STUDY ON EFFECT OF MONOSODIUM GLUTAMATE ON MURINE MESENCHYMAL STEM CELL LINE C3H10T1/2

[1]Devyani Rathore, [1]Seemha Rai, [1]Anuj Gupta

1) Center for Stem Cell Tissue Engineering and Biomedical Excellence, Panjab University, Chandigarh

Corresponding author - Anuj Gupta

Address of Corresponding author- Center for Stem Cell Tissue Engineering and Biomedical Excellence, Panjab University, Chandigarh- 160014, India

Abstract: Monosodium glutamate (MSG) is a well-known sodium salt of glutamic acid, a non-essential amino acid commonly used as a flavour enhancer worldwide. MSG has been associated with various health issues in the past. The present study was pursued to delineate the role of MSG on mouse mesenchymal stem cell line C3H10T1/2 differentiation potential. Here, we evaluated the growth and various parameters for adipogenesis in murine mesenchymal stem cell line upon MSG administration. So far, there is insufficient data available regarding the effect of MSG on stem cell differentiation patterns. Existing literature strongly insinuate towards the damaging health effects of MSG consumption especially during routine administration. So, an intensive research is essential to probe the diverse effects of MSG administration related metabolic and molecular mechanisms in stem cells and their differentiation patterns.

Keywords: monosodium glutamate (MSG), mesenchymal stem cells (MSC), differentiation, adipogenesis.

Introduction: Over the last two centuries, in spite of tremendous progress in the medical science to build up a universal remedy for disease-free world, newer types of disease-morbidities keeps adding to the ever-growing list. For the past two decades majority of these abnormalities have been reported to be associated with the diet and different lifestyle patterns which plays a significant role in developing chronic diseases; however the complexity of this relationship is yet to be understood. Dietary pattern investigation, which reflects the complexity of dietary intake, has emerged as an alternative and complementary approach to examine the association between diet and chronic diseases (Medina, 2016). Earlier, people used to love home-cooked foods in order to retrieve their nutritional benefits maximally. But keeping a pace with the changing scenario, due to time-constraints, numerous job profiles and myriad of reasons the dietary patterns of the majority of population has been changed drastically. Consequently, eating out has become such a vogue which led to revolutionary changes in the world's fast food industry evolving at a swift pace. Moreover, the availability of such ready to cook and instant foods even at far-fetched areas has made a large diaspora vulnerable to dietary and nutritional disorders. In spite of increased awareness about the guidelines issued by the Food and Drug Safety (FDA), regarding the ingredients and the nutritional content of food items, still people generally overlook about their harmful consequences (Rhodes et al, 1991). One of such compound commonly known as "ajinomoto" has become a household name in

India but was primarily used in Chinese food market and is regular feature in many Chinese food items. Its chemical name is monosodium glutamate (MSG), normally used as a flavour enhancer but have been suspected of a silent killer, and is increasingly found in many packed foods. Previously only Chinese food contained this ingredient but now it has become one of the regularly used components in our daily ready to eat food. Many people know that MSG can sometimes be the reason for headaches, migraines, seizures possibly even auto-immune diseases and many other so-called diseases of civilization such as obesity. The link to obesity often goes unrecognized which typically afflicts 50 – 65% of the adult population (Cordain, 2005). The latest adverse effect attributed to MSG is obesity. MSG appears to be a critical factor in its initiation and aberrations in fat metabolism, whereas calorie intake may modulate the progression of disease (Brosnan et al, 2014). Upon MSG ingestion, the pancreas is stimulated which results in secretion of insulin even when one's sugar level is normal. This drop in sugar level of the body is caused by excess insulin makes one feel hungry ultimately leading to overeating resulting in obesity. Since the last two and half decades obesity has become a major worldwide health problem because it brings in plethora of diseases along, including insulin resistance, type 2 diabetes, atherosclerosis and ischaemic heart disease that reduce life expectancy and together have huge economic and social consequences. (Ouchi, 2011) In the current scenario around 2.1 billion people – nearly 30% of the world's population – are either obese or overweight, according to a new analysis of data from 188 countries. The rise in global obesity rates over the last three decades has been substantial and widespread, presenting a major public health epidemic worldwide. According to Lancet (May 29, 2016) rates of overweight and obesity among adults have increased for both men (from 29% to 37%) and women (from 30% to 38%). Looking at individual countries, the highest proportion of the world's obese people (13%) live in the United States. China and India Introduction 3 (with 30 million obese people) together represent 15% of the world's obese population. Adipose tissue is an active endocrine organ that produces a variety of humoral factors, known as adipocytokines (Matsuzawa, 2006; Koerner et al, 2005). Adipocyte dysfunction makes an important contribution to metabolic disease like obesity, and hence understanding the intricacies of adipogenesis is of major relevance to human diseases (Unger et al, 2010). Adipose tissue obesity is thought to depend on both hypertrophy of preexisting adipocytes and hyperplasia due to formation of new adipocytes from precursor cells (Hausman, 2001). Approximately 10% of adipocytes turn over in human adipose tissue each year, which strongly indicates that the newly forming adipocytes are metabolically flexible in nature which could substantially improve metabolic diseases (Spalding et al, 2008). Mesenchymal stem cells (MSCs) are one such adult stem cells which are non-hematopoietic, multipotent stromal cells including osteoblasts, chondrocytes, myocytes and adipocytes. MSCs can avoid the ethical issue surrounding the embryonic stem cells research and thus giving them an edge over other stem cells. The above-mentioned properties of mesenchymal stem cells make them a suitable model system for identifying the effect of various compounds to channelize them into diverse lineage pathways during differentiation. The present piece of research was aimed to identify whether MSG have a role to initiate adipogenesis in MSCs which may exacerbate the rising number of obesity patients with the latest craze for fast-food culture. This is for the first time a preliminary study was carried out to examine the effect of MSG administration at the dose concentration of 0.8 mM and 1.0 mM on mesenchymal stem cell viability, cell migration and differentiation potential on mesenchymal stem cell line C3H10T1/2.

Materials and method

Reagents: All the chemicals used in the study were of molecular grade. Dulbecco's modified eagle medium (DMEM), penicillin-streptomycin, phosphate-buffered saline (PBS), fetal bovine serum (FBS), MSG were obtained from HiMedia Lab. Mumbai.

