Monosodium Glutamate: A Good Replacement For Hydrogen Peroxide In Bone Preparations

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Abstract

Monosodium glutamate (MSG) is one of the additives (taste enhancer) used in food industries. MSG is widely used in Nigeria today as a spice despite the adverse effect on health that has been reported, based on researches done. This study was carried out to appraise the bleaching effects of MSG on the caprine and porcine skulls. The bones were divided into 2 groups: one group was bleached with MSG while the control was bleached with hydrogen peroxide. Our preliminary observations showed that MSG had strong bleaching effects on the bones. These effects competed favorably with the actions of hydrogen peroxide used in the control group. By these preliminary observations, MSG may economically and functionally replace hydrogen peroxide in osteological preparations.

INTRODUCTION

Monosodium glutamate (MSG), also known as Sodium glutamate and MSG, is a sodium salt of the naturally occurring non-essential amino acid, glutamic acid. It is used as a food additive and is commonly marketed as a flavour enhancer. Trade names of monosodium glutamate include Ajinomoto, Vedan, and Accent. It was once predominantly made from wheat gluten, but is now mostly made from bacterial fermentation. It is acceptable for celiacs following a gluten-free diet[1]. Although traditional Asian cuisine had often used seaweed extract, which contains high concentrations of glutamic acid, MSG was not isolated until 1907 by Kikunea Ikeda. From 1909 to the mid 1960s, MSG was prepared by the hydrolysis of wheat gluten, which is roughly 25% glutamic acid. Glutamic acid is one of the least soluble amino acids, which facilitates its purification[2], MSG was subsequently patented by Ajinomoto Corporation of Japan in 1909. It was introduced to the United States in 1947 as Ac'cent flavor enhancer[3].

MSG is used commercially as a flavour enhancer, although once associated with foods in Chinese restaurants, MSG is now used by most fast food chains and in many foodstuffs, particularly processed foods. Only the L-glutamate enantiomer has flavour-enhancing properties.[4] MSG improves the palatability of meals and thus influences the appetite centre positively with it resultant increase in body weight[5]. Though MSG enhances appetite, reports indicate that it is toxic to human and experimental animals[6]. MSG has a toxic effect on the testis by causing a significant oligozoospermia and increase abnormal sperm morphology in a dose-dependent fashion in male Wistar rats[7]. It has been implicated in male infertility by causing testicular hemorrhage, degeneration and alteration of sperm cell population and morphology[8]. It has been reported that MSG has neurotoxic effects resulting in brain cell damage, retinal degeneration, endocrine disorder and some pathological conditions such as addition, stroke, epilepsy, brain trauma, neuropathic pain, schizophrenia, anxiety, depression, Parkinson's disease, Alzheimer's disease, Huntington's disease, and amyotrophic lateral sclerosis[9,10].

The safety of MSG's usage has generated much controversy locally and globally[11]. 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. Notably of such is 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[12]. In Nigeria, most communities and individuals often use MSG as a bleaching agent for the removal of stains from clothes[13].

Hydrogen peroxide (H_2O_2) on the other hand is a very pale blue liquid, slightly more viscous than water, which appears colourless in dilute solution. It is a weak acid, has strong

oxidizing properties, and is a powerful bleaching agent. It is used as a disinfectant, antiseptic, oxidizer, and in rocketry as a propellant.[14] About 50% of the world's production of hydrogen peroxide in 1994 was used for pulp- and paper-bleaching[15].Other bleaching applications are becoming more important as hydrogen peroxide is seen as an environmentally benign alternative to chlorine-based bleaches. It is highly corrosive to metal. Its oxidizing properties are used in the bleaching of substances, such as hair, ivory, feathers, bones and delicate fabrics, which would be destroyed by other agents. It is also used medicinally, in the form of a 3% aqueous solution, as an antiseptic and throat wash and its greatest activity is towards Gram-positive bacteria, but the presence of catalase in these bacteria makes dilutions below three percent less effective [16].

Bleaching of bones is necessary so as to make the bones whiter and more presentable. Historically this procedure has been performed since antiquity by using just sunlight as a bleaching agent, sunlight acts as a bleach through a process leading to similar results: high energy photons of light, often in the violet or ultraviolet range, can disrupt the bonds in the chromophore, rendering the resulting substance colorless. Extended exposure often leads to massive discoloration usually reducing the colors to white and typically very faded blue spectrums.[17] but later due to the environmental dependence and time waste it was replaced by chemicals such as sodium hypochlorite although a bleaching agent is also used as a contaminant remover[18].The most commonly accepted chemicals used for bleaching is hydrogen peroxide which is currently used today although report has it that it has effects on bone mineral matrix ratio[19]. With hydrogen peroxide the bone samples are immersed in 4%-35% hydrogen peroxide for 24 hours or few days depending on the concentration and temperature after which it is dried on an absorbing paper in open air[20].

