerin, görme yeteneğinin azaldığını tespit ettiler. Hiroşi Ohguro, lezzet verici olarak kullanılan monosodyum glutamat maddesinin yoğun olarak kullanıldığı Asya bölgesinde, glukom olarak bilinen göz hastalığının bir çeşidinin çok sık görüldüğünü belirterek, bu durumun araştırılması gerektiğini söyledi. Monosodyum Glutamat, Türkiye'de de pek çok hazır gıda da lezzet verici olarak kullanılıyor.

MSG katkılı gıdalar "Tad Alma" duyumuzu etkiliyor

Tad alma duyumuz nasıl çalışır?

Tat alma duyusu, dil üzerindeki 200 adet tat tomurcuğunun içine tükürük tarafından ayrıma uğrayan kimyasal maddelerin girmesiyle başlar. Burada oluşan sinyaller, sinirler yoluyla beyine taşınarak tad alma duyumuzu harekete geçirir. Dilimiz genelde 4 farklı tadı algılayabiliyor. Bunlar, tatlı, acı, ekşi ve tuzlu olarak biliniyor.

Tatlı besinler dilin ucu, acı dilin kökü, ekşi ve tuzlu ise, dilin yan kısımları tarafından ayırdediliyor. Dilimiz 4 veya 5 tadı ayırdebilirken beynimiz, yüzlerce tadın karışımını değerlendirebiliyor. Lezzet ise, tat ve koku duyularının ortak çalışmasıyla algılanıyor. Koku alma duyusu, lezzeti ayırdetme görevinin yüzde 70-80 gibi önemli bir kısmını üstleniyor.

MSG katkılı ürünlere dikkat!

Monosodyum Glutamat, tad alma duyumuzu etkiliyor. Ağzımıza attığımız ilk yemekle birlikte tat alma duyusu harekete geçerek, beyne ilk sinyalini gönderiyor. Bu ilk sinyalle birlikte tadı oluşturan madde ağzımızda kaldığı sürece (yuttuktan sonrada tad ağzımızda bir süre daha kalıyor.) sinyallerin seviyesine karşı duyarlılık hızla düşmeye başlıyor. Bu nedenle bazen yediğimiz çok tatlı bir yiyecekten sonra alınan gıda (örn. içilen çay) bize şekersizmiş gibi geliyor. Bizler farkında olmasak dahi yemek yerken bile aynı olay gerçekleşiyor. Yediğimiz aynı yemekte bile ilk lokma ile son lokma arasında bir tad azalması oluyor. Monosodyum Glutamat içeren gıdalar yediğimizde ise, tad alma duyumuz daha fazla hassaslaşıyor ve bu nedenle MSG'li gıdalar daha fazla tüketiliyor. MSG'li yiyeceklerden sonra alınan normal besinlerde tad alma duyarlılığımız azalıyor. Yapılan araştırmalarda, çocukların ve gençlerin yedikleri hazır gıda maddelerden sonra (örn. cipsler, gofretler) diğer besleyici besinleri tat alamadıkları gerekçesiyle yemedikleri gözlemlendi.

Monosodyum Glutamat, birçok gazlı içecek ve hazır gıda da olduğu gibi, kimyasalların bir kısmı dilimizdeki artıkları hızla parçalayarak midemize gönderiyor, diğer bir kısmı ise bunları nötrleştirerek, her lokmanın ilk lokmaymış gibi algılanmasına neden oluyor.

Monosodyum Glutamat çocuklarda büyüme hormonunun baskılanmasına neden oluyor!

Mono Sodyum Glutamat. (E621) lezzet verici katkı maddesi sayesinde hazır gıda ürünler, kişiler tarafından çok lezzetli olduğu için sıklıkla tüketiliyor. Bu madde (msg) beynin, en berbat yiyecekleri bile son derece lezzetliymiş gibi algılatıyor.

Verdiği zararlar:

• Nörotiksin bir madde olan MSG, sinir hücrelerine zarar veriyor.
• Sebep olduğu hastalıklar ise, merkezi sinir sistemi tahribatına bağlı olarak Alzheimer, Parkinson, Huntington hastalıkları ve Sara (epilepsi),
• Retinal dejenerasyonu (göz retina tabakası hasarı),
• Yağ birikimi, doyma mekanizmasında bozukluk, Obezite,
• Büyüme hormonunun baskılanması,
• Pankreas hasarı, insülinde artış ve buna bağlı olarak diyabet gelişimi,
• Böbrek ve karaciğerde hasar,
• Bu madde hamilelerde plasenta bariyerini geçerek bebeklerinde aynı etkilere maruz kalmasına neden oluyor.

Bu zararların hepsi çok sayıda çalışmayla kanıtlanmış ve bununla ilgili bir rapor Dünya Sağlık Örgütüne sunulmuş durumda.
MSG'nin neden olduğu reaksiyonlar:
• Baş ağrısı,
• Bulantı
• İshal,
• Terleme,
• Göğüste sıkışma,
• Boyun arkasında yanma
Bu tür reaksiyonlar fazla miktarda MSG alınması sonucunda oluşur. Bu maddeyi tüketen astımlı hastalarda ağır astım atakları oluşabilmektedir.
Msg katkılı ürün grupları:
• Hemen hemen tüm cipslerde,
• Bazı katı ve ekmek üstü yağlarda,
• Et sularında,
• Hazır çorbalarda,
• Hazır soslarda,
• Tatlı-tuzlu hazır ürünlerin bazılarında…
Bu madde bazı ürün gruplarında; Mono Sodyum Glutamat, Msg, Glutamic asit, Glutamin ve Glutamat olarak adlandırılmıştır.
Monosodyum Glutamat Hamileleri ve Doğacak Bebekleri de Etkiliyor…
Anne karnında gelişmekte olan bebek ya da emzik çağında olan bebekler de MSG'den etkileniyor. Anne adayları ya da anne olanlar, yedikleri MSG'li hazır gıdalar nedeniyle hem hamilelikte hem de emzirirken, bu zarar verici katkı maddesini farkında olmadan bebeğinde almasını sağlıyor. Bu katkı maddesi bazı ülkelerde uyarı ile satılmaktadır. Bazılarında ise, çocuklar için üretilen ürünlerde kullanmak yasaktır. Bu madde özellikle çocuklar açısından "kesinlikle ciddiye alınmalıdır".
Monosodyum Glutamat, Anne karnındaki bebeklerde ve en az iki yaşına kadar olan çocuklarda "kanserojen özelliği" olabileceği tespit edilmiş ciddi zararları olan bir maddedir
indigodergisi.com/arsiv den alıntı
30th January 2013, hastalıkta sağlıkta tarafından yayınlandı

Yorum

Burada bazı konular Kanıta Dayalı Tıp Kavramında netleştirilmelidir.

- Kaynak iletilmelidir ki "Uzmanlar, hazır gıdalardaki bu lezzet arttırıcının, özellikle çocukların gelişiminde önemli bir risk oluşturduğunu ve sıkça kullanıldığında birçok hastalığı da beraberinde getirdiğini söylüyor" tanımında bunu belirten uzman kimdir sorusu akla gelmektedir.
- Burada vurgulanalar "Uzmanlar Türk mutfaklarında da sıklıkla kullanılan Monosodyum Glutamatın pek çok zararı olduğunu söylüyor. Oluşan zararlı reaksiyonlar nedeniyle özellikle çocukların etkilendiği söyleyen uzmanlar, bu lezzet arttırıcının, "alzheimer'dan parkinson'a göz hasarından çocuklarda büyüme hormonunun baskılanmasına" kadar" olup, erişkin sorunlarıdır ve büyüme hormonuna etkisi olması bir doğal aminoasidin anlamlı olmamaktadır. Bazı fenilalanin yüksekliğinin Toksisite yarattığı bilinmekte ve fenil Ketonüri yaparken Glutamat ile ilgili bir yayın bilenmemektedir. Çinliler kısa diye buna bağlanması da anlamsız olmaktadır.
- Çin lokanta sendromunun gerçek veri olmadığı ve belirgin olarak Çin'de gözlenmediği bilinmelidir. Dünyada en kalabalık ülkesinde Çin lokanta sendromu olmaması ilginçtir.
- Glokom retina değil, lens ile ön kamera arasındaki sorunlar oluşturmaktadır. Belirtilen makale bulunamamıştır. Ortada bir yaklaşım hatası vardır.
- Tat verici bir maddenin tat almayı engelleme "MSG'li yiyeceklerden sonra alınan normal besinlerde tad alma duyarlılığımız azalıyor" iddiası anlamsız olmaktadır.
- Birçok zararlı olduğu verilerin "Bu zararların hepsi çok sayıda çalışmayla kanıtlanmış ve bununla ilgili bir rapor Dünya Sağlık Örgütüne sunulmuş durumda" çok olduğu ve WHO sunulduğu iddiası olmakta, bunlar ispat edildiği beyanı sadece sözel kalmaktadır.
- Kanser yaptığı konusunda ise veri yoktur.

SONUÇ: Toplumda sıklıkla yenilen ve kullanılan MSG maddesine karşın, belirtilen sorunların olmaması, gözlenmemesi yanında, halen ruhsatlı olarak, güvenli olduğunun belirtilmesi de bir paradoks olmaktadır.

4) Monosodyum Glutamat Zararları

https://www.zararlar.com/monosodyum-glutamat-zararlari.html
Monosodyum Glutamat Zararları, Monosodyum glutamat kısaltılmış adıyla MSG ve ya koduyla E621, glutamat amino asidinin sodyum tuzudur. Monosodyum glutamat gıdalarda genellikle lezzet arttırıcı olarak kullanılmaktadır. Bu madde vücuda alındığında tükürük bezleri salgısını etkileyerek tükürük salgısını arttırır. Böylece gıdanın lezzet özellikleri artar tüketen de daha hızlı ve daha sık yeme isteği uyanır. Monosodyum glutamat ilk defa 1865 yılında keşfedilmiştir. Ticari olarak ise 1909 yılında kullanılmaya başlanmıştır. Başta Japonya ve Çin olmak üzere ülkemizde de özellikle hazır gıdalarda sıklıkla kullanılmaktadır.

MSG bazı katı yağlarda, hazır cipslerde, et sularında, hazır çorbalarda, işlenmiş kırmızı et, balık ve tavuklarda, mayonezlerde, baharat karışımlarında, renkli yoğurtlarda, bebek mamalarında ve bir çok tüketim ürününe farklı isimlerde kullanılmaktadır. Hazır gıdaların yanı sıra organik gıdalar için kullanılan gübrelerde MSG içermektedir.
Hazır gıdalarda lezzetlendirme amacıyla kullanılan monosodyum glutamatın güvenirliği tartışılmaktadır. Bu maddenin lezzetlendirici olarak kullanıldığında göğüs ağrısı, baş ağrısı, yüzde kızarıklık, ödem, nefes darlığı ve terlemeye neden olduğu bilinmektedir. Buna Çin restoranı sendromu denilmektedir. Ayrıca bu maddeyi tüketen insanlar daha sonrasında normal gıdaları aldığında onlara lezzetsiz gelmektedir. Buda insanların daha çok MSG içeren ürünlere yönelmesine neden olmaktadır. Bu durum bir bakıma bağımlılığa yol açmaktadır.
Monosodyum glutamatın uzun süreli kullanımlarında aşağıda ki zararlarla karşılaşmak olasıdır:

- MSG bir bakıma nörotoksindir. Yani sinir hücrelerine zarar vermektedir. Bu yüzden merkezi sinir sistemini tahribata uğratarak alzheimer, parkinson ve epilepsi gibi hastalıklara neden olabilmektedir.
- Retinal dejenarasyona neden olabilmektedir.
- Yağ birikimi, doyma mekanizmasında bozukluklara ve bunlara bağlı olarak obeziteye neden olabilmektedir.
- Büyüme hormonunu baskılar böylece gelişim geriliğine neden olabilir.
- İnsülün hormonunu uzun süreli artmış seviyede salgılatır buna bağlı olarak pankreasta tahribatlara yol açar ve diyabete neden olabilir.
- Böbrek ve karaciğerlerde tahribatlara neden olabilmektedir. Ayrıca bu madde plasentadan da rahatça geçebilmektedir. Buda tüm bu riskleri anne karnında ki bebeğe de yansıtmaktadır.
- Ayrıcı astımlı hastaların bu maddeyi tüketmeleriyle ağır astım atakları geçirebilirler.

Bu madde bizler ve tüm sevdiklerimiz için tehlike saçmaktadır. Kendimiz ve sevdiklerimiz için bu maddeyi içeren gıdaları çevremizden uzak tutmalıyız ve tüketmekten kaçınmalıyız.

Yorum

Burada belirtilenler, aynı konuların tekrarlandığı görülmektedir, kaynağı bulunmamaktadır.

5) Deciphering the MSG controversy

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2802046/

Jennifer S. Xiong, Debbie Branigan, and Minghua Li. Int J Clin Exp Med. 2009; 2(4): 329–336.

Abstract

Monosodium glutamate (MSG), a common flavor enhancer in various canned food and stereotypically associated with food in Chinese restaurants, has been claimed and tested to have side effects including headache and dizziness. However, the mechanism behind MSG-induced headache was not clear. Using dissociated mouse neuronal culture and cell injury assays, we determined whether incubation of neurons with clinically relevant concentrations of MSG induces cell swelling or death, and whether any measure can be taken to prevent or reduce MSG effects. We demonstrated that (1) Treatment with MSG induces a dose-dependent swelling and death of mature neurons (12-14 days in culture) with little effect on young immature neurons (<1 week in culture). The threshold concentration of MSG for neuronal injury is 3 μM; (2) MSG only injures neurons with little effect on glial cells; (3) Boiling MSG does not affect its toxicity but the addition of Vitamin C provides significant protection against MSG toxicity; (4) Pretreatment of neurons with a low dose of MSG reduces subsequent injury by a large dose of MSG. Together, our studies suggest that the side effect of MSG may be mediated, at least in part, by its toxic effect on brain neurons. Pre-exposure to low doses of MSG or the use of Vitamin C may prevent or reduce the side effects of MSG.

Keywords: Monosodium glutamate, headache, neuron, injury, tolerance

Yorum

Makalenin tümü incelenmiş ve 12-14 gün kültür matür nöronlarda etkin varken, İmmatür olanlarda sorun gözlenmediği belirtilmiştir. Gıda ile alınması ile kültüre konulması arasında farklılık olduğu da belirgindir. Daha geniş ve ilintili çalışmalar ile desteklenmesi beklenmelidir. 2009 yayını olup, aradan geçen süre içinde yinelenen çalışma gözlenmemiştir.

6) Reconsidering the effects of monosodium glutamate: a literature review.

Freeman M . J Am Acad Nurse Pract. 2006 Oct;18(10):482-6.

This article reviews the literature from the past 40 years of research related to monosodium glutamate (MSG) and its ability to trigger a migraine headache, induce an asthma exacerbation, or evoke a constellation of symptoms described as the "Chinese restaurant syndrome."

DATA SOURCES:

Literature retrieved by a search using PubMed, Medline, Lexis-Nexus, and Infotrac to review articles from the past 40 years.

CONCLUSIONS:

MSG has a widespread reputation for eliciting a variety of symptoms, ranging from headache to dry mouth to flushing. Since the first report of the so-called Chinese restaurant syndrome 40 years ago, clinical trials have failed to identify a consistent relationship between the consumption of MSG and the constellation of symptoms that comprise the syndrome. Furthermore, MSG has been described as a trigger for asthma and migraine headache exacerbations, but there are no consistent data to support this relationship. Although there have been reports of an MSG-sensitive subset of the population, this has not been demonstrated in placebo-controlled trials.

IMPLICATIONS FOR PRACTICE:

Despite a widespread belief that MSG can elicit a headache, among other symptoms, there are no consistent clinical data to support this claim. Findings from the literature indicate that there is no consistent evidence to suggest that individuals may be uniquely sensitive to MSG. Nurse practitioners should therefore concentrate their efforts on advising patients of the nutritional

pitfalls of some Chinese restaurant meals and to seek more consistently documented etiologies for symptoms such as headache, xerostomia, or flushing.

Yorum

Çin restoran sendromunu teyit eden bir veri olmadığı belirtilmektedir. Uzun süreçte belirtilen semptomlarla başvuru olmadığı vurgulanmaktadır.

7) Cognitive and biochemical effects of monosodium glutamate and aspartame, administered individually and in combination in male albino mice.

Abu-Taweel GM[1], A ZM[1], Ajarem JS[2], Ahmad M[3]. Neurotoxicol Teratol. 2014 Mar-Apr;42:60-7. doi: 10.1016/j.ntt.2014.02.001. Epub 2014 Feb 18.

Abstract

The present study was designed to investigate the in vivo effects of monosodium glutamate (MSG) and aspartame (ASM) individually and in combination on the cognitive behavior and biochemical parameters like neurotransmitters and oxidative stress indices in the brain tissue of mice. Forty male Swiss albino mice were randomly divided into four groups of ten each and were exposed to MSG and ASM through drinking water for one month. Group I was the control and was given normal tap water. Groups II and III received MSG (8 mg/kg) and ASM (32 mg/kg) respectively dissolved in tap water. Group IV received MSG and ASM together in the same doses. After the exposure period, the animals were subjected to cognitive behavioral tests in a shuttle box and a water maze. Thereafter, the animals were sacrificed and the neurotransmitters and oxidative stress indices were estimated in their forebrain tissue. Both MSG and ASM individually as well as in combination had significant disruptive effects on the cognitive responses, memory retention and learning capabilities of the mice in the order (MSG+ASM)>ASM>MSG. Furthermore, while MSG and ASM individually were unable to alter the brain neurotransmitters and the oxidative stress indices, their combination dose (MSG+ASM) decreased significantly the levels of neurotransmitters (dopamine and serotonin) and it also caused oxidative stress by increasing the lipid peroxides measured in the form of thiobarbituric acid-reactive substances (TBARS) and decreasing the level of total glutathione (GSH). Further studies are required to evaluate the synergistic effects of MSG and ASM on the neurotransmitters and oxidative stress indices and their involvement in cognitive dysfunctions.

