

# Histological Studies Of The Effects Of Monosodium Glutamate On The Ovaries Of Adult Wistar Rats

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## Abstract

The effect of monosodium glutamate (MSG) used as food additive on the ovaries of adult wistar rat was investigated. Both adult male and female Wistar rats (n=24) of average weight of 185g were randomly assigned into three groups A, B and C of (n-8) in each group. The treatment groups (A and B) were given 3g and 6g of MSG thoroughly mixed with the grower's mash, respectively on a daily basis. The control group ©; received equal amount of feeds (Grower's mash) without MSG added for fourteen days. The grower's mash was obtained from Edo Feeds and Flour Mill Ltd, Ewu, Edo State and the rats were given water liberally. The rats were sacrificed on day fifteen of the experiment. The ovaries were carefully dissected out and quickly fixed in 10% formal saline for routine histological procedures. The histological findings in the treated groups showed evidence of cellular hypertrophy, degenerative and atrophic changes with the group that received 6g of MSG more severe. These findings indicate that MSG may have some deleterious effects on the oocytes of the ovaries of adult Wistar rats at higher doses and by extension may contribute to the causes of female infertility. It is recommended that further studies aimed at corroborating these findings be carried out.

## INTRODUCTION

Pathological processes frequently involve the body's normal responses to abnormal environmental influences. Such noxious external influences as pathogenic microorganisms, trauma, dietary deficiencies and hereditary factors acting alone or in a complex interaction with environmental factors, cause diseases<sub>1</sub>. Various environmental chemicals, industrial pollutants and food additives have been implicated as causing harmful effects<sub>2</sub>. Most food additives act either as preservatives, or enhancer of palatability. One such food additive is Monosodium glutamate (MSG) and it is sold in most open market stalls and stores in Nigeria as "Ajinomoto" marketed by West African Seasoning Company Limited; as "Vedan" or "White Maggi" marketed by Mac and Mei (Nig) Limited.

The safety or otherwise of this product's usage has generated much controversy locally and globally<sub>3</sub>. In Nigeria, most communities and individuals often use MSG as a bleaching agent for the removal of stains from clothes. There is a growing apprehension that its excellent bleaching properties could be harmful or injurious to the stomach mucosa, or worse still inducing terminal diseases in consumers when ingested as a flavor enhancer in food. Despite evidence of negative consumer response to MSG, reputable international

organizations and nutritionist have continued to endorse MSG, reiterating that it has no adverse reactions in humans<sub>4</sub>. The Food and Drug Administration (FDA) of the United States reports that Monosodium glutamate is safe and that it should be maintained on the "Generally Recognized as Safe" (GRAS)-list of foods. MSG is thus reportedly permitted to be a safe food additive that requires no specified daily intake, or an upper limit intake requirement. The Directorate and Regulatory Affairs of Food and Drug Administration and Control (FDA & C) in Nigeria, now NAFDAC has also expressed the view that MSG is not injurious to health<sub>4</sub>. When MSG is added to food, it provides a flavoring function similar to the naturally occurring free glutamate: which differ from the four classic tastes of sweet, sour, salty and bitter.

The toxic effect of MSG was further corroborated by the work done on the testis, causing significant oligozoospermia and increase abnormal sperm morphology in a dose-dependent fashion in male wistar rats<sub>4</sub>. It has also been established that MSG may be implicated in cases of male infertility as it causes testicular hemorrhage, degeneration and alteration of sperm cell population and morphology<sub>5</sub>.

Through its stimulation of the orosensory receptors and by

improving the palatability of meals, MSG influences the appetite positively, and induces weight gain<sub>6</sub>. Despite its taste stimulation and improved appetite enhancement, reports indicate that MSG is toxic to human and experimental animals<sub>7</sub>.

