Attachment: References on monosodium glutamate safety and sodium reduction benefits.

1. *21 C.F.R. 182.1(a) Substances that are generally recognized as safe. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=182.1*
2. *FDA, Questions and Answers on Monosodium glutamate (MSG) (accessed on March 30, 2019 at https://www.fda.gov/food/food-additives-petitions/questions-and-answers-monosodium-glutamate-msg*
3. *Fish and Fishery Products Hazards and Controls Guidance (Fourth Edition – August 2019) (accessed on August 30, 2019) at https://www.fda.gov/media/80637/download*
4. *Managing Food Safety: A Regulator's Manual for Applying HACCP Principles to Risk-Based Retail and Food Service Inspections and Evaluating Voluntary Food Safety Management Systems (April 2006) (accessed August 30,2019 at https://www.fda.gov/media/72067/download*
5. *Daniel J. Raiten John M. Talbot. Executive Summary from the Report: Analysis of Adverse Reactions to Monosodium Glutamate (MSG). The Journal of Nutrition, Volume 125, Issue 11, November 1995, Pages 2891S–2906S. https://academic.oup.com/jn/article-abstract/125/11/2891S/4730581?redirectedFrom=fulltext*
6. *Geha R., Beiser A., Ren C., Patterson R., Greenberger P., Grammer L., Ditto A., Harris K., Shaughnessy M., Yarnold P., Corren J., Saxon A., "Multicenter, double-blind, placebo-controlled, multiple-challenge evaluation of reported reactions to monosodium glutamate," J Allergy Clin Immunolog 2000;106:973-80. https://www.ncbi.nlm.nih.gov/pubmed/11080723*
7. *Institute of Medicine of the National Academies, National Academies Press Washington, DC. "Taste and Flavor Roles of Sodium in Foods: A Unique Challenge to Reducing Sodium Intake", pp.65-86, in Strategies to Reduce Sodium Intake in the United States, edited by Henney J.E. et al,. 2010. https://www.nap.edu/catalog/12818/strategies-to-reduce-sodium-intake-in-the-united-states*
8. *National Academies of Sciences, Engineering, and Medicine. 2019. Dietary Reference Intakes for Sodium and Potassium. Washington, DC: The National Academies Press. p. 410. https://doi.org/10.17226/25353*
9. *International Glutamate Technical Committee. Glutamate contributes to the reduction of dietary sodium intake. Technical statement, 1, 2017. Attached.*

INTERNATIONAL GLUTAMATE TECHNICAL COMMITTEE

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

International Glutamate Technical Committee (IGTC)
Avenue Jules Bordet 142
B-1140 Brussels, Belgium

EUROPE - PARIS
European Committee for Umami (ECU)
153, rue de Courcelles
F-75817 PARIS CEDEX 17, France

JAPAN – TOKYO
SOUTH KOREA-SEOUL
Amino Acids Seasoning Alliance of Northeast Asia
(ASANA)
Hatchobori 3-11-8
Chuo-ku, Tokyo 104-0032, Japan

REPUBLIC OF CHINA - TAIPEI
Taiwan Amino Acid Manufacturers Association ROC
(TAAMA)
Yuan Hsing Bldg., 4th Floor.
No.6 Chang Chun Rd.
Taipei, Taiwan, 104
Republic of China

SOUTH AMERICA - SAO PAULO
Institute for Glutamate Sciences in South America
(IGSSA)
P.O. Box 5789
Sao Paulo SP, Brazil

SOUTHEAST ASIA - BANGKOK
Regional Committee for Glutamate Sciences (RCGS)
487/1 Si Ayutthaya Road
Phaya Thai, Bangkok 10400
Thailand

U.S.A. - WASHINGTON, DC
The Glutamate Association United States
(TGA)
1010 Wisconsin Avenue, Suite 350
Washington, DC 20007
USA

Glutamate Contributes to the Reduction of Dietary Sodium Intake

The World Health Organization (WHO) recommendation on sodium consumption for adults is 2 g sodium/day (equivalent to 5 g salt/day). However, most people consume much more with the current mean global sodium consumption estimated to be at 3.95 g sodium/day (Mozaffarian et al. 2014). Since high sodium intake is reported to be associated with various non-communicable diseases (NCDs) such as hypertension, cardiovascular disease and stroke, the reduction of sodium intake is a very important public health concern around the world (WHO, 2003).

While sodium reduction in the diet is an important objective, when salt (NaCl) levels are reduced in foods, its palatability is also generally decreased. Monosodium glutamate (MSG) is a flavour enhancer that contains about 12% sodium, which is less than half of that contained in regular table salt at about 39%. Therefore, by the addition of an appropriate amount of MSG, the palatability of low salt foods can be recovered with the overall sodium content of the food being substantially reduced.