Yorum

MSG ve ASM (Aspartame) deney hayvanlarında, dopamin ve seratonin düzeyini azalttığı ve oksidatif stres yarattığı belirtilmekte, ancak daha ileri çalışmanın da gerektiği vurgulanmaktadır.

8) MONOSODIUM GLUTAMATE. Human Health Effects:

https://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+580

Toxicity Summary:

Walker R and Lupien JR; J Nutr 130 (4S Suppl): 1049S-52S (2000)] **PEER REVIEWED** PubMed Abstract

L-Glutamic acid and its ammonium, calcium, monosodium and potassium salts were evaluated by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1988. The Committee noted that intestinal and hepatic metabolism results in elevation of levels in systemic circulation only after extremely high doses given by gavage (>30mg/kg body weight). Ingestion of monosodium glutamate (MSG) was not associated with elevated levels in maternal milk, and glutamate did not readily pass the placental barrier. Human infants metabolized glutamate similarly to adults. Conventional toxicity studies using dietary administration of MSG in several species did not reveal any specific toxic or carcinogenic effects nor were there any adverse outcomes in reproduction and teratology studies. Attention was paid to central nervous system lesions produced in several species after parenteral administration of MSG or as a consequence of very high doses by gavage. Comparative studies indicated that the neonatal mouse was most sensitive to neuronal injury; older animals and other species (including primates) were less so. Blood levels of glutamate associated with lesions of the hypothalamus in the neonatal mouse were not approached in humans even after bolus doses of 10 g MSG in drinking water. Because human studies failed to confirm an involvement of MSG in "Chinese Restaurant Syndrome" or other idiosyncratic intolerance, the JECFA allocated an "acceptable daily intake (ADI) not specified" to glutamic acid and its salts. No additional risk to infants was indicated. The Scientific Committee for Food (SCF) of the European Commission reached a similar evaluation in 1991. The conclusions of a subsequent review by the Federation of American Societies for Experimental Biology (FASEB) and the Federal Drug Administration (FDA) did not discount the existence of a sensitive subpopulation but otherwise concurred with the safety evaluation of JECFA and the SCF.

Yorum

Toxinet Toksikolojinin tüm yayınlarının toplayan bir Amerika Bakanlık kuruluşudur. Yayınında belirgin toksisitesi olmadığı vurgusu vardır.

1. [Moneret - Vautrin DA; Allerg Immunol (Paris) 19 (1): 29-35 (1987)] **PEER REVIEWED**

   Human Toxicity Excerpts:

   /HUMAN EXPOSURE STUDIES/ ... A high dose of 2.5 g was tested in 6 healthy controls and 30 asthmatics (7: allergic asthma; 15: intrinsic asthma with intolerance to aspirin; 8: intrinsic asthma with aspirin intolerance, intolerance to alcohol or to food additives). Two patients presented with a mild bronchospasm, occurring 6 to 10 hours after the ingestion. Different mechanisms are discussed. A cholinergic mechanism might be incriminated, either due to

stimulation of the synthesis of acetylcholine, or due to a vagal reflex elicited by a reflux esophagitis. However, a high vagal hyperreactivity seems to be needed for the occurrence of asthma. It is concluded that a very small subset of patients with intrinsic asthma might present with an intolerance to monosodium glutamate if high doses are consumed.

Yorum

Yüksek dozda, hafif bronkospazm belirtilmiş ve tartışmada, vagal reflü ile asetilkoline bağlanmıştır.

2. [Wilkin JK; J Am Acad Dermatol 15 (2): 225-30 (1986)] **PEER REVIEWED** PubMed Abstract
/HUMAN EXPOSURE STUDIES/ Monosodium glutamate is widely regarded as the provocative agent in the "Chinese restaurant syndrome," of which flushing is regarded as part of the reaction. Six subjects were monitored by laser Doppler velocimetry for changes in facial cutaneous blood flow during challenge with monosodium glutamate and its cyclization product, pyroglutamate. Additionally, records of patients challenged with monosodium glutamate in the laboratory were reviewed. No flushing was provoked among the twenty four people tested, eighteen of whom gave a positive history of Chinese restaurant syndrome flushing. These results indicate that monosodium glutamate provoked flushing, if it exists at all, must be rare. Monosodium glutamate and its cyclization product, pyroglutamate, may provoke edema and associated symptoms.

Yorum

Ödem ve ilintili semptom oluşabileceği, 24 hastada uyarı ile yapılmasına karşın 18'inde pozitif hikâye vermişlerdir.

3. [Woods RK et al; J Allergy Clin Immunol 101 (6 Pt1): 762-71 (1998)] **PEER REVIEWED** PubMed Abstract
/HUMAN EXPOSURE STUDIES/ /The objective of this study was/ to determine whether monosodium glutamate (MSG) would induce bronchoconstriction in a group of adults with asthma who perceived that they were MSG sensitive. Twelve subjects (seven women, mean age 35.3 years) with clinically documented asthma and a perception of MSG-induced asthma were recruited. FEV1 and peak expiratory flow data were obtained for 3 whole control days, as well as time-matched data for 3 separate challenge days (1 g MSG, 5 g MSG, and 5 g lactose [placebo]). Opaque capsule challenges were given as a single dose in the morning after an overnight fast. Subjects complied with an elimination diet throughout the study. Nonspecific bronchial hyperresponsiveness was measured at baseline, after the control days, and at the conclusion of the challenges. Venous blood samples were taken at baseline and on each challenge day to determine soluble inflammatory marker (eosinophil cationic protein and tryptase) activity. No immediate or definite late asthmatic reactions occurred. One subject's FEV1 declined more than 15% on MSG challenge, but 95% confidence limits for the control-day spirometry showed that this decline was within her daily variation. No, significant changes in bronchial hyperresponsiveness or soluble inflammatory markers were found.

Yorum

MSG bağlı astım olduğu belirtilen olgular ele alınmış ve ancak %15 hava akımında azalma saptanmıştır.

4. [Simon RA; J Nutr 130 (4S Suppli): 1063S-6S (2000)] **PEER REVIEWED** PubMed Abstract
/HUMAN EXPOSURE STUDIES/ This study sought to determine the prevalence of reactions to additives, including monosodium glutamate (MSG), in patients with chronic urticaria using a rigorous protocol. Sixty-five subjects (44 women, 21 men; ages 14-67) /were studied/. All had urticaria for >6 wk without discernible etiology. Subjects with active urticaria were studied while they were taking the lowest effective dose of antihistamine. Screening challenges to the 11 additives most commonly associated with exacerbations of chronic idiopathic urticaria were performed in a single-blind fashion. The dose of MSG given was 2500 mg. Skin scores were obtained to determine a positive reaction in an objective manner. Subjects with a positive screening challenge were rechallenged (at least 2 wk later) with a double-blind, placebo-controlled protocol as in-patients in our General Clinical Research Center. Two subjects had positive single-blind, placebo-controlled challenges, but neither had a positive double-blind, placebo-controlled challenge. It is concluded, with 95% confidence, that MSG is an unusual (<3% at most) exacerbant of chronic idiopathic urticaria.

Yorum

MSG ürtikeri olgularda ilintili bulunmamıştır, ancak %3 en fazla olabileceği belirtilmektedir.

5. [Woessner KM et al; J Allergy Clin Immunol 104 (2 Pt 1): 305-10 (1999)] **PEER REVIEWED** PubMed Abstract
/HUMAN EXPOSURE STUDIES/ The purpose of this study was to determine whether monosodium glutamate (MSG) ingestion induces asthma attacks in asthmatic subjects. With single-blind, placebo-controlled screening challenges, 100 subjects with asthma (30 subjects with a history of Oriental restaurant asthma attacks; 70 subjects with a negative history) were challenged with 2.5 g of MSG. A total of 78 patients were proved to have aspirin-sensitive asthma. No patient had a significant fall in FEV(1) value or the development of asthma symptoms during the MSG challenge ... Subjects with an MSG-positive history showed no significant percent decrease in FEV(1) values after placebo challenges compared with MSG 2.5 g oral challenge (P =0.28). In the group with an MSG-negative history, there was no statistical difference in the change in lowest FEV(1) values between the placebo and MSG challenges

(p = 0.44). The exact 1-sided 95% confidence interval (CI) for the probability of MSG sensitivity in individuals with aspirin-sensitive asthma (negative history) is 0% to 0.04%. When combined with previous studies that did not demonstrate MSG-provoked asthma, the 95% CI is 0% to 0.03%. For patients with an MSG-positive history, the exact 1-sided 95% CI for the probability of MSG sensitivity in this study was 0% to 0.07%, which is somewhat wider because of the smaller sample size.

Yorum

MSG astımı provoke etmediği gösterilmiştir.

6. [Yang WH et al; J Allergy Clin Immunol 99 (6 Pt 1): 757-62 (1997)] **PEER REVIEWED** PubMed Abstract
   /HUMAN EXPOSURE STUDIES/ Oral challenge studies /were conducted/ in self-identified monosodium glutamate (MSG)-sensitive subjects to determine whether they had a statistically significant difference in the incidence of their specific symptoms after ingestion of MSG compared with placebo. First, 5 g MSG or placebo was administered in random sequence in a double-blind fashion. Subjects who reacted only to a single test agent then underwent rechallenge in random sequence in a double-blind fashion with placebo and 1.25, 2.5, and 5 g MSG. A positive response to challenge was defined as the reproduction > 2 of the specific symptoms in a subject ascertained on prechallenge interview. Sixty-one subjects entered the study. On initial challenge, 18 (29.5%) responded to neither MSG nor placebo, 6 (9.8%) to both, 15 (24.6%) to placebo, and 22 (36.1%) to MSG (p = 0.324). Total and average severity of symptoms after ingestion of MSG (374 and 80) were greater than respective values after placebo ingestion (232 and 56; p = 0.026 and 0.018, respectively). Rechallenge revealed an apparent threshold dose for reactivity of 2.5 g MSG. Headache (p < 0.023), muscle tightness (p < 0.004), numbness/tingling (p < 0.007), general weakness (p < 0.040), and flushing (p < 0.016) occurred more frequently after MSG than placebo ingestion ...
7. [Fernstrom JD et al; J Clin Endocrinol Metab 81 (1): 184-91 (1996)] **PEER REVIEWED** PubMed Abstract
   /HUMAN EXPOSURE STUDIES/ Fasting male subjects received each of four treatments on different days: a large oral dose of monosodium L-glutamate (MSG; 12.7 g), the MSG vehicle, an iv injection of TRH, or a high protein meal. Blood samples were drawn via an indwelling venous line before and at 20-min intervals after each treatment for 4 hr. Plasma glutamate levels rose 11-fold within 1 hr of MSG ingestion, but did not change appreciably with any of the other treatments. Plasma PRL levels rose 10-fold after TRH infusion and 2-fold after the protein meal, but did not rise significantly after MSG ingestion. No effects resulted from any of the treatments on plasma LH, FSH, testosterone, GH, or cortisol concentrations. Plasma levels of TSH, T4, and T3 showed minimal changes after any of the treatments except TRH; TRH elevated plasma TSH and T3 levels. Self-rating instruments of mood and side-effects revealed no treatment-related effects on mood or physical state for up to 48 hr after each treatment. Together, these results suggest that acute pharmacological elevations of plasma glutamate levels in adult men produce minimal, if any, effects on hypothalamic or pituitary function.
8. [FDA; MSG: A Common Flavor Enhancer in FDA Consumer (January-February 2003) Available from, as of March 20, 2007: http://www.cfsan.fda.gov/~dms/fdacmsg.html **PEER REVIEWED**
   /SIGNS AND SYMPTOMS/ MSG Symptom Complex can involve symptoms such as numbness, burning sensation, tingling, facial pressure or tightness, chest pain, headache, nausea, rapid heartbeat, drowsiness, and weakness. Asthmatics may experience these symptoms as well as difficulty in breathing. Additional studies in asthmatics under controlled conditions have not produced consistent results.
9. [Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987., p. 453] **PEER REVIEWED**
   /SIGNS AND SYMPTOMS/ Clinical findings: feeling of pressure in head, tightness of face; seizures. /From table/
10. [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II-407] **PEER REVIEWED**
    /SIGNS AND SYMPTOMS/ Subjective symptoms of burning sensation, facial pressure & chest pains have been provoked in human subjects by large oral doses of MSG (18 of 36 subjects responded to 4 g or less).
11. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 1204] **PEER REVIEWED**
    /SIGNS AND SYMPTOMS/ /SRP Idiosyncratic reaction/: Burning, tightness, and numbness of the neck and face, chest pain, and headache are noted generally after a meal with MSG is taken on an empty stomach by a susceptible individual. Two hundred mL of wonton soup alone was sufficient to provoke an attack.
12. …
    /SIGNS AND SYMPTOMS/ /SRP Idiosyncratic reaction/: Dizziness, nausea, and vomiting may develop. In one recent case, a 3 yr old experienced inappropriate behavior, confusion, and slight ataxia after eating wonton soup. The serious headache/nausea side effect may not begin for some hours (often 6) after ingestion, but can last for a half day to 2 days. Spontaneous remission of symptoms within 30 min has been observed after oral use in susceptible subjects.
13. [Ebadi M et al; Q Rev Drug Metab Drug Interact 4 (4): 289-331 (1982)] **PEER REVIEWED** PubMed Abstract

/SIGNS AND SYMPTOMS/ The acute ingestion of excessive monosodium glutamate will, in some individuals, cause a group of symptoms including among others headache, weakness, stiffness, and heartburn, collectively known as the Chinese Restaurant Syndrome. These symptoms can be prevented by prior supplementation with vitamin B6. The beneficial effect is ascribed to the correction of a deficiency in the activity of glutamic oxaloacetic transaminase, an enzyme that is dependent on pyridoxal phosphate.

14. [FDA; FDA and Monosodium Glutamate (MSG) in FDA Backgrounder. August 31, 1995. Available from, as of March 20, 2007: http://www.cfsan.fda.gov/~lrd/msg.html **PEER REVIEWED**
/SIGNS AND SYMPTOMS/ ... An unknown percentage of the population may react to MSG and develop MSG symptom complex, a condition characterized by one or more of the following symptoms: burning sensation in the back of the neck, forearms and chest numbness in the back of the neck, radiating to the arms and back tingling, warmth and weakness in the face, temples, upper back, neck and arms facial pressure or tightness chest pain headache nausea rapid heartbeat bronchospasm (difficulty breathing) in MSG-intolerant people with asthma drowsiness weakness. In otherwise healthy MSG-intolerant people, the MSG symptom complex tends to occur within one hour after eating 3 grams or more of MSG on an empty stomach or without other food. A typical serving of glutamate-treated food contains less than 0.5 grams of MSG. A reaction is most likely if the MSG is eaten in a large quantity or in a liquid, such as a clear soup. Severe, poorly controlled asthma may be a predisposing medical condition for MSG symptom complex. No evidence exists to suggest that dietary MSG or glutamate contributes to Alzheimer's disease, Huntington's chorea, amyotrophic lateral sclerosis, AIDS dementia complex, or any other long-term or chronic diseases. No evidence exists to suggest that dietary MSG causes brain lesions or damages nerve cells in humans. The level of vitamin B6 in a person's body plays a role in glutamate metabolism, and the possible impact of marginal B6 intake should be considered in future research. There is no scientific evidence that the levels of glutamate in hydrolyzed proteins causes adverse effects or that other manufactured glutamate has effects different from glutamate normally found in foods.
15. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 1204] **PEER REVIEWED**
/CASE REPORTS/ /SRP Idiosyncratic reaction/: The toxic dose of MSG that frequently provokes an attack is at least 1 g orally. However, one subject ingested 25 g of MSG without symptoms.
16. [Oliver AJ et al; Oral Surg Oral Med Oral Pathol 71 (5): 560-4 (1991)] **PEER REVIEWED** PubMed Abstract
/CASE REPORTS/ A case is reported in a 15 year old white girl who had a swollen lower face and lips; a diagnosis of orofacial granulomatosis was made. It was suspected that her condition had an allergic basis because an increase in clinical signs and symptoms was shown to be related to the food additive monosodium glutamate. Treatment with a restricted diet resulted in resolution of the facial swelling.
17. [Chiu YK et al; J Am Acad Dermatol 55 (2 Suppl): S1-5 (2006)] **PEER REVIEWED** PubMed Abstract
/CASE REPORTS/ /The case of/ a 7-month-old male infant with a foreign body granuloma caused by monosodium glutamate (MSG) after a Bacille Calmette-Guerin (BCG) immunization /is described/. A ridged, erythematous, indurated plaque developed over a BCG injection site on his left upper arm 1 month after the first BCG immunization. Biopsy showed multiple noncaseating foreign body granulomas without detectable mycobacteria by both Ziehl-Neelsen stain and polymerase chain reaction assay. Birefringent crystals were identified in the foreign body giant cells with polarized light microscopy. The crystals were further determined to be glutamic acid by the method of fast atom bombardment. Hence, MSG, the only composite of BCG vaccine except the bacillus, was believed to be responsible for the granulomatous foreign body reaction ...
18. [Smith JD et al; Ann Pharmacother 35 (6): 702-6 (2001)] **PEER REVIEWED** PubMed Abstract
/CASE REPORTS/ ... Four patients diagnosed with fibromyalgia syndrome for two to 17 years are described. All had undergone multiple treatment modalities with limited success. All had complete, or nearly complete, resolution of their symptoms within months after eliminating monosodium glutamate (MSG) or MSG plus aspartame from their diet. All patients were women with multiple comorbidities prior to elimination of MSG. All have had recurrence of symptoms whenever MSG is ingested ...
19. [Geha RS et al; J Allergy Clin Immunol 106 (5): 973-80 (2000)] **PEER REVIEWED** PubMed Abstract
/EPIDEMIOLOGY STUDIES/ ... A multicenter, multiphase, double-blind, placebo-controlled study with a crossover design to evaluate reactions reportedly caused by MSG was conducted. In 3 of 4 protocols (A, B, and C), MSG was administered without food. A positive response was scored if the subject reported 2 or more symptoms from a list of 10 symptoms reported to occur after ingestion of MSG-containing foods within 2 hours. In protocol A 130 self-selected reportedly MSG-reactive volunteers were challenged with 5 g of MSG and with placebo on separate days (days 1 and 2). Of the 86 subjects who reacted to MSG, placebo, or both in protocol A, 69 completed protocol B to determine whether the response was consistent and dose dependent. To further examine the consistency and reproducibility of reactions to MSG, 12 of the 19 subjects who responded to 5 g of MSG but not to placebo in both protocols A and B were given, in protocol C, 2 challenges, each consisting of 5 g of MSG versus placebo. Of 130 subjects in protocol A, 50 (38. 5%) responded to MSG only, 17 (13.1%) responded to placebo only ($p < 0.05$), and 19 (14.6%) responded to both. Challenge with increasing doses of MSG in protocol B was associated with increased response rates. Only half ($n = 19$) of 37 subjects who reacted to 5 g of MSG but not placebo in protocol A reacted similarly in protocol B, suggesting inconsistency in the response. Two of the 19 subjects responded in both challenges to MSG but not

placebo in protocol C; however, their symptoms were not reproducible in protocols A through C. These 2 subjects were challenged in protocol D 3 times with placebo and 3 times with 5 g of MSG in the presence of food. Both responded to only one of the MSG challenges in protocol D...

