MONOSODIUM GLUTAMATE: FALLACIES AND FACTS

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Foreword

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Food choices today are shaped not only by tradition and taste but also by growing awareness of health and nutrition. In this evolving landscape, it is vital that our understanding of food ingredients—especially food additives—is informed by science rather than outdated fears or misinformation.

Monosodium Glutamate (MSG), a flavour enhancer responsible for the umami taste, has long been at the centre of such debate. Like salt is to salty taste, MSG is to umami—one of the five basic tastes. Glutamates occur naturally in many common foods such as tomatoes, mushrooms, and even mother's milk. Yet, despite its natural presence and decades of scientific evaluation, MSG continues to face suspicion.

Globally, leading food safety authorities—including the Joint FAO/WHO Expert Committee on Food Additives (JECFA)—have reviewed MSG extensively and declared it as safe. In 1987, JECFA allocated an ADI 'not specified' for MSG. The committee also stated that infants metabolize MSG in a similar way to adults and, in light of all the data, concluded there is no cause for concern about health risks. Further, MSG has been granted GRAS (Generally Recognized as Safe) status by the US FDA.

While India has gradually expanded the permissible use of MSG, the continued requirement for warning labels—particularly suggesting it is unsafe for infants and pregnant women—remains inconsistent with international norms and lacks scientific backing. This often leaves a lingering suspicion in the minds of consumers that MSG is inherently unsafe, with many even believing, incorrectly, that its use is banned in India.

This monograph by Dr. Jamuna Prakash, a respected voice in food science and nutrition, addresses these issues head-on. It presents clear, evidence-based insights into the safety and uses of MSG, demystifies long-standing myths, and highlights its potential role in reducing dietary sodium—an important public health priority. The inclusion of tested recipes featuring Indian staples demonstrates how MSG can enhance both health and flavour in everyday cooking.

At the Food Future Foundation, we are happy to publish this timely and thoughtful monograph. As India aspires to align its food systems with global best practices, we believe that rational, transparent, and science-led regulation is the way forward.

We thank Dr. Jamuna Prakash for her contribution and hope this monograph becomes a valuable resource for policymakers, researchers, industry professionals, and informed citizens alike.

Acknowledgements

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THE SCIENCE OF TASTE

Food is essential to life and is foundational to civilizations. Historically, agriculture and food processing have been important occupations. While diets were shaped by the availability of local food, food patterns have dramatically changed in the past decades as transport and storage facilities revolutionized. The levels of processing, too, vary from primary to tertiary products. The market in the tertiary products category is primarily driven by taste. In this chapter, we dwell on the quality of taste in food.

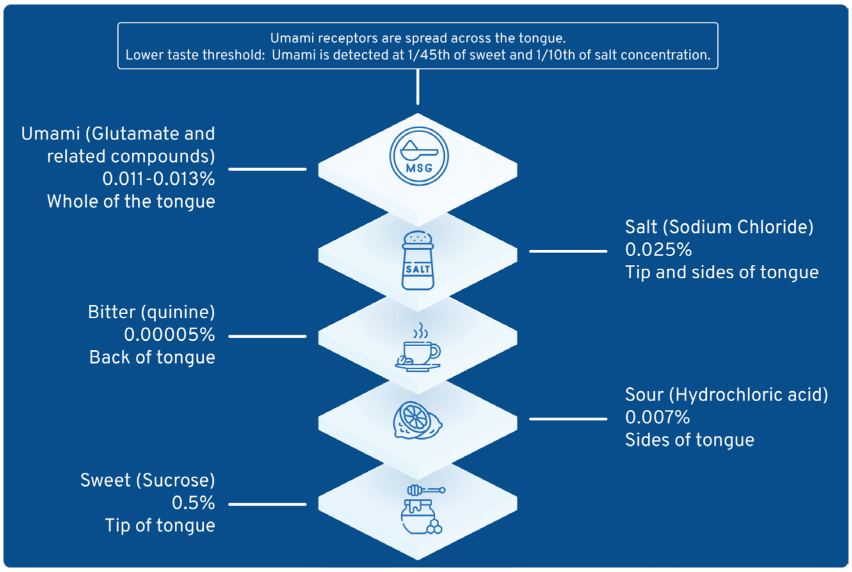
Quality refers to relative excellence. For food, quality refers to a collective of associated characteristics like safety, sensory, microbial, nutritional, economic and agricultural attributes, among others. Key quality parameters vary depending on the end user. For example, while a consumer would consider attributes like sensory, affordability, and nutritional value, a manufacturer would consider the economics, process, and shelf life of raw material. Safety, a hidden quality, cuts across all foods and is enforced by regulatory authorities.

Sensory quality drives food acceptability. When food looks, tastes, smells, and feels acceptable, it appeals to our visual, aesthetic, gustatory, and olfactory senses. The sensorial aspects of food can be broadly classified into appearance, colour, texture, and flavour. Appearance and colour are the first criteria of selection, as they represent the quality or freshness of a product, while texture gives food its unique characteristics.

The ultimate criterion for selecting food, however, is its flavour. Flavour results from the interplay of taste and aroma, receptors for which are present in our tongue and nose. Aroma is perceived by millions of receptors in the nasal cavity. Nerves carry the generated electrical impulses to the brain. Recognizing a familiar food aroma adds to the experience of taste.

Physiology of taste

Taste buds on the tongue recognize taste. These are onion-shaped organs that contain receptor cells within. Each bud contains minute pores that open at the surface of the tongue which help dissolved ions and molecules in the food reach the receptor cells clustered inside. This activates the sensory neurons, which then send a signal to the brain.



5 taste receptors & threshold values

Each of the basic tastes is conformed to specific regions of the tongue where taste can be perceived.

Modern sensory science recognizes five basic tastes based on the below criteria:

- The taste of a compound should be unique
- The taste cannot be produced by mixing any other basic taste stimuli
- It should be induced by components of foods present in nature

The taste of a compound can be detected at a particular concentration called the threshold level. This is different for each taste compound (explained in the chart below). While threshold levels are meant for detecting a taste, desired concentrations help make food palatable.

Specific area of tongue and threshold concentration for primary taste sensation*

Taste	Area of tongue	Threshold concentration
Sweet (Sucrose)	Tip of tongue	0.5%
Salt (Sodium chloride)	Tip and sides of tongue	0.25%
Sour (Hydrochloric acid)	Sides of tongue	0.007%
Bitter (quinine)	Back of tongue	0.00005%
Umami (Glutamate and related compounds)	Whole of the tongue	0.011-0.013

The taste of umami

Umami is the fifth basic taste. It is best represented by glutamate and related compounds such as inosinate and guanylate. It feels savory, meaty, brothy, or mouthful.

Protein, a structural constituent of all body cells and tissues, is made up of amino acids. Glutamic acid is a common non-essential (dispensable) amino acid. This way, glutamates are present in all body tissues and are critical for the growth and repair of the body. Traditionally, ingredients high in free amino acids or protein hydrolysates were used in cooking to enhance the sensory quality of various foods. This is done in two ways: i) free glutamate naturally present in food in the form of L-glutamic acid, or, ii) cooking techniques like fermentation, aging, ripening, or heating (consider that ripening of tomatoes increases its glutamate levels by five times). Glutamates are also present in indigenous fermented foods such as fermented fish, fish sauce, and soy sauce. All varieties of cheese carry large amounts of glutamate.

Natural free glutamic acid content in foods (mg/100g)

Name	Content
Beans	11
Capsicum	9
Tomato (sour) Tomato (sweet)	91 26
Fresh green peas	10
Amaranth leaves (green)	9
Mint leaves	21
Spinach	23
Coriander leaves	27
Cabbage	25
Onion	6
Potato	22

Source: Prabhavati (2018).

Name	Content
Cow's milk	2
Human milk	22
Parmesan cheese	1200
Eggs	23
Chicken	44
Duck	69
Beef	33
Pork	23
Cod	9
Mackerel	36
Salmon	20
Peas	200
Corn	130
Beets	30
Carrots	33
Onions	18
Spinach	39
Tomatoes	140
Green pepper	32

Source: Loliger (2000).

FAQ's

How much MSG can be taken in a day?

Like salt, MSG is a self-limiting seasoning. The intake level of MSG across population ranges from 0.5 to 2.2 g (please see the table "The daily intake of MSG in various countries (Far East)" in Chapter V. Because of its self-limiting characteristic higher amounts cannot be added to foods.

Is MSG a synthetic additive?

No, MSG is not a synthetic additive as it is manufactured from fermentation process. The raw materials used are sugar cane, corn, cassava, wheat, sago palm, and sugar beet. It is the sodium salt of glutamic acid, which is a non-essential (dispensable) amino acid present in the human body. Hence, MSG is a natural seasoning.

In nature, many foods contain free glutamate such as meat, fish, milk, and some vegetables like tomatoes, cabbage, cauliflower, potatoes, and mushrooms. These foods are naturally perceived as tasty. Umami can also be elicited in food by seasoning it with monosodium glutamate, or MSG. Ultimately, we ingest a large quantity of glutamate in our daily diets, irrespective of whether it is in the form of MSG or naturally present in our food.

References

1. Loliger J. (2000). Function and importance of glutamate for savory foods. Journal of Nutrition, 130, 915S–920S.
2. Prabhavati S.N. (2018). Studies on flavor potentiating effect of monosodium glutamate with special reference to synergism between spices and salt in different food matrices. A Ph.D. thesis submitted to University of Mysore, Mysuru
3. www.foodiesite.com/article/2000-11/cheesejsp
4. www.umds.ac.vk./physiology/jimtesteold.htm
5. www.cf.ac.vk.biosi/staft/jacob/teaching/sensory/taste.htm.

GLUTAMATES AS FLAVOUR ENHANCERS OF TASTE

Food combines various ingredients, and each contributes its distinct characteristics and aroma. The final dish is a unique synergy which we perceive as a blend of flavours. It is poignant to note that flavour or its intensity does not represent a single basic taste but is a symphony of different tastes, aromatic compounds, varied cooking techniques, and spice mixes. The temperature and texture of the food also determine our food preferences.

Food choices are influenced primarily by taste, flavour, and visual appeal. Some food products are also sold for 'feel-good' factors, usually to impart a happy and positive state of mind. Consumer preferences are shifting to products that carry natural ingredients and clean labels. Now there is a greater consumer desire for the naturality of products and environmental sustainability. However, a clear focus on the nutritional profile of the food – such as organic foods with no added chemicals like synthetic colors and additives – is still a miss.

The entry of ultra-processed food (UPF) into the market has again put the need for healthy and nutritious products in the spotlight. From the view of manufacturers, reducing the use of salt, sugar, and fat (associated with HFSS or high-fat, salt, and sugar foods) adversely affects the food's sensory properties, impacting how people enjoy that food.

There is clearly a need for an alternative approach that retains the deliciousness of a food product while also reducing salt, sugar, or fat content in it. Many manufacturers use seasonings like herbs and spices or glutamates to improve the taste of foods without significantly disturbing the flavour profile.