Further reduction in dietary sodium can also be achieved through the use of other forms of glutamate, such as calcium di-glutamate (CDG) and monomagnesium di-glutamate (MDG), which do not contain sodium. These other forms of glutamate have been shown to provide similar taste enhancing properties that are only marginally lower than those obtained by the use of MSG, therefore maintaining food palatability without contributing to any dietary sodium intake.

A considerable number of studies have demonstrated that glutamates can help to reduce the use of salt in the diet by enhancing the palatability of different types of foods including soups, prepared dishes, processed meat and dairy products.

.

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

The use of glutamate to replace salt in foods

In Japan, Yamaguchi investigated the palatability of Japanese clear soup containing varying amounts of NaCl with or without MSG (as shown in the Fig. 1). When the use of NaCl alone was reduced from its optimal level of about 0.92%, the palatability score of the soup decreased dramatically. However, by combining 0.38% MSG with 0.41% NaCl, the palatability rating of the soup recovered to the same level of pleasantness as was achieved by 0.92% NaCl alone. The sodium content of the soup with 0.92% NaCl was 0.36%, compared with 0.21% in the soup with 0.38% MSG and 0.41% NaCl, representing a 40% overall sodium reduction (Yamaguchi & Takahashi, 1984).

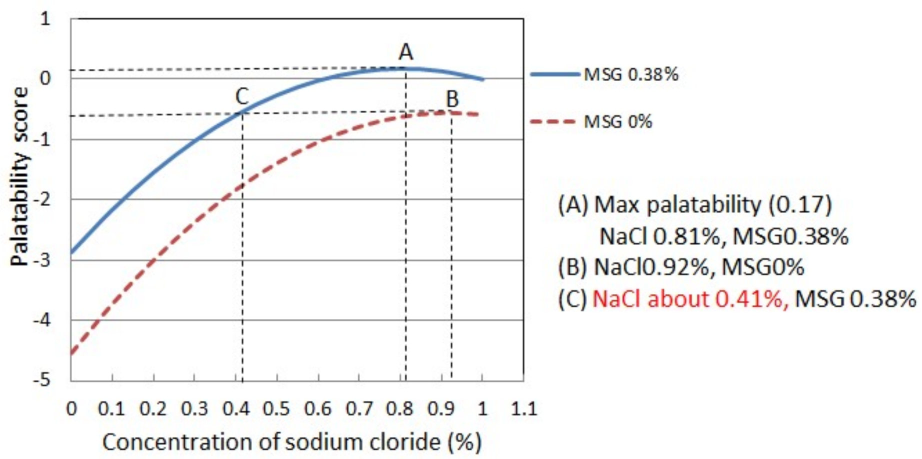

Fig 1. Palatability scores of clear soup at various concentrations of NaCl
(Created using the data by Yamaguchi and Takahashi, J. Food Sci. 49(1):82-85, 1984)

Research in the USA found that chicken broth containing 0.70% NaCl and 0.30% MSG had an equal palatability score when compared with a broth containing 0.84% NaCl and 0.19% MSG, representing a total sodium reduction of about 11% (Chi and Chen, 1992).

The effects of umami substances on the preferences on low-salt soups with 0.3% and 0.5% salt were assessed in Finland. The subjects consumed soup with or without MSG during six sessions in five weeks. Ratings were higher in soup containing MSG in both 0.3%- and 0.5%-salt groups. The authors concluded that the pleasantness ratings of reduced-salt foods could be increased by addition of umami substances such as MSG (Roininen *et al.*, 1996).

A group in Australia managed to reduce sodium content of a reference commercial pumpkin soup containing 150mM NaCl by substituting it with 50mM NaCl and 43mM MSG or CDG, while maintaining similarly acceptable taste characteristics. The level of sodium contained in a typical serving of the reference soup was estimated to contain 57 mmol of sodium. The soup prepared with the NaCl and CDG combination however contained only 33 mmol of sodium, representing a 40% reduction (Ball *et al.*, 2002).

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

Another study in the USA by Carter et al. reported that CDG could partly replace NaCl at constant levels of liking and pleasantness (Carter *et al.*, 2011). They showed that pleasant and liking ratings of 0.85% NaCl chicken broths were not significantly different from that of 0.53% NaCl broths with 0.33% CDG. These data showed that sodium concentration of chicken broths could be reduced by 38% with CDG supplementation.

A Brazilian group evaluated the use of MSG together with KCl to replace 25% and 50% NaCl in varying proportions, which helped to maintain the sensory acceptability of a garlic seasoning salt formulation when applied to cooked rice (Rodrigues *et al.*, 2014).

In Malaysia, subjects were presented with local spicy soup dishes, such as curry chicken and chili chicken, containing varying amounts of NaCl and MSG. It was found that the optimal acceptance level of these dishes was 0.8% NaCl when used by itself. However, the partial replacement of NaCl with MSG in the ratio of 0.3% NaCl and 0.7% MSG achieved the same level of palatability. (Jinap *et al.*, 2016).