20. [FDA; FDA and Monosodium Glutamate (MSG)in FDA Backgrounder. August 31, 1995. Available from, as of March 20, 2007: http://www.cfsan.fda.gov/~lrd/msg.html **PEER REVIEWED**
/SURVEILLANCE/ Between 1980 and 1994, the Adverse Reaction Monitoring System in FDA's Center for Food Safety and Applied Nutrition received 622 reports of complaints about MSG. Headache was the most frequently reported symptom. No severe reactions were documented, but some reports indicated that people with asthma got worse after they consumed MSG. In some of those cases, the asthma didn't get worse until many hours later.
21. [Goldschmiedt M et al; Am J Clin Nutr 51 (5): 794-7 (1990)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ ... /The authors/ evaluated whether adding coloring or monosodium glutamate to food increases the cephalic phase of gastric acid secretion or gastrin release. When ordinary food coloring or unusual food coloring was added, acid secretion and gastrin release were similar to a control study with no food coloring added. Moreover, addition of 360 mg monosodium glutamate to beef consomme soup had no effect on the acid secretory or gastrin response to the meal. Thus, the food additives studied led to no objective alteration in the gastric exocrine or endocrine response to food.
22. Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982., p. 59] **PEER REVIEWED**
Drug Warnings:
The large doses of sodium glutamate required for the treatment of hepatic encephalopathy may result in dangerous alkalosis and hypokalemia ... important to keep close control on the electrolyte balance during therapy.
23. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982., p. 59] **PEER REVIEWED**
Injections of sodium glutamate should be given with caution to patients with hepatic cirrhosis, impaired renal function, or liver disease not associated with hyperammonemia.
24. [Report of the American Academy of Pediatrics Committee on Drugs in Pediatrics 93 (1): 142 (1994)] **PEER REVIEWED**
Food and Environmental Agents: Effect on Breast-Feeding: Monosodium glutamate: None. /from Table 7/
25. [FDA; FDA and Monosodium Glutamate (MSG)in FDA Backgrounder. August 31, 1995. Available from, as of March 20, 2007: http://www.cfsan.fda.gov/~lrd/msg.html **PEER REVIEWED**
Populations at Special Risk:
The FASEB report identifies two groups of people who may develop a condition the report refers to as "MSG symptom complex." One group is those who may be intolerant to MSG when eaten in a large quantity. The second is a group of people with severe, poorly controlled asthma. These people, in addition to being prone to MSG symptom complex, may suffer temporary worsening of asthmatic symptoms after consuming MSG. The MSG dosage that produced reactions in these people ranged from 0.5 grams to 2.5 grams.
26. FOLKERS K ET AL; BIOCHEM BIOPHYS RES COMMUN VOL 100 (3): 972 (1981)] **PEER REVIEWED**
Biochemical evidence for the deficiency of vitamin B6 is given for subjects reacting to monosodium l-glutamate
27. [(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Jan 4, 2007.] **PEER REVIEWED**
Probable Routes of Human Exposure:
NIOSH (NOES Survey 1981-1983) has statistically estimated that 60,341 workers (22,829 of these are female) are potentially exposed to monosodium glutamate in the US(1). Occupational exposure to monosodium glutamate may occur through dermal contact with this compound at workplaces where monosodium glutamate is produced or used(SRC). The general population is exposed to monosodium glutamate primarily via ingestion of food products containing this additive(SRC).
28. [Rumack BH POISINDEX(R) Information System Micromedex, Inc., Englewood, CO, 2017; CCIS Volume 172, edition expires May, 2017. Hall AH & Rumack BH (Eds): TOMES(R) Information System Micromedex, Inc., Englewood, CO, 2017; CCIS Volume 172, edition expires May, 2017.] **PEER REVIEWED**
Emergency Medical Treatment:
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express or implied. Truven Health Analytics Inc. makes no representation or warranty as to the accuracy, reliability, timeliness, usefulness or completeness of any of the information contained in the products. Additionally, Truven Health ANALYTICS INC. makes no representation or warranties as to the opinions or other service or data you may access, download or use as a result of use of the Truven Health ANALYTICS INC. products. All implied warranties of merchantability and fitness for a particular purpose or use are hereby excluded. Truven Health Analytics Inc. does not assume any responsibility or risk for your use of the Truven Health Analytics Inc. products.
The following Overview, *** MONOSODIUM GLUTAMATE ***, is relevant for this HSDB record chemical
Range of Toxicity:
TOXICITY: Flushing, facial pressure, chest pain, headache, and nausea have been reported in patients following the ingestion of food containing MSG. Patients usually experience these symptoms within an hour of eating 3 g or more of MSG on an empty stomach. In one study, very high oral doses of glutamate (147 g/day) given to adult humans as the sole source of nonessential nitrogen for 2 to 6 weeks was tolerated, with no neurological changes. In other studies, doses 60 to 150 mg MSG/kg body weight were also tolerated.

29. Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 1204] **PEER REVIEWED**
Antidote and Emergency Treatment:
/SRP Idiosyncratic reaction/: No decontamination measures have been reported. No antidotes exist. Supportive measures: Follow with ECG and cardiac evaluation if chest pain persists. Alert patient to avoid foods with MSG.

30. [Walker R and Lupien JR; J Nutr 130 (4S Suppl): 1049S-52S (2000)] **PEER REVIEWED** PubMed Abstract
Toxicity Summary:
L-Glutamic acid and its ammonium, calcium, monosodium and potassium salts were evaluated by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1988. The Committee noted that intestinal and hepatic metabolism results in elevation of levels in systemic circulation only after extremely high doses given by gavage (>30mg/kg body weight). Ingestion of monosodium glutamate (MSG) was not associated with elevated levels in maternal milk, and glutamate did not readily pass the placental barrier. Human infants metabolized glutamate similarly to adults. Conventional toxicity studies using dietary administration of MSG in several species did not reveal any specific toxic or carcinogenic effects nor were there any adverse outcomes in reproduction and teratology studies. Attention was paid to central nervous system lesions produced in several species after parenteral administration of MSG or as a consequence of very high doses by gavage. Comparative studies indicated that the neonatal mouse was most sensitive to neuronal injury; older animals and other species (including primates) were less so. Blood levels of glutamate associated with lesions of the hypothalamus in the neonatal mouse were not approached in humans even after bolus doses of 10 g MSG in drinking water. Because human studies failed to confirm an involvement of MSG in "Chinese Restaurant Syndrome" or other idiosyncratic intolerance, the JECFA allocated an "acceptable daily intake (ADI) not specified" to glutamic acid and its salts. No additional risk to infants was indicated. The Scientific Committee for Food (SCF) of the European Commission reached a similar evaluation in 1991. The conclusions of a subsequent review by the Federation of American Societies for Experimental Biology (FASEB) and the Federal Drug Administration (FDA) did not discount the existence of a sensitive subpopulation but otherwise concurred with the safety evaluation of JECFA and the SCF.

31. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
Human Toxicity Excerpts:
/LABORATORY ANIMALS: Acute Exposure/ Groups of 10-12-day old Swiss Webster albino mice, each containing 7-23 animals, were given single oral doses of MSG at levels of 0.25, 0.50, 0.75, 1.0, or 2.0 g/kg. Groups of 2 or 4 mice of the same age were given single oral doses of either 1.0 or 3.0 g/kg L-glutamic acid or monosodium-L-aspartate or 3.0 g/kg L-glutamate-L-aspartate, monosodium glutamate, NaCl, L-glycine, L-serine, L-alanine, L-leucine, D,L-methionine, L-phenylalanine, L-proline, L-lysine, L-arginine, or L-cysteine. The animals were sacrificed after dosing and brains were examined by either light or electron microscopy. The severity of brain damage was estimated by quantifying the pathological changes in the hypothalamus. One g/kg of glutamic acid destroyed approximately the same number of hypothalamic neurons as a comparable dose of MSG. Of the amino acids tested, only aspartate and cysteine produced hypothalamic damage. These amino acids caused both retinal and hypothalamic lesions similar to those found after treatment with MSG.

32. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ At birth, the rat brain glutamate concentration is about 4 mM and increases over a period of 20 days to the adult value of approximately 10 mM. When a 4 g/kg dose was given intragastrically, convulsions were seldom observed, and then only after 90 minutes. Two g/kg MSG given intraperitoneally always caused convulsions. When young rats were given 4 g/kg MSG, monosodium aspartate, or glycine, the glutamine level was increased significantly in the brain in all cases, but only monosodium glutamate and aspartate caused convulsions. D-Glutamate (4 g/kg), which is not deaminated by the rat, also caused convulsions. These results suggest that the convulsions caused by MSG are not due to liberated ammonia, but rather to the amino acid anion. At 4 g/kg, MSG gave rise to serum concentrations of glutamate of about 70 mM, strongly suggesting osmotic problems.

33. WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ Fifty weanling rats (Food and Drug Research Labs strain), 3 days of age, were divided into five groups. Each group was subdivided and the test animals given either single intragastric or single subcutaneous doses of monosodium glutamate, sodium chloride, sodium gluconate, potassium glutamate (all 10% solutions, 10 mg/kg b.w.), or water. Another group of 12-day old rats were treated in a similar manner. All animals in these groups were killed 24 hours after dosing. In addition, another group of 60 rats (3 days of age) was divided into subgroups and treated with the same test compounds at the same dose levels. Half of each group was sacrificed at 6 hours and the other half at 24 hours after dosing. Microscopic examination of the brain, particularly the ventral hypothalamus, did not show neuronal necrosis of the hypothalamic arcuate nuclei, except in 1 rat dosed with 1 g/kg monosodium glutamate at 3 days of age, and killed 24 hours later, which showed an area in the median eminence which contained cells with slight nuclear pyknosis and prominent vacuolation.

34. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ Groups of male and female hamsters aged 25 days were deprived of water or water and food overnight, then offered solutions containing 0, 2, 4, 6, or 8% MSG for 30 minutes. Six hours later the animals were killed and the brains examined; no hypothalamic lesions were seen.

35. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ Three infant monkeys, 5 days of age, received MSG by stomach tube at a dose of 2 g/kg. Two infant monkeys at 10 days of age, 2 at 20 days of age, and 2 at 40 days of age, received the same treatment. Two animals at 80 days of age received 4 g/kg. One control monkey was included in each group. The animals were observed for 4 hours after dosing and then sacrificed. After a period of fixation, a block of tissue was removed from each brain which included the hypothalamus. Serial sections, 10 mm thick, were made in the horizontal plane and examined by light microscopy. No changes that were considered to be associated with the administration of MSG were observed in the hypothalamus of the monkeys.

36. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ A group of 3 to 4 day-old cynomolgus monkeys received either subcutaneously or orally single doses of 1 g/kg b.w. monosodium glutamate, sodium chloride, sodium gluconate, or potassium glutamate and were sacrificed 3 or 24 hours post-dosing. Another group of monkeys (3 to 4 days old) received orally either 4 g/kg monosodium glutamate or sodium chloride, and were sacrificed at 3, 6, and 24 hours post-dosing (3 and 24 hours in the case of sodium chloride-dosed monkeys). Detailed microscopic examination of the hypothalamus did not show any evidence of monosodium glutamate-induced necrosis or any differences between any of the groups. Examination of the eyes did not reveal any effects due to monosodium glutamate. Glutamate and glutamine blood levels showed considerable variation in individual values among the animals dosed orally and subcutaneously. Subcutaneous dosing resulted in values an order of magnitude higher than those observed by oral dosing.

37. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ Sixteen infant monkeys (M. mulatta or M. irus) were fasted for 4 hours before receiving by stomach tube single doses of a 50% solution of monosodium glutamate, equivalent to doses of 1, 2, or 4 g/kg b.w. Control animals received distilled water. At 6 hours post-dosing the animals were sacrificed and the brains perfused for examination by light and electron microscopy. No morphological differences were observed in the hypothalamic regions of treated and control monkeys. Inadequately fixed tissue had the same appearance as that of a previously-reported brain lesion in a newborn monkey.

38. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Acute Exposure/ Groups of 3 infant monkeys were dosed with a mixture of water and skimmed milk containing either added NaCl or MSG, on an equivalent mole/kg basis. Administration was via nasogastric tube. Other groups were injected subcutaneously with either a 25% aqueous solution of MSG or a 10%

solution of NaCl. The doses ranged from 1-4 g/kg b.w. All animals were sacrificed after dosing and the brains examined by combined light and electron microscopy. Infants given relatively low oral doses of MSG (1 and 2 g/kg) sustained small focal lesions confined primarily to the rostro-ventral aspect of the infundibular nucleus. Those treated with high subcutaneous doses developed lesions which spread throughout, and sometimes beyond, the infundibular nucleus. At all doses tested, and by either route of administration, rapid necrosis of neurons (within 5 hours) was observed. Measurements of blood glutamate levels suggested that the threshold for lesion formation in 1-week old rhesus monkeys may be in the range of 200 mg/L.

39. Dhindsa KS et al; Acta Anat 109 (2): 97-102 (1981)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ The effect of monosodium glutamate (MSG) on the thyroid gland of mice is studied. MSG induces marked histological changes in the thyroid tissue, indicative of hypothyroidism. The follicular epithelium, is greatly compressed and the follicles have enlarged due to distension with the accumulation of colloid. The histological picture of the thyroid gland remains unchanged for the animals sacrificed after short-term (13 weeks) and long-term (52 weeks) treatment. MSG, therefore, has a cumulative effect. The hypothyroidism is attributed to the influence of the drug on hypothalamus-pituitary function and the secretion of hormones responsible for the thyroid metabolism.

40. [Diniz YS et al; Nutrition 21 (6): 749-55 (2005)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ ... Male Wistar rats (65+5 g, n = 8) were fed a standard diet (control), a standard diet supplemented with 100 g of MSG/kg bw, a diet rich in fiber, or a diet rich in fiber supplemented with 100 g of MSG/kg bw. After 45 days of treatment, sera were analyzed for concentrations of insulin, leptin, glucose, triacylglycerol, lipid hydroperoxide, and total antioxidant substances. A homeostasis model assessment index was estimated to characterize insulin resistance. Voluntary food intake was higher and feed efficiency was lower in animals fed the standard diet supplemented with MSG than in those fed the control, fiber-enriched, or fiber- and MSG-enriched diet. The MSG group had metabolic dysfunction characterized by increased levels of glucose, triacylglycerol, insulin, leptin, and homeostasis model assessment index. The adverse effects of MSG were related to an imbalance between the oxidant and antioxidant systems. The MSG group had increased levels of lipid hydroperoxide and decreased levels of total antioxidant substances. Levels of triacylglycerol and lipid hydroperoxide were decreased in rats fed the fiber-enriched and fiber- and MSG-enriched diets, whereas levels of total antioxidant substances were increased in these animals...

41. [Pavlovic V et al; Bratisl Lek Listy 107 (5): 185-91 (2006)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ ... Wistar rats (male) were exposed to monosodium glutamate (MSG) (4 mg/g body wt, ip) for 6 consecutive days and sacrificed on 30th and 45th day after last MSG dose. Thymocyte proliferation was evaluated by measuring the expression of proliferating cell nuclear antigen by flow cytometry. Apoptosis was detected using the Annexin V-FITC/PI apoptosis detection kit and cells were analyzed using a flow cytometer. Expression of Bcl-2 and Bax proteins were determined with flow cytometry using respective monoclonal antibodies. The current study results demonstrated that MSG significantly decreased thymocyte proliferation ($p < 0.001$) induced by ConA and increased apoptosis rate ($p < 0.001$) of the cells during /the/ examination period. MSG treatment induced down regulation of Bcl-2 protein while Bax protein levels were not significantly changed...

42. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ An experiment was conducted in which 45 male and 45 female rats were fed 1 or 250 mg/kg MSG daily from 1 to 90 days of age, at which time the animals were killed. A comparable control group received only laboratory chow over the same period of time. General clinical observations, body weights, hematologic parameters, and other clinical chemical measurements were within the normal range. At autopsy, organ weights were within the normal range. Histochemical and ultrastructural studies of the hypothalamus and median eminence showed no evidence of repair or replacement of neuronal cells by elements of glial or ependymal cells.

43. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Groups of 10-day old Charles-River rats (10 male and 10 female) were dosed orally with 0.2 ml of either strained baby food containing no monosodium glutamate, strained baby food containing monosodium glutamate up to 0.4%, or strained baby food containing monosodium glutamate equal to a dosage level of 0.5 g/kg, additional to that found in normal commercially distributed baby food (390 mg per jar). The rats were mated; half of the offspring were removed from parental females and sacrificed after 5 hours. Histological studies were made of brains in the area of the hypothalamus at the roof and the floor of the third ventricle. The remaining rats were returned to parental females and allowed to grow to maturity (90 days post-weaning), then sacrificed and histological studies made of the brain. No lesions were observed in the brains of animals sacrificed at either 5 hours post-treatment or after reaching maturity. Animals which were reared to maturity showed normal growth and food consumption.

44. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Doses of 250 mg or 1 g/kg MSG were administered orally daily for 30 days to two groups of 3 infant rhesus monkeys starting at 1 day after birth. General clinical observations over a period of 30 days revealed normal growth, development, and activity. No changes were observed in the levels of hemoglobin, hematocrit, RBC or WBC counts, or reticulocytes. The levels of glucose, urea nitrogen, and serum potassium, calcium, and sodium were within the normal ranges. At autopsy, complete histological, histochemical, and ultrastructural investigations of the entire arcuate nuclei and median eminence region failed to reveal any necrotic or damaged neurons.

45. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Ten infant squirrel monkeys were fed either a 0, 4.8, 9.1, or 17% (based on dry weight) MSG formula diet for 9 weeks. Three of the test monkeys died. Two died of effects not related to MSG. The third, which was on the 17% diet, developed convulsive seizures. However, the other 2 animals in this group were unaffected. Clinical observations were made daily, and at the end of the test period the monkeys were sacrificed and the major organs examined microscopically. Sections of the retina and hypothalamus were examined by electron microscopy. No hypothalamic or retinal lesions were observed.

46. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Groups of 6 pups, 3 to 4 days of age, were dosed either orally or subcutaneously with 1 g/kg b.w. monosodium glutamate, sodium chloride, sodium gluconate, potassium glutamate, or water. Pups were sacrificed at either 3 hours, 24 hours, or 52 weeks after dosing. Other groups of dogs 35 days of age received single doses of test material, and were sacrificed at either 4 or 24 hours post-dosing. Body weights of dogs which were dosed once at 3 days of age and followed for a year, showed no evidence of effects of any treatment. Femur weight, as well as weight of the pituitary gland, ovaries, uterus, and mammary glands were similar to controls. Gross and microscopic examinations of these tissues failed to reveal any abnormalities. Extensive microscopic examination of brain tissue of all test animals did not show any treatment-related changes.

47. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ One control group of 200 male mice and six test groups of 100 male mice received 1 or 4% L-glutamic acid, monosodium L-glutamate, or DL-monosodium glutamate in their diet. No malignant tumors appeared after 2 years that could be related to the administration of test material. Growth and hematology were normal, and histopathological examination showed no abnormalities in the test animals. ... /In another study/ Six groups of C57B1 mice, comprising 50 males and 50 females, were given diets containing 1 or 4% L-glutamic acid, L-MSG, or DL-MSG for 715 days. A further control group of 100 animals of each sex received basal diet. No treatment-related differences were seen in mortality, body-weight gain, incidence of concurrent disease, hematology, or tumor incidence.

48. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Six groups of Sprague-Dawley rats, comprising 35 animals of each sex, were fed diets containing 0.4 or 4% L-glutamic acid, L-MSG, or DL-MSG from 12 weeks to 2 years of age; a control group of 61 males and 69 females received basal diets. The protocol included a reproduction phase. No adverse effects were noted on behavior, body-weight gain, food consumption, motor activity, clinical observations, hematology, or tumor incidence. Fertility, survival of the young, organ weights, and histopathology were comparable between controls and test animals ... . /In another study/ Groups of 40 rats of each sex were given diets containing 0, 1, 2, or 4% MSG or 2.5% sodium propionate (positive control) for 104 weeks. Animals of each sex per group were examined at 12 weeks with full histopathology. Ophthalmological examinations every 13 weeks were negative and no adverse effects were noted on body weight, food consumption, haematology, blood chemistry, terminal organ weights, or survival rates. Tissues from 25 organs were examined histologically. Water consumption, urinary volume, and sodium excretion were increased at the 4% MSG level and sub-epithelial basophil deposits were observed in the renal pelvis. Focal mineral deposits from the renal corticomedullary junction were equally distributed in all groups.

49. WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ Beagle dogs were fed diets containing 0, 2.5, 5, or 10% MSG or 5.13% sodium propionate (control) for 104 weeks. There were no adverse effects on body-weight gain, food consumption, behavior, ECG, ophthalmology, hematology, blood chemistry, organ weights, or mortality due to treatment. Urinary volume and sodium excretion were slightly elevated in animals receiving MSG or sodium propionate but kidney function was unimpaired. No treatment-related histological changes were observed.

50. LAMPERTI A, BLAHA G; BIOL REPROD 14 (3): 362 (1976)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ The effects of neonatally-admin /saline or 8 mg/ MSG on the reproductive system of adult hamsters. MSG causes reproductive problems in hamsters. Female hamsters had ovaries with small follicles & with no corpora lutea.

51. [Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, 1986., p. 399] **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ /Monosodium glutamate was/ injected in mice on 17th or 18th day of gestation with 5 mg/kg. Nuclear pyknosis was found in the cells of the arcinate and ventro medial nuclei of the fetuses after 3 hr. Examination of treated fetuses after a 24 hr period did not show any abnormal lesion. ... Immature mice injected with substantial doses of monosodium glutamate developed brain lesions.

52. [National Research Council. Drinking Water and Health, Volume 6. Washington, D.C.: National Academy Press, 1986., p. 76] **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Rabbits were given an oral dose (25 mg/kg) of monosodium glutamate for 1 month. The effects of the study were inhibition of spermatogenesis, reduced fertility, and atrophy of testes. /From table/

53. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 461] **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ In chick embryos glutamate has caused damage in the inner layers of the retina, including the ganglion cells. Concentrations that killed about half of the embryos caused cataracts in 77% of those that survived, and total destruction of the lens at the highest concentration used. /Glutamate/

54. [Yu T et al; Brain Res 747 (2): 195-206 (1997)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Monosodium glutamate (MSG) was shown to penetrate placental barrier and to distribute to embryonic tissues using (3H)glutamic acid ((3H)Glu) as a tracer. However, the distribution is not even; the uptake of MSG in the fetal brain was twice as great as that in the maternal brain in Kunming mice. Other maternal mice were given po MSG (2.5 mg/g or 4.0 mg/g bw) at 17-21 days of pregnancy, and their offspring behaviors studied. The results showed that maternal oral administration of MSG at a late stage of pregnancy decreased the threshold of convulsion in the litters at 10 days of age. Y-maze discrimination learning was significantly impaired in the 60-day-old filial mice. On the other hand, no significant difference in spatial learning or tail flick latency was measured between the experimental animals and the controls. The filial mice of MSG-treated mothers could either not grasp a rope tightly, or grasped the rope tightly but could not crawl along the rope at the beginning of the training. However, such mice, after training, could grasp and crawl along the rope as well as controls. Obvious neuronal damage was not detected in the periventricular organs or the hypothalamus under a light microscope. The rate of weight gain for experimental animals was greater than for controls throughout the period from 20 to 90 days. Mating of treated males with treated females resulted in pregnancies and normal offspring, indicating that oral administration of MSG at a late stage of pregnancy did not affected the reproductive capacity of the offspring.

55. [Miskowiak B et al; Folia Morphol (Warsz) 58 (2): 105-13 (1999)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ The study aimed at determining effects of monosodium glutamate (MSG), introduced in the perinatal period, on the reproductive system of sexually mature female rats. In days 2, 4, 6, 8, 10 the newborns received sc injections of MSG (4 mg/g bw) or 2% NaCl solution. When the animals reached the age of 6, 12 or 18 months, their ovaries and uteri were isolated for histological and morphometric studies while in their sera estradiol level was estimated by the RIA technique. The perinatal injection of MSG was found to decrease relative weights of ovaries and uteri. In the ovaries increased numbers of primordial follicles and decreased numbers of graafian follicles were detected. Also the thickness of endometrium and of the epithelium, which lined the endometrium, were lowered in females, which received perinatal injections of MSG, as compared to the controls. Serum estradiol level in MSG injected females was lowered at the age of 12 and 18 months. In 12 and 18 month old females the alterations were accompanied by obesity and a decreased body length.

56. [Goldfrank, L.R. (ed). Goldfrank's Toxicologic Emergencies. 7th Edition McGraw-Hill New York, New York 2002., p. 108] **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Oral administration (1 month) to rabbit at 25 mg/kg induced inhibition of spermatogenesis, reduced fertility, and atrophy of testes /monosodium glutamate/.

57. [Goldfrank, L.R. (ed). Goldfrank's Toxicologic Emergencies. 7th Edition McGraw-Hill New York, New York 2002., p. 108] **PEER REVIEWED*

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Injection in mouse (17-18 day pregnant) at 5 mg/kg induced nuclear pyknosis in cells of arcinate and ventro medial nuclei of fetuses.

58. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Monosodium glutamate was administered to 6 pregnant rhesus monkeys (Macaca mulatta) at a daily dosage equivalent to 4 g/kg b.w. during the last third of pregnancy. Four pregnant monkeys not receiving treatment were used as controls. Body weight and condition was unaffected throughout the gestation period. The duration of gestation was within the accepted range (156-178 days). There were no cases of delayed parturition or dystocia. Nursing, suckling, and behavioral patterns were normal except for one monkey which killed its infant at birth. Birth weights of the neonates were within the normal range. Infants, when removed from mothers, showed distress but no signs of abnormal behaviour. The hypothalamus region and related structure of the brain were examined by light microscopy. No abnormalities were observed.

59. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ A multi-generation reproduction study on MSG was conducted on IVCS and Swiss albino mice. Groups of 3-5 60-day old male and female mice were maintained on diets containing O, 2, or 4% MSG from 2 weeks prior to mating until 100 days after parturition. Animals in the F1 generation were maintained on the same diets and mated at 90 days of age. Animals in the F2 generation were killed on day 20. No significant abnormalities were observed on growth, food consumption, oestrus cycle, date of sexual maturation, organ weights, litter sizes, body weights of offspring, or histopathology of major organs (including brain and retina) of the parents and the F1 generation. Mice of the F2 generation showed normal date of eye-opening. No teratogenic effects were observed.

60. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ In a 3-generation reproduction study, two groups of 17 male and 51 female CD-1 COBS mice were given 1 or 4% MSG in the diet; a further control group of 33 male and 99 female animals received diets without MSG. Animals in the F1 and F2 generations were sacrificed at 27-36 weeks of age, while some of the F3 generation animals were examined histopathologically at 0, 3, 14, and 21 days. Growth and food intake were similar in all groups. The actual MSG intakes were 1.5 and 6 g/kg b.w./day for males and 1.8 and 7.2 g/kg b.w./day for females in the 1 and 4% treatment groups respectively. The MSG intake of dams rose markedly during lactation, rising to a maximum of 25 g/kg b.w./day. No adverse effects were noted on fertility, gestation, viability, or lactation indices of progeny of any generation, and no brain lesions or other treatment-related histopathology were observed.

61. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Groups of female rats were maintained on diets containing 0.5, 1, or 2% vitamin mix. At each vitamin level diets also contained monosodium glutamate at 0, 1, or 2%. Reproductive performance of the parental rats as well as of the F1 offspring maintained on similar diets was studied. The addition of monosodium glutamate to the diet resulted in an increased fertility rate as well as increased survival at weaning of the offspring of the F1 generation. Addition of monosodium glutamate to the diet had no effect on growth rate in the neonatal period. Analysis of the brain tissue of first and second generation offspring at birth for RNA, DNA, protein, nucleus number, and cellular size showed that the brains of rats born of parental mothers on monosodium glutamate diets contained a smaller number of nuclei and larger cells than controls. In contrast, offspring of the F1 generation showed increased RNA, DNA, and nucleus numbers when compared with the offspring of the parental generation. The differences present at birth disappeared at weaning.

62. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Groups of 25 pregnant Wistar-derived rats were given 0, 4.5, 21, 97, or 450 mg monopotassium glutamate/kg b.w. by oral intubation on days 6-15 of pregnancy. No effects were observed on nidation or on maternal of fetal survival and the number of abnormalities in the offspring in the test groups did not differ from those occurring spontaneously in controls.

63. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007:

http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Four groups of rabbits (24 females and 16 males) received 0, 0.1, 0.825, or 8.25% monosodium glutamate in their diet for 2 or 3 weeks before mating. A positive control group of 22 pregnant females received 100 mg/kg thalidomide from days 8 to 16 of pregnancy. All does were sacrificed on days 29 or 30 of gestation and the uteri and uterine contents were examined. All males were sacrificed and the gonads and any abnormal organs examined. No significant effects on body-weight gain, food consumption, general appearance, or behaviour were observed. Gross and histopathological examinations revealed no toxic effects on embryos or resorptions. Pups and all litter data were comparable among test animals and negative controls. The brains of 5 female and 5 male pups at the 8.25% level were subsequently checked for neuronal necrosis compared with controls, but none was found. Similar investigations on 5 male and 5 female pups at the 0.1 and 0.825% levels were also negative.

64. [blanks JC et al; Exp Eye Res 32 (1): 105 (1981)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Retinas from older chick embryos in culture appeared more susceptible to the destructive effects of monosodium glutamate. Effects studied as a function of embryonic age.

65. [NEMEROFF CB ENDOCRINOLOGY 101 (2): 613 (1977)] **PEER REVIEWED**
/LABORATORY ANIMALS: Neurotoxicity/ Analysis of the disruption in hypothalamic-pituitary regulation in rats treated with MSG: evidence for involvement of tuberoinfundibular cholinergic & dopaminergic systems in neuroendocrine regulation.

66. [Dawson RJ et al; Neuroendocrinology 34 (4): 292-6 (1982)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ Monosodium glutamate (MSG) administration to neonatal mice results in destruction of the arcuate nucleus (AN) of the hypothalamus and numerous behavioral, endocrine and neurochemical sequelae. The present study assessed high-affinity neurotransmitter uptake into hypothalamic synaptosomes isolated from adult mice which were treated on postnatal day 4 with either MSG (4 mg/g) or saline. MSG treatment produced a significant reduction in synaptosomal uptake of dopamine (DA), choline (Ch) and GABA when expressed in terms of hypothalamic wet weight. However, MSG treatment resulted in a significant loss (70%) of synaptosomal protein and consequent increases in synaptosomal uptake of these neurochemicals when expressed per unit of synaptosomal protein. The results indicate that MSG treatment produced an overall reduction in net hypothalamic uptake, with surviving neuronal elements exhibiting an increased uptake which may reflect compensatory changes in these nerve terminals. MSG may thus disrupt pituitary and intrahypothalamic functions via its effects on neuronal systems of the AN.

67. [Branka'ck J and Klingberg F; Biomed Biochim Acta 49 (6): 481-7 (1990)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ 10 rats of the Long Evans strain were treated from the first to the eleventh postnatal day with daily subcutaneous injections of 4 mg/g body weight monosodium L-glutamate in aqua dest. 10 rats were used as controls and received isotonic sodium chloride solution on the same days. When rats were 4 months old, electrodes were implanted in different depths of the superior colliculus to investigate averaged evoked potentials by flash and by click stimuli. The flash stimulus in the superficial layers of the colliculus of monosodium L-glutamate rats were strongly reduced in their amplitudes and irregularly shaped with the most prominent result that the primary negative component N28 was missing. The deeper recordings were made, the less this polarity reversed primary component was affected with still significant amplitude reduction in the deepest layer. Shape and peak times of the click stimuli from the same electrodes in different depths were not significantly changed. However, the amplitudes of the early negative positive and the second negative positive deflections were enhanced in all monosodium L-glutamate treated rats, and the amplitude proportions between flash and click stimuli were in favor of click stimulus in contrast to the controls. Heteromodal interactions of paired click and flash stimuli with an interval of 100 ms resulted in nearly total suppression of the flash stimulus, in contrast to controls in which flash were rather uninfluenced by the preceding click. Also the behavior dependent reduction of flash stimulus during grooming and exploratory behavior was much stronger in monosodium L-glutamate treated rats compared with controls. The evoked potential analyses revealed greater interindividual heterogeneity of flash stimulus in monosodium L-glutamate treated rats than in controls.