Factors involved in food acceptability

Glutamates as flavour enhancers

Monosodium glutamate (MSG) is a nature-derived seasoning. Currently, it is produced through a natural fermentation process using molasses from sugar cane or sugar beets, starch, or corn sugar.

MSG occurs in food both in free and bound form. When it is present in free form, it enhances the flavour of food, thereby acting as a flavour potentiator. The uniqueness of MSG is that it does not interfere with the original flavour of food, but helps in enhancing it to a higher level, thus making the food highly flavourful and delicious. By itself MSG is bland with no flavour, though a very slight salty taste can be detected. However, when it is added to foods, the taste profile of the food totally changes. It goes well with foods with salty and sour taste and does not synergize with sweet or bitter taste. Hence it is used for foods with savory and acidic tastes only.

The use of glutamates as flavour enhancers has an interesting history. The naturally occurring glutamate was first discovered by Karl Ritthausen (1913) from acid hydrolysate of wheat gluten and was predominantly present in the form of L-glutamic acid. In 1908, Prof. Kikunae Ikeda identified the salts of glutamic acid and attributed the unique taste of umami to it. Prof. Ikeda basically discovered glutamic acid from a soup which was made up of stock prepared from 'kombu', a seaweed which was considered as the main contributing factor for umami taste. Thereafter, other salts associated with umami tastes were also identified. Mr. Shintaro Kodama discovered that the umami source in dried bonito (a type of dried fish) was the nucleotide 'inosinate' in 1913. Dr. Akira Kuninaka discovered that the nucleotide 'guanylate' was responsible for the umami taste of dried shiitake mushrooms. He then further discovered the synergistic effect of combining the amino acid glutamate and the nucleotides, inosinate and guanylate. Subsequently Dr. Nirupa Chaudhari, a biologist of Indian origin discovered the unique receptors for umami taste.

Codex categories the following additives, which are glutamate

PROPERTIES OF MONOSODIUM GLUTAMATE

- MSG dissolves easily in water.
- It does not agglomerate, so easy to mix.
- It is non-hygroscopic, hence can be stored easily.
- It only imparts taste of Umami and no other taste.
- It is synergistic with many savory and acidic flavors hence can be used for a wide variety of food.
- It also blends well with the flavor of spice.
- It imparts a definite delicious taste as a flavor enhancer making the food palatable.
- It is needed in very small amounts to bring out the desired effect.
- It is comparatively a very low-cost additive.
- It can be used to make nutritious food more palatable to increase consumption, especially useful for children, elderly and convalescing patients.

and its salts as flavour enhancers. There is no acceptable daily intake described for these and they can be used at an optimum level for the desired effect.

- Monosodium glutamate
- Monopotassium glutamate
- Calcium diglutamate
- Monoammonium glutamate
- Magnesium diglutamate
- Glutamic acid

Glutamates are commonly used in the processed food industry; particularly MSG, which is added to many savory foods to enhance flavour and increase consumer acceptability. MSG dissolves easily in water and is non-hygroscopic. Its flavour-enhancing properties have been tested across various food matrices, showing that the addition of MSG increases flavour perception and creates a positive correlation between overall liking and perceived saltiness. The incorporation of MSG can enhance saltiness, which plays a crucial role in its flavour-boosting effects. In convenience foods, the concentration of added glutamates typically ranges from 0.1% to 0.8%. Glutamates are also present in hydrolyzed vegetable protein and are used in seasonings and flavourings for canned foods, dry mixes, sauces, and more. MSG is especially common in Asian cuisine.

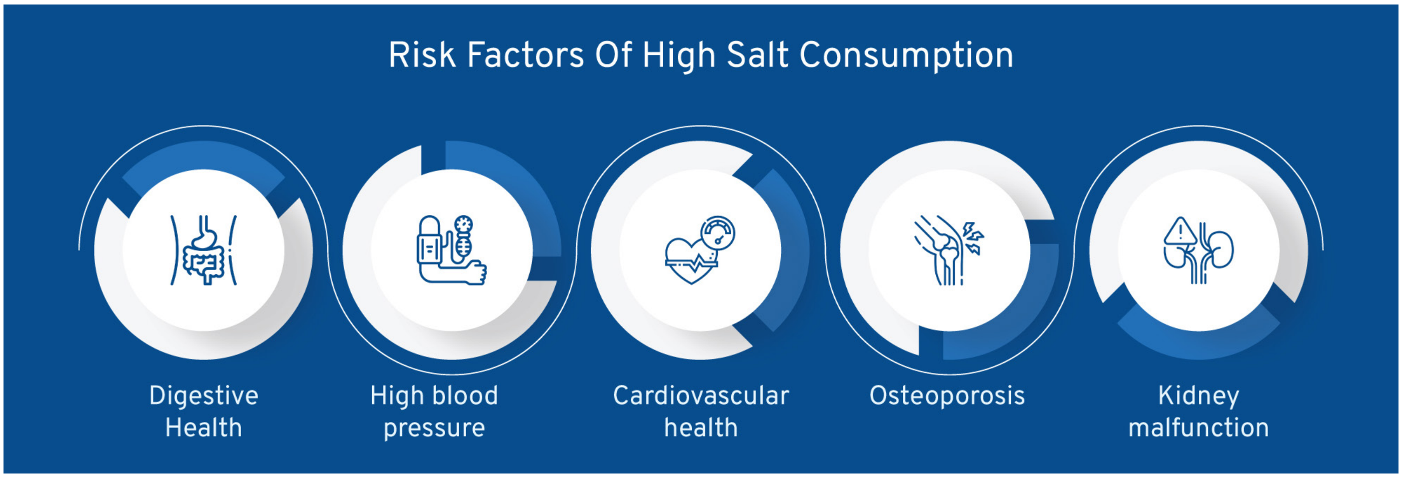
The ability to recognize the flavour of MSG varies among individuals, leading to different levels of acceptance between Western and Asian populations. While most people appreciate the umami taste, some may be indifferent or even dislike it. It’s important to note that glutamates should not be used excessively, as they can worsen the taste of a dish. An optimal amount is necessary to achieve the best flavour. MSG can work well in dishes with reduced sodium and fat content, making it suitable for health and wellness products due to its ability to maintain palatability. Additionally, MSG can be particularly beneficial in enhancing food intake for patients in recovery, cancer patients, or the elderly, where increased food intake is needed.

ROLE OF GLUTAMATE IN SODIUM REDUCTION

Salt, a natural condiment, is an indispensable food ingredient. Many types of salt are used in cooking; these are sourced from either seawater (common table salt), salt springs, or from mines (mineral salt). Salt is made up of sodium (approximately 39%) and chloride. It is a major source of sodium which is an essential mineral. However, excessive sodium intake is linked with many adverse health conditions like rise in blood pressure, cardiovascular diseases, gastric cancer, and decreased bone mineral density. Our current sodium intake is estimated to be exceeding the normal recommendation at an alarming rate globally. Even in India, 28.5% of adults are said to be suffering with hypertension; this means that at least one in four adults have high blood pressure and only 12% have their blood pressure under control. India has set a target of 25% relative reduction in prevalence of hypertension by 2025 under the 'India Hypertension Control Initiative', also termed as the 'high impact low-cost solution', which involves effective monitoring and treatment of hypertensive patients through wellness centres. However, when translated to preventive dietary approaches, a simple low-cost strategy is to simply reduce salt intake in our diet.

Risk factors of high salt consumption

High salt can be the single largest contributor of sodium excess in our bodies. Sodium is a positively charged electrolyte responsible for regulating fluid balance in the body. However, too much sodium can lead to fluid retention in the body, causing severe swelling and edema. It also increases the blood volume, which, in turn, can raise blood pressure. Kidneys must overwork to filter extra sodium which strains them over time. In populations, where dried fish and cured meats are habitually consumed, a higher incidence of stomach cancer is reported. These products are highly salted to utilize the preservative action of salt. A high-sodium diet may cause calcium depletion from bones, increasing the risk of osteoporosis, which weakens bones causing frequent bone fractures. Elderly women are particularly prone to this condition.



Role of salt in food

Though the most important role of salt is to provide the ‘salty’ taste to dishes, it also has other roles to play in food systems. It influences many functional parameters of the food matrix. Salt is very often used for its osmotic effect to bring out the water from food such as in the making of pickles when salt is added to cut vegetables. Salt assists in prolonging the shelf life of food. It is included in the list of Class I preservatives indicating that it can be used in any amount for its preservative action; most spoilage organisms cannot grow in the presence of salt. Hence, salt is used as a preservative in cured meats, salted and dried fish, pickles, fermented products, etc. A small amount of salt added to sweet products brings out a better flavour and reduces the level of sugar to be added, thus elevating the perception of sweetness and adding depth to other flavours. Salt also suppresses bitter tase and other undesirable taste. It also helps to control and stabilize the development of colors in products. Salt helps to solubilize proteins better, and by this action, it helps to bind and strengthen the gluten network (a wheat protein responsible for producing a viscoelastic dough which retains its texture even after baking, as seen in breads and cakes). Salt helps maintain smooth texture of expanded dough by binding water and carbon dioxide. It also aids in preserving a desirable texture in products such as cheese and meat sausages. To summarize, salt is a desirable natural additive valued for its functionality.

How much salt should we eat?

The habitual salt intake among Asian population is around 10-12 g/day against the WHO recommendation of 5-6g/day (Indians also have a similar average intake). In Western countries, 75% of the sodium intake is believed to come from processed foods and food from outside homes. It should be noted that even in the Indian population, the consumption of packaged processed foods is increasing at an alarming rate, contributing to the existing high salt consumption levels.

In a study, salt and fat content of commercial snacks were analyzed and the results revealed that in the unorganized sector [such as locally made non-branded snacks], the salt content ranged from 1.74 to 2.33%. Under packaged branded items sold, there was a wide range of salt seen from 1.45 to 2.74%. Salted biscuits also had a high range of salt [1.4-2.06%]. Even a 30 g serving size of these snacks contribute somewhere between 150-250 mg of sodium in one intake!

Salt and fat content of some Indian commercial snacks

Name	Salt	Fat	Name	Salt	Fat
Non-packaged deep fried snacks*					
Chakuli	1.93	33.6	Ribbon chips	2.07	31.7
Kodubale	1.74	38.8	Boti	1.93	31.0
Nippattu	2.33	28.8	Friums	1.78	32.4
Packaged deep fried snacks					
A	1.45	30.1	E	2.74	32.1
B	1.54	37.3	F	2.23	36.4
C	1.81	39.6	G	1.89	32.5
D	1.77	22.1	H	2.71	42.3
Packaged salt biscuits					
A	1.85	21.0	C	1.4	23.2
B	1.71	23.5	D	2.06	24.4

[Source: Vinod Raj. Etal., 2015]

**: Values represent an average of products procured from three different sources.*

An effective sodium reduction can be brought about only by reducing the intake of salt through conscious efforts. Understandably, reducing salt affects the overall palatability of foods which may be less desirable to consumers. Reduced salt also raises concern about the shelf stability of product and a possible adverse influence on textural quality. These parameters can affect the marketability of a food product. Thus, food manufacturers look for suitable alternatives with low sodium content which can be used as salt substitutes while retaining the savory taste.

