*Ind. J. Nutr. Dietet., 2013,* **50**, 1

# MONO SODIUM GLUTAMATE AS A SUBSTITUTE FOR SODIUM CHLORIDE IN INDIAN DIETS

**PREMAKUMARI, S., LAKSHMI, U.K. AND AMIRTHAVENI, M.**

*(Department of Food Science and Nutrition,*
*Avinashilingam Institute for Home Science and Higher Education for Women,*
*Coimbatore – 641 043)*

*(Received 20th June, 2011)*

## Introduction

Glutamate in the free form is abundantly found in all natural foods and it has been used as a flavour enhancer for more than thousand years across the world[1]. It is a multifunctional amino acid. Around 50g of glutamate is synthesised in the body and 20 to 40 g is obtained from the food every day. In the central nervous system glutamate is the dominant excitatory neurotransmitter as it regulates several neuronal related functions in the body[2]. Human and animal studies indicate that glutamate is the major oxidative fuel for the gut and the dietary glutamate is extensively metabolised by the intestine.

Today, the sodium salt of glutamic acid namely Mono Sodium Glutamate (MSG) is widely consumed by the public at home level, restaurants and the food industries as a flavour enhancer and it is the purest form of umami, the fifth basic taste. However, all the categories have one reservation in common i.e. whether MSG is good for health. All over the world studies were carried out to explore the safety aspects of MSG. The plethora of evidences suggests that MSG is a safe product and there is no evidence to show any direct relationship between the intake of MSG and harmful health effects. Safety endorsements have been made by several regulatory bodies worldwide.

- The Joint Expert Committee of FAO / WHO on Food Additives has declared MSG as safe for human consumption and concluded it under "Accepted Daily Intake" not specified
- The USFDA has reaffirmed MSG as GRAS substance like pepper, salt and baking powder
- The Indian Food Safety and Standards Regulation 2011 declared MSG as a permitted taste maker in different foods. However, specific label declaration is mandatory if the foods contain MSG

Some of the facts on MSG are:

- The non essential amino acid glutamate is synthesised in the brain and the level of glutamate in the brain is higher than plasma glutamate level. It neither rises nor falls with change in plasma glutamate due to blood brain barrier[2].
- Since placenta is impermeable to glutamate, it is removed from foetal circulation.
- Human milk has the highest content of glutamate i.e. 19 mg against 1 mg in cow's milk[3].
- MSG contains only one third of the amount of sodium in table salt and when used in combination with table salt it can help to reduce the total sodium content

in a recipe by 20 to 40 per cent while maintaining the flavour[4,5].

Low sodium therapeutic diets are the solution to hypertensive subjects. However, low salt or less salt makes the food most unpalatable and at the same time poses difficulty to consume the foods meeting the quantum requirements. Hence there is a need to find out ways and means of enhancing the taste of low sodium diets without further addition of salt. One possibility is to substitute MSG for salt in recipes and enhance their acceptability. Towards this goal a study was undertaken to determine the suitable level of substitution of salt with MSG in various recipes.

**Materials and Methods**

In this study, 100 commonly consumed recipes classified under eight different categories were standardised as given in Figure 1.

For arriving at the suitable levels of substitution of MSG in place of sodium chloride, random trials were performed. Two standardized recipes were randomly selected from each of the eight groups and tried out with several levels of substitution. Based on the results observed following variations were tried out for detailed evaluation of all the recipes.

- Salt 100 per cent ( Standard recipe )
- MSG 50 per cent and salt 50 per cent
- MSG 75 per cent and salt 25 per cent
- No salt

All the 100 recipes were evaluated using 9 point hedonic scale with the help of 20 semi trained taste panel members. The results were quantified as given below and analysed in terms of categories and sub groups.