68. [Banka'ck J, Klingberg F; Biomed Biochim Acta 49 (6): 473-80 (1990)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ 13 rats of the Long Evans strain were treated from the first to the eleventh postnatal day with daily subcutaneous injections of 4 mg/g body weight monosodium-L-glutamate in aqua dest. Further 13 rats were used as controls and received isotonic sodium chloride solution on the same days. When rats were four months old, epidural electrodes were implanted on the visual cortex to investigate averaged evoked potential by flash and by click stimuli. All flash stimulus components of monosodium-L-glutamate rats were changed in their amplitudes and peak times. Mainly the early components were strongly reduced and irregularly split. Click stimulus in the visual cortex of monosodium-L-glutamate rats were also significantly changed. Photically evoked afterdischarges were not statistically altered. The evoked potential analysis revealed great interindividual heterogeneity and their topographical distribution was also strongly modified. The postmortem macroscopic inspection of the brains resulted in strong atrophy of the optic nerves and the chiasma. During two month observations no restoration of the evoked potentials to normal values was observed.

69. [Jessop DS et al; Neuropeptides 18 (3): 165-70 (1991)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ Adult rats treated neonatally with monosodium glutamate exhibit lesions in the arcuate nucleus of the hypothalamus. Following monosodium glutamate lesioning, dopamine content in median eminence/arcuate nucleus tissue extracts declined by 60-70%. Substance P content as determined by radioimmunoassay was significantly decreased in the paraventricular nucleus (531 + or - 30 pg, mean + or - SEM) compared to controls (871 + or - 110 pg) but was unchanged in median eminence/arcuate nucleus extracts. Substance K content decreased to 257 + or - 20 pg in the paraventricular nucleus of lesioned animals compared to controls (367 + or - 31 pg) and the median eminence/arcuate nucleus content of substance K was also significantly decreased (236 + or - 36 pg compared to control levels of 619 + or - 65 pg). The CRF-41 content of the paraventricular nucleus and median eminence/arcuate nucleus was unchanged by monosodium glutamate lesioning, indicating that these areas are not affected by monosodium glutamate. The partial depletion of substance P and substance K in the paraventricualr nucleus following monosodium glutamate treatment provides evidence that at least some of the neurokinin content of the paraventricular nucleus may originate in cell bodies of the arcuate nucleus. However, the lack of response of the median eminence/arcuate nucleus substance P to monosodium glutamate treatment may suggest that the arcuate nucleus is not the major source of substance P in the median eminence.

70. Phelix CF, Hartle DK; Neurosci Lett 117 (1-2): 31-6 (1990)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ Neuronal damage in the area postrema of adult Sprague-Dawley rats was induced by subcutaneous administration of monosodium glutamate, 9 mg/g body wt). Serotonin-immunoreactive neurons were visualized in the area postrema 3 hr or 7 days after control or monosodium glutamate treatment. At 3 hr post monosodium glutamate, many serotonin immunoreactive neurons showed morphological signs of degeneration, such as, cytoplasmic vacuolization, chromatin clumping and dendritic hypertrophy. Monosodium glutamate treatment caused a 30% reduction of detectable area postrema serotonin immunoreactive neurons after 7 days. It was concluded that a subpopulation of serotonergic neurons in the area postrema is sensitive to the neuroexcitotoxic effect of systemic glutamate.

71. [[Wallace DR, Dawson R Jr; Neurochem Res 15 (9): 889-98 (1990)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ ... When administered in an acute, subconvulsive dose (500 mg/kg ip), monosodium L-glutamate altered neurotransmitter content in discrete brain regions of adult (6 month old) and aged (24 month old) male Fischer 344 rats. Norepinephrine content was reduced in both the hypothalamus (16%) and cerebellum (11%) of adult rats, but was increased in both hypothalamus (7%) and cerebellum (14%) of aged rats after monosodium L-glutamate treatment. Monosodium L-glutamate also altered the dopamine content in adult rats in both the posterior cortex and the striatum, causing a reduction (23%) and an increase (12%), respectively. Glycine content in the midbrain of aged rats increased (21%) after monosodium L-glutamate injection. Of particular interest is the widespread monoamine and amino acid deficits found in the aged rats in many of the brain regions examined. Norepinephrine content was decreased (11%) in the cerebellum of aged rats. Dopamine content was reduced in both the posterior cortex (35%) and striatum (10%) of aged rats compared to adult animals. Cortical serotonergic deficits were present in aged rats with reductions in both the frontal (13%) and posterior cortex (21%). Aged rats also displayed deficits in amino acids, particularly the excitatory amino acids. There were glutamate deficits (9-18% reductions) in the cortical regions (posterior and frontal) as well as midbrain and brain stem. Aspartate, the other excitatory amino acid transmitter, was reduced 10% in the brainstem of aged rats. These data indicate that an acute, subconvulsive, dose of monosodium L-glutamate may elicit neurochemical changes in both adult and aged male Fisher 344 rats, and that there are inherent age related deficits in particular neurotransmitters in aged male Fisher 344 rats as indicated by the reduction in both monoamines and amino acids.

72. [Beas-Z'arate C et al; Epilepsy Res 4 (1): 20-7 (1989)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ Adult rats (60 days old) were injected ip with 5 mg/g monosodium L-glutamate. During the convulsive period (1 hr/after injection), uptake and release of 3(H) norepinephrine and 14(C) dopamine were measured in a crude synaptosomal fraction and in slices of cerebral cortex and caudate nucleus, respectively. A significant reduction of 3(H) norepinephrine uptake was detected in cortical slices (by 42%) and in synaptosomal fraction (by 33%) of rats treated with monosodium L-glutamate, whereas potassium(+) stimulated 3(H) norepinephrine release was decreased by 32% and 39% in brain slices and in a synaptosomal fraction of cerebral cortex, respectively, in comparison with animals injected with 0.9% sodium chloride aqueous solution. In the caudate nucleus, 14(C) dopamine uptake was increased by 100% in brain slices and by 36% in the synaptosomal fraction following monosodium L-glutamate administration, whereas potassium(+) stimulated 14(C) dopamine release was enhanced by 80% in slices and by 25% in synaptosomes as compared to aqueous solution injected rats. Data suggest that catecholaminergic neurotransmission may play an important role in the etiopathology of convulsions in the experimental model using monosodium L-glutamate.

73. [Praputpittaya C and Wililak A; Nutr Neurosci 6 (5): 301-7 (2003)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ The purpose of this study was to examine the effect of monosodium glutamate on the visual performance in rats. The Wistar strain of neonatal rats were injected sc with a solution of the glutamate at doses of 1 or 2 or 4 mg/g bw on days 2, 4, 6, 8 and 10 postnatally. Control rats received an injection of physiological saline. ...The 4 mg/g glutamate treatment was observed to impair brightness discrimination performance at 1 month of age as compared to the control animals. This impairment was also observed in animals at 2 and 3 months as compared, in addition, to the values in other doses of glutamate treatment... At 2 months of age, /pattern discrimination/ performance in the 2- and 4 mg/g glutamate-treated groups was lower than those in the control group. This comparison was more pronounced at 3 months of age ...

74. [Kiss P et al; Neurotox Res 8 (3-4): 235-44 (2005)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Neurotoxicity/ ... The aim of the present study was to examine the neurobehavioral development of newborn rats treated with MSG. Rats received MSG at postnatal days 1, 3, 5, 7, and 9. Appearance of neural reflexes and reflex performance as well as motor coordination were examined for 5 weeks after birth. The efficacy of MSG treatment was confirmed by histological examination of the arcuate nucleus. /The authors/ found that MSG treatment delayed the appearance of forelimb placing, forelimb grasp and righting reflexes, besides the retarded somatic development. The treated pups performed surface righting in significantly longer times. Also, worse performance was observed in the foot-fault and rota-rod tests. However, MSG-treated rats reached control levels by the end of the fifth postnatal week.

75. [Olivera-Cortes E et al; Pharmacol Biochem Behav 82 (2): 247-251 (2005)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ ... Place learning acquisition and retrieval were assessed in mature adult rats after sc injection of monosodium glutamate (4 mg/g bw) in eight neonatal rat pups at postnatal days one, three, five, and seven. Eight untreated rats were used as controls. At four months of age, the rats were challenged over a period of nine days with a place learning task. The task used an acquisition-retrieval paradigm in a Morris maze. Place learning acquisition was impaired in the experimental rats, which were unable to reduce their escape latencies during the nine training days. Controls improved between the fifth and ninth days of training. Test trials showed that retrieval of spatial information was also impaired in the experimental animals. These results show that both place learning acquisition and retrieval abilities in mature rats are impaired by neonatal treatment with monosodium glutamate ...

76. [Gonzales-Burgos I et al; Neurosci Lett 363 (1): 22-4 (2004)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ ... Eighteen Sprague-Dawley adult male rats were used. Monosodium glutamate-treated rats (4 g/kg bw, ip) showed tonic and clonic epileptic seizures, as well as less dendritic spines in the apical arborization of their hippocampal CA1 pyramidal cells, compared to both control groups. No changes were seen in the proportional density of thin, stubby, mushroom-shaped, wide, or ramified spines between groups. Excessive glutamate-mediated excitatory activity on receptors could have led dendritic spines to shrink until they disappeared, while the spine-type proportion may be kept balanced as an adaptive response.

77. [Bodnar I et al; Brain Res Bull; 55 (6): 767-74 (2001)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ The effect of neonatal treatment with monosodium L-glutamate (MSG) on the dopaminergic systems of the medial basal hypothalamus has been investigated using tyrosine hydroxylase (TH) and aromatic L-amino acid decarboxylase (AADC) immunocytochemistry. Changes in plasma levels of prolactin (PRL) and alpha-melanocyte-stimulating hormone (MSH) have also been determined in intact and in MSG-treated rats after inhibition of TH by alpha-methyl-p-tyrosine (alpha-MpT) or without inhibition of enzyme activity. Monosodium glutamate resulted in a 40% reduction in the number of TH immunopositive tuberoinfundibular neurons, but no change in the number of AADC-positive tuberoinfundibular nerve cells, indicating that this reduction has occurred mainly in TH-positive but AADC-negative elements, i.e., in L-DOPA-ergic neurons. ... These findings suggest that MSG affects primarily L-DOPA-ergic neurons located in the ventrolateral part of the arcuate nucleus, but not dopaminergic neurons situated in the dorsomedial part of the arcuate nucleus; neither PRL nor MSH secretion is altered by MSG ...

78. [Skultetyova I et al; Neuroendocrinology 67 (6): 412-20 (1998)] **PEER REVIEWED** PubMed Abstract
/LABORATORY ANIMALS: Neurotoxicity/ Hypothalamic-pituitary-adrenocortical function in rats with brain lesions induced by neonatal monosodium glutamate (MSG) treatment (4 mg/g, 5 administrations, ip) was evaluated in the present study. Using in situ hybridization we found increased proopiomelanocortin (POMC) mRNA levels in the adenopituitary and normal corticotropin-releasing hormone mRNA levels in the hypothalamic paraventricular nucleus in MSG-treated rats. The total content of pituitary adrenocorticotropin (ACTH) was not changed, while pituitary ACTH concentration was higher in MSG-treated compared to control rats. The number of ACTH-immunostained cells per a constant area of adenohypophysial section, as measured by immunohistochemistry, was unchanged indicating that no significant condensation of corticotropes occurred. Basal plasma ACTH concentrations were not different, whereas morning corticosterone levels were elevated in rats with MSG treatment. While ACTH response to stress stimuli was similar in both groups of rats, corticosterone response to exogenous ACTH (500 ng/kg, iv, Synacthen), short-lasting handling and immobilization was of the same magnitude but prolonged in MSG-treated rats. Based on the decline of [3H] corticosterone in plasma, a decreased corticosterone clearance rate was found in MSG-treated rats ...

79. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 461] **PEER REVIEWED**
/ALTERNATIVE and IN VITRO TESTS/ In young frog retinas in vitro, glutamate caused decrease in protein synthesis in the inner retina, but increase in synthesis in the photoreceptors. /Glutamate/

80. [Peter RE et al; Cell and Tissue Res 212 (3): 429-42 (1980)] **PEER REVIEWED**
/ALTERNATIVE and IN VITRO TESTS/ Monosodium L-glutamate (MSG) was injected intraperitoneally into goldfish at a dosage of 2.5 mg/g body weight. At 24 hr post-injection there was a marked hypertrophy and edema in the region of the nucleus lateralis tuberis (NLT) from the anterior margin of the pituitary stalk through to the posterior end of the NLT, irrespective of the sex of the goldfish. A similar hypertrophy and edema occurred ventral to the anterior commissure in the preoptic region in the anterior-ventral nucleus preopticus periventricularis (NPP). At 6 hr post-injection a slight vacuolization was evident in these two regions, and at two days the hypertrophy and edema had abated from the extent observed at 24 hr post-injection. At five and eight days post-injection only necrotic cells were found in the affected NLT region, but only a small band of necrotic cells was evident in the anterior-ventral preoptic region. No other brain lesions were evident. Serum levels of gonadotropin (GtH) were increased at 6 hr, 24 hr, and two days after treatment with MSG, but were similar to control values at five, seven and eight days after MSG in male and female goldfish. Exocytosis of small dark secretory granules in gonadotrophs was evident at 24 hr after MSG in a fish with a somewhat greater increase in serum GtH than usually found. The time course of increased serum GtH

levels postinjection of MSG is consistent with the observed time course of hypertrophy and atrophy of NLT neurons; the increase in serum levels of GtH is interpreted to reflect a stimulation of release of GtH-releasing factor from neurons in the NLT. Electron microscope investigation indicates that prolactin cells have increased secretory and synthetic activity from 24 hr through to seven days post-injection of MSG. The mechanism for stimulation of the prolactin cells by MSG is not known. No other changes in activity of adenohypophysial secretory cells were found.

81. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/GENOTOXICITY/ Potassium and ammonium glutamate, L-glutamic acid, and L-glutamic acid HCl were not mutagenic when tested against S. typhimurium strains TA98, TA100, TA1535, TA1537, and TA1538 and Saccharomyces cereviseae in the presence or absence of S-9 mix.

82. [Kubera M et al; Pol J Pharmacol Pharm 43 (1): 39-44 (1991)] **PEER REVIEWED** PubMed Abstract
/IMMUNOTOXICITY/ Cell-mediated immunity was investigated in adult mice and rats treated with monosodium glutamate in their suckling period. Delayed-type hypersensitivity to xenogeneic cells and host-versus-graft reactivity to allogeneic cells were depressed in these mice. Their splenocytes showed reduced mitogen-induced blastogenesis in vitro which was restored by removal of nonadherent to glass spleen cells. Xenogeneic local graft-versus-host reaction induced by spleen cells taken from Wistar rats treated with monosodium glutamate was significantly decreased. Treatment with monosodium glutamate of neonatal mice and rats ... significantly reduced their cell-mediated immunity.

83. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ Numerous studies have been carried out in which large doses of MSG were administered by subcutaneous or intraperitoneal injection to neonatal mice. A common effect of this treatment is a metabolic obesity without hyperphagia and stunted growth ... . The observed obesity in these studies was associated with decreased adrenaline-stimulated lipolysis. Decreased pituitary weight and impaired pituitary function resulted in atrophy of related target organs such as the gonads, accessory sexual organs, thyroids, and adrenals. Prolactin and growth hormone levels were depressed, but hypothalamic LHRF was reported to be unaffected ... . Repressed ossification reported in one study was thought to be due to deranged PTH/calcitonin regulation... .. Similar experiments in rats also resulted in stunting and obesity, with reduction in weights of the pituitary, adrenals, and gonads. Growth hormone levels were reduced in both sexes but LHRH, TRH, somatostatin, and norepinephrin levels were unaffected. Rats receiving 1 g MSG/kg b.w. subcutaneously showed elevated prolactin but reduced growth hormone and TSH levels ... . The effects of treatment are age-dependent in both mice and rats. Neonatal rats show a permanent reduction in GH secretion without evidence of excessive prolactin secretion whereas acute administration of MSG to adults causes suppression of GH and PRL release by effects on the dopamine systems in the medial basal hypothalamus... .. Reduction in weight of the endocrine glands without obvious histological changes did not affect fertility.

84. [DEPAOLO LV ET AL; ENDOCRINOLOGY (BALTIMORE) 110 (3): 835 (1982)] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ Adult male rats (5 months old) treated during first 10 days of life showed endocrine abnormalities

85. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ Monosodium glutamate, monopotassium glutamate, sodium chloride, and sodium gluconate at 1 g/kg in a 10% w/v solution (and comparable volumes of distilled water), were administered orally and subcutaneously to mice and rats at 3 or 12 days of age and to dogs at 3 or 35 days of age and the animals were killed within 24 hours of dosage. Examination of the eyes and of the preoptic and arcuate nuclei of the hypothalamus by two pathologists revealed no dose-related histomorphological effects in any of the test groups at either of the two ages selected to correspond to the periods before and at the beginning of solid food intake.

86. [Bellhorn RW et al; Invest Ophthalmol Vis Sci 21 (2): 237-47 (1981)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ Monosodium glutamate (MSG) administered to neonatal rats on postnatal days 1 to 10 caused a generalized degeneration of the inner retinal layers. MSG administered only on postnatal days 8, 9, 10, and/or 11 caused a retinopathy limited to more peripheral retinal areas ...

87. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

/OTHER TOXICITY INFORMATION/ Seventy-five infant Swiss albino CD-1 mice (3 to 10 days old) were given single subcutaneous injections of MSG at concentrations equal to 2 or 4 g/kg (0.1 mL in distilled water). Another group of 50 adult CD-1 mice were injected either subcutaneously or intraperitoneally with MSG at doses varying from 6 to 10 g/kg (1 mL volume). Control animals were injected with sodium chloride. Brain tissue was examined by light and electron microscopy. Ninety-five percent of the animals injected with MSG developed brain lesions in the arcuate nucleus of the hypothalamus. Lesions involved primarily microglial cells, with no effects to the perikarya of neurons. Distal neuronal processes were only slightly affected.