Using flavour potentiators to compensate the taste

Conventionally, a gradual lowering of salt intake is suggested to reduce sodium content of diets. However, this approach requires several months and decreases food palatability. Another strategy is to employ salt substitutes which can mimic the taste of salt. Salts such as potassium chloride, calcium chloride, and magnesium sulphate have been tried to replace or enhance salty taste in a range of food products. However, their use at present is limited as they tend to have certain undesirable traits such as bitter after-taste, metallic, or astringent tastes.

The other viable solution to improve the sensory profile of low-sodium products is to incorporate certain flavouring agents such as herbs and spices and flavour-potentiating agents. One of the most important flavour potentiating agents is MSG which is responsible for contributing umami flavour and has been proven to be a good flavour enhancer in low-sodium chloride products. MSG contains 12% of sodium, which is comparatively lower than common table salt, and its incorporation helps to achieve normal salty taste perception while maintaining food's sensory attributes. Consumer acceptance of MSG incorporated low-sodium products is expected to be easier as it is known to alter the flavour profiles through which it brings about enhanced palatability. Over time, consumers may prefer MSG incorporated products.

Many research studies have indicated that salt can be replaced partially with MSG while retaining its palatability. The foods include sausages, vegetable soups, tomato soup, rice crackers, lentil soup, shrimp paste, cheese, fried Indian snacks, herb chutneys, gravy dishes, etc. This can bring down the sodium level by 20-40%. Replacement of salt with MSG can maintain the pleasantness, saltiness, familiarity and taste intensity of various products. Hence, with low sodium chloride it would be possible to achieve a greater level of consumer acceptability without substantially adding up to increased sodium consumption thus minimizing the prevailing problem associated with high sodium intake.

Reference

1. Vinod Raj M.C., Sandeep P.G., Bhavya S.N. and Prakash J. (2015) Salt consumption among selected subjects and salt content of common processed snack foods. Indian Journal of Nutrition and Dietetics. 52 (4), 442-451.

METABOLISM AND HEALTH ASPECTS OF GLUTAMATES

Glutamates are supplied through dietary sources either in bound or free form. When bound to protein, it is tasteless and has no flavour enhancing effect. The free form of glutamate is responsible for the flavour effect. Glutamates are also supplied through additives during food processing.

In the gastrointestinal tract, it can be supplied through endogenous breakdown of proteins. Glutamates are present in many proteins, peptides, and most tissues. They are synthesized in body and bind with other amino acids to form structural protein. In circulation, L-glutamine and L-alanine are quantitatively the most abundant amino acids in the blood and extracellular fluids followed closely by the branched chain amino acids.

Metabolism

Glutamate and disodium inosinate (IMP) are considered oral stimulators of appetite and metabolism. They support the normal functioning of digestive tract and aid in digestion. Dietary free glutamates are also linked with evoking a visceral sensation (feeling of satiation of hunger) from the stomach, intestine and portal vein. It should specifically be noted that body metabolises natural and added glutamate similarly, hence any added glutamate (as in case of flavour enhancer) to diets will be treated similarly.

Glutamates are liberated from food protein by the sequential action of digestive enzymes, namely pepsin, trypsin, and chymotrypsin. Proteins are broken down to smaller peptide chains of amino acids and absorbed by intestinal lumen. Thereafter, they are taken by cells for metabolic purposes such as protein synthesis, energy metabolism, ammonia fixation or reused as transmitter.

Glutamates serve as an important oxidative substrate for intestinal mucosa. They serve as an energy source for certain tissues and as a substrate for glutathione synthesis. They also serve as precursors for arginine and proline synthesis. Glutathione, a very important antioxidant, protects mucosa from peroxide damage and dietary toxins.

Health aspects of glutamates

Protein metabolism

Glutamine plays a major role in protein regeneration, repair, and growth. It acts as a precursor for purine/pyrimidine. It is also a major substrate for gluconeogenesis in kidney, lymphocytes and monocytes. The demonstrable effects seen in case of supplementation of glutamate and glutamine to patients with injury or infection through an improvement is mainly attributed to its ability to alter negative nitrogen balance, hepatic protein synthesis and reduced protein degradation. It has been shown to have a protective role against nitrogen related hepatic dysfunction. In skeletal muscle and heart, glutamate and glutamine are reported to exert control on the maintenance of amino acid concentration in the intracellular space facilitating the regulation of whole-body protein metabolism.

Ammonia metabolism and nitrogen balance

Both glutamate and glutamine play a vital role in ammonia metabolism. They help dispose ammonia, thus regulating the nitrogen balance. Glutamate also acts as a receptor of amino group from other amino acids, which further undergoes oxidative deamination in the liver [removal of amino group]. It also serves as an amino group donor in the synthesis of non-essential amino acids.

Glutamine serves to provide nontoxic storage and transport form of ammonia. The net output of glutamine from muscle is known to be always taking place continuously which mainly represents the disposal of amino groups from branched chain amino acid. The major mechanism that involves removing ammonia from the brain is through glutamine formation. Glutamine has also been used for therapeutic purposes supporting protein metabolism as evidenced from following observations -

Supplementation of glutamine improves nitrogen balance in patients who have undergone major surgery or bone marrow transplantation.

A reduction in the incidences of infection and length of hospital stay has been reported in patients with glutamine supplementation.

In skeletal muscle injury, a lower level of glutamine has been observed, indicating its vital role in the synthesis of muscle protein.

Based on these facts, supplementation of stable derivatives of glutamine in total parenteral nutrition for patients with injury or infection is recommended.

Central nervous system

Glutamate is very important in neural communication as it functions as an excitatory neurotransmitter. Neurotransmitters are chemical messengers which carry signals between nerve cells and other cells in the body. They are responsible for neural communications, thereby controlling almost all body functions, starting from mood to involuntary regulatory functions. Excitatory neurotransmitters stimulate or excite the nerve cells to carry the message forward to another nerve cell, whereas inhibitory neurotransmitters prevent this function.

Gastrointestinal secretions

Glutamine helps in the maintenance of gut-barrier function. Its modulation occurs through the synthesis of nucleotides, glucosamine and mucus glycol proteins. The gastrointestinal tract is the principal organ which utilizes glutamine from circulation (12-13%) and from enteral supply (50-60%). It serves as a major fuel and as source of energy for enterocytes and tends to enhance mucosal immunologic functions. It has been demonstrated to exhibit several functions such as stimulation of blood flow to the gut, maintenance of muscle integrity, prevention of villous atrophy, and promotion of bacterial translocation.

During digestion, proteolytic enzymes break down proteins to peptides and amino acids in the gut, which significantly contributes to the supply of glutamine to peripheral tissues. Impaired gut function has been shown to lower the glutamine levels significantly. This leads to impairment in the incorporation of amino acids to proteins. Clinical observations indicate that a supplement enriched with glutamine has a positive effect on nitrogen balance and improves gut morphology.

Reproduction and growth

Both glutamine and glutamate have been demonstrated to play an important role in fetal and placental metabolism. Mother's milk contains appreciably higher amounts of free form of glutamate, an essential element in post-natal development of offspring. Glutamine supplementation is known to afford significant benefits for low-birth-weight infants and among critically ill patients by way of decreased incidence of nosocomial infections (infections acquired during hospital stay). Glutathione, a very powerful antioxidant and a free radical scavenger synthesized from glutamate in erythrocytes, hepatic tissue and intestinal mucosa has been shown to reduce the incidences of low birth weight in children and among children suffering from kwashiorkor. Hence, supplementation of glutamine and other amino acids has been proposed to play a vital role in maintaining normal health and integrity of immune system.

Immunity

Glutamine is proposed to act as a major source of nutrition for cells of immune system that would be released from muscles, adipose tissues and other sources, thus, indicating its vital role in immune function. It facilitates the maintenance of general immune competence by stimulating the synthesis of cellular proteins involved in immune system and mediates hepatic acute phase protein response. An increased bacterial translocation observed in severe sepsis also tends to reduce glutamine uptake and utilization. It has been stated that L-glutamine is the major precursor of gamma amino butyric acid (GABA) which has been reported to exert anti-stress activity and also helps to improve cell mediated immunity through neurogenesis of cells undergoing rapid proliferation. This function has been proven to be beneficial for treating HIV cases.

Anti-cancer activity

Glutamine supplementation was demonstrated to increase the efficiency of some anti-cancer drugs and prevent toxicity in others. Parenteral supplementation of glutamine to bone marrow transplant patients prevented infectious morbidity and reduced length of hospital stay. It was well tolerated even in pediatric patients with no unsafe rise in levels of plasma glutamine or ammonia.

Role of glutamine in vital organ function

Organ	Function
Kidney	Glutamine metabolism in kidney helps to maintain acid-base balance in the plasma.
Intestines	• Serves as an important fuel for tissue. • An important component for maintaining gut integrity. • Lessons the burden induced by mechanical intestinal obstruction. • Glutamine administration helps to reduce bacterial translocation. • Helps to normalize the increased intestinal permeability normally seen in association with HIV-AIDS.
Liver	Glutamine metabolism in liver plays a vital role in regulating ammonia levels in venous blood.
Central nervous system	Acts as a major transmitter at excitatory synapses.
Immune system	Glutamine is utilized at higher rates by the major isolated cells such as lymphocytes, macrophages and neutrophils, whereas glutamate serves as a precursor for ornithine synthesis in macrophages and monocytes.
Pancreatic β-cell	• Glutamine, induced by leucine or arginine, has been proposed to enhance insulin secretion from pancreatic β-cell. • Glutamate is required as a substrate for the enzyme glutamic acid decarboxylase for production of a signaling molecule, GABA.
Skeletal muscle	The major site for glutamine synthesis is muscle which accounts for 90% of the whole body glutamine pool. About 60% of the amino acid released during post absorptive state contains alanine and glutamine. Glutamate acts as an important anaplerotic precursor (synthesis of intermediates needed to replenish TCA cycle).

SAFETY AND REGULATORY ASPECTS OF MONOSODIUM GLUTAMATE

Monosodium glutamate and other glutamate additives are sold in regular shops and used for their flavour enhancing effect in small amounts in various dishes. A very common question is if MSG is safe for humans. Let us first understand how safety of an additive or a chemical intended to be added to foods is assessed.

Determining safety of a food additive

For assessing the safety of an additive, the process follows four steps, hazard identification, hazard characterization, exposure assessment and risk characterization. (Codex Alimentarius Commission (CAC/GL 62-2007)).

1. Hazard identification [wherein, a probable hazard, which may pose risk on ingestion, is identified]. So, you ask a question, is there a hazard? In other words, if this substance is consumed, will it result in any harmful effect on health?

