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PILOT TEST STUDY ON EFFECT OF MONOSODIUM GLUTAMATE ON BODY WEIGHT AND REPRODUCTIVE CAPACITY OF MICE

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ABSTRACT

A pilot test study on the effect of ingesting monosodium glutamate on reproductive capacity of mice was carried out by increasing body weight assessment and physical observation to determined gravidity. The results revealed that Cage A, showed initial weight of mice at week 1, to be (31.2g and 19.5g) for two male mice respectively, while female mice had (19.7g and 20.8g) body weight respectively. The second week showed gradual increasing weight up to week four from (314g and 19.9g for male mice and 19.7g and 21.3g) for female mice to 31.7g and 20.4g for male mice while 33.8g and 35.6g for female mice. The control mice in cage B, showed only slight increase in body weight of female mice from15.6g and10.7g at week 1, to 17.7g and 20.2g in the week four (4) respectively. However, the control male mice showed slight decrease in body

Introduction:

Monosodium glutamate (MSG) is the sodium salt of the non-essential amino acid glutamic acid, one of the most abundant amino acids found in nature. Glutamate is thus found in a wide variety of foods, and in its free form has been shown to have a flavour enhancing effect which is often deliberately added to foods, either as purified monosodium salt (MSG) or as hydrolyzed protein (Food standards, 2003). Monosodium glutamate is among many flavour-enhancers and also a category of food additives that are frequently utilize

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weight from 22.6g and 27.7g in the week 1, to 22.5g and 20.2g at the week four (4). After the 21 days of experimental observation, the female (Test) mice in cage A, were observed to be gravid, thus had conceived earlier than the control mice. It is hereby recommended that further studies on the effect of MSG on reproductive capacity of Mice should be carried out to ascertain the above findings.

Keyword: *Monosodium glutamate. (MSG), Reproductive capacity. Body weight.*

for domestic and industrial uses worldwide. Many industrially-prepared foods are made palatable and attractive to consumers by the addition of flavour-enhancers to encourage continuous ingesting it in food (Igwebuike *et al.,* 2010). Flavour-enhancers increase the sensory perception of food stimulated by the sensory systems linked to the interactions of different properties of food such as food texture and fat content of food whose properties influence the perception of flavour. There have been reports that the fat content of food may influence the release and retention of flavor. However, the influence of dietary fat content on other possible interactions between flavour-enhancers and the body remains incompletely explored (Igwebuike *et al.,* 2010).

According to Food standards (2003), MSG have molecular weight of 187.13, essentially produced as a white crystalline powder from fermentation processes using molasses from sugar cane or sugar beet, as well as starch hydrolysates. It has a characteristic taste called *unami,* which is considered distinct from the four other basic tastes (sweet, sour, salty, and bitter). The optimal palatability concentration for MSG is between 0.2 – 0.8% with the largest palatable dose for humans being about 60mg/kg body weight. MSG has been purported to be the cause of Chinese restaurant syndrome or *MSG symptom complex* and bronchoconstriction in some asthmatic individuals (Food standards 2003).

According to food experts, MSG is an active ingredient in Ajinomoto, and has no adverse health issues as purported by some quarters. The report

also said that must of our local food contain glutamate which helps to reduce the amount of sodium in foods, it contains one- third percent less sodium than table salt (Akpunonu., 2020). Therefore, there is growing interest in the understanding of the effects of MSG on the body. There is need to ascertain the above fact on the effect of MSG on body weight and reproductive capacity of mice was conducted. Monosodium glutamate (MSG), a glutamic acid salt derivative, is widely consumed as a flavor enhancer all over the world (Eweka *et al.,* 2010). It is commonly marketed and acknowledged as a safe food additive that requires no specific daily intake limit. Excessive intake of MSG, however, happens rather commonly because of the high MSG content in processed foods that are sold without labeling. Since its first introduction for communal consumption in 1909 by Kikunae Ikeda, the estimated average daily intake (ADI) of this substance has been rising due to its popularity and efficacy in inciting palatability of food (Sand., 2005). Brosnan *et al.*, (2014) estimated in their report that MSG taken by Asian (10 to 20 fold that of European and American ADI) ranges from 1200 to 3000 mg per day. Most of the previous studies mentioned were mainly reported on the MSG toxicity on rats given at extremely high dose ranging from 2000 to 8000 mg/kg body weight, which is very unlikely to be taken by human at any equivalent dose. This dose is equivalent to 120 mg/kg body weight in rats (Shin *et al.,* (2010).