The aim of this study is to compare the bleaching effects of MSG with the conventional hydrogen peroxide which is currently used to bleach bones. We figured out that if we carry out an experiment to compare the effect of MSG and hydrogen peroxide on bones, we might be able to replace hydrogen peroxide with MSG which is cheaper and easily available in other to be able to bleach bones easily at a more affordable price, for use in natural history museums, forensic laboratories and medical schools.

MATERIALS AND METHOD

MATERIALS

960g goat head

1.2kg pig head

2%/1000 hydrogen peroxide (in 4l)

2%/1000 monosodium glutamate (120mg in 4l of water)

Stove

Pot

Detergent

Scalpel

5 liters of Acetone

5 liters of kerosene

METHOD

We obtained a 960g goat head and 1.2kg pig head from Sabo market Sagamu

The goat and pig head were macerated in boiling detergent for one hour[21]

The skulls were then defattened with a defattening agent (acetone) for 2hours and dried[22]. Afterwards the mandible was separated from the pig's skull and the skull was then bleached with MSG while the mandible with hydrogen peroxide (control). The mandible from the caprine skull was separated and the skull was bleached with hydrogen peroxide (control) while the mandible with MSG at room temperature for a day. After defattening and bleaching the bones were dried in open air on an absorbent paper for a whole day[20] and both specimens were compared in terms of the level of whiteness of the bones after which pictures were taken.

OBSERVATION/RESULT

It was observed that the bleaching of bones immersed in monosodium glutamate solution competed favorably well with those bleached with hydrogen peroxide solution, after it was immersed in both solutions and left on an absorbent paper to dry[20]. These observations reveals that MSG, a commercial spice used for household cooking proved to be an effective bleaching agent in bone preparation. We also observed that MSG proved to be cost effective in view of its low cost and availability as compared to hydrogen peroxide which is very costly and not readily available in rural setting.

The result of the experiment showed that MSG was able to bleach the bones and the effect competed favorably with hydrogen peroxide.

Figure 1

A TABLE SHOWING THE COMPARISM BETWEEN PRICES OF VARIOUS CHEMICALS USED

SPECIMEN	QUANTITY	PRICE [$]
MONOSODIUM GLUTAMATE	**2%/1000** [120mg in 4l of water]	0.33
HYDROGEN PEROXIDE	**2%/1000** [in 4l of water]	20
ACETONE	5litres	20
DETERGENT	60g	0.27

PICTURES

Figure 2

CAPRINE SKULL BLEACHED WITH H2O2 [2HOURS OLD]

Figure 3

PORCINE SKULL BLEACHED WITH MSG [2 HOURS OLD]

Figure 4

PORCINE MANDIBLE BLEACHED WITH H2O2 [2 HOURS OLD]

Figure 5

CAPRINE MANDIBLE BLEACHED WITH MSG [2 HOURS OLD]

Figure 6

PORCINE SKULL BLEACHED WITH MSG (11/2 YEARS OLD)

Figure 7

CAPRINE SKULL BLEACHED WITH H2O2 (11/2 YEARS OLD)

Figure 8

CAPRINE MANDIBLE BLEACHED WITH MSG (11/2 YEARS OLD)

Figure 9

PORCINE MANDIBLE BLEACHED WITH H2O2 (11/2 YEARS OLD)

Figure 10

OTHER BONES SAMPLES BLEACHED WITH MSG

DISCUSSION

It was observed that 120mg of monosodium glutamate costs only $0.33 while its hydrogen peroxide equivalent costs $20 so, hydrogen peroxide is not just only expensive but it is not readily available in rural settings like our university environment. Researches have also shown that MSG has a beaching effect not only on bones but also on clothing fabrics. It was then figured out that if more research is carried out in this aspect, MSG can be used to replace hydrogen peroxide which is more costly and less easily available moreover further researches has shown that hydrogen peroxide may have effect on the bone matrix[19] Although MSG has also been showed to have effect on the medial geniculate body by causing cellular degenerative changes, autophagic vacuoles and neuronal hypertrophy[13] and in the testis by causing cystic degeneration, vacuolations and degenerative and atrophic changes which is worse in the high dose[23], all the effects above can only manifest when ingested. If MSG can replace hydrogen peroxide it would be easier for people especially students to bleach bones whichever the settings they may find themselves at a very low cost without necessarily having a standard laboratory hence more specimen can easily be bleached. This will better equip our anatomical museums and could also be used for the preparation of small bones like the temporal bones for the purpose of display, exhibition or competition. The bone preparation methodology also has prosthetic implications[24].