2. Hazard characterization –To get an answer to above question, systematic scientific studies are carried out with various levels of test compounds to identify the level at which there may be an adverse reaction, or there may not be any adverse reaction at all. These studies are conducted using various animal models. The tests are designed to get results in short term trials [for acute toxicity] and long-term trials [to get an answer for long term ingestion of the test substance]. The data collected is extrapolated to humans, or if possible, tests are also conducted with human volunteers after the safety is established in animals. With this data a dose response relationship is established. There are definite procedures outlined for conducting all such studies which are followed by scientists to establish the safety of a chemical. Based on all such data, after extensive deliberations, an acceptable daily intake [ADI] level is arrived which is safe for humans.

3. Exposure assessment – Another set of data which is needed for safety assessment is the probable amount of test compounds which may be consumed over a certain period through food or water. This is collected through dietary surveys or through purchasing patterns. Habitual consumption of any test compound by any ethnic population and traditional use is also considered while determining exposure to a substance.

4. Risk characterization –Determining the qualitative and/or quantitative estimation, including attendant uncertainties, of the probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterization and exposure assessment.

This work is taken up by Codex Alimentarius, the international food regulatory body. Under codex, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) examines the safety aspects of food additives from time to time.

How is ADI for an additive derived?

With the experimental data on animals – No Observed Adverse Effect Level [NOAEL] is obtained in g/kg body weight/day. This means that the given dose has not shown any type of harmful effect on the animal. This figure is divided by uncertainty factor, which is 100, if the data comes from animal studies, and 10, if the data comes from clinical studies on humans. This is to ensure absolute safety on ingestion of the test compound. This would mean that the safety margin is very high as the permitted level is far below the level which is considered safe for animals or humans.

Safety of MSG

For examining the safety of MSG, the measures adopted by Codex and the decisions taken thereon were as follows:

- JECFA examined 109 scientific papers in 1970 at its 14th meeting and allocated an ADI of 0-120mg/kg body weight of MSG for humans, except infants less than one year of age.

- In 1972, the committee established general principles for the use of food additives for infant foods that "It is prudent that foods intended for infants under 12 weeks should contain no additives at all".

- Again, the committee met during 1973 at its 17th meeting and examined 144 scientific papers on MSG and changed its ADI of 0-120 mg/kg bw from "as MSG" to "as glutamic acid" and the note for infant was amended as "infants under 12 weeks of age" following the general principle of the committee.

- At its 31st meeting in 1987, the committee further examined 237 scientific papers including additional publications and concluded that for MSG, there was no ADI specified, which would mean that MSG is totally safe and can be used within the bounds of good manufacturing practice (GMP) without numerical upper limit.

- They further removed the note for infant and stated, "in view of the finding that infants metabolize MSG in a similar way to adults, no additional hazard to infants was indicated" and "This committee was reassured by information about the intake and effects of MSG in infants since it shows that there is no cause for concern about health risks".

- At this juncture, it may also be noted that MSG is a self -limiting additive like salt. It is delicious only if it is added in small amounts, in fact, the acceptable range is given as 0.1-0.8% by weight of food. The addition of too much of MSG does not result in flavour enhancement, rather, it can result in off-flavour. Hence under no circumstances, too much MSG can ever be eaten.

- There are reports that under the experimental conditions, when humans have orally ingested even 10 g of MSG, no adverse reactions have been seen, though 10 g is extremely high compared to normal MSG intake. All the MSG taken in diet is absorbed and metabolized in the intestines, and only a small amount can be seen in circulation.

"ADI not specified": is a term applicable to a food substance of very low toxicity which, on the basis of the available data, the total daily intake of the substance, arising from its use at the levels necessary to achieve the desired effect and from its acceptable background in food, does not represent a hazard to health.

MSG has been a very controversial and the most researched food additive. There are more papers published on MSG than on any other additive in scientific literature. Let us understand what MSG is made of - it contains glutamate, which is an amino acid, and sodium. Both these constituents can be metabolized by the body; hence, it is not a xenobiotic or a foreign substance to the body. It is present in almost all foods we eat, hence, there has been no evidence of toxicity whatsoever. The natural glutamate present in food and glutamate added as MSG, both are metabolized in a similar way. The body does not distinguish between added glutamate and naturally present glutamate. Hence it is categorized as the safest food additive. There is no clinical data to support the widespread belief that glutamate can elicit asthma, migraine headaches, and the so-called Chinese restaurant syndrome. On rare occasions, some people may express sensitivity to glutamates. This is like food intolerance which only happens in few.

DID YOU KNOW?

The phrase 'Chinese Restaurant syndrome' originated in 1968 from a letter (anecdotal case report) wrote by one Dr. Kwok to the editor of a journal detailing certain vague symptoms he experienced after eating in a Chinese Restaurant. This letter stated MSG as a possible cause of these symptoms. However, thereafter multiple scientific studies carried out in many laboratories could never consistently reproduce these results. Even when many subjects who reported such symptoms were a part of a scientific study, no effect of food added MSG could be demonstrated.

Country	Intake of MSG (g/day)
USA	0.55
Netherlands	0.66
Thailand	1.50
Japan	1.42
Indonesia	0.60
Korea	1.57
Malaysia	0.37
China	2.2

Oriental countries have been using MSG as a regular seasoning every day since 1908 and no adverse effect has been reported in such populations. Even in other regions, where Chinese, Japanese, Thai, Korean, or Vietnamese cuisine is being used, glutamates are added as flavour enhancers and consumption of such foods has not been associated with any harmful reactions. People may be consuming glutamates without their knowledge through natural foods or through added seasonings. The average daily intake of MSG in various countries alongside indicates that high use countries are Thailand, Japan, Korea, and China. It is important to note that even the highest use is only 2.2 g per day, which is a small amount.

Regulatory aspects of Monosodium Glutamate

The US Food and Drug Administration designated glutamate as a GRAS (generally recognized as safe) ingredient in the year 1958 along with other food ingredients such as salt, vinegar, and baking powder (USDHHS 1958). The safety evaluation of MSG was first determined by JECFA in 1971 and 1974 respectively. At that time the accepted daily intake was fixed at 0-120 mg/kg body weight. JECFA conducted a more comprehensive safety evaluation in 1987. The meta pharmacokinetics toxicological data which were conducted on humans was reviewed by JECFA (1988). The review indicated that glutamate had a very low acute toxicity under normal circumstances. The LD50 value which is lethal to 50% of the subjects showed that in case of rats and mice it was ranging between 15,000-18,000 mg/kg body weight. Studies which were conducted for 2 years duration on sub-chronic and chronic toxicity, among mice and rats including their reproductive history did not exhibit any adverse effect even when glutamate was supplemented at a dietary level of up to 4%. Another investigation was conducted among dogs for a period of two years where they were given diets containing 10% of glutamate. This also did not reveal any adverse outcome with respect to abnormal weight gain, organ weight, and change in clinical indices, mortality or general behaviour. With the available results, JECFA concluded that when they are used at levels necessary to achieve the desired technological effect, they do not endanger human health and wellbeing. A point to be noted here is that MSG is used in very small amounts, usually less than 1%, to affect the flavour enhancing ability. Like salt, larger amounts cannot be used; hence it is self-limiting.

A similar safety evaluation was conducted by the scientific committee for food, by the commission of the European communities (SCF 1991). They also concluded that glutamate could be allocated an ADI "not specified". The Federation of American Societies for Experimental Biology (FASEB) concluded that it could cause adverse reactions in some sensitive individuals, but there was no scientifically verifiable evidence which can prove that high levels of exposure to glutamate could cause harm for the general population. The findings of the FASEB were found to be consistent with the results of investigations carried out by JECFA and SCF. These authoritative organizations have affirmed the safety of glutamate at levels which is normally consumed by the general population and there is no conclusive evidence to say that current glutamate use is linked to any long-term medical problems among the general population. In 1995, the European Commission fixed the maximum limit for glutamate use to be 10 g/kg (as glutamic acid) for the L-glutamate and other salts for food in general. For certain foods, such as baby foods, glutamate use is restricted as same as other additives, and for seasoning and condiments, the maximum level has not been specified (quantum satis).

Codex Alimentarius

Codex has permitted the use of MSG as a flavour enhancer in a wide range of food categories according to Good Manufacturing Practices (GMP). According to the Codex General Standard of Food Additives (GSFA), MSG is listed in Table 3 with Not Specified JECFA ADI that are acceptable for use in foods in general when used at quantum satis levels and in accordance with the principles of GMP. Also, it can be added to food categories in which food additive use is generally restricted such as frozen vegetables, seaweeds, nuts and seeds, fermented vegetables, dried pasta and noodles and other related products, non- vegetarian foods like fresh meat, poultry, frozen fish, fish fillets, crustaceans, frozen minces and creamed fish, cooked/fried fish, smoked and dried, fermented and or salted fish and salt substitutes according to GMP. The approvals of above foods were reported in 2014 and 2015 (Codex 1995, revised list).

As per the FDA (1995) regulations it is important to include the list of all the ingredients on the label which are used in processed and packaged foods. When MSG is added to a food, it is mandatory that it must be mentioned in the ingredient list with a common or usual name "monosodium glutamate". When a glutamate containing ingredient is used as a component of a food product, they can be indicated by their common or usual name. For instance; parmesan cheese, tomatoes, soy sauce, hydrolyzed protein or autolysed yeast extract are used while preparing any dish they must be included in the food product label (21 CFR section, 101.22).

Indian Regulations

Under Indian food regulations, MSG is a permitted food additive and allowed under GMP. It can be added in minimum quantities as needed to get the desired effect. In the year 2016, FSSAI declared that the flavour enhancer MSG may be added to certain specified foods as per GMP level and proper declaration needs to be provided according to Food Safety and Standard regulations of packaging and labeling (http://www.fssai.gov.in). Under the Labeling Act, it is mandatory that the packaged foods containing MSG declare it on the label as "Contains Added MSG – Not Recommended for Infants Below 12 Months and pregnant women." Since such labels are not required for any other chemical additive, this warning may be unnecessary for MSG in isolation. Moreover, it has been accepted as a safe food additive by all international regulatory bodies and such labels are not required in any other countries.

Could MSG be used for children and pregnant women?

- As mentioned earlier, there has been no risk detected for MSG in any of the studies. It is metabolized like natural glutamate. Hence, it can be used for children in limited amounts.

- Human milk contains a large amount of glutamate; so a baby ingests the largest amount of glutamate through breast milk per kg body weight than even an adult would through food. It can be said that it is provided in nature through breast milk so that the baby likes to feed as well as it helps in digestion. Hence, MSG can be considered safe for children and babies too.

- In the recommendation of CODEX, only babies below 12 weeks of age are excluded from the 'ADI not specified range' and older babies can be given MSG.

- If a pregnant woman ingests MSG, almost all glutamate from MSG is absorbed and metabolized in the intestine, therefore, ingested glutamate hardly enters the blood stream and does not pass through placental barrier, so the growing fetus is not exposed to MSG.

FAQ's

Is MSG safe during pregnancy?