According to Igwebuike *et al.*, (2010). The reproductive system is an easy target for glutamate-induced injury due to the abundance of glutamate receptors found in the reproductive organs and sperm itself rendering them susceptible to excitatory damage by excessive glutamate in the body. Moreover, glutamate toxicity is also known to cause direct toxic effect to the hypothalamic- pituitary-gonadal axis, consequently causing reproductive homeostatic imbalance and previous studies have shown that oral supplementation of MSG could cause reproductive toxicity (Igwebuike *et al.,* 2010)

In the mammalian central nervous system (CNS), there is a glutamate excitatory neurotransmitter, playing an important role in both physiological and pathological processes (Meldrum., 2000). They are

dispersed throughout the central nervous system including amygdala, hippocampus and hypothalamus where they regulate many vital metabolic and autonomic functions (Collison *et al*., 2012). Neonatal rats had been reported to have significant side effect of neuronal necrosis at high dose of MSG (Pelaez *et al.,* 1999). Could also lead to changes in central cortex (Gonzalez-Burgos *et al*., 2001) and loss of cortical cell number from postnatal day 8-14 compared to control rats (Rivera- Cervantes *et al.,* 2004). Another experiment had shown that MSG injected resulted in 30% and 40% reduction of pituitary weight in ages of 6 and 12 months respectively (Miskowiak and Partyka., 1999). Furthermore, numerous studies have shown that neonates treated with MSG exhibited neuronal cell death with reduction of photoreceptor and glial cells (Blanks *et al*., 1981, Reif-Lehrer *et al.*, 1975, Hyndman and Adler 1981).

Monosodium Glutamate (MSG) has a flavor-enhancing effect in food and the flavoring function is said to be similar to naturally occurring free glutamate (International Food Information Council Foundation IFICF, 2001).MSG is added to food like meats, poultry, seafood, snacks, soups and stews to improve their flavours (International Food Information Council Foundation IFICF, 2001). According to the inquiry by the governments of Australia and New Zealand in 2003, Chinese restaurant meal contains between 10 and 1500 mg of MSG per 100 g. A condensed soup typically contains between 0 and 480 mg and packaged sauces or seasonings contain 20 to 1900 mg (Freeman, 2006).

The consumption of MSG has increased all over the world in recent years with an average daily intake from foods reported to be about up to 1 g in Europe, 4 g in Asian countries and 10 g in Germany (Park *et al.,* 2014). Other food containing MSG for example are Frozen and processed meat such as; bacon, pastrami, pepperoni, sausages, luncheon meats, smoked meat products, hamburger, cold cuts and salami. Sauces and dressing such as; ketchup, mayonnaise, barbecue sauce, salad dressing, soy sauce and mustard. Soup bases such as; bouillon cubes and granulated powders. Flavored snacks such as potato chips. Seasoning, spices, gelatin containing substance and bodybuilding protein powder (Anglesey, 1997; Lavine,

2007; Populin *et al.,* 2007). Also, Fast-food restaurants commonly use MSG to enhance the flavor of anything from chicken nuggets, burger, and fried chicken to the seasoning used on some French fries (Lavine, 2007).

The use of MSG was linked to Chinese restaurant syndrome(CRS), which was firstly described in 1968, which is characterized by headache, throbbing of the head, dizziness, a feeling of facial pressure, tightness of the jaw, burning or tingling sensations over parts of the body, chest pain and back pain (Park *et al.,* 2014). Also, the adult male reproductive system consists of two testes, each joined to its own epididymis and connected to the penis via the vas deferens, and functioning majorly in the production and transportation of sperm for the fertilization of an ovum, leading to the development of an offspring. Germ cells develop in the testes and travel through the epididymis (caput to cauda) where they mature and gain motility. During copulation, sperm is released as semen into the female reproductive tract, where the final stages of maturation takes place (capacitation) and leave the sperm ready for fertilization should an ovum be present. Male reproductive dysfunction describes a condition where one or more of the components of the male reproductive system is malfunctioning or performs below its expected capability. This may have a debilitating effect on the individual and may result in other secondary conditions. Some of the implicated factors for male reproductive dysfunction includes hormonal disorders, reactive oxygen species, testicular inflammation, endocrinal disturbance, genital infection, illness, injury, chronic health problems, heavy metals, genetic defects, exposure to radiation, lifestyle, and diet (Park *et al.,* 2014).

Monosodium glutamate (MSG), a white crystalline powder, is the sodium salt of a naturally occurring non-essential amino acid, glutamic acid (Furst and Stehle, 2004). Monosodium glutamate (MSG) is widely used in food preparation industry as a flavor enhancer all over the world and has been consumed regularly (Eweka *et al.,* 2010). It is commonly marketed and acknowledged as a safe food additive that requires no specific daily intake limit. Excessive intake of MSG however, happens rather commonly because of the high MSG content in processed foods that are sold without labeling.