88. [IEIRI T ET AL; DOKKYO J MED SCI 8 (2): 69 (1981)] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ Neonatal treatment of rats depressed the synthesis & enhanced the release of growth hormone by anterior pituitary isolated from adult males.

89. [TORII K ET AL; LIFE SCI 28 (25): 2855 (1981)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ Adult rats given 4 g/kg ip produced hypothalamic lesion, incr in plasma osmolarity, hypovolemia, alkalosis, hypernatremia, uremia; plasma levels of chloride & potassium decreased.

90. [NAKAO K; J KYOTO PREFECT UNIV MED 89 (6): 435 (1980)] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ Admin of monosodium glutamate to suckling mice caused pituitary lesions with subsequent histological changes in the liver and pancreas.

91. [Rascher K; Cell Tissue Res 220 (2): 239 (1981)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ The brains of neonate albino rats were examined with the light and electron microscope following subcutaneous administration of monosodium glutamate (MSG). In addition to lesions in areas known to be vulnerable to glutamate, such as the arcuate nucleus of the hypothalamus, distinct areas of necrotic tissue were detected in the granular portion of the retrosplenial cingulate cortex. The affected cells display the cytological features characteristic of MSG-lesioned brain tissue, including vacuolization of the endoplasmic reticulum and clumping of chromatin. Numerous pyknotic nuclei can be detected as early as 3 hr following treatment. ...

92. [Komeda K et al; Experientia 36 (2): 232-4 (1980)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ Neuronal necrosis in the arcuate and ventromedial hypothalamus regions is easily induced in 1-day-old Chinese hamsters by the administration of monosodium glutamate (MSG). New-born Chinese hamsters injected with MSG showed no sign of obesity, even when grown up, but apparently developed a diabetic syndrome.

93. [Arbogast LA, Voogt JL; Neuroendocrinology 52 (5): 460-7 (1990)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ This study compared tyrosine hydroxylase mRNA signal levels, relative quantity of tyrosine hydroxylase protein, and the catalytic activity of tyrosine hydroxylase in the tuberoinfundibular dopaminergic neurons of male and ovariectomized female rats. In addition, the effects of monosodium glutamate neurotoxicity on these parameters of tyrosine hydroxylase regulation were evaluated. Neonatal rats were injected with monosodium glutamate (4 mg/g body weight) or 10% sodium chloride (controls) on alternate days for the first 10 days of life. Females were ovariectomized on day 45 of age, and all rats were used between 60 and 80 days of age. The tyrosine hydroxylase mRNA sign levels, as assessed by an in situ hybridization technique, were 2 fold higher in control females than in control males, whereas the number of tyrosine hydroxylase mRNA containing cells was similar between sexes. The tyrosine hydroxylase immunostainings of the tuberoinfundibular dopaminergic neurons perikarya in the arcuate nucleus and of the nerve terminals in the median eminence were qualitatively more intense in females than males. The catalytic activity of tyrosine hydroxylase, as determined by in vitro DOPA accumulation in the stalk median eminence, was 3 fold greater in females than males. Neonatal monosodium glutamate treatment resulted in a marked reduction in the number of tyrosine hydroxylase mRNA containing cells and tyrosine hydroxylase immunopositive cells in the arcuate nucleus of both sexes, as well as a decrease in the intensity of tyrosine hydroxylase immunostaining in the median eminence. The cellular mRNA signal levels for tyrosine hydroxylase were markedly reduced in females after monosodium glutamate treatment, but were unchanged in males. Monosodium glutamate treatment reduced tyrosine hydroxylase activity to 20% of control levels in females, but did not alter enzyme activity in males.

94. [Dawson R JR; Neuroendocrinology 42 (2): 158-66 (1986)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ Neonatal administration of monosodium glutamate to rodents results in severe damage to the arcuate nucleus of the hypothalamus. Monosodium glutamate induced hypothalamus damage produces profound alterations in hypothalamic neurotransmitters and anterior pituitary function. Reproductive function is also severly compromised in both male and female monosodium glutamate treated rats. The present study investigated the developmental sequelae of monosodium glutamate induced alterations in hypothalamic monoamine metabolism as well as other aspects of monosodium glutamate toxicity. Female rats given 4 mg/kg of monosodium glutamate on postnatal days 2 and 4 did not exhibit any significant alterations in hypothalamic monoamine metabolism on postnatal days 21 or 30, however, postpubertal monosodium glutamate treated females had signifiantly reduced levels of mediobasal hypothalamic dopamine and DOPAC. In contrast, male monosodium glutamate treated rats had slight reductions in hypothalamic and mediobasal hypothalamic dopamine levels but these reductions were not statistically significant. Male monosodium glutamate treated rats did exhibit significant reductions in hypothalamic DOPAC on postnatal day 30 and mediobasal hypothalamic homovanillic acid levels on day 100. Acetylcholine levels were also measured in the mediobasal hypothalamic and pituitary of adult male monosodium glutamate treated rats and found to be unaltered. The developmental profile of hypothalamic monoamines and their metabolites and

monosodium glutamate induced alterations in dopamine and DOPOAC levels in the mediobasal hypothalamic of female rats are discussed in relation to the neurochemical mechanisms involved in triggering puberty.

95. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 461] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ ... The retinotoxic effect of glutamate in the mouse was related to the age at which the glutamate was administered. The severity of damage to the ganglion cells and to cells of the inner muclear layer increased with age up to the tenth postnatal day, but after the tenth to eleventh days it was difficult to produce significant lesions in the retina even with lethal doses. At the tenth postnatal day, the retina showed a rapid response and progression of changes. Within 30 min of a single subcutaneous injection, morphologic changes were evident, and massive edema of the inner portions of the retina developed within 90 min, increasing the thickness of the whole retina by 40 to 60% in several hr. Within the first day most of the cells of the inner layers became necrotic and degenerated, and within 48 hr the fragments mostly disappeared, thinning the retina to about 65% of normal. No primary effect on photoreceptor cells was found either by light or electron microscopy, while most of the neurons of the ganglion cell layer were destroyed. Changes in nerve fibers at a distance from ganglion cells in the optic nerve and tracts occurred later. /Glutamate/

96. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 461] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ In rabbits, retinotoxicity has been reported even at adult age. Prolonged treatment has caused degeneration of the ganglion cell layer and inner neclear layer, but without great change in the electroretinogram or the electroculogram. /Glutamate/

97. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 461] **PEER REVIEWED**
/OTHER TOXICITY INFORMATION/ ... In young rats, glutamate in sublethal doses destroyed nerve cells in the ganglion cell layer and the inner nuclear layer, causing disappearance of the beta waves, and causing reduction of myelinated axons in the optic nerves to 1% of normal. The retina in rats becomes resistant to toxic action of glutamate at 10 days after birth, but this does not appear to be related to development of the blood retina barrier. /Glutamate/

98. [Tirassa P et al; Neuroreport 6 (18): 2450-2 (1995)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ The effects of MSG treatment on nerve growth factor (NGF) and neuropeptide Y (NPY) levels were analyzed in the hypothalamus, pituitary, adrenal, thyroid and testis of adult rats. Daily iv injections of MSG (1g/kg for 1 wk) induced an increase of NGF in the hypothalamus (control (C) = 378 +/- 54; saline (S) = 369 +/- 36; MSG = 479 +/- 35 pg g-1 tissue; $p < 0.001$) and pituitary (C = 310 +/- 34; S = 376 +/- 114; MSG = 576 +/- 98 pg g-1 tissue; $p < 0.01$). Hypothalamic and pituitary NPY concentrations were also altered in the MSG-treated rats. Compared with saline-treated rats, the NPY concentration increased by 43% in the hypothalamus and 37.5% in the pituitary of MSG-treated rats. No significant changes in NGF and NPY content were found in the adrenal or thyroid of treated animals ...

99. [Pesini P et al; Anat Histol Embryol 33 (5): 273-7 (2004)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ ... Treatment of neonatal rats with MSG could affect the nitrergic cells of the subfornical organ (SFO). In the present work, alterations in the NADPH-diaphorase activity (a commonly used marker for nitrergic neurons) in the SFO of MSG-treated rats of either sex ... /were examined/. ... The treatment of neonatal rats with MSG induced a substantial reduction in the volume of the SFO and in the number of its nitrergic cells with regard to control animals.

100. [de Andrade IS et al; Neurosci Lett 398 (1-2): 6-11 (2006)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ ... In the present study, newborn male Wistar rats were injected, sc, five times, every other day, with monosodium glutamate (MSG, 4 g/kg bw) or saline (as control, C), during the neonatal period. MSG animals developed destruction of the arcuate nuclei (ARC) with absence of neuropeptide Y (NPY)-immunoreactive cell bodies, which impaired both the food intake (baseline) and the 2-deoxy-D-glucose (2DG) glucoprivic feeding response. ... After systemic 2DG injection, neither the C nor the MSG rats increased their food intake, but they showed similar hyperglycemic responses, whereas plasma free fatty acids (FFA) increased only in the C group. In other groups, 2DG, norepinephrine (NE), neostigmine (NEO) and saline were intracerebroventricularly (icv.) administered. In this condition, impairment of the hyperglycemic and food intake responses, associated to a lower increase in plasma FFA levels, were observed. As opposed to this, the MSG treatment gives support to NE effects, enhancing food intake, as well as plasma glucose and FFA levels. After NEO, plasma glucose increased only in the MSG group, while plasma FFA levels were elevated in the C rats. Taken together, the results obtained after MSG treatment point to a separate neural control of the hyperglycemic response and of the lipid mobilization when stimulated by central 2DG, NE or NEO administration.

101. [Urena-Guerrero ME et al; Neurochem Int 42 (4): 269-76 (2003)] **PEER REVIEWED** PubMed Abstract
/OTHER TOXICITY INFORMATION/ ... This work evaluates the effect of neonatal MSG treatment on glutamic acid decarboxylase (GAD) activity and kinetics in the cerebral cortex, striatum, hippocampus and cerebellum of the rat brain during postnatal development. Neonatal MSG treatment decreased GAD activity in the cerebral cortex at 21 and 60 postnatal days (PD), mainly due to a reduction in the enzyme affinity (K(m)). In striatum, the GAD activity and the enzyme maximum velocity (V(max)) were increased at PD 60 after neonatal MSG treatment. Finally, in the hippocampus and cerebellum, the GAD activity and V(max) were increased, but the K(m) was found to be lower in the experimental group.

102. [Goldsmith PC; J Nutr 130 (4S Suppl): 1032S-8S (2000)] **PEER REVIEWED** PubMed Abstract

/OTHER TOXICITY INFORMATION/ ... To investigate glutamate-induced cellular responses, groups of nursing 7-d-old mice (n = 31-93) were given single sc injections of 0.1-0.5 mg monosodium glutamate (MSG)/g bw or an equivalent volume (30-50 uL) of water vehicle (n = 93). Injection of 0.2 mg MSG/g bw produced a 16-fold rise in plasma glutamate after 15 min (2.10 vs. 0. 122 mmol/L control) and was the lowest harmful dose tested. It not only induced injury of small bilateral groups of medial basal hypothalamic neurons at 5 hr postinjection, but also enhanced their expression of the N-methyl-D-aspartate (NMDA)R1 glutamate receptor subunit. Higher dosages of 0.3-0.5 mg MSG/g bw yielded dose-related increases in NMDAR1 staining intensity and larger numbers of damaged neurons within the ventromedial arcuate nucleus. Administration of the live-cell nuclear stain bis-benzimide (0.95 umol/L) indicated that MSG accessed the entire brain (n = 20) and methylene blue (1.0 g/L) permeated extracellular spaces by 15 min postinjection (n = 19), before cell death was evident (0.75 mmol/L propidium iodide) from co-injected MSG.

103. [Doull, J., C.D. Klaassen, and M. D. Amdur (eds.). Casarett and Doull's Toxicology. 2nd ed. New York: Macmillan Publishing Co., 1980., p. 198] **PEER REVIEWED**

/OTHER TOXICITY INFORMATION/ Large doses of monosodium l-glutamate produce hypothalamic & retinal lesions in newborn mice. The lateral geniculate nucleus also shows degeneration ... the site of hypothalamic damage is the arcuate nucleus. ... controversy as to whether or not MSG affects the hypothalamus in monkeys.

104. [Liu R et al; Ying yong sheng tai xue bao (The journal of applied ecology) 17 (7):1286-90 (2006)] **PEER REVIEWED**

Ecotoxicity Excerpts:

/PLANTS/ To make a comprehensive assessment on monosodium glutamate wastewater pollution, a pollution exposure experiment was carried out on the seed germination and root elongation of wheat, Chinese cabbage and tomato by using the wastewater discharged from different processing phases of monosodium glutamate production. The results showed that there were significantly positive linear relationships between the inhibition rates of wheat seed germination and root elongation and the COD(Cr) of mother liquor scraps. The toxicity of monosodium glutamate wastewater to the test crops was in the order of tomato > Chinese cabbage > wheat, indicating that tomato was most sensitive to the wastewater, and could be considered as an ideal toxic bioindicator. The half-effect concentration (IC50) based on the seed germination and root elongation of test crops exposed to the wastewater discharged from various processing phases of monosodium glutamate production was 22.0 to approximately 32432 mg/L and 17.3 to approximately 3320 mg/L, respectively.

105. [DHHS/NTP; Genetic Toxicity Study of Monosodium glutamate (1988) Study # 481338. Available from, as of February 21, 2007: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=salmonella.overallresults&cas_no=142-47-2&endpointlist=SA **PEER REVIEWED**

National Toxicology Program Studies:

Monosodium glutamate tested negative in mutagenicity studies with Salmonella typhimurium strains TA97, TA98, TA100, TA1535 in the presence or absence of 10 or 30% of S9 in the S9 mixture (metabolic activation enzymes and cofactors from Aroclor 1254-induced male Sprague-Dawley rat or Syrian hamster liver) that was added to cultures. /From table/

106. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

Metabolism/Pharmacokinetics:

Metabolism/Metabolites:

Glutamic acid is metabolized in the tissues by oxidative deamination ... or by transamination with pyruvate to yield oxaloacetic acid ... which, via alpha-ketoglutarate, enters the citric acid cycle ... .. Quantitatively minor but physiologically important pathways of glutamate metabolism involve decarboxylation to gamma-aminobutyrate (GABA) and amidation to glutamine ... . Decarboxylation to GABA is dependent on pyridoxal phosphate, a coenzyme of glutamic acid decarboxylase ..., as is glutamate transaminase. Vitamin B6-deficient rats have elevated serum glutamate levels and delayed glutamate clearance ... . /Glutamic acid/

107. [CACCIA S ET AL; TOXICOL LETT 10 (2-3): 169 (1982)] **PEER REVIEWED** PubMed Abstract

Oral dose of 1 g/kg monosodium glutamate given to rats was followed by only a small rise in plasma pyroglutamate levels. No incr of pyroglutamate or glutamate brain levels was observed under these conditions.

108. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER**

Absorption, Distribution & Excretion:

Glutamate is absorbed from the gut by an active transport system specific for amino acids. This process is saturable, can be competitively inhibited, and is dependent on sodium ion concentration... . During intestinal absorption, a large proportion of glutamic acid is transaminated and consequently alanine levels in portal blood are elevated. If large amounts of glutamate are ingested, portal glutamate levels increase ... . This elevation results in increased hepatic metabolism of glutamate, leading to release of glucose, lactate, glutamine, and other amino acids, into systemic

circulation ... . The pharmacokinetics of glutamate depend on whether it is free or incorporated into protein, and on the presence of other food components. Digestion of protein in the intestinal lumen and at the brush border produces a mixture of small peptides and amino acids; di-and tri-peptides may enter the absorptive cells where intracellular hydrolysis may occur, liberating further amino acids. Defects are known in both amino acid and peptide transport ... .. Glutamic acid in dietary protein, together with endogenous protein secreted into the gut, is digested to free amino acids and small peptides, both of which are absorbed into mucosal cells where peptides are hydrolyzed to free amino acids and some of the glutamate is metabolized. Excess glutamate and other amino acids appear in portal blood. As a consequence of the rapid metabolism of glutamate in intestinal mucosal cells and in the liver, systemic plasma levels are low, even after ingestion of large amounts of dietary protein. /Glutamic acid/

109. [Walker R and Lupien JR; J Nutr 130 (4S Suppl): 1049S-52S (2000)] **PEER REVIEWED** PubMed AbstractREVIEWED**

Intestinal and hepatic metabolism results in elevation of levels in systemic circulation only after extremely high doses given by gavage (>30mg/kg body weight). Ingestion of monosodium glutamate (MSG) was not associated with elevated levels in maternal milk, and glutamate did not readily pass the placental barrier. Human infants metabolized glutamate similarly to adults.

110. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

Oral administration of pharmacologically high doses of glutamate results in elevated plasma levels. The peak plasma glutamate levels are both dose and concentration dependent ... . When the same dose (1 g/kg b.w.) of monosodium glutamate (MSG) was administered by gavage in aqueous solution to neonatal rats, increasing the concentration from 2% to 10% caused a five-fold increase in the plasma area under curve; similar results were observed in mice ... . Conversely, when MSG (1.5 g/kg b.w.) was administered to 43-day-old mice by gavage at varying concentrations of 2 to 20% w/v, no correlation could be established between plasma levels and concentration ...

111. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

Administration of a standard dose of 1 g/kg b.w. MSG by gavage as a 10% w/v solution resulted in a marked increase of plasma glutamate in all species studied. Peak plasma glutamate levels were lowest in adult monkeys (6 times fasting levels) and highest in mice (12-35 times fasting levels). Age-related differences between neonates and adults were observed; in mice and rats, peak plasma levels and area under curve were higher in infants than in adults while in guinea pigs the converse was observed.

112. Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

Studies on the effects of food on glutamate absorption have been carried out in mice, pigs, and monkeys. When infant mice were given MSG with infant formula or when adults were given MSG with consomme by gastric intubation, peak plasma glutamate levels were markedly lower than when the same dose was given in water, and the time to reach peak levels was longer . The simultaneous administration of metabolizable carbohydrate was found to increase glutamate metabolism in mice, pigs, and monkeys, leading to lowered peak plasma levels. In contrast to gastric intubation, ad lib feeding of MSG in the diet caused only slight elevation of plasma glutamate above basal levels. Similar effects of food on glutamate absorption and plasma levels have been observed in man. Only slight rises in plasma glutamate followed ingestion of a dose of 150 mg MSG/kg b.w. to adults with a meal; human infants, including premature babies, have the capacity to metabolize similar doses given in infant formula ... . Human plasma glutamate levels were much lower when large doses of MSG were ingested with meals compared to ingestion in water. ... In general, foods providing metabolizable carbohydrate significantly attenuate peak plasma glutamate levels at doses up to 150 mg MSG/kg b.w. Carbohydrate provides pyruvate as a substrate for transamination with glutamate in mucosal cells so that more alanine is formed and less glutamate reaches the portal circulation.

113. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

When MSG (8 g/kg b.w.) was administered orally to rats on day 19 of gestation, maternal plasma levels rose from approximately 100 ug/mL to 1650 ug/mL, but no significant changes were observed in plasma glutamic acid of the fetuses... . Infusion of MSG into pregnant rhesus monkeys at a rate of 1 g/hr led to a 10-20-fold increase in maternal plasma glutamate, but fetal levels remained unchanged. Higher rates of infusion resulted in maternal plasma glutamate levels up to 70 times basal levels, but fetal levels increased less than 10 times... . In vitro perfusion studies using human placenta indicated that the placenta served as an effective metabolic barrier to the transfer of glutamic acid.

114. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

In guinea pigs, rats, and mice, brain glutamic acid levels remained unchanged after administration of large oral doses of MSG which resulted in plasma levels increasing up to 18-fold ... . Brain glutamate increased significantly only when plasma levels were about 20 times basal values following an oral dose of 2 g MSG/kg b.w. Subcutaneous injection of high doses (2 g MSG/kg b.w.) to neonatal mice caused an increase in serum glutamate to 270 times basal values, while levels in the arcuate nucleus increased 4-7 fold... .No appreciable changes in glutamate concentrations were observed in the lateral thalamus and in the arcuate nucleus of adult or neonatal rats given 4 g MSG/kg b.w. or 2 g MSG/kg b.w., respectively, by garage. Peak plasma glutamate levels were 11-12 tmes normal after these doses.

115. [WHO Food Additive Series 22; L-Glutamic Acid and its Ammonium, Calcium, Monosodium and Potassium Salts. Available from, as of March 20, 2007: http://www.inchem.org/documents/jecfa/jecmono/v22je12.htm **PEER REVIEWED**

Mechanism of Action:

L-Glutamate and GABA supposedly act as excitatory and inhibitory transmitters, respectively, in the central nervous system. Glutamate is also involved in the synthesis of proteins. /Glutamate/

116. [Farombi EO amd Onyema OO; Hum Exp Toxicol 25 (5): 251-9 (2006)] **PEER REVIEWED** PubMed Abstract

Interactions:

Monosodium glutamate (MSG) administered intraperitoneally /for 10 days/ at a dose of 4 mg/g bw markedly increase malondialdehyde (MDA) formation in the liver, the kidney and brain of rats. Simultaneous administration of VIT C, VIT E and quercetin to MSG-treated rats significantly reduced this increase in MDA induced by MSG. VIT E reduced lipid peroxidation mostly in the liver followed by VIT C and then quercetin, while VIT C and quercetin showed a greater ability to protect the brain from membrane damage than VIT E. The decreased glutathione (GSH) level elicited by MSG in the three organs corresponded with marked increase in the activity of glutathione-S-transferase (GST). While MSG increased ($p < 0.001$) the activities of superoxide dismutase and catalase in the liver, it decreased significantly the activities of these enzymes in the kidney and the brain. The three antioxidants were effective at ameliorating the effects of MSG on GSH levels and the enzymes in the three organs examined. While MSG increased the activity of glucose-6-phosphatase in the liver and kidneys of rats ($p < 0.001$), the activity of the enzyme was abysmally low in the brain. There were marked increases in the activities of alanine aminotransferase, aspartate aminotransferase and gamma-glutamyl transferase in rats treated with MSG. The antioxidants tested protected against MSG-induced liver toxicity significantly. MSG at a dose of 4 mg/g significantly ($p < 0.01$) induced the formation of micronucleated polychromatic erythrocytes (MNPCEs). Co-treatment of rats with VIT C and quercetin inhibited the induction of MNPCEs by MSG ($p < 0.001$) ...

117. [National Library of Medicine - Medical Subject Headings (2007)] **PEER REVIEWED**

Pharmacology:

Therapeutic Uses:

One of the FLAVORING AGENTS used to impart a meat-like flavor. Medically it has been used to reduce blood ammonia levels in ammoniacal azotemia, therapy of hepatic coma, in psychosis, and mental retardation.

118. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982., p. 59] **PEER REVIEWED**

Drug Warnings:

The large doses of sodium glutamate required for the treatment of hepatic encephalopathy may result in dangerous alkalosis and hypokalemia ... important to keep close control on the electrolyte balance during therapy.

119. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982., p. 59] **PEER REVIEWED** Food and Environmental Agents: Effect on Breast-Feeding: Monosodium glutamate: None. /from Table 7/[Report of the American Academy of Pediatrics Committee on Drugs in Pediatrics 93 (1): 142 (1994)] **PEER REVIEWED**

Injections of sodium glutamate should be given with caution to patients with hepatic cirrhosis, impaired renal function, or liver disease not associated with hyperammonemia.

120. [Farombi EO amd Onyema OO; Hum Exp Toxicol 25 (5): 251-9 (2006)] **PEER REVIEWED** PubMed Abstract

Interactions:

Monosodium glutamate (MSG) administered intraperitoneally /for 10 days/ at a dose of 4 mg/g bw markedly increase malondialdehyde (MDA) formation in the liver, the kidney and brain of rats. Simultaneous administration of VIT C, VIT E and quercetin to MSG-treated rats significantly reduced this increase in MDA induced by MSG. VIT E reduced lipid peroxidation mostly in the liver followed by VIT C and then quercetin, while VIT C and quercetin showed a greater ability to protect the brain from membrane damage than VIT E. The decreased glutathione (GSH) level elicited by MSG in the three organs corresponded with marked increase in the activity of glutathione-S-transferase (GST). While MSG increased ($p < 0.001$) the activities of superoxide dismutase and catalase in the liver, it decreased significantly the activities of these enzymes in the kidney and the brain. The three antioxidants were effective at ameliorating the effects of MSG on GSH levels and the enzymes in the three organs examined. While MSG increased the activity of glucose-6-phosphatase in the liver and kidneys of rats ($p < 0.001$), the activity of the enzyme was abysmally low in the brain. There were marked increases in the activities of alanine aminotransferase, aspartate aminotransferase and gamma-glutamyl transferase in rats treated with MSG. The antioxidants tested protected against MSG-induced liver toxicity significantly. MSG at a dose of 4 mg/g significantly ($p < 0.01$) induced the formation of micronucleated

polychromatic erythrocytes (MNPCEs). Co-treatment of rats with VIT C and quercetin inhibited the induction of MNPCEs by MSG ($p < 0.001$) ...

121. **PEER REVIEWED**

Environmental Fate & Exposure:

Environmental Fate/Exposure Summary:

Monosodium glutamate's production and use as a food additive, may result in its release to the environment through various waste streams. If released to air, monosodium glutamate will exist solely in the particulate phase in the atmosphere since it is a salt. Particulate-phase monosodium glutamate will be removed from the atmosphere by wet or dry deposition. Monosodium glutamate does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight. If released to soil, monosodium glutamate is expected to have very high mobility based upon an estimated Koc of 4. Volatilization from soil and water surfaces will not occur since monosodium glutamate is a salt. Several genera of bacteria have been shown to possess enzymatic capability to degrade l-glutamic acid and monosodium glutamate was readily degraded in sediment/water microcosms using both seawater and estuarine water. If released into water, monosodium glutamate is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. An estimated BCF of 1 suggests the potential for bioconcentration in aquatic organisms is low. Occupational exposure to monosodium glutamate may occur through dermal contact with this compound at workplaces where monosodium glutamate is produced or used. The general population is exposed to monosodium glutamate primarily via ingestion of food products containing this additive. (SRC)

122. [(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Jan 4, 2007.] **PEER REVIEWED**

Probable Routes of Human Exposure:

NIOSH (NOES Survey 1981-1983) has statistically estimated that 60,341 workers (22,829 of these are female) are potentially exposed to monosodium glutamate in the US(1). Occupational exposure to monosodium glutamate may occur through dermal contact with this compound at workplaces where monosodium glutamate is produced or used(SRC). The general population is exposed to monosodium glutamate primarily via ingestion of food products containing this additive(SRC).

123. [(1) Rhodes J et al; Food Addit Contam 8: 663-672 (1991)] **PEER REVIEWED** PubMed Abstract

Average Daily Intake:

The estimated intake of monosodium glutamate for the general population of the UK was estimated as 1.56 grams per week in a National Food Survey conducted in 1990(1).

124. [Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 14th Edition. John Wiley & Sons, Inc. New York, NY 2001., p. 1014] **PEER REVIEWED**

Natural Pollution Sources:

Sodium salt of glutamic acid, one of the common naturally occurring amino acids.

125. [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Yoshida T; Kirk-Othmer Encycl Chem Tech. 3rd NY: Wiley 2: 410-21 (1978) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9, 5-5 (1990) (4) Wirsen CO, Jannasch HW; Microbiol Ecology 1: 25-37 (1974)] **PEER REVIEWED**

Environmental Fate:

TERRESTRIAL FATE: Based on a classification scheme(1), an estimated Koc value of 4(SRC), determined from a water solubility of 3.85X10+5 mg/L(2) and a regression-derived equation(3), indicates that monosodium glutamate is expected to possess very high mobility in soil(SRC). Volatilization will not be an important fate process because salts do not volatilize. Monosodium glutamate degraded rapidly using marine water/sediment and estuarine water/sediment microcosms(4), suggesting biodegradation will occur readily in soil.

126. [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Yoshida T; Kirk-Othmer Encycl Chem Tech. 3rd NY: Wiley 2: 410-21 (1978) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9, 5-5 (1990) (4) Franke C et al; Chemosphere 29: 1501-14 (1994) (5) Wirsen CO, Jannasch HW; Microbiol Ecology 1: 25-37 (1974)] **PEER REVIEWED**

AQUATIC FATE: Based on a classification scheme(1), an estimated Koc value of 4(SRC), determined from a water solubility of 3.85X10+5 mg/L(2) and a regression-derived equation(3), indicates that monosodium glutamate is not expected to adsorb to suspended solids and sediment(SRC). Volatilization in water will not be an important fate process because monosodium glutamate will form the sodium and glutamate ions in water which do not volatilize. According to a classification scheme(4), an estimated BCF of 1(SRC), from the water solubility(2) and a regression-derived equation(3), suggests the potential for bioconcentration in aquatic organisms is low(SRC). Monosodium glutamate degraded rapidly using marine water/sediment and estuarine water/sediment microcosms(5).

127. **PEER REVIEWED**

ATMOSPHERIC FATE: Monosodium glutamate is the sodium salt of glutamic acid and will exist in the particulate phase if released to the atmosphere. Particulate-phase monosodium glutamate may be removed from the air by wet or dry deposition. (SRC)

128. [(1) Kawakita T; Kirk-Othmer Encyclopedia of Chemical Technology. (2005). NY, NY: John Wiley & Sons; L-Monosodium Glutamate (MSG) Online Posting Date: December 4, 2000. (2) Rhodes J et al; Food Addit Contam 8: 663-672 (1991)] **PEER REVIEWED**

Food Survey Values:

Monosodium glutamate is used in large quantities as a flavor enhancer throughout the world(1). Monosodium glutamate was identified in 502 food products in a National Food Survey conducted in the UK in 1990(2). The mean percentage of monosodium glutamate contained in the various food items ranged from 0.06% in cured pork to 8.7% in meat and yeast extracts(2).

129. [FDA; MSG: A Common Flavor Enhancer in FDA Consumer (January-February 2003) Available from, as of March 20, 2007:

Environmental Standards & Regulations:

FDA Requirements:

Glutamate is commonly found in food, primarily from protein sources. Foods and ingredients that contain glutamate as an inherent component are not required to list glutamate on the label. ...When MSG is added to food the FDA requires "monosodium glutamate" to be listed on the label. Other salts of glutamic acid--such as monopotassium glutamate and monoammonium glutamate--also have to be declared on labels and cannot be lumped together under "spices," "natural flavoring" or other general terms.

130. [21 CFR 182.1; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of March 1, 2007: http://www.ecfr.gov **PEER REVIEWED** http://www.cfsan.fda.gov/~dms/fdacmsg.html **PEER REVIEWED**

It is impracticable to list all substances that are generally recognized as safe for their intended use. However, by way of illustration, the Commissioner regards such common food ingredients as salt, pepper, vinegar, baking powder, and monosodium glutamate as safe for their intended use.

131. [Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 4rd Edition, Boca Raton, FL: CRC Press 2002.] **PEER REVIEWED**

Consumption Patterns:

Annnual Consumption (U.S.): 31,000,000 lb (From the PAFA database, originating from a NAS survey of 1987 and assumes only 60% of poundage was reported). Individual Consumption: 26.2711 mg/kg/day

132. [SRI] **PEER REVIEWED** Derivate: Processed Food, 30%; Soups, 25%; Institutional, 25%; Direct Consumer, 15%; Misc, 5% (1983) [CHEMICAL PRODUCTS SYNOPSIS: Monosodium Glutamate, 1984] **PEER REVIEWED**

26% used in dry & wet soup products; 22% in convenience foods; 22% by institutions (hospitals, schools, restaurants, hotels, etc); 16% by formulators of flavorings for various end uses; 12% in direct consumer sales; 2% in animal feed to induce early weaning of baby pigs (1975)

Toplu Yorumlar

- 2,5 gram MSG alınması ile baş ağrısı, adale sertliği, hissiyattı bozulma, genel zayıflık, ateş basması daha sık olduğu belirtilmektedir. Burada dozun yüksek olması yanında zaten Glutamat nörotransmitter olarak bu yönde etkisinin olması beklenilen, fizyolojik bir boyuttur.
- 12,7gram MSG verilmesi ile serum düzeyinin 11 kat fazla olması ile, hipotalamus ve pituiter açıdan etkisi minimaldir.
- FDA (Amerikan İlaç ve Gıda Bakanlığı) yayınında yeterli yan etki gözlenmediği vurgulanmaktadır.
- 4 gram üstünde MSG benzer yakınmaları oluşturabilmektedir.
- 200mL üstünde çorba içmek ile ancak etkileşim olabilmektedir.
- 3 yaşındaki bir çocukta benzer sorun rapor edilmiştir.
- B6 Vitamini önceden almak ile bu yakınmalar gözlenmemektedir.
- 1 gram ile oral semptom olurken, 26gram alınması ile hiç etkileşim olmadığı da görülmektedir.
- BCG aşısı ile verilen MSG yabancı cisim reaksiyonu vermiştir.
- MSG eliminasyonundan bir ay sonra adale ağrısı olanlarda semptomlar yatışmıştır.
- MSG deneklerde verilen 2 saat sonra %13,1 oranında semptom gözlenmiştir.