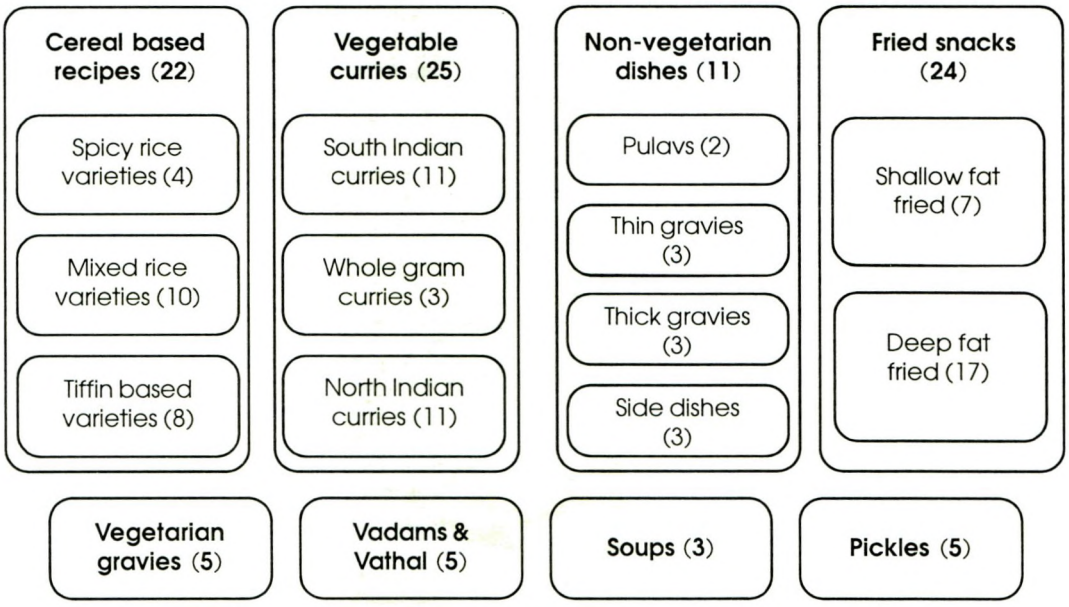


**Figure 1**
**Standardised Recipes**

| Scale Description | Score |
|---|---|
| Like extremely | 8 |
| Like very much | 7 |
| Like moderately | 6 |
| Like slightly | 5 |
| Neither like nor dislike | 4 |
| Dislike slightly | 3 |
| Dislike moderately | 2 |
| Dislike very much | 1 |
| Dislike extremely | 0 |

## Results and Discussion

The common observation made was that in all the 100 recipes the standard recipe scored the highest followed by 50:50 and 75:25 variations. The recipes without salt were rejected by the judges. The findings of the study are highlighted below.

### *Cereal based recipes*

Cereal based recipes included spicy rice varieties, mixed rice varieties and tiffin based varieties. Of the three groups of cereal based recipes, the spicy rice varieties scored higher than mixed rice varieties and tiffin varieties which were milder in taste. Table I presents the results obtained for spicy rice recipes.

The standard recipes recorded the highest mean acceptability score (7.50) followed by 50 per cent level of substitution (6.65), 75 per cent level of substitution (3.02) and no salt recipes (0.60). All the comparisons were found to be statistically significant ($p<0.01$).

### *Vegetable curries*

Out of 25 vegetable curries, 11 were South Indian curries, 11 were North Indian curries and three were whole gram curries. The acceptability of North Indian curries is presented in Table II.

**TABLE I**

**Acceptability of Spicy Rice Varieties**

**Max. Score: 8**

| Recipe | Standard I | 50:50 II | 75:25 III | No salt IV | Combinations compared | 't' value |
|---|---|---|---|---|---|---|
| Vegetable biriyani | 7.4 | 6.6 | 2.1 | 0.3 | I Vs II | 7.0** |
| Mushroom biriyani | 7.3 | 6.7 | 2.6 | 0.8 | I Vs III | 9.5** |
| | | | | | I Vs IV | 34.5** |
| Chinese fried rice | 7.8 | 6.3 | 2.4 | 0.2 | II Vs III | 8.4** |
| | | | | | II Vs IV | 33.6** |
| Capsicum rice | 7.5 | 7.0 | 5.0 | 1.1 | III Vs IV | 4.9** |
| Mean±SD | 7.5±0.18 | 6.65±0.25 | 3.02±1.12 | 0.6±0.37 | | |