Cell Culture: Murine mesenchymal pluripotent stem cell line C3H10T1/2 was procured from National Centre for Cell Science, (NCCS, Pune, Maharashtra, India) and cells were maintained in growth medium (DMEM, 10% FBS, 100 µg/ml penicillin/streptomycin). Cells were plated in six-well plates at a density of 1.2 x 10^4 cells/ well.

Preparations of Dose

Stock solution of Monosodium glutamate 1.8713 g of MSG was weighed. To this 10 ml of DDW was added and filtered using 0.22 µm syringe filter. A 1 M stock solution was filtered through a 0.22 µm filter and stored at 4°C until use, from this stock solution two concentration of doses that is 1mM and 0.8 mM were used.

Experimental design

C3H10T1/2 cells were taken from a T-25 and passaged to T-75 flask. After reaching 80-90% confluency, T-75 flask was trypsinized. Cells were counted and 12,000 cells/well were plated in six well plates. The plates were incubated for 24 h at 37°C humidified atmospheres, allowing the cells to attach and spread on the surface and form a confluent monolayer. Upon reaching 80-90% confluency the cells were treated with MSG with induction media. Different doses of MSG were used and their effect on C3H10T1/2 cells was determined. Two six well plates were seeded, each set of well was duplicated and repeated twice, as follows:

Trypan Blue dye exclusion test

Trypan blue was added to trypsinized cells, loaded onto a hemocytometer and cells were viewed under a microscope.

Scratch Wound Healing Assay

Scratch Assay: Cells were plated in a six-well plate, and incubated for 24 h at 37 ºC allowing the cells to attach and spread in the wells. A confluent layer of C3H10T1/2 cells was scraped, and respective doses of MSG were added, cells were observed and photographed for the next three consecutive days.

Adipogenic Induction Media

Adipogenic differentiation dose added into 6-well plate. It consist of IBMX (0.5 µM per well), insulin (10 µg/ml per well) and 1µM dexamethasone for initial two days in vitro. Followed by further culture in presence of insulin alone for different periods up to 6 days in vitro. Culture medium was changed every 2 days and dosage was done.

Oil red O Staining

For Oil Red-O staining, C3H10T1/2 cells were fixed with 4% formaldehyde in PBS for 10 min., washed with PBS and dried. After Fixation, cells were stained with Oil Red-O staining solution for 20 min at room temperature, followed by thrice washing with PBS. Cells were allowed to dry completely and photographed.

Results

The present study was designed to investigate the effect of monosodium glutamate administration on mesenchymal stem cell line, C3H10T1/2. In the current study murine mesenchymal stem cell line C3H10T1/2 was used as a paradigm and was treated with adipogenic induction media to differentiate them towards adipogenic lineage. The effect of MSG administration at two different dose concentrations of 0.8 mM and 1 mM were examined in order to identify its putative role in adipogenesis with and without adipogenic induction media. To achieve these conditions, C3H10T1/2 cells were cultured with adipogenic induction media (1 μM dexamethasone, 10 μg/ml, 0.5 mM IBMX) for 2 days *in vitro* followed by insulin alone for 6 days. At day 7, Oil Red O staining was performed to identify lipid accumulation via lipid staining of cells. In addition, the effect of MSG administration at two dose concentrations i.e., 0.8 mM and 1 mM on the migration of the cells was also examined employing wound healing/scratch assay. Differentiation is the phenomenon in which the cells undergo changes to acquire a specialized function while during proliferation cells go through controlled symmetrical division. Both these processes are very tightly regulated by delicate cross-talk between various signalling pathways. MSCs have the characteristic of differentiating into cell types of mesodermal lineages such as adipocytes, myocytes, osteocytes etc. and hold significant advantages over other type of stem cells. Several studies have been carried out to identify the potential compounds which may affect the proliferation and differentiation of stem cells without causing any loss of their unique inherent properties i.e., self-renewability and potency. This potent nature of these cells can be exploited by designing chemical concoctions that have the potential to stimulate differentiation in the cells to a particular lineage *in vitro* (Reznikoff et al, 1973).

All experiments in the present study were carried out on murine mesenchymal stem cell line C3H10T1/2, an adherent cell line exhibiting fibroblast like morphology in culture as shown in Fig. 1 The cells were cultured in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10% Fetal Bovine Serum (FBS), Antibiotic Solution Penicillin-Streptomycin (100 IU/ml and 50 μg/ml respectively) during all experiments. Primarily, to examine the effect of MSG treatment on C3H10T1/2 cells, MSG was administered at two different dose concentrations i.e. 0.8 mM and 1 mM on the cells plated in 6-well plates and the following assays were performed. At the outset, in order to observe that whether the MSG at these dose concentrations (0.8 mM & 1 mM) would have any adverse effect on the viability of the cells, trypan dye exclusion test was performed on C3H10T1/2 cells 24h post-treatment of MSG. Cells was plated in 6 well plates and were allowed to grow until 90% confluency was achieved. The cells were then treated with two different dose concentrations i.e., 0.8 mM and 1.0 mM of MSG and the control cells were left untreated. 24h post treatment established cells from control wells as well those treated with MSG at two different dose concentrations were trypisinized. Then, they were mixed in 1:1 dilution with the trypan blue dye for 10 minutes and were placed on Neubauer's haemocytometer slide using cover slip and were viewed under inverted microscope. The total cell count was performed including the cells which appeared blue and the ones which remained colourless. Cells are very selective for the compounds which pass through their hydrophobic core of the membrane. In a viable cell, trypan blue cannot infiltrate the membrane while it traverses the membrane in a dead cell hence imparting blue colour in them. Hence, dead cells were visualised as blue in colour whereas live cells remained colourless, as represented in the haemocytometer slide (Fig. 2). The total cell count was taken including the cells appearing blue

and those which appeared colourless. The percentage viability was calculated and plotted in the graph as shown in Fig. 3.