- 1980-1994 yılları arasında 622 olgu belirtilmiş, sadece birinde astım bulguları olmuş ama saatler içinde ilerleme ve kötüleşme görülmemiştir.
- Midede asit gastrik sekresyonunda 360mg MSG verilmesinin etkisi olmamıştır.
- Hepatik ensefalopatili tedavisinde MSG kullanılmaya çalışılmış, tedavide elektrolit dengesi dikkatlice yapılmalıdır vurgusu iletilmektedir.
- Hepatik sirozda verilmiş ve Hiperamonemi nedeni olarak saptanmamıştır.
- Anne sütü etkisi gözlenmemiştir.
- 0,5 gramdan 2,5 grama MSG artması ile astım etkisi artabileceği uyarısı yapılmaktadır.
- B6 Vitamini eksikliği olanlar MSG ters etki, reaksiyon verebilmektedirler.
- 3 gram MSG alanlarda 2 saat sonra etkileşim olmakta, buna karşın 60-150mg alanlarda bir sorun olmadığı da rapor edilmiştir.
- İdioenkrazik reaksiyon tanımlanmıştır.
- Yüksek doz hayvanlarda damardan verilmesi ile hipotalamus ve retinal hasarlarla sorunlar rapor edilmiştir (31. Kaynak).
- Yüksek doz osmotik sorunlar yaratabilir.
- Hipotalamus lezyon gözlenmeyen hayvan çalışması sunulmaktadır.
- Maymunlarda hipotalamus lezyon görülmemiştir. Başka çalışmada ters etkisi için 200mg/L kan düzeyi gereklidir.
- Damardan verilmesi ile oral alma arasında belirgin serum farkı vardır ama hipotalamus sorun hayvan çalışmasında saptanmamıştır.
- Uzun süre verilmelerde hipotalamus, hipofiz yolunda etkileşim olduğu vurgusu vardır.
- Timosit modülasyonunu MSG azaltmaktadır.
- Hipotalamusta herhangi bir etki gözlenmemiştir.
- Beyin gelişiminde etkisi saptanmamıştır.
- Nörotik ve hasarlı hücre rastlanmamıştır.
- Renal toksik etki gözlenmemiştir.
- Hamsterlerde ovarian sorunlar olduğu saptanmıştır. Ufak ovarium ve korpus lutea olup, spermatogenez de başka çalışmada azaldığı belirtilmiştir.
- Yüksek dozda katarakt oluşturulmuş %77'si geriye dönmüştür.
- Geç dönem gebelikte MSG sorun yaratmamaktadır.
- Yüksek dozda obesite ve vücut uzunluğu/boyda etkileme sıçanlarda gözlenmiştir.
- Hayvanlarda yüksek doz ile nükleer piknositoz saptanmıştır.
- Kortikosteron temizlenmesinde MSG etkisi görülmüştür.
- Katekolaminler etkisi ile kasılmalarda etkili olabileceği vurgusu vardır.
- İç retinada protein sentezi azalıyor, fotosensörler artmaktadır.
- Prolaktin hücrelerin sekresyonunda artma belirtilmiştir.
- Sıçanlarda büyüme hormonunda azalma saptanmıştır.
- Glutamat protein sentezinde de rol oynamaktadır.
- Kan ammonium düzeyini azaltmak için tıbbi ilaç olarak kullanıldığı, hepatik koma ve psikozlarda ve mental geriliklerde uygulandığı yayınlanmıştır.
- Oksidatif stress yapabileceği şeklinde hayvan çalışmaları vardır.
- Gıda endüstrisinde olup MSG ile cilt temasında bulunanlar olmakta, yan etki kısmen olduğu, bazı çalışmalarda da belirtilmemektedir.
- İngiltere'de haftada 1,56gram tüketildiği hesaplanmıştır.
- Tuzlar buharlaşmamaktadır, parçalanmaktadırlar.
- Biyolojik olarak suda yıkıldığı belirtilmektedir.
- İngiltere'de etlerde %8,7 oranında kullanılmakta olduğu bildirmektedir.
- MSG olan yiyeceklerin üstünde bildirilmesi zorunludur.
- Tuz, biber, sirke gibi güvenli olduğu şeklinde raporla bulunmaktadır.

- Günlük bireyse kullanım oldukça yüksektir. Dolayısıyla zarar unsuru olduğunda belirgin bulgular gözlenmelidir.
- %26 çorbada, %22 diğer yiyeceklerde, %22 işletmelerde (hastane, okullar, restoranlarda), %16 gıdalarda lezzet artırıcı, %12 tabet olarak satışlarda, %2 hayvanların yiyecekleri olarak kullanılmaktadır.

SONUÇ: Glutamat bir aminoasit olarak nöral uyarı oluşması/gönderilmesinde rol oynayan bir etkiye sahiptir. Her bir şeyin dengesi gerekli olduğu gibi, toksik dozu da olmaktadır ve genellikle saptanan zararların yüksek doz ile oluştuğu anlaşılmaktadır. Bunun gibi fazla kullanılmaması ve devamlı FDA ve diğer ruhsat mercilerinin uyarılarına dikkat edilmelidir.

Tüm iletilen toksik kayıtlarda olanların doğrudan belirtildiği şekilde sunulması, bireylerin kaynakları incelemesi olanağı sağlanması gözetilmiştir.

Kanıta Dayalı Tıp

Bir kanıtın geçerliliği önemlidir. Dünya mı, Güneşin etrafında dönmekte, Güneş mi? Her gün görünüme göre Güneşin Dünya etrafında döndüğü kesindir ama bilim tam tersini söylemektedir. Bunun gibi söylenen, algı ile olanlar ile gerçeklik, doğruluk ancak bilim ile oluşabilir. Hekimliğin etik ilkelerde temeli zararımızın dokunmamasıdır. Bu açıdan yarar için zarar örtülemez.

KANITA DAYALI TIP Kaynağı: Ergör, G. Kanıta Dayalı Tıp Nedir? Ergör G. Kanıta dayalı tıp, Modern Tıp Seminerleri Dizisi, Sayı: 27, Güneş Kitapevi Yayınları, Ankara, 2003, sayfa 1–6.

Kanıt Düzeylerine Göre Yapılan Gruplandırma

KANIT DÜZEYLERİ VE ÖNEM DERECELERİ

1: Sistematik derleme, randomize klinik çalışmalar	KANIT PİRAMİDİ
2'a: Sistematik derlemeler, Kohort	Meta analiz
2 b: Kohort çalışmalar, izlemde kalan %80 olan randomize klinik çalışmalar	Randomize kontrollü çalışmalar Kohort
3'a: Sistemik derleme, olgu kontrol çalışmalar	Olgu-kontrol çalışmaları
3 b: Olgu kontrol çalışmalar	Olgu serisi
4: Olgu serileri, kontrolsüz Kohort veya randomize klinik çalışmalar	Olgu sunumu Uzman görüşü, Editör makalesi
5: Uzman görüşü, eleştirel değer biçmeye dayalı olmayan çalışmalar	Hayvan deneyleri İn vitro çalışmalar

Kanıtlara Göre Uygulamalar

a) Hak edişe göre yaklaşım/adalet

- YAP (A)
  1++ Bireysel yanılgı az
  1+ Yanlı olma riski az
  1- Yüksek yanlı olma durumu
- YAPILMALI (B)
  2++ Yanlılık riski düşük, kontrol çalışması var
  2+ Karışıklık yapacak yanlılık riski az
  2- Yanlılık riski yüksek
- OLGUYA GÖRE (C)
  3. Vaka serileri, analitik olmayan çalışmalar
- UZMAN GÖRÜŞÜ-ARAŞTIRMA (D)
  4. Konsey Kararları, ortak değerlendirme ile alınan kararlar Deneysel çalışmalar (Etik Kurul kararları gereklidir)

b) Zarar Vermeme

- Sakıncalı, Zararlı, Kontra-Endikasyon
- UYARILAR: Dikkat edilecekler ve yapılacaklar

- YAN ETKİLER: Temel etki yerine destekleyici
- ADVERS ETKİ, Ters etkiler
- KOMPLİKASYON: İstenmeyen ama beklenen etki

c) İnsancıl Kullanım

Ruhsat Dışı Kullanım veya Yarar olasılığı olan ilaç ve yaklaşımlar

d) Plasebo

Yalancı ilaç veya yaklaşım yapmak (etkilerin gerçek boyutunu anlayabilmek için kontrol gönüllüler, kontrol olduğunu bilmeden uygulanmaktadır)

Bir çalışmanın Uygun Kanıtlı olup olmadığının sorgulanması

KANITA DAYALI TIP UYGULAMASINDAKİ 5 ADIM

1. ADIM: Problemi uygun bir SORU haline dönüştürmek
2. ADIM: Yanıtlamak için LİTERATÜR taraması
3. ADIM: Makalelerin ELEŞTİRİSEL değer biçme (critical appraisal)
4. ADIM: KARAR verme (eldeki kanıt, hekimin deneyimi, hastanın seçimi)
5. ADIM: Karar ve tüm sürecin DEĞERLENDİRİLMESİ

Yorum

Kanıtların gerçek olup olmadığı ötesinde, bunun karar olarak net ortaya konulması gerekir.

Bilim şüphecilik gerektirir.

Sorgulama, felsefe bilimi temelinde ele alınırsa:

Sorgu	İngilizce	Anlam
Ne	Wh-at	Süje, olay birey, duruma göre irdelenmelidir, özgün ve özerk
Nerede	Wh-ere	Olay, durum ve oluşum
Niçin	Wh-y	Gerekçesi, dayanakları
Ne zaman	Wh-en	Zamana göre mahkeme kararı bile fark etmektedir
Nasıl	Wh-at way, How	İşlenme boyutu, güdü
Kim	Wh-o	Sorumlu olan kişi, cezayı alacak olan kişi

Bunlar bir mahkemenin olayı irdelemesine benzer.

Türk Ceza Kanunu'nda da: *Cezanın belirlenmesi;* ***MADDE 61.-*** *(1) Hâkim, somut olayda; (Olay somut ve delilere dayalı olmalı, soyut olay olamaz). a) Suçun işleniş biçimini,* (Nasıl), *b) Suçun işlenmesinde kullanılan araçları* (Ne şekilde ve ne ile), *c) Suçun işlendiği zaman ve yeri* (Nerede ve ne zaman), *d) Suçun konusunun önem ve değerini* (Neden, gerekçesi), *e) Meydana gelen zarar veya tehlikenin ağırlığını* (Ne, zarar nedir), *f) Failin kast veya taksire dayalı kusurunun ağırlığını* (Niçin), *g) Failin güttüğü amaç ve saiki* (Amacı ve güdüsü), (Değerlendirerek karara varır).

Sonuç

Tavuk suyu veya et suyu ile hazırlanan pilav yemek isteyenler, daha önce hazırladıkları et veya tavuk suyundan pilav yapmaları, zaman süreci ve modern boyut ile neredeyse olanaksız olmaktadır.

Hazır satılan tavuk su ve et suları da kullanılması beklenilmelidir.

Ancak, tüm et ürünlerinde lezzet vermesi için Glutamat değil, başka amino asitlerin de gündeme gelmesi beklenilmektedir. Bulunması açısından Glutamat, buğdayda 100 gram proteinde 30 g gibi bir oranda olması ile sık bulunan ve neticede sık kullanan amino asit olmaktadır.

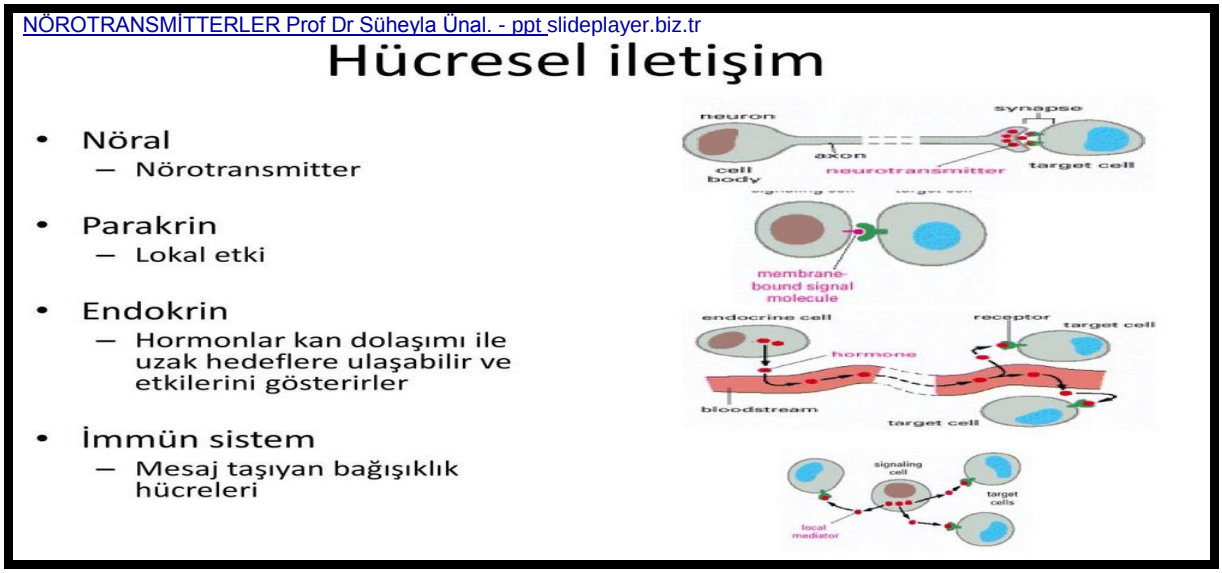
Bir kişi MSG zehir gibi kabul ediyorsa, elbet yemesi beklenmez.

Buna karşın tüketilmesi açısından bir zararlı durumun gözlenmediği de bir hakikattir.

Glutamat ne işe yarar

Glutamat vücudumuzda önemli etkileri olduğu ve bazı belirtilen sorunların kaynağın bu etkiden dolayı olduğu anlaşılacaktır.

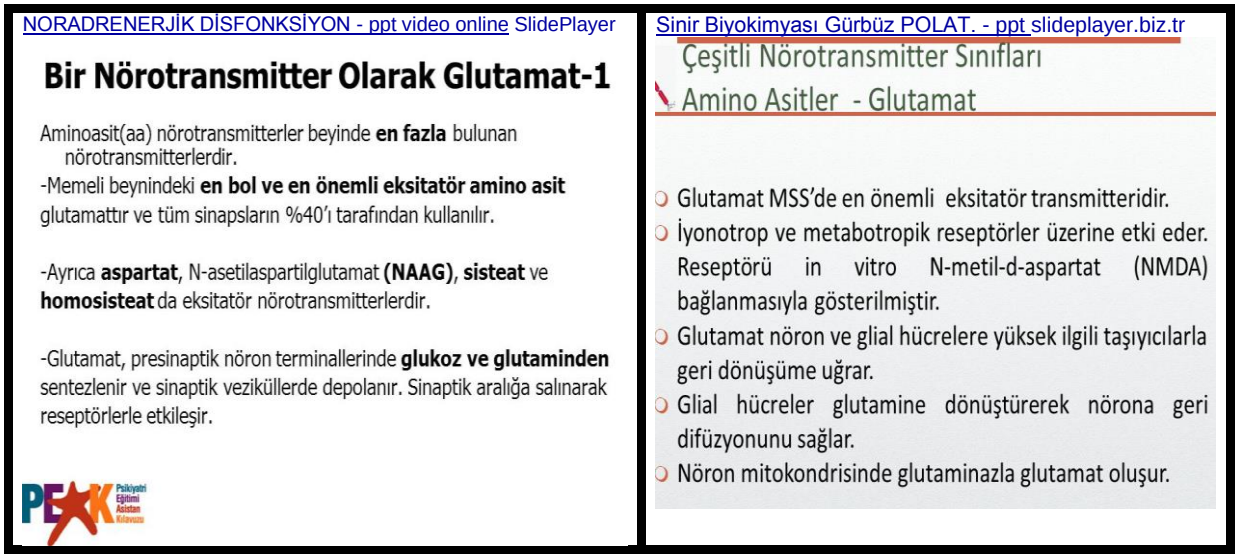
Hücreler arası iletişim yolları



Şekil 1: Hücresel iletişim; a) nöral, b) lokal etki, c) endokrin ve d) İmmün sistemle olmaktadır.

Nöral iletişim konusunda Glutamat amino asit olarak önemli etkisi ve katkısı vardır.

Glutamat işlevi, Nöral iletişimi sağlaması;



Şekil 2: Glutamat sinirsel uyarıcı olarak önemli rolü vardır

Glutamat santral sinir sisteminde uyarıcı rolü fazla olduğu için, bu maddenin verilmesi ile santral sinir veya nöronal sinirlerde uyaran görülmesi ve fazla verildiğinde de ters etkileşim de bir bakıma amino asitin işlevi olduğu anlaşılacaktır. Dolayısıyla toksik olarak gösterilen boyut, temelde fizyolojik beklenen etkileşim gurubu içine girmektedir.

Sağlık ile Gıda ve Tarım Bakanlığı tarafından Ruhsatlı olan (Amerika'da FDA) ve devamlı izlenen boyutlar bakılmalıdır. En ufak zarar söz konusu ise bunun uyarılar olacağı bilinmelidir.

Ülkemizde A Grubu dışındakilerin ruhsatlandırılmadığı dikkate alındığında en güvenli Ülkelerden olmaktayız

Denetleme mekanizması açısından da ülkede olan firmalar, örneğin Eti, Ülker, gibi firmaların laboratuvarlarda ciddi inceleme olmaktadır. Dolayısıyla ekonomik açıdan sorunlu gıdalar ihbar ile bildirilmekte ve gereken yaklaşımlar yapılmaktadır. Bunun örnekleri belirgindir.

Zorlama insanlık ile bağlantılı olmadığı için, MSG kullanımı da kişilerin inisiyatifine bırakılmalıdır.

SON SÖZ

Bir kişi 500mL şişeden su içse ve sonra tuvalete gitmek istese, bu suyun yan etkisi midir? Elbette hayır. Bir kişi çay ve kahve içmesi ile uykusunun gelmemesi kahvenin yan tesiri midir? Bu kahvenin etkisidir. Dolayısıyla Glutamat bit sinir sistemini uyaran olduğu için, özellikle fazla alınmasının etkisinin gözlenmesi doğaldır. Bu açıdan belirtilenler tesiri içine girmektedir.

Yan etki nedeniyle ruhsat alan ilaçlar vardır. Viagra (Sidenafil) genişletici olarak fizyolojik etki yaparken, penil uyaran yapması nedeniyle ruhsat almıştır. Bu açıdan yan etki, ters etki anlamında değildir.

Bu kadar belirtilen etkilerin, ters etki ve istenmeyen etki boyutunda olmadığı için, FDA dahil bilimsel kuruluşlar ve Yönetsel kuruluşlar MSG aleyhine karar almamaktadır.

Basit olarak eğer kahve uykunuzu kaçırıyorsa, içmeyin denilir. Az içmesi ile akşam, gece içmemesi önerilir.

Her bireye göre etkileşim de farklı olabilir. Yüksek kahve uykuyu da getirdiğini belirtenler vardır.