MSG is safe to be consumed during pregnancy as it does not cross the placental barrier. Additionally, almost all the ingested MSG is absorbed and metabolized in intestine, therefore, intestinal absorption of MSG itself is limited and all the ingested glutamate is not absorbed into the blood stream.

Is MSG safe for children?

MSG is totally safe for children as they metabolize the seasoning the same way as adults. In natural foods, glutamates are consumed habitually, being a part of many vegetables and flesh foods, including milk and cheese. It also helps children consume vegetables willingly by making them more delicious and acceptable.

Can MSG affect children's brains?

No, MSG has no effect on children's brains. Infants metabolize glutamate similarly to adults. Glutamates cannot cross the blood-brain barrier. This barrier is also well developed in human infants; hence, any ingested glutamate does not enter the brain. In neonatal mice, this is not so well developed which is why they show adverse effects of glutamate administration in experimental animal studies.

Why is MSG not allowed in infant foods?

According to Codex, in principle, food additives including MSG are not allowed in food meant for infants less than 12 weeks of age unless safety for infants below 12 weeks is evaluated by JECFA. In general, no chemical additive is allowed in infant food. This is because the human body has metabolic pathways to deal with natural substances but no xenobiotics like synthetic flavours, medicines, etc. This is underdeveloped in infants up to one year of age. However, firstly, MSG belongs to the category of natural substance (sodium salt of nutrient amino acid) which can be metabolized by the body. Secondly, an infant ingests more MSG through the mother's milk than from any other food source. Hence, the advisories for older infants were later modified. According to the Codex advisory list of amino acids and other nutrients for use in foods for special dietary uses intended for infants and young children, sodium salt of glutamic acid, namely MSG, is allowed for formulas for special medical purposes intended for infants as a nutrient.

MONOSODIUM GLUTAMATE AND INDIAN CUISINE

MSG is generally associated with oriental cuisine, specifically with Chinese, Japanese and Korean cooking. In contrast, Indian cuisine draws its flavour from spices and cooking techniques. Basically, Indian food is very flavourful and spicy. The varieties of flavours originate from a combination of multiple ingredients, multiple cooking techniques and particularly, spices.

The use of MSG as an additive is not traditional to Indian cooking, and it is a totally new taste for the Indian palate. Though foods with natural glutamates such as onion, garlic, capsicum, and meat have been used for their flavour, addition of MSG to Indian traditional dishes opens a new dimension of taste experience dissimilar to the original dish, yet with an acceptable flavour profile. In addition, it can be used to reduce the sodium content of dishes by using less salt.

A summary of exploratory scientific studies for possible utilization of MSG for Indian palate is presented below.

Sensory attributes of MSG incorporated rice crackers:

The Indian snack food market is one of the largest in the world with dominance of deep-fried foods. The traditional snack foods sold are shelf-stable fried products, semimoist fried products, popped cereals, expanded rice and legumes, flaked cereals, extruded snacks, and fermented products. Almost all snack foods are prepared from cereals, legumes and spices; however, use of flavour enhancers is not found.

The objective of the study was to incorporate MSG, a flavour potentiator, at different levels to an Indian traditional deep-fried snack product - rice crackers, and to assess its sensory attributes and storage stability. Rice crackers prepared with a combination of rice flour with decorticated pulses, [either black gram or green gram] are popular snacks used in the states of Karnataka and Tamil Nadu. These were prepared using three different oils, with three levels of MSG and with or without the addition of spices. All products were subjected to sensory analysis by 30 semi-trained panel members. For storage stability, the products were stored in PET (polyethylene terephthalate) containers at room temperature for 0, 10 and 20 days, and were analyzed for free fatty acid and peroxide values using standard procedures. Results showed that MSG improved the organoleptic quality [taste] of products and exhibited synergistic effects with spice flavour. The storage study indicated that the products could be stored up to 20 days as judged by free fatty acid and peroxide values. MSG improved the sensory attributes of this traditional snack item prepared using three different oils and did not affect the storage stability [1].

Exploring the flavour potentiating effect of MSG on ‘poories’

‘Poories’ are deep fried flatbreads used very commonly as staple. They are prepared using whole wheat flour and a small amount of salt, and sometimes with the addition of spices too. For the study, poories were prepared with three levels of MSG, 50, 75 and 100mg/100g of flour and subjected to sensory evaluation using standardized procedures by 40 semi-trained panelists. Results indicated that products prepared with MSG received high scores indicating an improved flavour profile in comparison to control products prepared with no MSG. To understand the effect of addition of spices on these products, four spices, namely chili, omum, pepper, and cumin, were used either singly or in combination. Spice added products also received high scores demonstrating the flavour enhancing effect of MSG. The scores were significantly higher for products with a mixture of spices indicating synergism between spices and MSG. Hence, results showed that MSG can be used to improve the flavour profile of poories [2,3].

Utilizing MSG for fresh herb chutneys

Chutneys are a ubiquitous accompaniment to many snacks, breakfast foods and meals in India. There are varieties of chutneys used, among which the ones based on fresh herbs are also common. Chutneys are characterized by their strong flavours and very spicy taste. They are pungent, aromatic and combine the taste of salt, sweet and sour, sometimes with a hint of bitterness and astringency too.

An investigation was designed to evaluate the sensory characteristics of MSG incorporated fresh herb chutneys based on mint (Mentha spicata), coriander (Coriandrum sativum) and curry leaves (Murraya koenigii). The products were standardized by incorporating three different levels of MSG viz, 100, 150 and 200 mg/100g of the product. Product without MSG served as control. The products were evaluated by a group of 10 trained panelists for the sensory attributes like appearance, taste, mouth feel, aroma and overall quality. The results showed that all products were highly acceptable. MSG incorporation had a positive impact on the sensory parameters of all the products. As the level of MSG was increased, the acceptability scores of products increased showing the amplification of flavour [4].

The flavour profile of tomato soup prepared using MSG and spices

The flavour potentiating effect of MSG in salt reduced tomato soups prepared using different spices was explored. Five soup formulations were prepared using spice powders, chili [two varieties], clove, cinnamon, and pepper (*Capsicum annum L., Capsicum fructescens L., Syzygium aromaticum L., Cinnamomum verum, C. and Piper nigrum L.*), employing three different levels of salt (0.55, 0.75 or 0.95%) along with different levels of MSG (50, 100 or 150 mg/100g). Products without MSG served as control. The formulated products were evaluated by trained panelists (n=10) using a score card. The results revealed that products with the lowest level of salt scored lower in comparison with higher salt products. However, the addition of MSG significantly improved the taste, mouthfeel, aroma and overall acceptability of salt reduced products. The effect was more prominent with higher levels of MSG. Hence, the study showed that MSG can be used to lower the salt content of tomato soup while retaining the acceptability scores of products. The soups formulated with different spice combination with the incorporation of MSG exhibited maximum acceptability [5,6].

Formulation of low sodium vegetable soup mixes

In another study, low sodium vegetable soup mixes were formulated, and their acceptability was assessed. Four different soup mixes (tomato, onion, onion + tomato and mixed vegetable) were prepared. In each type of soup mix five different variations varying in levels of salt and with or without added MSG were prepared. One of the soup preparations with normal salt level of 1% (based on preference) served as control (I). Other samples were prepared with 0.7% salt (II), 0.7% salt with 40 mg MSG (III), 0.5% salt (IV) and 0.5% salt with 80 mg MSG (V). Acceptability profile was tested with standardized procedures. Results revealed that in all products, 0.7% salt with MSG was accepted well and, in both soups, (II) and (IV), taste and acceptability improved after addition of MSG. Addition of MSG improved flavour profile of soups and assisted in salt reduction [7].

Conclusion

When the possibility of using MSG for Indian cuisine is deliberated, certain observations are to be noted:

- As MSG is a potent flavour enhancer, the amount to be used should be very small - many times use level of 50-400 mg/100g [0.05% to 0.4%] of dish is adequate to bring in the desired level. A very discernible difference in taste attributes even with such small additions of MSG can be felt. Addition of extra amount can result in strong off-flavour or after-taste and may also create a negative flavour by suppressing the aroma of natural spices.

- Since Indian traditional cuisine uses many spices, studies focused on the synergistic action of spices and MSG have shown that MSG compliments the taste of spices very well in many dishes.

- Since MSG can enhance the flavour of food, it can be added to savory foods to reduce the amount of added salt. Many studies on the taste quality of a series of Indian preparations with reduced salt and added MSG have shown that MSG is effective in reducing sodium. For example, the traditional Indian non-leavened flat breads like chapathi and khakara can be prepared with small amount of MSG for increased acceptability.

- In almost all traditional curries based on legume, vegetables, MSG was very effective in reducing the sodium level by increasing acceptability of low salt products. Since many of these gravy type dishes also contain acidulant, MSG goes well with both acidic and salty taste. It was also effective in traditional rice-based dishes to improve the taste and lower the sodium level.

- The addition of MSG can be explored for healthy snack products with reduced salt and fat. Most of the fried snacks contain a high level of fat (25-40%) and salt (1.5-2.0%). It should be noted that high salt levels compliment the strong flavour of pungency (arising from addition of chili) and acidulants (use of lime, tamarind, or citric acid). Fat is needed for the texture and taste of the product. Reducing fat and salt affects the palatability of products adversely. This can be compensated to a certain extent by the addition of MSG.

- At present, the Indian market has limited products for the elderly. Given the situation that most of the elderly would require a low salt, low fat, fiber rich healthy snack item, MSG could fill in the gap to provide a delicious flavour to this category of products. It will also result in improved food intake in elderly with poor appetite.

FAQ's

Can MSG be added to any type of food?

MSG is suitable only for savory and acidic foods. As per Codex standard (GSFA), MSG can be used for food in general and also frozen vegetables, sea weeds, nuts and seeds, fermented vegetables, dried pasta and noodles, and non-vegetarian foods like fresh meat, poultry, frozen fish, according to good manufacturing practices.

Does MSG lower the nutritional content of foods?

MSG has no effect on the nutritional content of food. It does not interact with any nutrient. On the contrary, it is a precursor of some amino acids, thus serving as an energy source and a substrate for glutathione production, which is a very powerful antioxidant.

Can MSG affect children's brains?

No, MSG has no effect on children's brains. Infants metabolize glutamate similarly to adults. Glutamates cannot cross the blood-brain barrier. This barrier is also well developed in human infants; hence, any ingested glutamate does not enter the brain. In neonatal mice, this is not so well developed which is why they show adverse effects of glutamate administration in experimental animal studies.

Can MSG withstand cooking temperatures?

Yes, MSG can be added to foods while cooking and it can withstand normal cooking temperatures.

Reference

1. Prakash, A., Prakash, J., Prabhavathi, S.N. (2014). Sensory attributes and shelf stability of monosodium glutamate-incorporated rice crackers prepared using different oils. Advances in Food Science. 36(2): 48-53.

2. Maheshwari, H.M., Prabhavathi S.N., Devisetti, R., Prakash, J. (2017). Determining efficacy of monosodium glutamate for salt reduction in plain and spiced 'poories' through sensory responses. Journal of Experimental Food Chemistry. 3:129.doi:10.4172/2472-.542.1000129. 1-9.