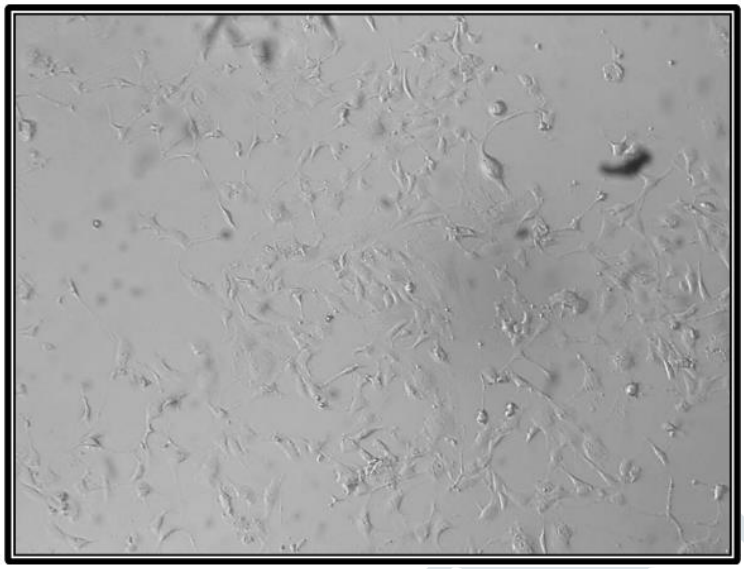


Fig..1 Mesenchymal Stem Cell line, C3H10T1/2 showing typical fibroblast like morphology.

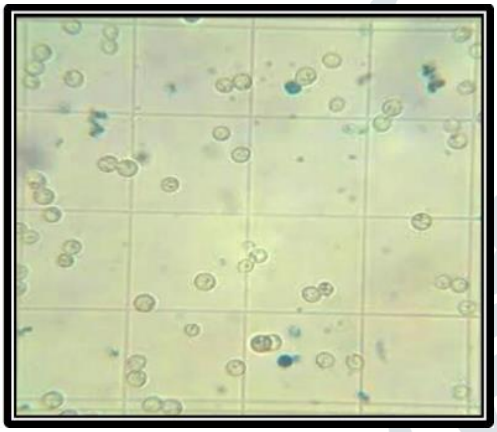


Fig. .2 Cells Stained with Trypan Blue

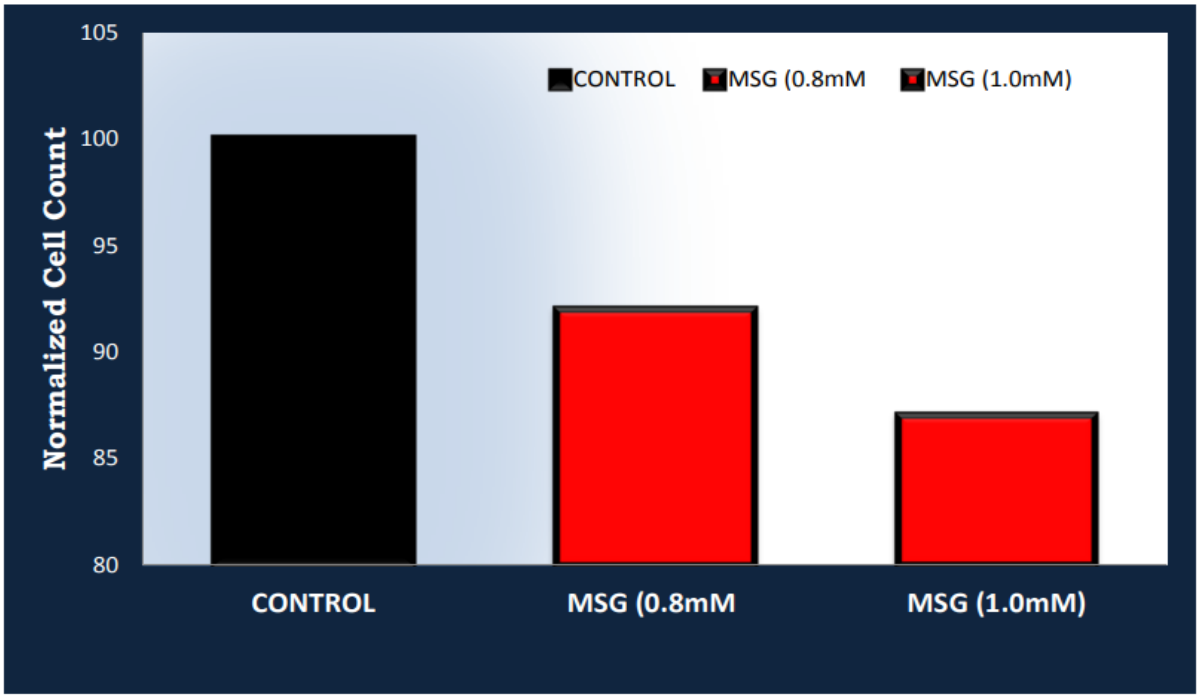
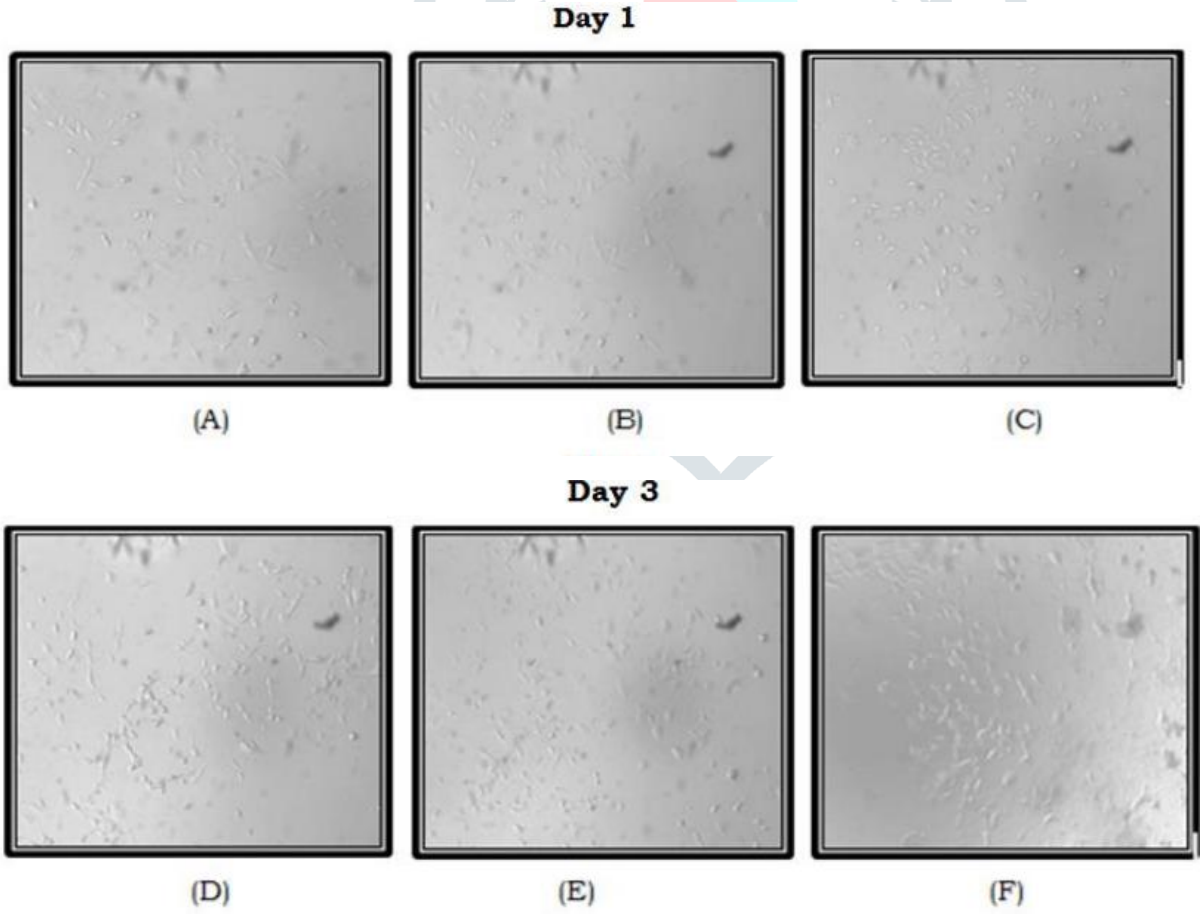


