Chronic Administration of Monosodium Glutamate Induces Oligozoospermia and Glycogen Accumulation in Wistar Rat Testes

Joseph U.E. Onakewhor[1], Israel A.O. Oforofuo[2], and Sarrjit P. Singh[3]

Abstract

The effect of monosodium glutamate (MSG) on spermatogenic and non spermatogenic cells was investigated in 30 Wistar rats. MSG caused significant oligozoospermia and increasing abnormal sperm morphology in a dose-dependent fashion in the treated rats. MSG-induced oligozoospermia, in turn, resulted in glycogen deposition in testicular interstitial space. The glycogen accumulation probably resulted from under-utilisation by the few available sperm cells, or from inhibition by MSG of glycogen phosphorylase activity, which is involved in glycogen metabolism. Chronic ingestion of large doses of MSG has serious implications for fertility of male rats. (*Afr J Reprod Health* 1998;2(2):190–197)

Résumé

L'administration chronique de glutamate de monosodium induit de l'oligozoospermie et une accumulation de glycogène dans les testicules des rats wistars. Une étude était faite des effets de la glutamate de monosodium (GMS) sur les cellules spermatogéniques et non-spermatogéniques de 30 rats wistars. Administré en une certaine dose, la GMS a provoqué une oligozoospermie importante et a augmenté l'anormalité de la morphologie du sperme des rats traités. L'oligozoospermie induite par la GMS a à son tour provoqué un dépot de glycogène dans l'interstice des testicules des rats. L'accumulation de glycogène est probablement le résultat de la sous-utilisation de ce glycogène par le peu de cellules spermatiques restants, ou alors de l'inhibition de l'activité de phosphorilation glycogène (qui est liée au métabolisme glycogénique) du fait de la GMS. L'ingestion chronique de larges doses de GMS comporte de serieuses implications pour la fertilité des rats males. (*Rev Afr Santé Reprod* 1998;2(2):190–197)

Key Words: *Monosodium glutamate, food additive, cytotoxicity, oligozoospermia*

[1] *Department of Obstetrics and Gynaecology,* [2] *Department of Chemical Pathology, Faculty of Medicine, University of Benin, Benin Cit, Nigeria and* [3] *Department of Anatomy, University of Calabar, Nigeria*
Correspondence: *Prof. I.A.O. Oforofuo, Faculty of Medicine, University of Benin, Benin City, Nigeria*

effectiveness by other routes. However, literature is replete with evidence that several doses administered to humans and experimental animals via several routes did produce varying levels of toxicity. Further work is currently being done on the effects of boiled or cooked MSG on testicular tissue. This will also simulate the form in which this drug is consumed in humans.

A wide variety of abnormality of the testicular structure and function have come to light during the course of clinical investigation of infertilities in humans.[20] Oligozoospermia (total sperm count less than 20×10^6 spermatozoa/ml or 20 percent reduction of the normal total sperm count), abnormal sperm morphology, and reduced motility of spermatozoa can all contribute to male infertility. Bostofte and Rebbe[21] have shown a clear relationship of high number of abnormal sperm and reduced fertility. Thus, the significance of the spermatozoa of MSG treated rats in our investigation may be indicative of possible reduced fertilizing capacity of the spermatozoa.

We postulate that chronic usage of large doses of MSG as food additive could be harmful to human through its effect in inducing oligospermia. While direct implications for human fertility have not yet been determined, further work on the reproductive effects of MSG on humans is warranted.

References

1. Nakamura M. and Kurihara K. Canine taste nerve responses to monosodium glutamate and disodium guanylate: differences between Umami and salt components with amiloride. *Brain Res* 1991; 541:21–8.
2. Commision of the European Communities. In: report of the Scientific Committee for Food. First series of Food Additives of various Technological Functions. Brussels, Belgium; Commission of the European Communities, 1991.
3. Rogers PP and Blundell JE. Umami and appetite: Effects of monosodium glutamate on hunger and food intake in human subjects. *Physiol Behav* 1990; 486:801–4.
4. Oliver AJ, Rich AM, Reacher PC, Varigose GA, Radden BG. Monosodium glutamate-related orofacial granulomatosis. *Oral Surg Oral Med Oral Path* 1991; 71(5):560–4.
5. Merritt JE, Williams PB. Vasospasm contributes to monosodium glutamate-induced headache. *Headache* 1990; 30:575–80.
6. Scopp AL. MSG and hydrolysed vegetable protein induced headache. *Headache* 1991; 31:107–10.
7. Belluardo M, Mudo G, Bindoni M. Effects of early destruction of the mouse arcuate nucleus by monosodium glutamate on age-dependent natural killer activity. *Brain Res* 1990; 534:225–33.
8. Okwuraiwe PE. The role of Food and Drug Administration and Control (FDA & C) in ensuring the safety of food and food ingredients. In: Food and Drug Administration and Control (FDA&C) Symposium. Held at Sheraton Hotel, Lagos. 1st September, 1992:6–15.
9. Durojaiye B, Abolurin B. Spice or Poison? Is monosodium glutamate (MSG) safe for human consumption? In: Bello T, ed. National Concord. Concord Publishers Ltd Lagos, 1993; January 4;15:5.
10. Marc and Mei (Nig.) Limited, Advertiser's Announcement. Global scientific perspectives on MSG: The facts. In: Izeze EE, ed. The Guardian. Guardian Newspapers Publ. Ltd, Turam House, Isolo, Lagos 1993; January 24, II:A14.
11. Drury RAB, Walligton E.A. General staining procedures, methods for glycogen, connective tissue fibres. In: Drury RAB and Wallington EA, eds. Carleton's Histological Techniques (4th Edn). London & New York, Oxford University Press, 1973; 129–208
12. Donham RS, Ogilvie KM, Kerner TM, Stetson MH. Daily rhythms of luteinizing hormone and follicle stimulating hormone persist in female hamsters sterilised by neonatal administration of monosodium glutamate. *Biol Reprod* 1990; 43:392–6.
13. Reddy KP, Svoboda D. Alterations in rat testis due to anti spermatogenic agent. *Arch Pathol* 1967; 8:376–92.
14. Aoki A, Fawcett DW. Is there a local feedback from the seminiferous tubules affecting activity of the Leydig cells? *Biol Reprod* 1978; 19:144–58.

15. Keeney DS, Ewing LL. Effects of hypophysectomy and alteration in spermatogenic function on Leydig cell volume number proliferation in adult rats. *J Androl* 1990;11:367–78.

16. Schild HO. Control of population: Male contraception. In: Applied Pharmacology. Churchill Livingstone. Edinburgh, London: 1980:476–80.

17. Frajese G, Silverstroni L, Malandrini F, Isidori A. High deoxyribonucleic acid content of spermatozoa from infertile oligospermic human males. *Fertil Steril* 1976;27(1):14–20.

18. Oforofuo IAO, Onakewhor JUE, Enumah J. Fructose concentration in seminal fluids and the deoxyribo-nucleic acid content of spermatozoa from infertile human males. *Afr J Reprod Health* 1997;1(1):89–96.

19. Lullman H, Lullman-Rauch R, Wasserman O. Drug induced phospholipidosis, *Crit Rev Toxicol* 1975; 185–215.

20. Lewis TLT, Chamberlain GVP. Reproductive medicine. In: Lewis TLT and Chamberlain GVP, eds. Gynaecology by ten teachers. Kent: ELBS and Edward Arnold, 1991;214–32.

21. Bostofte ES, Rebbe H. Infertility. *Int J Androl* 1982; 5:379–85.