In 1968, the first published report of an adverse reaction to Monosodium glutamate appeared in the *New England Journal of Medicine* where it was reported that Monosodium glutamate was neurotoxic; killing brain cells, causing retinal degeneration, endocrine disorder and also associated with a number of pathological conditions such as addition, stroke, epilepsy, brain trauma, neuropathic pain, schizophrenia, anxiety, depression, degenerative disorders such as Parkinson's disease, Alzheimer's disease, Huntington's disease, and amyotrophic lateral sclerosis<sub>8,9</sub>.

The ovary is a paired, egg-producing reproductive organ found in female organisms. The ovaries also functions in the production of various steroid and peptide hormones like estrogen and progesterone which subserve many functions in the reproductive system<sub>10</sub>.

This work is carried out to investigate some probable histological effects of MSG on the ovary and its likely involvement in female infertility in Nigeria. About 15% of cases of female infertility investigation will show no abnormality. In these cases abnormalities are likely to be present but not detected by current methods<sub>11</sub>.

### **MATERIALS AND METHODS**

**ANIMALS:** Twenty four, (24) adult wistar rats of both sexes with average weight of 185g were randomly assigned into three groups A, B and C of (n-8) in each group. Groups A and B of (n-16) serves as treatments groups while Group C (n-8) is the control. The rats were obtained and maintained in the Animal Holdings of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Nigeria. They were fed with grower's marsh obtained from Edo feed and flour mill limited, Ewu, Edo state and given water liberally. The rats gained maximum acclimatization before actual commencement of the experiment. The Monosodium glutamate (3g/ sachet containing 99+% of MSG) was obtained from Kersmond grocery stores, Uselu, Benin city.

**MONOSODIUM GLUTAMATE ADMINISTRATION:** The rats in the treatment groups (A and B) were given 3g and 6g of MSG thoroughly mixed with the grower's marsh, respectively on a daily basis. The control group © received

equal amount of feeds (Grower's marsh) without MSG added for fourteen days. The rats were sacrificed on the fifteenth day of the experiment. The Ovaries were quickly dissected and fixed in 10% formal saline for routine histological techniques. The 3g and 6g MSG doses were chosen and extrapolated in this experiment based on the indiscriminate use here in Nigeria due to its palatability. The two doses were thoroughly mixed with fixed amount of feeds (550g) in each group, daily.

### **HISTOLOGICAL STUDY**

The tissue were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 7 microns thick were obtained using a rotatory microtome. The deparaffinised sections were stained routinely with haematoxyline and eosin.

Photomicrographs of the desired results were obtained using digital research photographic microscope in the University of Benin research laboratory.

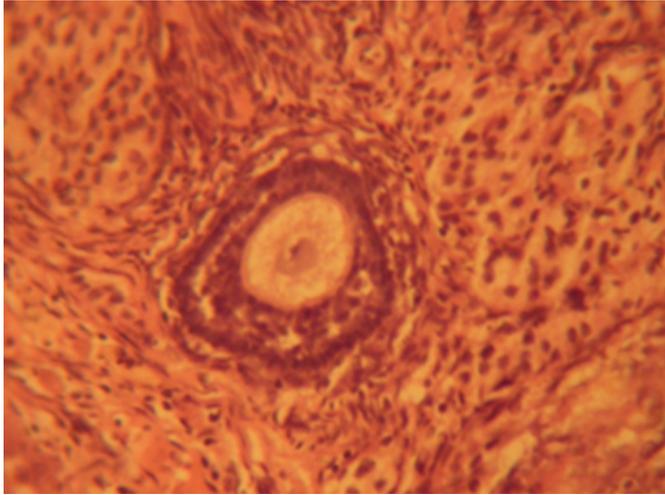
### **RESULTS**

The ovaries of the control group showed normal histological features, illustrating a well defined zonal granulosa surrounding the Oocyte and compact Theca folliculi and the presence of some primordial follicles (Figure 1).

The ovaries of the treated groups showed some cellular hypertrophy of the Theca folliculi, complete distortion/destruction of the basement membrane separating the Theca folliculi from the zona granulosa. Degenerative and atrophic changes were observed in the oocyte and zona granulosa; these were more pronounced in those that received 6g of MSG. There were marked vacuolations appearing in the stroma cells (Figures 2 and 3).