Fig. 3. Graph representing effect of MSG administration at dose concentration of 0.8 mM and 1 mM 24h post treatment on viability of mesenchymal stem cell line C3H10T1/2.

The results obtained from the trypan dye exclusion test indicated that the cells which were administered MSG at a dose concentration of 0.8 mM had almost a negligible effect with nominal decrease on the cell viability i.e. 8% while the cells treated with 1.0 mM MSG displayed approximately 17% decrease in the viability of cells compared to control cells (Fig.3). These results indicate that at these dose concentrations i.e. 0.8 mM and 1.0 mM of MSG administration, would not impart any noteworthy cytotoxic effect on the cells as shown by a marginal decrease in the cell viability. However, it cannot be ruled out that upon gradual increase in the MSG dose concentrations may aggravate the cytotoxicity among the cells at higher dose levels. The previous results lends support to the findings of the present study that a dose concentrations of up to 1 mM, did not have any consequential effect on the viability of the cells as represented by MTT assay carried out on C3H10T1/2 cells upon glutamate administration (Takarda et al, 2010). Additionally, these reports provide backing up for our results to deduce that application of MSG treatment at these dose concentrations on C3H10T1/2 cells was innocuous without adding any cytotoxic effect on the cells. Therefore, throughout the study the MSG administration were retained at dose levels of 0.8 mM and 1 mM. In order to discern the effect of MSG administration on any change in the surface morphology and number upon microscopic examination, the cells were plated in 6-well plates overnight and MSG dose was administered at two different dose concentrations i.e. 0.8 mM and 1 mM. Cells were allowed to grow at around 80% confluency and MSG treatment was given consecutively at day 1 and day 3 whereas the control cells remain untreated throughout the experiment. The photomicrographs were taken at day 1, 3, and 5 shown in Fig.4



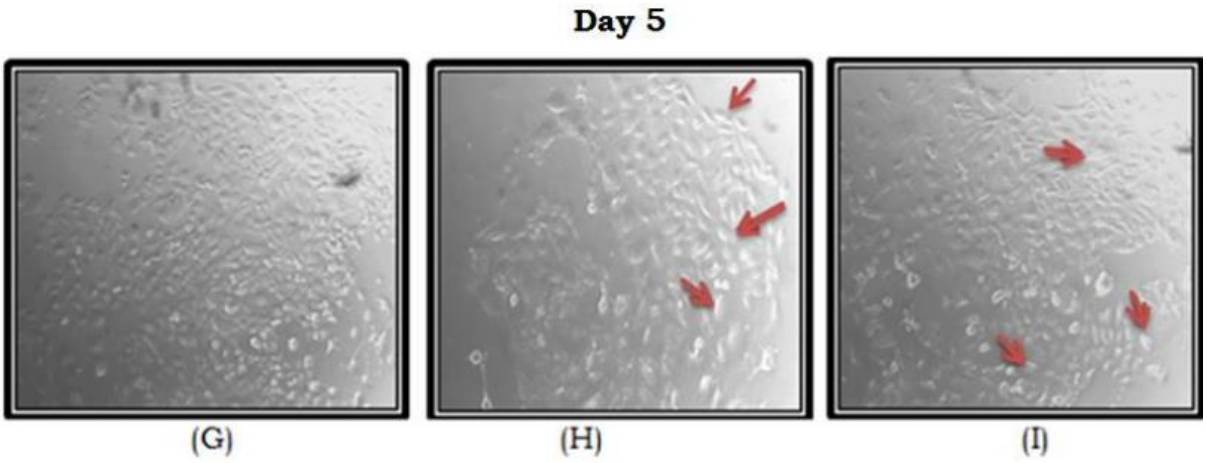


Fig. 4. Effect of MSG on MSCs; Photomicrographs observed at day 1, 3, and 5 were, taken at 10X

A: Day 1 (Control)

B: Day 1 (MSCs + 0.8 mM MSG)

C: Day 1 (MSCs + 1 mM MSG)

D: Day 3 (Control)

E: Day 3 (MSCs + 0.8 mM MSG)

F: Day 3 (MSCs + 1 mM MSG)
G: Day 5 (Control)