** Significant at one per cent level

**TABLE II**

**Acceptability of North Indian Curries**

**Max. Score: 8**

| Recipe | Standard I | 50:50 II | 75:25 III | No salt IV | Combinations compared | 't' value |
|---|---|---|---|---|---|---|
| Mirchi ka salan | 7.5 | 4.9 | 2.6 | 0.2 | | |
| Shahi paneer | 7.9 | 6.8 | 2.7 | 0.5 | I Vs II | 16.75** |
| Paneer curry | 7.6 | 5.8 | 2.6 | 0.9 | I Vs III | 29.8** |
| Palak paneer | 7.1 | 5.6 | 3.7 | 0.8 | I Vs IV | 81.75** |
| Cauliflower curry | 7.5 | 6.9 | 4.6 | 1.8 | II Vs III | 18.4** |
| Mushroom almond coriander curry | 7.8 | 6.3 | 3.9 | 1.4 | II Vs IV | 47.2** |
| Pepper paneer | 7.3 | 5.6 | 3.1 | 1.6 | III Vs IV | 2.2* |
| Dum aloo | 7.3 | 6.2 | 0.5 | 0 | | |
| Mushroom gravy | 7.9 | 6.6 | 3.7 | 1.4 | | |
| Tomato brinjal | 7.4 | 6.8 | 4.1 | 0.7 | | |
| Egg gravy | 7.0 | 6.9 | 1.7 | 0.2 | | |
| Mean±SD | 7.49±0.27 | 6.21±0.63 | 3.01±1.12 | 0.95±0.54 | | |

** Significant at one per cent level * Significant at five per cent level

Acceptability of North Indian curries which are spicier was higher among the three groups of curries namely North Indian, South Indian and whole gram curries. However the standard recipes alone scored the highest followed by the other variations as seen in the case of cereal recipes. All the comparisons were found to be statistically significant.

***Non vegetarian recipes***

Under non vegetarian recipes there were pulavs, thin gravies, thick gravies and side dishes. Table III presents acceptability of non vegetarian pulavs.

Non vegetarian pulavs were found to be more acceptable with the addition of MSG when compared to the other groups. Even the 75:25 combinations gave the mean score of 5.85. Pulavs, thick gravies and side dishes were more acceptable than thin gravies. In all the three groups namely pulavs, thick gravies and side dishes I vs II and II vs III were found to be non significant. Non vegetarian recipes in general were more acceptable to the addition of MSG.

***Soups***

Table IV presents the data on acceptability of soups.

Both vegetarian and non vegetarian soups were tried in this study. The standard

**TABLE III**

**Acceptability of Non-Vegetarian Pulavs**

**Max. Score: 8**

| Recipe | Standard I | 50:50 II | 75:25 III | No salt IV | Combinations compared | 't' value |
|---|---|---|---|---|---|---|
| Chicken biriyani | 7.5 | 7.2 | 5.6 | 0.1 | I Vs II<br>I Vs III | $1.1^{NS}$<br>4.5** |
| Chicken fried rice | 7.1 | 6.3 | 6.1 | 1.9 | I Vs IV<br>II Vs III | 50.0**<br>$1.76^{NS}$ |
| Mean±SD | 7.3±0.20 | 6.75±0.45 | 5.85±0.25 | 1.0 ±0.90 | II Vs IV<br>III Vs IV | 5.45**<br>5.2** |

** Significant at one per cent level NS Not significant

soups recorded the highest mean score of 7.2 followed by 50:50 (6.65), 75:25 (4.70) and no salt (1.30) variations showing significant difference among them.

***Fried foods***

Among the fried recipes seven were shallow fat fried and 17 were deep fat fried items. Deep fat fried items were more acceptable than the shallow fat fried recipes (Table V). Though the standard and 50 per cent substituted recipes scored higher, potato finger chips and egg bonda received scores above 5 even at 75:25 substitution levels.

***Pickles, vadams and vathals***

Substitution of MSG for salt in pickles was not found to be acceptable. Moreover when salt content of the pickles reduced, keeping quality became poor and pickles started spoiling within a week.In the case of vadams and vathals even at 50 per cent level of substitution the judges started disliking the

**TABLE IV**

**Acceptability of Soup Varieties**

**Max. Score: 8**

| Soups | Standard I | 50:50 II | 75:25 III | No salt IV | Combinations compared | 't' value |
|---|---|---|---|---|---|---|
| Chicken | 7.0 | 6.0 | 6.1 | 1.6 | I Vs II<br>I Vs III | 6.5**<br>5.2* |
| Amaranth | 7.3 | 5.6 | 3.6 | 1.0 | I Vs IV<br>II Vs III | 60.0**<br>2.6 * |
| Tomato | 7.8 | 6.4 | 4.5 | 1.5 | II Vs IV<br>III Vs IV | 6.68**<br>46.4** |
| Mean±SD | 7.2±0.33 | 6.65±0.25 | 4.7±1.03 | 1.3±0.23 | | |