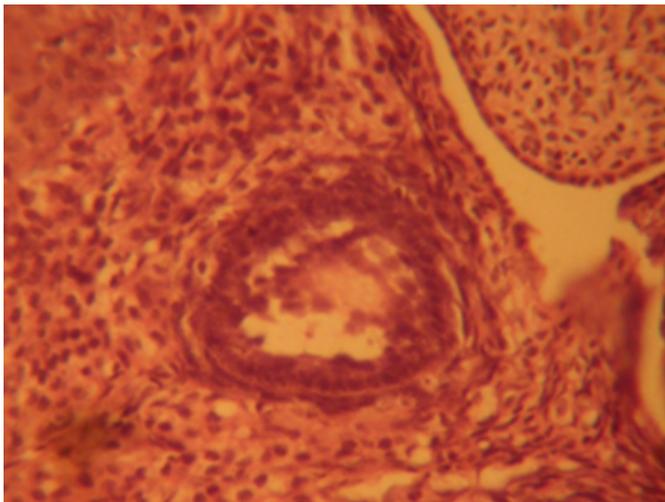
**Figure 1**

Figure 1: Control section of the ovary (Mag. x400).



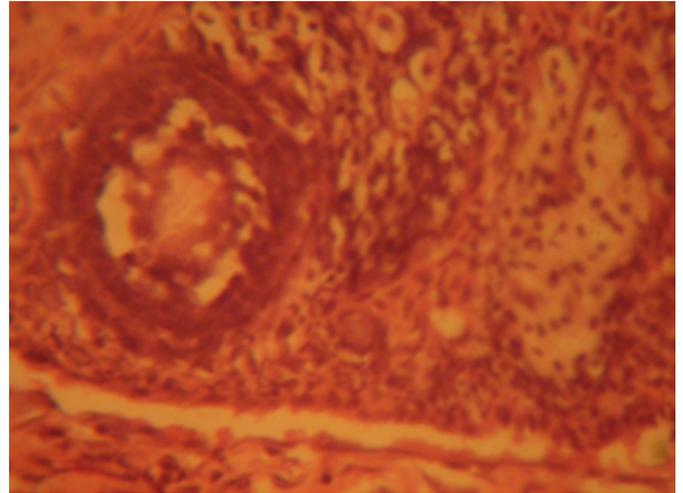
**Figure 2**

Figure 2: Treatment section of the ovary that received 3g MSG.(Mag. x400).



**Figure 3**

Figure 3: Treatment section of the ovary (6g MSG) (Mag. x400)



## DISCUSSION

The results of the haematoxylin and eosin staining (H & E) reactions showed some cellular hypertrophy of the Theca folliculi, complete distortion/destruction of the basement membrane separating the Theca folliculi from the zona granulosa. Degenerative and atrophic changes were observed in the oocyte and zona granulosa; these were more pronounced in those that received 6g of MSG. There were marked vacuolations appearing in the stroma cell.

The increase in cellular hypertrophy of the Theca folliculi in the treatment groups as reported in this study may have been as a result of cellular proliferation caused by the improved intake of food which MSG influences<sup>6,7,8</sup>. This corroborates the fact that MSG causes an increase in appetite and thereby leading to increase in weight and obesity<sup>8</sup>. The vacuolation probably indicates the presence of mucous. Degenerative and atrophic changes which were observed in the oocyte and zona granulosa were more pronounced in the groups treated with higher dose (6g) of MSG.

It may be inferred from the present results that higher dose and prolonged administration of MSG resulted in degenerative and atrophic changes observed in the ovaries. The actual mechanism by which MSG induced cellular degeneration observed in this experiment needs further investigation.