H: Day 5 (MSCs + 0.8 mM MSG)
I: Day 5 (MSCs + 1mM MSG)

Upon morphological examination, as observed in the photomicrographs shown in Fig. 4, 24h post plating of the cells i.e. at day 1, the cells in the control wells as well MSG treated wells appeared 80-90% confluent and displayed their characteristic fibroblastic morphology (Fig. 4, A-C). However, it was observed that at day 3 and day 5, (Fig. 4. D, G) cell density in the control well was enhanced without signifying any significant change in the morphology of the cells. However, in comparison to control, the MSG treated cells at dose concentration of 0.8 mM and 1 mM (Fig 4.4. E, F) respectively revealed marginal rise at day 3 but substantial increase at day 5 exhibiting significant change in the shape of the cell at both the dose concentrations of MSG. Upon careful examination of the photomicrographs it was analysed that there was noticeable changes in the morphological features of the cells and they began to display more of a rounded shape like morphology leaving behind their characteristic fibroblast thereby giving an early signs of cells similar to an adipocyte even without introducing any adipogenic media to the cells (Fig. 4 H, I, as shown in arrows). Although, it is too early to conclude that MSG may perhaps have the tendency to onset adipogenesis in these readily differentiated cell lines but nevertheless it is naive to overlook the profound impact MSG would have upon prolonged ingestion among humans and the system of the body. These observations are indeed suggestive of the adipogenic potential of MSG administration on C3H10T1/2 cells. This effect might be attributed to the presence of high amounts of glutamate. In the past also many reports had exploited glutamate administration on C3H10T1/2 cells to show that it suppress osteoblastic differentiation which might shift the balance towards boosting adipogenic

potential rather than its suppression unlike osteogenesis (Takarada et al, 2010). To evaluate the probable role of MSG on migration potential of cells, C3H10T1/2 cells were established in six-well plates and were allowed to grow until 80% confluency was achieved and a scratch was introduced using a micro-tip under sterile conditions. The cells were then treated with 0.8 mM and 1 mM of MSG and control cells were remain untreated. Photomicrographs were taken to analyse the rate of migration of cells upon MSG administration.

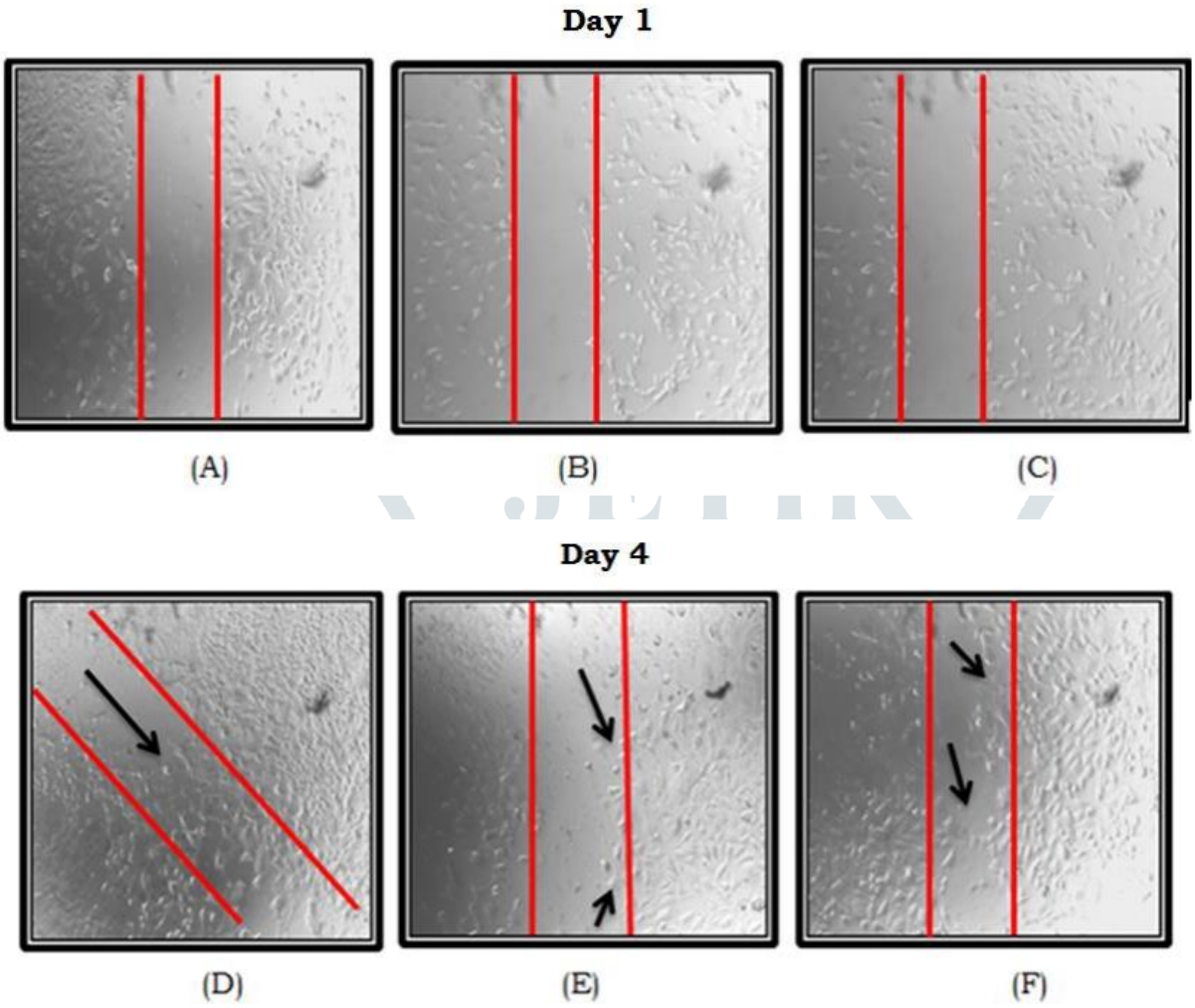


Fig.5 Scratch Assay; photomicrographs were observed at day 1, and day 3

were, taken at 10X (as shown in arrows)

(A) – Day 1, Control (scratch induced in well containing MSCs)

(B) – Day 1 (scratch induced in well containing MSCs + 0.8 mM dose of MSG)