3. Maheshwari, H.M., Prabhavathi, S.N., Prakash, J. (2017). Exploring the flavour potentiating effect of monosodium glutamate on acceptability profile of spiced 'Poories. Indian Journal of Nutrition and Dietetics. 54(3): 265-277.

4. Prabhavathi, S.N., Prakash, J. (2017). Sensory attributes of fresh herb Chutneys prepared using a flavor enhancer. EC Nutrition, 10.1, 26-36.

5. Prabhavathi, S.N., Prakash, J. (2016). Flavor potentiating effect of monosodium glutamate on acceptability profile of salt reduced tomato soups. Proceedings of the 2016 International Conference on Food Properties (ICFP2016) Bangkok, Thailand, May 31-June 2.

6. Prabhavathi, S.N., Prakash, J. (2017). Acceptability profile of tomato soup prepared using flavor potentiator and spices. International Journal of Food, Nutrition and Dietetics. 5 (2), 65-71.

7. Kumari Swati, Shirin Adel, P.R. Prakash, J. (2014) Formulation and Acceptability of Low Sodium Vegetable Soup Mixes. Indian Journal of Nutrition and Dietetics. Indian Journal of Nutrition and Dietetics. 51, 65-75.

TRADITIONAL INDIAN RECIPES WITH MONOSODIUM GLUTAMATE

MSG, although not traditionally part of Indian cuisine, can be used sparingly to create unique taste experiences. The following collection of recipes showcases everyday Indian dishes enhanced with MSG. These recipes are just a sample of the vast Indian cuisine that can be explored with MSG. Experimenting with MSG in other traditional dishes may yield surprising and delightful results. The recipes presented here have been tested and tried.

Note on the use of salt and MSG: The amounts of salt and MSG specified in these recipes are suggestions. Adjust salt to taste, but note that MSG enhances savory flavours, so less salt may be needed than usual. Use MSG in small amounts to enhance taste; too much may overpower the dish. For home cooking, four servings of 1/4 to 1/2 tsp of MSG are sufficient.

Weights of ingredients listed are for edible portions only.

Masala refers to traditional Indian spice blends. Different prefixes in recipes (e.g., Sambar masala) specify which blend is intended for that dish. These blends can be purchased or made at home. Recipes for these masalas are not included in this section.

Kasoori methi: Dry fenugreek leaves used for flavouring.

Abbreviations Used:

- **Tsp:** teaspoon
- **Tbsp:** tablespoon
- **Min:** minute
- **g:** gram

SEASONED VEGETABLES

1. GHERKINS

Ingredients:

- Gherkins – ½ kg
- Onion – 100 g
- Oil – 2 tbsp
- Mustard – ¼ tsp
- Red chili – 2-4 No.
- Black gram dal – 2 tsp
- Cumin seeds- 1 tsp
- Curry leaves – 1 twig
- Coriander seeds – 1 tsp
- Salt – ½ tsp
- Fresh coconut gratings – 25 g
- MSG – ¼ tsp
- Ground nuts – 25 g
- Water – as needed

Method

- Wash and cut gherkins lengthwise and cook with water, salt, and MSG till done.
- Dry roast chili, cumin seeds, coriander seeds, ground nuts, and powder coarsely along with coconut gratings.
- Mix the ground masala with cooked gherkins and heat for 5 min on low flame.
- Heat oil in a small 'Kadai' to prepare seasoning. Add mustard seeds, onions, black gram dal, and curry leaves, roast for 2 min, and add this to cooked vegetables and mix.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 40%

2. SAUTEED CABBAGE

Ingredients:

- Cabbage – ½ kg
- Oil- 2 tsp
- Fresh coconut gratings – 25 g
- Turmeric – a pinch
- Green chilies – 2 in no
- Water – as needed
- Black gram dal – 2 tsp
- Salt – ½ tsp
- Mustard – ½ tsp
- MSG – 1/8th tsp

Method

- Clean and shred the cabbage into small pieces.
- Heat oil in a pan. To the heated oil, add mustard, black gram dal, turmeric, and slit green chillies and fry for 2 min.
- Add shredded cabbage, salt, and MSG and fry for about 5 min.
- Add a small quantity of water and cook the cabbage on medium flame with constant stirring until done.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 43%

3. SAUTEED BEANS

Ingredients:

- Beans – ½ kg
- Curry leaves – one twig
- Onion – 100 g
- Asafoetida – a pinch
- Bengal gram dal – 1 tbsp
- Fresh coconut gratings – 30 g
- Black gram dal – 2 tsp
- Water – as desired
- Oil – 2 tbsp
- Salt – ½ tsp
- Mustard – ¼ tsp
- MSG – 1/4th tsp

Method

- Clean and chop the beans and pressure cook with salt and MSG.
- In a pan, heat oil and add mustard seeds, black gram dal, and Bengal gram dal and fry on low flame till they become golden brown.
- Finally, add onions and curry leaves and fry for another 3-4 min.
- To the prepared seasoning, add pressure-cooked beans and coconut gratings and mix well.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 36%

4. RIDGE GOURD

Ingredients:

- Ridge gourd- 300
- Oil – 3 tsp
- Red gram dal – 70
- Fresh coconut gratings – 25 g
- Onion – 100 g
- Water - as needed
- Curry leaves – one twig
  Salt – ½ tsp
- Mustard – ½ tsp
- Coriander leaves for garnishing
- Cumin seeds – ½ tsp
- MSG – ½ tsp

Method

- Soak red gram dal for 30 min.
- Peel and dice ridge gourd.
- Pressure cook red gram dal and ridge gourd with salt and MSG and keep aside.
- For the seasoning, heat oil in a Kadai. Add mustard seeds, cumin seeds, onion, curry leaves, and red chillis and fry for 3 min.
- To the above seasonings add pressure cooked dal and ridge gourd.
- Mix thoroughly and continue cooking on a medium flame for another 2 minutes.
-
- Remove from flame, garnish with fresh coconut gratings and finely chopped coriander leaves and serve.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 42%

DAL PREPARATIONS

1. PLAIN DAL

Ingredients:

- Red gram dal – 100 g
- Turmeric – a pinch
- Oil – 1 ts
- Water - as needed
- Mustard – ¼ tsp
- Salt – ½ tsp
- Cumin seeds – ½ tsp
- MSG – ½ tsp
- Slit green chillies – 2 in no
- Coriander leaves - for garnishing

Method

- Pressure cook red gram dal with salt and MSG.
- Heat a pan, add oil, mustard, and cumin seeds. When they start to crackle, add a pinch of turmeric, asafoetida, and green chillies and fry for a few seconds.
- Add the pressure-cooked dal to the pan, mix well, and cook for 4-5 min.
- 4. Garnish with coriander leaves and serve.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 40%

2. SPINACH DAL

Ingredients:

- Split green gram – 100 g
- Slit green chilies – 2 in no
- Spinach – 50 g
- Turmeric – a pinch
- Tomato – 50 gWater- as needed
- Mustard – ¼ tsp Salt – ½ tsp
- Cumin seeds – ½ tsp MSG - ½ tsp

Method

- Clean, wash, and cut spinach leaves. Wash green gram dal.
- Pressure-cook green gram dal and spinach with salt and MSG.
- Heat a pan and prepare to season with oil, slit green chillies, cumin seeds, and a pinch of turmeric.
- To the above mixture, add finely chopped tomato and cook for 5 min.
- 5. Add pressure-cooked dal and spinach, stir well, and cook for 5 min on low flame.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 41%

3. DAL AND POTATO CURRY

Ingredients:

- Red gram dal – 75 g
- Curry leaves – one twig
- Potato – 250 g
- Sambar powder – 2 tsp
- Tomato – 100 g
- Water – as needed
- Oil – 1 ts
- Salt – 1 tsp
- Mustard - ¼ tsp
- MSG - ½ tsp

Method

- Pressure-cook red gram dal, potato, and tomato with sambar powder, salt, and MSG.
- Heat oil in a pan, add mustard seeds, and curry leaves. Fry for a few min.
- Add the seasoning to the dal, boil for 2 min, and remove from flame.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 35%

GRAVY-BASED PREPARATIONS

1. BOTTLE GOURD KOFTA CURRY

Ingredients:

For Kofta

- Bottle gourd – 300 g
- Rice flour – 40 g
- Besan flour – 100 g
- Green chillis – 10 g
- Turmeric – a pinch
- Ginger garlic paste – 5 g
- Salt – ½ tsp
- Oil – For frying

For Gravy

- Onion – 100 g
- Tomato – 100 g
- Ginger, garlic paste – 5 g
- Cumin seeds – ¼ tsp
- Chili powder – 1 tsp
- Coriander seed powder – 1 tsp
- Garam masala – 1 tsp
- Oil – 2 tbsp
- Salt - ½ tsp
- MSG – 150 mg
- Coriander leaves – 15 g (for garnishing)

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 35%

Method

- Peel and grate bottle gourd. Squeeze extra water and keep it.
- Prepare ginger garlic paste. Mix grated bottle gourd with gram flour, rice flour, turmeric, finely chopped green chillis, ginger garlic paste, and salt. Make a tight dough. Add the squeezed water, if needed.
- Divide the dough into 25 equal-sized balls and deep fry in oil till golden brown and keep it aside.
- For preparing gravy, grind tomato to a puree. Heat oil in a pan. Add chopped onion, ginger garlic paste, red chili powder, coriander seed powder, garam masala, turmeric, tomato puree, salt and MSG. Fry the masala for 5 min. Add water and bring to a boil.
- When the mixture is boiled well, add fried koftas and simmer it for another 10 min.
- Garnish with fresh coriander leaves.