Degenerative changes have been reported to result in cell death, which is of two types, namely apoptotic and necrotic cell death. These two types differ morphologically and biochemically<sup>12</sup>. Pathological or accidental cell death is

regarded as necrotic and could result from extrinsic insults to the cell such as osmotic, thermal, toxic and traumatic effects<sup>13</sup>. In this experiment MSG could have acted as toxins to the oocyte and follicular cells of the Ovaries. The process of cellular necrosis involves disruption of membrane's structural and functional integrity which was also a landmark of this experiment. In cellular necrosis, the rate of progression depends on the severity of the environmental insults.

The greater the severity of insults, the more rapid it is the progression of neuronal injury<sup>14</sup>. The principle holds true for toxicological insults to the brain and other organs<sup>15</sup>. It may be inferred from the present results that prolonged intake of MSG resulted in increase toxic effects on the ovaries with that of higher dose more marked.

#### Conclusion

The results obtained in this study following the administration of 3g and 6g per day of MSG to adult wistar rats caused some cellular hypertrophy of the Theca folliculi, complete distortion/destruction of the basement membrane separating the Theca folliculi from the zona granulosa. Degenerative and atrophic changes were observed in the Oocyte and zona granulosa; these were more pronounced in those that received 6g of MSG. There were marked vacuolations appearing in the stroma cell. It is recommended that further studies be carried out to corroborate these findings.

#### References

1. Allen GH: The genetic basis of diseases, in General pathology Churchill Livingstone Medical Division Longman Co. Ltd, N.York. 1987 pp. 35056
2. Moore KL: Congenital malformations due to environmental; Developing Humans W.B. Saunders Co. Ltd Philadelphia 2nd Ed 2003. Chap 8. pp 173-183
3. Biodun D, Biodun A: A spice or poison? Is Monosodium

- glutamate safe for human consumption? National Concord, 4th Jan 1993. p5.
4. Onakewhor JUE, Oforofuo IAO, Singh SP: Chronic Administration of Monosodium glutamate Induces Oligozoospermia and glycogen Accumulation in Wister rat testes. Africa J. Reprod Health 1998; 2(2): 190-197.
  5. Oforofuo IAO, Onakewhor JUE, Idaewor PE: The effect of Chronic Admin. Of MSG on the histology of the Adult wister rat Testes: Bioscience Research Communications. Vol 9, No. 2, June 30. 1997.
  6. Rogers PP, Blundell JE : Umani and appetite: Effects of Monosodium glutamate on hunger and food intake in human subjects. Phsiol. Behav. 1990: 486:801-4.
  7. Belluardo M, Mudo G and Bindoni M. : Effect of early Destruction of the mouse arcuate nucleus by MSG on age Dependent natural killer activity. Brain Res.1990, 534:225-333
  8. Adrienne Samuels, Ph.D: The Toxicity/Safety of MSG; A study in suppression of information. Accountability in Research. 6(4): 259-310, 1999.
  9. Mozes S, Sefcikova Z: Obesity and changes of alkaline phosphatase activity in the small intestine of 40 and 80-day old rats subjected to early postnatal overfeeding of monosodium glutamate. Physiol Res. 2004. 53(2):177-86.
  10. Ovary: From Wikipedia, the free encyclopedia. <http://en.wikipedia.org/wiki/ovary> 03:04, 8 June 2007
  11. ^American Society for Reproductive Medicine (<http://www.asrm.org/Patients/faqs.html>) (FAQ)
  12. Wyllie AH: Glucocorticoid-induced thymocyte apoptosis is associated and endogenous endonuclease activation. Nature, London 1980. 284: 555-556.
  13. Farber J L Chein K R and Mittnacht S: The pathogenesis of irreversible cell injury in ischemia. American Journal of Pathology, 1981.102:271-281.
  14. Ito U, Sparts M, Walker Jt and Warzo: Experimental Cerebral Ischemia in Magolian Gerbils(1). Light microscope observations. Acta Neurophatology USA. 1975. 32:209-223.
  15. Martins LJ, Deobler JA, Shih T, Anthony A: Cytophotometric analysis of thalamic neuronal RNA in some intoxicated rats. Life Sci 1984. 35: 1593-1600.

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