(C) – Day 1 (scratch induced in well containing MSCs + 1.0 mM dose of MSG)

(D) – Day 4, Control (scratch observed in well containing MSCs)

(E) – Day 4 (scratch observed in well containing MSCs +0.8 mM dose of MSG)

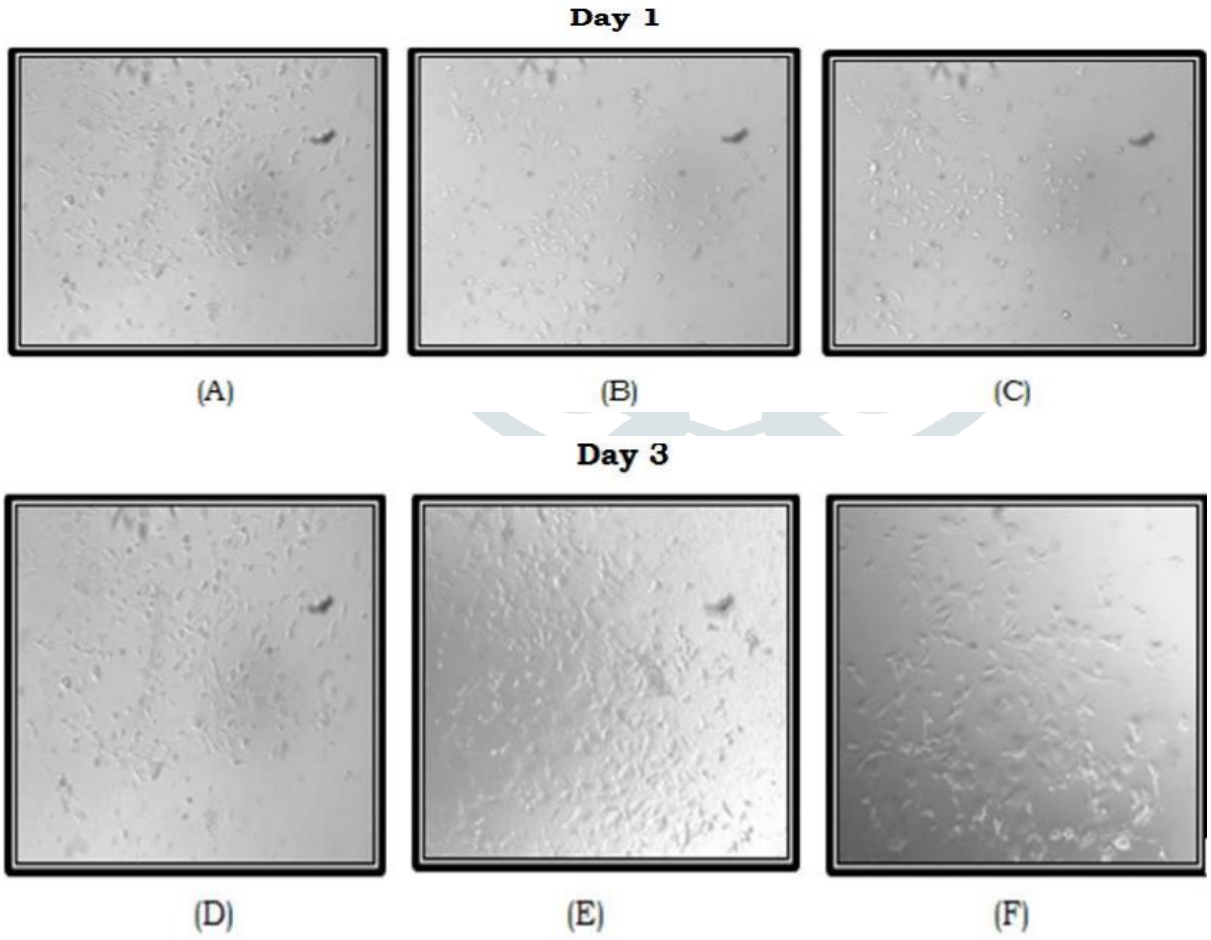
(F) – Day 4 (scratch observed in well containing MSCs + 1.0 mM dose of MSG)

(Parenthesis indicate the emigrated area remaining)

(A) and (D) are controls for scratch assay on days 1 and 4 respectively and depict migration of cells into the scratch. It shows adequate wound healing capacity of cells. (B) and (C) depicts the scratch induced in the well containing MSCs and MSG dosage. Upon careful examination of

the photomicrographs it was observed that MSG administration markedly enhanced the number of cells migrating towards the area where the scratch was introduced suggesting that it does not hinder the progression of cell proliferation. Similarly, normal cell migration were seen in the control cells indicating that even upon MSG administration it did not impair the migration of the cells thereby not executing any adverse effect on the cell migration and proliferation potential of C3H10T1/2 cells. However, it was observed that cell migration was more pronounced in the cells treated with MSG at dose concentration 1 mM and was comparable to control (D).

Moreover, to detect the effect of MSG treatment on the differentiation potential of C3H10T1/2 cells to initiate adipogenesis with and without adipogenic induction media, two different dose concentrations of MSG were administered. For promotion of differentiation into an adipocyte lineage, cells were cultured in the medium containing adipogenic inducers (1 µM dexamethasone, 10 µg/ml insulin and 0.5 mM IBMX) for two days in vitro followed by only insulin till the completion of the experiment. Cells were seeded in six well plates and were allowed to establish until 90% confluency was attained. Different dose concentrations of MSG (0.8 mM and 1.0 mM) and adipogenic induction media was added in different wells of a six well plate and the following results were obtained. Photomicrographs of the cells at day 1, 3, 5 and 6 were taken to analyse the morphological changes seen in the cells followed by Oil red O staining to confirm the lipid staining.