2. CAPSICUM GRAVY

Ingredients:

- Capsicum – 250 g
- Onion – 100 g
- Tomato – 100 g
- Fresh coconut gratings – 30 g
- Cashew nuts – 10 g
- Garlic – 10 g
- Red chili powder - 1 tsp
- Kasoori methi – 1 tsp
- Garam masala – 1 tsp
- Coriander seed powder – 1 tsp
- Oil – 2 tbsp
- Coriander leaves – 10 g
- Salt – 1 g
- MSG – ½ tsp

Method

- Chop onion and capsicum and keep aside.
- Prepare gravy paste by grinding tomato, coconut gratings, garlic, and cashew nuts into a fine paste.
- Heat oil in a pan and fry onion and capsicum for 5 min with salt and MSG.
- Add the ground masala, garam masala powder, coriander seed powder, red chili powder, and kasoori methi to capsicum and cook for 5-7 minutes. A small amount of water may be added if required to get the desired consistency.
- Remove from flame and garnish with chopped coriander leaves.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 36%

3. LADY'S FINGER SOUR GRAVY [SOUTH INDIAN STYLE

Ingredients:

- Lady's finger – 250 g
- Oil – 2 tbsp (for shallow frying)
- Fresh coconut gratings – 30 g
- Onion – 75 g (ground)
- Poppy seeds – ½ tsp
- Cinnamon – 2" piece
- Mustard – ¼ tsp
- Curry leaves – one twig
- Oil – 1 tbsp (for seasoning)
- Onion – 60 g (for seasoning)
- Chili powder – 1 tsp
- Sambar powder – 3 tsp
- Tamarind – 15 g
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Clean the Lady's finger and cut it into preferred shape.
- Add 2 tbsp of oil in a frying pan and shallow fry cut vegetables with salt and MSG till they acquire a light brown color.
- Soak tamarind in water and extract the liquid.
- Grind coconut gratings, onion, poppy seeds, and cinnamon into a fine paste.
- In another pan prepare seasoning with oil and mustard seeds. Add onion and curry leaves and fry till golden brown.
- Add the ground masala and heat for about 2 min. Then add the roasted lady's finger and mix well.
- Finally add chili powder, tamarind extract, and sambar powder and heat for 5 min on medium flame.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

4. BRINJAL SWEET AND SOUR GRAVY [South Indian Style

Ingredients:

- Green brinjal – 200 g
- Tamarind – 10 g
- Jaggery – 10 g
- Oil – 1 tbsp
- Mustard – ¼ tsp
- Asafoetida- a pinch
- Salt – ½ tsp
- MSG – ½ tsp

For gravy

- Coconut gratings – 25 g
- Copra gratings – 10 g
- Coriander seeds – 2 tsp
- Bengal gram dal – 3 tsp
- White gingelly seeds – 2 tsp
- Fenugreek seeds – 10 in no
- Cumin seeds – 1 tsp
- Red chili – 6 in no

Method

- For preparing gravy, dry roast coriander seeds, red chili, Bengal gram dal, white gingelly seeds, fenugreek seeds, cumin seeds, and copra and grind into a fine paste along with fresh coconut.

- Soak tamarind in water and take out the extract.

- Prepare seasoning with oil, mustard seeds, and asafoetida. Add chopped brinjal, salt and MSG. Add a sufficient amount of water to the brinjal and cook till it becomes soft.

- Add the ground masala, tamarind extract, and jaggery and boil for another 3 minutes. A sweet, sour, and spicy dish is ready.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

5. KABULI CHANA MASALA [WHITE CHICKPEA GRAVY

Ingredients:

- White chickpea – 150 g
- Potato – 100 g
- Onion – 60 g
- Tomato – 100 g
- Coriander seeds – 1 tsp
- Aniseed – 1 tsp
- Salt – 1 g
- MSG - ½ tsp
- Chole spice mix – 2 tsp
- Ginger garlic paste – 1 tsp
- Turmeric – a pinch
- Green chillies – 2 in no
- Fresh coconut gratings – 2 tbsp
- Poppy seeds – ½ tsp
- Chili powder – 1 tsp
- Oil – 1 tbsp

Method

- Wash and soak the chickpea for about 4-5 hours. Peel and cut potatoes. Pressure-cook chickpeas and potatoes with salt and MSG. Soak water can be used for cooking.
- Dry roast aniseed and coriander seeds and powder.
- Grind fresh coconut and poppy seeds to a fine paste.
- Heat oil in a pan, add cut onions, and shallow fry for 3 min followed by ginger garlic paste and cut tomatoes, and cook for 5 min.
- To this mixture, add ground coriander+aniseed powder, chili powder, Chole spice mix, turmeric, and slit green chillies and cook for 3 min.
- Towards the end add coconut and poppy seed paste and cook for another 2 min. Add boiled chickpeas and potatoes to the above mixture and boil for 10 min.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

6. GREEN GRAM MASALA GRAVY

Ingredients:

- Green gram–125 g
- Onion – 50 g
- Tomato - 50 g
- Green chillies - 10 g
- Cinnamon – 1" piece
- Turmeric – a pinch
- Coriander leaves – 5 g
- Ginger garlic paste – 1 tsp
- Pepper – 3 in no
- Poppy seeds - ½ tsp
- Oil – 1 tbsp
- Mustard seeds – ¼ tsp
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Wash and soak green gram for about 4-5 hours. Pressure cook the soaked legumes with salt and MSG.
- For the gravy, grind cut onions, tomatoes, cinnamon, turmeric, green chilies, coriander leaves, peppercorn, and poppy seeds to a fine paste in a grinder.
- In a pan, heat oil and add mustard seeds.
- To this, add ground masala and ginger garlic paste and fry for about 5 min. Then add pressure-cooked green gram, mix it well, and allow to boil for 10 min.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 34%

7. GREEN PEAS AND POTATO KURMA

Ingredients:

- Green peas – 120 g
- Potato – 100 g
- Tomato – 60 g
- Onion – 50 g
- Fresh coconut gratings – 30 g
- Poppy seed- ½ tsp
- Cinnamon – 1" piece
- Green chilies – 2 in no
- Ginger – 5 g
- Garlic – 3 g
- Red chili powder – 1 tsp
- Turmeric – a pinch
- Coriander powder – 1 tsp
- Garam masala – ½ tsp
- Coriander leaves – 5 g
- Oil – 1 tbsp
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Pressure cook green peas along with peeled and cut potato, tomatoes, salt, and MSG and keep aside.
- Grind coconut gratings, poppy seed, onion, cinnamon, ginger, garlic, and green chilies to a fine paste.
- Heat oil in a pan. Add the ground masala, coriander powder, chili powder, turmeric, and garam masala and fry for about 5 minutes.
- Add the pressure-cooked vegetables and boil for another 5 min.
- Take off from flame and garnish with coriander leaves.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 36%

SOUTH INDIAN SAMBAR AND RASAM RECIPES

1. RIDGE GOURD SAMBAR

Ingredients:

- Red gram dal – 60 g
- Ridge gourd – 200 g
- Tomato – 100 g
- Onion – 50 g
- Sambar powder – 3 tsp
- Fresh coconut gratings – 20 g
- Tamarind – 10 g
- Oil – 1 tsp
- Curry leaves – one twig
- Mustard – ¼ tsp
- Red chili – 2 No.
- Asafoetida – a pinch
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Peel and cut the ridge gourd to the desired size. Chop onions and tomatoes too.
- Wash red gram dal. Add sufficient water and pressure cook with ridge gourd, tomatoes, onions, sambar powder, salt, and MSG.
- Soak tamarind in water and take out the extract.
- Add tamarind extract and fresh coconut to sambar.
- Prepare seasonings with oil, mustard seeds, red chili, asafoetida, and curry leaves. Add to the sambar and boil for another 5 min.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

2. MIXED VEGETABLE SAMBAR

Ingredients:

- Red gram dal – 100 g
- Beans – 50 g
- Carrot – 50 g
- Tomato – 50 g
- Potato – 50 g
- Sambar powder – 4 tsp
- Tamarind extract – 2 tsp
- Coconut gratings – 30 g
- Oil – 2 tsp
- Red chillies – 4 in no
- Mustard – ¼ tsp
- Curry leaves – 15 in no
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Clean and chop beans, carrots, tomato and potato. Wash red gram dal. Add water and pressure cook dal with all vegetables, sambar powder, salt, and MSG.

- Add to the above-cooked vegetables, sambar powder, and tamarind extract and boil for 5 min.

- Soak tamarind in water and take out the extract. Add tamarind extract and fresh coconut to sambar.

- Prepare seasonings with oil, mustard seeds, red chili, asafoetida, and curry leaves. Add to the sambar and boil for another 5 min.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 31%

3. MIXED SPROUTED GRAM SAMBAR

Ingredients:

- Horse gram – 40 g
- Green gram – 40 g
- Bengal gram – 20 g
- Onion – 50 g
- Beans – 35 g
- Knol khol – 75 g
- Tomato – 100 g
- Sambar powder – 3 tsp
- Tamarind – 15 g
- Coconut gratings – 25 g
- Coriander leaves – 5 g
- Ginger – 4 g
- Poppy seed – ½ tsp
- Cloves – 2 in no
- Cinnamon – 2” piece
- Cumin seeds – 1 tsp
- Curry leaves – 15 in no
- Salt – ½ tsp
- MSG – ½ tsp
- Oil – 1 tbsp

Method

- Wash and soak whole grams for about 6-8 hours. Drain the water and tie in a wet cloth. Allow to sprout for 24 hours.
- Wash and chop onions, beans, knol khol, and tomato. Add sufficient water and pressure cook all the sprouted grams along with vegetables, salt, and MSG.
- For the masala, grind coconut gratings, onion, poppy seeds, cloves, cinnamon, ginger, and coriander leaves to a fine paste.
- Soak tamarind and take out the extract.
- Mix the ground masala with the pressure-cooked sprouted grams, add sambar powder, and tamarind extract, and allow to boil for 5-10 min.
- Heat oil in a pan and prepare seasonings with cumin seeds and curry leaves. Add it to the sambar and boil for another 2 min.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 32%

4. GREEN LEAFY VEGETABLES SAMBAR

Ingredients:

- Amaranth leaves – 80 g
- Amaranthus tricolor leaves - 50 g
- Red gram dal – 50 g
- Sambar powder- 3 tsp
- Tomato – 100 g
- Tamarind extract – 2 tsp- Fresh coconut gratings – 20 g
- Oil – 1 tsp
- Garlic – 2 g
- Mustard – ¼ tsp
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Wash and clean the leafy vegetables well, chop them fine, and keep aside.
- Wash and pressure cook red gram dal.
- Cook tomato, leafy vegetables, sambar powder, salt, and MSG in an open vessel till done.
- Now add cooked dal, tamarind extract, and coconut gratings and boil for another 5 min.
- Heat oil in a pan. Add mustard seeds, and crushed garlic to prepare seasonings.
- Add this seasoned mixture to the sambar, boil for 2 min, and remove from flame.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 28%

5. FENUGREEK LEAVES SAMBAR

Ingredients:

- Fenugreek leaves – 50 g
- Red gram dal – 50 g
- Tomato – 100 g
- Sambar powder – 2 tsp
- Fresh coconut gratings – 20 g
- Tamarind extract – 2 tsp
- Oil – 1 tsp
- Garlic – 2 g
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Clean, wash, and fine chop fenugreek leaves. Wash red gram dal and cook with fenugreek leaves, tomato, sambar powder, salt, and MSG till done.
- Add tamarind extract and coconut gratings and boil for another 5 min.
- Season crushed garlic with a tsp of oil and add to the sambar.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 36%

6. FIELD BEANS SAMBAR

Ingredients:

- Field beans – 170 g
- Tomato – 100 g
- Coconut gratings – 25 g
- Poppy seed – ½ tsp
- Cinnamon – 1” piece
- Onion – 50 g
- Cumin seeds – 1 tsp
- Sambar powder – 4 tsp
- Curry leaves – one twig
- Garlic – 5 g
- Mustard – ¼ tsp
- Oil – 2 tsp
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Pressure cook field beans and tomato along with sambar powder, salt, and MSG.
- In a mixie jar add coconut gratings, poppy seed, cinnamon, cumin seeds, and onion. Grind to a fine paste.
- Add the ground masala to the pressure-cooked field beans and boil for 5-7 minutes.
- Season with oil, mustard seeds, curry leaves, and crushed garlic, and continue boiling for another 2 minutes.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 34%