CONCLUSION

Bone preparation for use in medical schools, natural history museums and in forensic analysis[25] can be made easier, cheaper and faster if readily available materials such as

MSG can replace conventional chemicals such as hydrogen peroxide. The very high cost and unavailability of hydrogen peroxide in most parts of the country especially the rural university Community is also a drawback.

References

1. Leung, Albert Y, Foster, Steven. Monosodium Glutamate.In: Encyclopedia of Common Natural Ingredients: Used in Food, Drugs, and Cosmetics,2nd ed. New York: Wiley; 2003: 373-375.2.
2. Kawakita, Tetsuya, Sano, Chiaki, Shioya, Shigeru; Takehara, Masahiro, Yamaguchi, Shizuko. Monosodium Glutamate. In: Ullmann's Encyclopedia of Industrial Chemistry.; 2005.
3. Sand, Jordan .A Short History of MSG. Gastronomica; 2005:5 (4):38–49.
4. Rundlett, Kimber L, Armstrong, Daniel W. Evaluation of free D-glutamate in processed foods. Chirality;1994:6 (4): 277–282.
5. ogers PP, Blundell JE. Umani and appetite: Effects of monosodium glutamate on hunger and food intake in human subjects. Phsiol. Behav; 1990;486:801-4.
6. 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
7. 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: 190-197.
8. Oforofuo IAO, Onakewhor JUE, Idaewor PE. The effect of chronic admin of MSG on the histology of the Adult wistar rat Testes. Bioscience Research Communications; 1997 9(2)
9. Samuels A. The Toxicity/Safety of MSG. A study in suppression of information. Accountability in Research;1999: 6(4): 259-310.
10. 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.
11. Biodun D, Biodun A. A spice or poison? Is monosodium glutamate safe for human consumption? National concord (Nigerian daily newspaper); 1993; 5.
12. Okwuraiwe PE. The role of food and Drug Administration and control (FDA&C) in ensuring the safety of food and food Ingredients: A symposium held at Sheraton Hotel, Lagos;1992: 6-15.
13. Eweka AO. Histological studies of the effects of Monosodium-glutamate on the medial geniculate body of adult wistar rats; The Internet Journal of Health; 2007 :(6)2.
14. Hill CN. A Vertical Empire; The History of the UK Rocket and Space Programme, 1950-1971. Imperial College Press; 2001.
15. Hage R, Linke A. Applications of Transition-Metal Catalysts to Textile and Wood-Pulp Bleaching. Angewandte Chemie Intl Edn; 2005:45 (2): 206–222.
16. McDonnell G, Russell AD. Antiseptics and disinfectants: Activity, action and resistance. Clinical Microbiology Reviews.1999;12(1):147-79.
17. Bloomfield, Louis A. Sunlight. How Things Work. Home Page. Retrieved 2006-03-02.
18. Kemp B, Smith D. Use of bleach to eliminate contaminating DNA from the surface of bones and teeth. Forensic Sci Intl. 2009; 154 (1):53-61.
19. Chen T, Shea DA, Morris MD. Effect of Hydrogen Peroxide Bleaching on Bone Mineral/Matrix Ratio. Appl. Spectrosc. 2002;56:1035-1037.
20. Gestel WV. cleaning skulls and skeleton. In: maceration; 2001.
21. Tompsett DH. In: Anatomical Techniques. E&S, Livingstone London; 1961(2)242-247.
22. Svensson J, Lall S, Dickson SL, Bengtsson BA, Romer J, Ahnfelt-Ronne I, Ohlsson C, Jansson JO. The GH secretagogues- Ipamorelin and GH releasing pepetide-6 increase bone mineral content in adult female wistar rats. Journal of endocrinology; 2000;165: 569-577.
23. Eweka A & Om'Iniabohs F. Histological Studies Of The Effects Of Monosodium Glutamate On The Testis Of Adult Wistar Rats. The Internet Journal of Urology; 2008; 5(2).
24. Maten, Frederick A. Method of Bone Preparation for Prosthetic Fixation, Pub. No.: WO/1991/010411 Publication;1991.25.
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