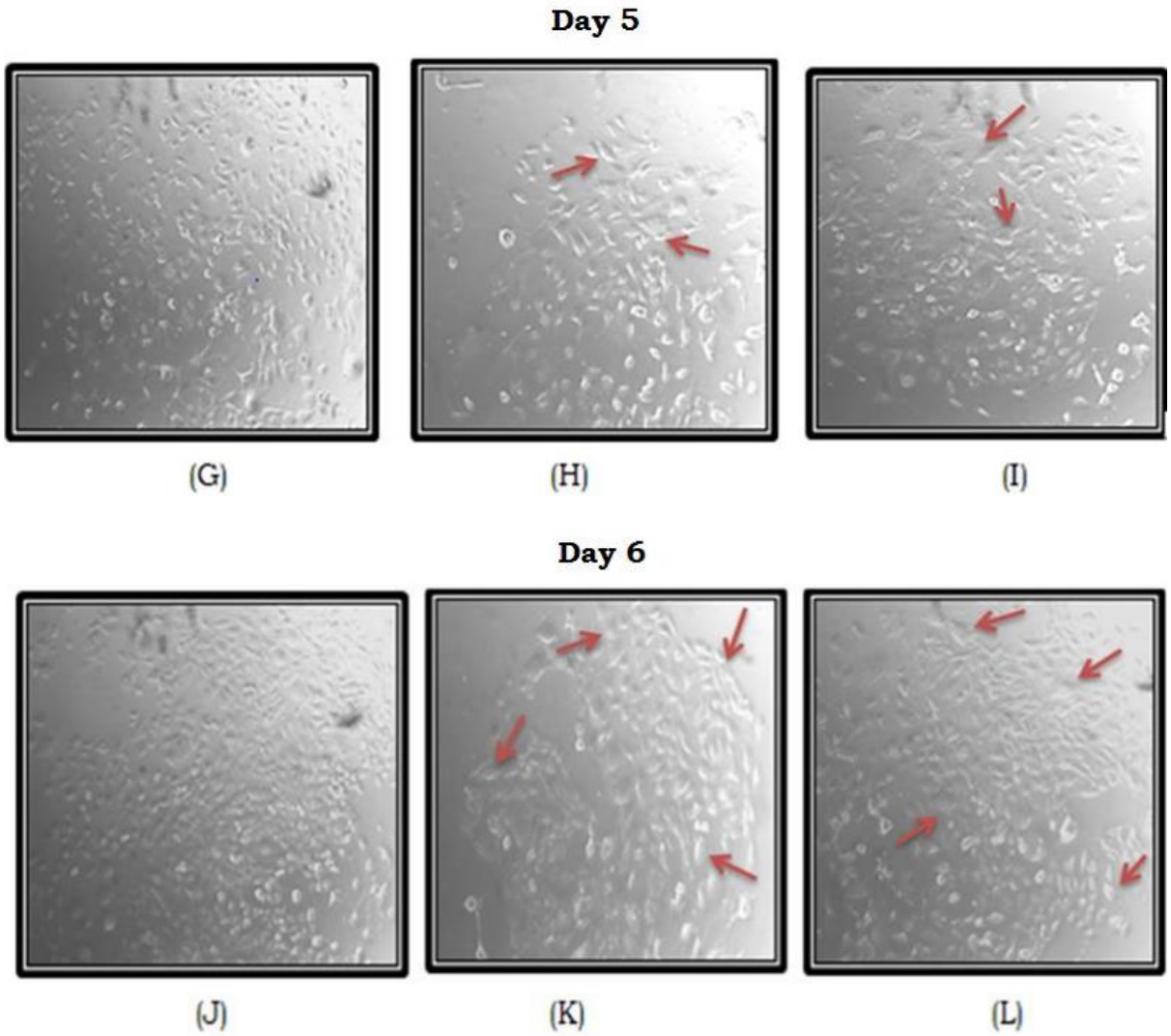


Fig.6 MSG doses + Adipogenic cocktail; Photomicrographs observed at day 1, day 3, day 5, day 6 where, taken at 10X (as shown in arrows)

A: Day 1 (MSCs + Adipogenic cocktail)

B: Day 1 (MSCs + 0.8 mM Dose + Adipogenic cocktail)

C: Day 1 (MSCs + 1mM Dose + Adipogenic cocktail)

D: Day 3 (MSCs + Adipogenic cocktail)

E: Day 3 (MSCs + 0.8 mM Dose + Adipogenic cocktail)

F: Day 3 (MSCs + 1mM Dose + Adipogenic cocktail)

G: Day 5 (MSCs + Adipogenic cocktail)

H: Day 5 (MSCs + 0.8 mM Dose + Adipogenic cocktail)

I : Day 5 (MSCs + 1mM Dose + Adipogenic cocktail)

J: Day 6 (MSCs + Adipogenic cocktail)

K: Day 6 (MSCs + 0.8 mM Dose + Adipogenic cocktail)

L: Day 6 (MSCs + 1mM Dose + Adipogenic cocktail)

The results obtained in the present study, visibly demonstrated that there was an onset of adipocytic like morphology among the cells at the end of day 6 however as expected no such change in the morphology was observed in the untreated cells (Fig.4, G). Nevertheless, while comparing the cells treated simultaneously with adipogenic induction media and MSG dose concentrations, the cells treated with 0.8 mM of MSG represented a marginal number of cells with shapes similar to adipocytes whereas cells treated with 1 mM exhibited higher percentage of cells displaying adipocyte like morphology (Fig.6, K and L respectively).

Additionally, to confirm the results obtained morphologically that C3H10T1/2 cells indeed underwent adipogenic differentiation, Oil Red O staining was carried out. Oil Red O is a lysochrome diazo dye used specifically for staining neutral triglycerides. Cells were established in 6 well plates and were allowed to grow until 80% confluency was achieved and then dose treatment was given to cells at 0.8 mM and 1 mM concentration of MSG in the absence and presence of adipogenic induction media (1 µM dexamethasone, 10 µg/ml insulin, 0.5 mM IBMX) for 2 days in vitro followed by only insulin till the completion of the experiment. On the 7th day cells were first fixed using 10% formalin and then stained with Oil Red O and were observed under the microscope.