7. DAL AND TOMATO RASAM

Ingredients:

- Red gram dal – 50 g
- Tomato -200 g
- Cumin seeds – ½ tsp
- Pepper – 6 corns
- Coriander leaves – 5 g
- Curry leaves – one twig
- Ghee – 2 tsp
- Garlic – 5 in no (10g)
- Rasam powder – 4 tsp
- Asafoetida – a pinch
- Mustard – ¼ tsp
- Turmeric – a pinch
- Tamarind – 10 g
- Jaggery – 10 g
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Wash and pressure cook red gram dal and keep aside.
- Crush cumin seeds and peppercorns coarsely and keep aside.
- Soak tamarind in a small quantity of water and extract the juice.
- Heat oil in a pan. Add mustard seeds. Once it starts to crackle, add crushed cumin and pepper, crushed garlic, curry leaves, chopped tomato, asafoetida, and turmeric. Fry for 2 min.
- Add the seasonings, Rasam powder, jaggery, and tamarind extract to the pressure-cooked dal. Add an adequate quantity of water to get a thin consistency. Boil for 5 min. Garnish with chopped coriander leaves and remove from flame.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

INDIAN FLATBREADS

1. CHAPATHIS

Ingredients:

- Whole wheat flour - 100g
- Oil – 1 tbsp (for shallow frying),
- MSG- 100 mg
- Salt – a pinch

Method

- Place wheat flour and MSG in a mixing bowl. Add water and make a soft dough. Knead the dough well.
- Keep the dough aside for half an hour. Then divide the dough into small balls of equal size.
- Roll out the balls into medium size chapatis of 2 mm thickness. Cook on a hot tava for 1 minute on both sides smearing a little oil.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 60%

2. RICE ROTIS

Ingredients:

- Rice flour – 100 g
- Salt – ½ tsp
- Oil – 1 tsp
- Water – 60ml
- MSG – ½ tsp

Method

- Boil the required quantity of water with salt and MSG in a big vessel.
- Add rice flour gradually to the boiling water and stir continuously to prevent lump formation. Put off the flame.
- Cool the dough and knead well with a tsp of oil.
- Divide the dough into small balls and pat it into circular shape with hands on a sheet.
- Transfer to a hot pan. Cook both sides of the roti. Store in a covered container.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 36%

3. METHI PARATHA

Ingredients:

- Whole wheat flour – 100 g
- Fenugreek leaves – 15 g
- Salt – ½ tsp
- Chili powder – ¼ tsp
- Turmeric – a pinch
- Oil – 1 tsp for dough and 5 tsp for shallow frying
- Omum – ½ tsp
- MSG – ½ tsp

Method

- In a mixing bowl add whole wheat flour, salt, MSG, chili powder, omum, and turmeric and mix well.
- Add washed and finely chopped fenugreek leaves to the dry flour mixture and prepare a soft dough with water.
- Knead it well by adding 1 tsp oil and keep it aside for half an hour.
- Divide the dough into small balls, roll it into chapatis, and shallow fry both sides using little oil.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 40%

RICE BASED DISHES

1. VEGETABLE FRIED RICE

Ingredients:

- Basmati rice – 200 g
- Beans – 50 g
- Carrot – 75 g
- Cabbage – 60 g
- Onion – 50 g
- Ginger – 10 g
- Garlic – 10 g
- Soya sauce – 2 tsp
- Oil – 3 tbsp
- Pepper powder - ½ tsp
- Salt - 1 tsp
- MSG – ½ tsp

Method

- Soak basmati rice for 30 min. Wash it and cook. Add a tsp of cooking oil while cooking the rice to get a grainy texture. Spread the rice on a plate and allow it to cool.
- Clean and chop all the vegetables. Heat the vessel. Add oil and all the chopped vegetables one after another. Fry till they become crunchy.
- Towards the end, add salt, MSG, pepper and soya sauce. Mix well and continue frying for another 2 min.
- To the fried vegetable mixture, add the cooked and cooled rice, mix well, and serve.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 45%

2. JEERA RICE

Ingredients:

- Basmati rice – 150 g
- Cumin seeds - 2 tsp
- Cloves - 3 in no.
- Fenugreek leaves – 25 g
- Mint leaves – 10 g
- Coriander leaves – 10 g
- Salt – 1 tsp
- Cardamom - 2 in no
- Cinnamon - 2” piece
- Capers (Marathi moggy) – 2 pieces
- Turmeric - a pinch
- Garlic – 5 g
- Oil – 2 tbsp
- MSG – ½ tsp

Method

- Soak basmati rice for 30 min.
- Clean and chop coriander leaves, mint leaves, and fenugreek leaves.
- Heat oil in a vessel. When it is hot, add turmeric and cumin seeds. When the seeds crackle, add cardamom, cinnamon, capers, and garlic, and fry for 2 min.
- Add all the chopped leaves and continue frying for another 2 min.
- To this mixture add soaked and washed rice, fry for 5 min, add the required amount of water, salt, and MSG, and cook till it is done.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 40%

MISCELLANEOUS SNACKS

1. POTATO PAKODA

Ingredients:

- Potato – 100g
- Besan flour – 100g
- Salt – 1 tsp
- Chili powder – 1 tsp
- Omum – ¼ tsp
- Oil – 110 ml (for deep frying)
- MSG – ½ tsp

Method

- Wash and peel the potatoes. Slice them thinly and keep them aside.
- In a mixing bowl, take besan flour, salt, omum, chili powder, and MSG. Add water and prepare a smooth batter.
- Place oil in a frying pan and heat on medium flame.
- Dip the potato slices in gram flour batter and deep fry in oil till golden brown.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

2. ONION PAKODA

Ingredients:

- Besan flour – 45 g
- Onion – 50 g
- Rice flour – 5 g
- Chili powder – ½ tsp
- Heated oil – 2 tbsp
- Oil for deep frying – 150 ml
- Salt – ½ tsp
- MSG – ½ tsp

Method

- Peel and cut onions lengthwise. In a mixing bowl take besan flour, onions, rice flour, chili powder, salt, MSG, and heated oil (2 tbsp) and mix well to blend all the ingredients.

- Sprinkle a little water and mix to bind all ingredients.

- Take small quantities of the above mixture and deep fry in hot oil till golden brown.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 30%

3. DHOKLA

Ingredients:

- Bengal gram dal – 50 g
- Green gram dal -50 g
- Curds – 50 ml
- Sugar – 2 tsp
- Turmeric – a pinch
- Fruit salt- ¼ tsp
- Slit green chilies – 2 in no
- Mustard – ¼ tsp
- Oil – 1 tbsp
- Coconut gratings – 20 g
- Coriander leaves – 10 g
- Salt – 1 tsp
- MSG – ½ tsp

Method

- Soak Bengal gram dal and green gram dal for 3 hours.
- Drain the water and grind to a fine paste along with curds.
- To the ground mixture add sugar and allow to ferment for 4-6 hours.
- Now add turmeric, table salt, fruit salt, and MSG to the fermented mixture and mix thoroughly.
- Take a shallow container for steaming the dhokla and smear it with oil. Pour the batter into the container and steam cook the mixture for 30 min.
- Cool the container, de-mould the dhokla, and cut it into desired shape.
- Prepare seasonings with oil, mustard seeds, and slit green chilies. Pour over the dhokla.
- Garnish with coconut gratings and coriander leaves.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 35%

4. PESARATTU [Green gram dosa]

Ingredients:

- Whole green gram – 100 g
- Onion – 50 g
- Ginger- 2 g
- Cumin seeds- 1 tsp
- Green chilies – 6 g (2 in no)
- Oil- 2 tbsp (for shallow frying)
- Salt – 1 tsp
- MSG – ½ tsp

Method

- Soak green gram for 4-6 hours. Drain water and keep it aside.
- To the mixie jar, add soaked whole green gram, cumin seeds, cut onion, green chilies, ginger, salt, and MSG, and grind to a smooth paste. Allow it to ferment for 4-6 hours.
- Pour a ladleful of batter on a hot griddle and spread in a circular motion to prepare dosa. Cook on both sides. Add ½ tsp of oil while the dosa is being cooked. Serve with chutney or pickle.

Approximate sodium reduction achieved by using a combination of reduced salt and MSG: 40%

Source: Recipes are adapted from a Ph.D. thesis entitled ***"Studies on flavour potentiating effect of monosodium glutamate with special reference to synergism between spices and salt in different food matrices"*** *" submitted to the University of Mysore, Mysuru, by Dr. Prabhavati S.N. [2018].*

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Dr. Jamuna Prakash is a former Professor of Food Science & Nutrition at University of Mysore, Mysuru, with a teaching and research experience of nearly 50 years. A gold medalist from University of Mysore, she has served many national and international organizations as Visiting Professor. A **Fellow of International Union of Food Science and Technology, Canada and National Academy of Agricultural Sciences, India,** at present she is serving as Nutrition Advisor at Cuu Long University, Vietnam.

She has had an exemplary academic career with many awards and accolades to her credit. She is actively involved in research as evident from publication of more than 270 research and review papers, 21 books/book chapters, and more than 600 presentations with **total citations for published papers exceeding 7200. Her name is included in Top 2% of Scientists under food science from the global database published from Stanford University from the year 2021 onwards till date, which is a rare honour.** She has served/serving on Editorial Board of many journals. Many of the presented and published papers have won awards. Many doctoral and post-doctoral students have worked under her guidance. She has completed many research and educational projects funded by different organizations and is an active consultant for Food Companies. Her research interests are compositional analysis of foods, product formulation, sensory evaluation, nutrient digestibility and bioavailability, functional properties of foods, nutrition status of population, food behaviour, diet surveys, nutrition and cognition, nutrition education, etc.

She is also a very popular resource person for extension lectures taking the results of research to field in true spirit of lab to land with many invited lectures to her credit. Nutrition education and training form a very important component for improving the overall nutrition status of population as actively demonstrated by programs undertaken for school children, for cooks of mid-day meal program and residential schools, for health workers, for housewives, etc. Different projects undertaken to facilitate these are utilizing green leafy vegetables in diets for women, longitudinal educational program for school children along with impact assessments, demonstrations/exhibitions for health workers, development of a model training module for improving the quality of Mid-Day meal program through training of personnel etc.

She has contributed extensively to lesson plans for Distance Education Program of National Open School, New Delhi and Karnataka State Open University, Mysore. She is a member of many National and International committees involved with food science and nutrition and a life member of many professional organizations. She is the recipient of prestigious Dr. Rajammal Devdas Award for research in Applied Nutrition, Best Home Scientists award, Prof. M. Vishwanathan Honour award for research achievements, Best Teacher award, Leela Phadnis Memorial Award, Mohan Memorial Award, to name a few.