First introduced for communal consumption in 1909 by Kikunae Ikeda, the estimated average daily intake (ADI) of this substance has been rising due to its popularity and efficacy in inciting palatability of food (Sand., 2005). The male reproductive system is very susceptible to many factors including chemicals, environmental and industrial pollutants as well as dietary (Nordkap *et al.,* 2012). Previous studies suggest that MSG could increase body weight of rodents and could cause obesity (França *et al.,* 2014; Miranda *et al.,* 2017). MSG may induce male reproductive toxicity via oxidative damage, tissues alterations, hormonal dysfunction, and reduced sperm quality (Kayode *et al;* 2020) Some researchers suggested MSG usage on food may increase women BMI and weigh while other study found that MSG did not change women motivation to take more meals, and no weight gain and increase hemoglobin level in women. One study even stated that women had decrease in snack and hunger after MSG containing food (Carter et al. Shi *et al.,* 2012). MSG in some studies increase energy intake in elderly and elevated glucose level in blood (He 2008). This proposed MSG might elevate body weight as MSG add delicacy and motivate people to take more foods. The study of MSG has become focus research in many years. Most of the study was conducted on animal's samples and human substance in vitro (Ataseven *et al.,* 2016; Ilegbedion *et al.,* 2013). Although most research in animals and human lymphocytes showed negative effect of MSG, researchers state that the results of the studies should not be generalized for human. Besides, some antioxidant like vitamin C, and quercetin.It has been suggested that toxicity of MSG can be overcome by the use of certain kinds of vitamin like A, C, D and E. Quercetin and diltiazem have also been suggested to play a protective role in MSG-induced toxicity (Mustafa *et al.,* 2017). Vitamin A and C have been shown to protect nerve cells and cerebral cortex in male albino rat models. The supplementation of vitamin D and E in MSG-induced oxidative stress led to decreased lipid peroxidation, catalase and superoxide dismutase in the liver. (Mustafa *et al.,* 2017)

METHOD (Animals and treatments)

A total of 4 male and 4 female mice of weight ranging between 20g and 36 g, and age between 2 and 3 weeks old. The animals were obtained from Animal Unit, Biological garden, Federal Polytechnic, Damaturu. All mice were maintained in well-ventilated room throughout the period of experiment. They were given free access to their designated feed pellet and drinking water. Commercial brand of food-grade package of MSG was used in the study. 140 mg/kg body weight of MSG was given which was 20mg above the one as described by (Brosnan *et al.,* 2014), while control Mice were given distilled water. The weight of both mice in cage A and B were measured every two days for the period of 21 days. On the 21th day, the mice were weighed to determine their final weight.

RESULT

	TEST	**CONTROL**
TIME	**WEIGHT (g) OF MICE (CAGE A)**	**WEIGHT (g) OF MICE (CAGE B)**
WEEK 1	Male: 31.2[a] 19.5[a] Female: 19.7[b] 20.8[b]	22.6[a] 27.7[a] 15.6[b] 10.7[b]
WEEK 2	Male: 31.4[a] 19.9[a] Female: 19.7[b] 21.3[b]	22.9[a] 22.9[a] 16.7[b] 19.7[b]
WEEK 3	Male: 31.7[a] 20.4[a] Female: 26.9[b] 28. 3[b]	22.8[a] 22.3[a] 16.9[b] 20.1[b]
WEEK 4	Male: 31.7[a] 20.4[a] Female: 33.8[b] 35.6[b]	22.5[a] 22.2[a] 17.7[b] 20.2[b]

Key: superscript a = male. Superscript b = female.

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DISCUSSION

The result on the study of monosodium glutamate on increased weight and reproduction in mice was carried out and the result reveals that Cage A, showed initial weight of mice in week 1, (31.2g and 19.5g) for the two male mice respectively, while female had (19.7g and 20.8g) body weight respectively. The second week showed gradual increasing weight up to week four (4) from (314g and 19.9g in male mice and 19.7g and 21.3g) in female mice to 31.7g and 20.4g in male mice while 33.8g and 35.6g in female mice. The results is in line with previous studies as observed by (Akpunonu 2020) and (França *et al.,* 2014; Miranda *et al.,* 2017) that MSG is safe and could increase body weight of rodents and could cause obesity. Some researchers suggested MSG usage on food may increase women body mass index (BMI) and while other study found that MSG did not change women motivation to take more meals, and no weight gain and increase hemoglobin level in women. (Carter *et al.,* Shi *et al.,* 2012). Thus, the study does not agree with as he observed that MSG may induce male reproductive toxicity and reduced sperm quality. The control in cage B, also showed only slight increase in body weight of female mice from15.6g and10.7g at week 1, to 17.7g and 20.2g in the week four (4) respectively. Whereas the control male mice showed slight decrease in body weight from 22.6g and 27.7g in the week 1, to 22.5g and 20.2g at the week four (4). After the 21 days of experimental observation, the female mice in cage A, (Test) were observed to be gravid (*Kayode et al.,* 2020).

CONCLUSSION

It can be concluded base on the findings of this work that, monosodium glutamate has tendency to stimulate body weight and enhances mating ability in mice.

RECOMMENDATION

The above pilot test report should be supported with a full fledge research work on the effect of monosodium glutamate on body weight and reproduction in mice.

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