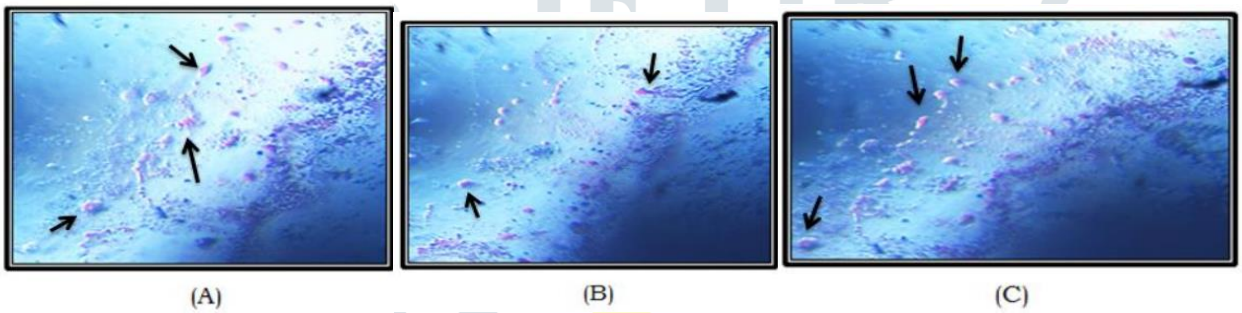


Fig. 7 Images of C3H10T1/2 cells upon staining with Oil Red O Dye,

taken at 10X (shown in arrows)

A: MSCs + Adipogenic cocktail

B: MSCs + MSG (1mM)

C: MSCs + MSG (1mM) + Adipogenic cocktail.

The oil red O dye specifically stains the lipid droplets in pink colour. These droplets are characteristic of adipocytes thereby revealing onset of adipogenesis. As shown in Fig.7. (A), a substantial number of oil red O - stained cells were visible in the wells which were treated with only adipogenic induction media demonstrating the initiation of cells of adipocytic lineage. However in comparison the cells treated with 1 mM MSG dose did manifest a reduced but noteworthy number of dye stained cells. (B) in comparison to (A) and (C) depicts the sizable number of adipocytes thus demonstrating that MSG dose may have a realistic role in promoting the adipogenesis. The findings in the present study are additionally supported by numerous reports which suggest that component of the MSG have a significant effect on pre-adipocytes promoting adipogenic differentiation. It is well known that adipogenic differentiation is regulated by expression of transcription activators namely CCAAR/enhancer-binding protein (C/EBP) and PPARγ. Mesenchymal precursors give rise to adipocytes whose commitment and differentiation along the course of adipogenesis is closely regulated. An inability of adipose tissue to expand consequent to its exhaustive capacity results into recruitment of new

adipocytes, this might underlie the over stimulation of endogenous mesenchymal stem cell pool to differentiate into adipocytes resulting in metabolic syndrome and related disorders (Christodoulides et al, 2008). Normal metabolic balance is maintained by a complex homeostatic system involving multiple tissues and organs. Acquired and inherited defects in any part of this system can lead to metabolic disorders such as obesity and diabetes (Camp et al, 2002). Despite the optimal safety profile (Beyreuther et al, 2007), a large cross-sectional study revealed that MSG consumption is related to obesity including type II diabetes and other metabolic syndromes as its intake in healthy Chinese adults correlates with the resulting increase in body mass index regardless of energy intake (Nagata, 2006). Though the confines of the present study are well accepted but nevertheless the preliminary results does present a compelling thought towards a possible link between MSG consumption and the onset of adipogenesis. However, a detailed, exhaustive and exquisitely designed set of experiments are required to validate the present findings in the future to conclude that sustained exposure to MSG may lead to a significant increase in adipogenesis and eventually give rise to the obesity related problems. A variety of reports exists in the literature that suggested a potential link between MSG and the metabolic disorders as obtained from the data on animal models. High doses of MSG injected in rodents during the neonatal period leadto the development of glucose intolerance, insulin resistance (Hirata, 1997), and obesity (Nagata, 2006) along with adipose tissue hypertrophy, hyperinsulinemia, hyperglycemia, hyperleptinemia, and decreased insulin stimulated glucose transport in adipocytes and muscle (Zorad et al, 1997; Macho et al, 2000; Baculikova et al, 2008). Obesity with MSG intake is probably not due to the energy intake-induce obesity leading to insulin resistance, rather MSG may enhance shifting the dietary glucose towards lipid synthesis (Macho et al, 2000], increasing the rate of lipogenesis (Bueno et al, 2005) and activating gene expression of enzymes involved in lipid biosynthesis and storage in adipose tissue (Collison et al, 2009). To our knowledge, this is the first introductory demonstration of the propensity of C3H10T1/2 cells towards the adipogenic lineage upon MSG administration even though the results are preliminary but noteworthy. Considering the aforementioned results along with the previous findings, it is highly conceivable that MSG could be a key determinant of differentiation into an adipogenic lineage in mesenchymal stem cells. The exact mechanism underlying the preferential modulation by MSG of the differentiation fate of mesenchymal stem cells, however, remains to be elucidated in future studies. This study could thus provide a novel window of targeting the MSG which may likely to cause metabolic disorders leading to obesity. Finally, even though observational studies often provide useful information for hypothesis formulation, given the significant questions and concerns rose in the present study, it is premature to even generate a plausible hypothesis on MSG intake and obesity. Because the key variable for this study is monosodium glutamate (MSG) as a determinant of incident onset of adipogenesis but necessarily a reliable and valid experimentation of using MSG is critical.

Conclusion

In the present study, mesenchymal stem cell line C3H10T1/2 was administered with monosodium glutamate (MSG) at two different dose concentrations i.e. 0.8 mM and 1.0 mM alone and in combination with adipogenic induction media (dexamethasone, insulin and isobutyl methyl xanthine). It is apparent that there is no shortage of research conducted on this ubiquitous ingredient and its potential health effects; but its effect on stem cells is yet to be elucidated comprehensively. The present study demonstrated that MSG induced morphological

marked changes in the mesenchymal stem cell line C3H10T1/2, which are suggestive of its propensity towards adipogenic differentiation thereby playing a critical role in inducing obesity. Although the limitations of the present study are well accepted, yet the preliminary results obtained in the present study does present a compelling thought towards a possible link between MSG consumption and the onset of adipogenesis. However, it is imperative that in future an exquisitely designed set of experiments and a thorough analysis is warranted to validate the findings obtained in the present study, which may perhaps conclude that sustained exposure to MSG might escalate the onset of adipogenesis and eventually give rise to obesity related complications.

Declaration of Competing Interest
None

Acknowledgments

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