** Significant at one per cent level * Significant at five per cent level

**TABLE V**

**Acceptability of Deep Fat Fried Snacks**

**Max. Score: 8**

| Recipe | Standard I | 50:50 II | 75:25 III | No salt IV | Combinations compared | 't' value |
|---|---|---|---|---|---|---|
| Finger chips | 6.3 | 6.7 | 5.8 | 4.4 | | |
| Cauliflower fry | 7.6 | 6.9 | 1.2 | 0.2 | I Vs II | 7.01** |
| Chilly soy | 7.3 | 6.5 | 4.0 | 0.4 | I Vs III | 31.5** |
| Stuffed capsicum bajji | 7.5 | 6.0 | 3.7 | 0.6 | I Vs IV | 68.0** |
| Raw plantain vada | 7.6 | 7.2 | 3.5 | 1.2 | II Vs III | 17.07** |
| Egg bonda | 6.9 | 5.3 | 5.4 | 0.8 | II Vs IV | 42.01** |
| Masala vada | 7.3 | 6.1 | 1.7 | 0.9 | III Vs IV | 17.9** |
| Yam balls | 7.3 | 4.1 | 3.2 | 1.1 | | |
| Raw plantain bajji | 7.2 | 4.8 | 2.7 | 1.4 | | |
| Plantain flower vada | 7.2 | 4.5 | 2.9 | 1.0 | | |
| Bonda | 6.8 | 5.1 | 4.1 | 1.5 | | |
| Urad dal vada | 5.6 | 6.5 | 4.6 | 1.3 | | |
| Greengram dal pakoda | 7.7 | 6.4 | 4.6 | 1.5 | | |
| Maida pakoda | 7.5 | 6.2 | 3.2 | 0.9 | | |
| Onion pakoda | 7.6 | 6.5 | 3.8 | 0.1 | | |
| Crisp ladies finger fry | 7.3 | 5.1 | 0.7 | 0.1 | | |
| Birds nest | 7.1 | 4.1 | 2.3 | 0.3 | | |
| Mean±SD | 7.16±0.55 | 5.76±0.96 | 3.01±1.12 | 1.04±0.96 | | |

** Significant at one per cent level

products. Vadams are dehydrated, gelatinized starchy preparations. Vathals are vegetable pieces soaked in butter milk and salt and dried under the sun. The dehydrated products are stored under room temperature in air tight containers. Whenever required, deep fat fried and consumed as adjuncts to main dishes.

## Summary and Conclusion

Mono Sodium Glutamate acts as an excellent flavour enhancer in recipes when a pinch per 2-3 servings is added while cooking. Spicy rice based recipes, North Indian recipes, gravies and soups are more suitable for the addition of MSG. However MSG when substituted for salt at 50 per cent level, acceptability was significantly reduced in all the recipes when compared to the standard ones. Substitution at 75 per cent level resulted in poor acceptability in all the recipes except potato finger chips and egg bonda. May be moderate levels of substitution i.e. 75 per cent salt and 25 per cent MSG combination would be more acceptable. The current trials were performed on young adolescent girls who were not used to the inclusion of MSG in their normal food. The less acceptability scores even at 50 per cent level of substitution may be due to the non familiarity with the "Umami" taste or lack of prior tasting experiences with a reduced salt level or due to low level of usage of MSG in normal cooking. However, the potential offered by MSG as a salt substitute cannot be overlooked. The hypertensive patients, who literally eat a bland food with no salt or low salt stand to benefit more by eating the MSG added food, which are more palatable and eatable . Further studies on acceptability trials and data on quantum food consumption with hypertensive subjects may highlight the usefulness of adding MSG in the diets for promoting their health and well being.

## Acknowledgement

The authors acknowledge the financial support from Ajinomoto Pvt. India Ltd. for the conduct of the study.

## *REFERENCES*

1. Anonymous, Mono Sodium Glutamate (MSG): A scientific summary by the Food Technologist Expert Panel on Food Safety and Nutrition, Institute of Food Technologists, Chicago, 1987, 1-8.
2. Mallick, H.N. Understanding safety of glutamate in food and brain. *Ind. J. Physiol. Pharmacol.*, 2007, **51**, 216-234.
3. Poonam Singh, Saxena, S.K. and Mallick, H.N. Free glutamic acid content of milk in Indian mothers. *Ind. J. Physiol. Pharmacol.*, 2004, **48**, 365-369.
4. Altug, T. and Demirag, K. Influence of Mono Sodium Glutamate on flavour acceptability and on the reduction of sodium chloride in some ready made soups, *Chem. Microbiol. Technol. Lebensmitt.*, 1993, **15**, 161-164.
5. http://www.glutamate.org/media/nutrition.htm