Similarly, the effects of sodium reduction and flavor enhancers such as MSG on the sensory profile of two types of hawker foods commonly consumed in Singapore, namely chicken rice and *mee soto* broth, were examined. Addition of 0.40% MSG into the 40% salt-reduced recipes resulted in a 22% sodium reduction, and the perception of saltiness of these recipes was maintained when compared with the control (Leong *et al.*, 2016).

Several groups also investigated the potential of glutamates to reduce salt in processed meat and dairy products. In France, Bellisle found that addition of MSG to meat *pâté* maintained its palatability even though NaCl content was reduced (Bellisle, 1998).

Elsewhere, CDG was used to improve palatability of salt-reduced sausage in a study conducted in Australia by using 0.12% NaCl and 0.10% CDG, which would be equivalent to a formulation with 0.69% NaCl (Woodward *et al.*, 2003).

In Brazil, the use of MSG in combination with other umami substances (disodium inosinate, disodium guanylate) and amino acids (lysine, taurine) helped to reduce the negative sensory properties, such as bitter, astringent and metallic tastes, of using KCl to replace 50% and 75% of NaCl in cooked sausages (dos Santos *et al.*, 2014). In a separate study, MSG in combination with KCl was used in reduced sodium formulations of Mozzarella cheese, which helped to maintain acceptable sensory properties for formulations with up to 54% sodium reduction (Rodriguez, 2014). Quadros et al. also examined the acceptability of fish burgers containing various concentrations of NaCl and MSG, with the formulation containing 0.75% NaCl and 0.3% MSG scoring equally if not better than the formulation containing 1.5% NaCl only, therefore providing a 50% reduction (Quadros et al., 2015).

Apart from sensory studies involving reduced-salt product formulations, a clinical study investigating the use of glutamate in the form of MDG as part of a low sodium diet and

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

its effect on food intake and dietary sodium intake was undertaken by Kawano et al. Over several weeks, a group of psychiatric patients in Japan were alternately provided with standard meals containing 3.28g sodium/day and low sodium meals with MDG containing 2.43g sodium/day. Their food intake was measured and was found not to be significantly different when provided with standard meals or low sodium meals containing MDG, indicating that palatability was not adversely affected for the latter. As a result, average daily sodium intake was found to have decreased by 0.85g sodium/day when consuming the low sodium meal with MDG (Kawano *et al.*, 2015).

Recognition of the role of glutamate in dietary salt reduction by authoritative public health bodies

In 2010, the Institute of Medicine (IOM) in the United States indicated that compounds imparting umami taste and flavour can be used to reduce the need for added salt. The IOM Report on Strategies to Reduce Sodium Intake in the United States stated that "It is possible to replace some of the salt in foods with other taste or flavor compounds. --- A prominent example of an added compound involves glutamic acid (an amino acid). Combining glutamic acid with sodium creates the well-known flavoring compound monosodium glutamate, or MSG. MSG imparts a savory taste (called "umami") as well as a salt taste to food. Some studies have shown that it is possible to maintain food palatability with a lowered overall sodium level in a food when MSG is substituted for some of the salt." (IOM, 2010)

In 2013, the Academy of Nutrition and Dietetics in the United States performed a systematic review to evaluate the effect of umami compounds (such as MSG) or foods rich in umami (such as soy sauce, fish sauce, etc.) on the sodium content in foods and/or sodium intake. Based on the evidence reviewed, it was concluded that "*the addition of umami compounds or foods rich in umami allows for reductions in sodium content of foods (reported as sodium chloride) without sacrificing taste, liking and pleasantness. However, the resulting reduction in sodium may vary depending on the type of food consumed as well as the amount and type of umami compounds present.*" (Academy of Nutrition and Dietetics, 2013)

Conclusion

The reduction of sodium intake is a major health concern worldwide. However, it is very difficult to develop sodium-reduced diets with an acceptable palatability, since salt taste is an important basic taste that significantly contributes to the palatability of food. Based on the wide body of evidence from studies conducted in various geographical regions, the addition of glutamate to different types of foods belonging to different cultural traditions, can allow for substantial reductions in sodium consumption without a significant deterioration in palatability. The proper use of glutamate should therefore be considered in the discussion on how to reduce population sodium intake.

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

References

Academy of Dietetics and Nutrition. Without sacrificing taste, what is the effect of adding umami compounds (such as monosodium glutamate [MSG]) or foods rich in umami (such as soy sauce, fish sauce, etc.) on the sodium content in foods and/or sodium intake? Evidence Analysis Library, 2013.

Ball, P., Woodward, D., Beard, T., Schoobridge, A., and Ferrier, M. Calcium diglutamate improves taste characteristics of lower-salt soup. European Journal of Clinical Nutrition 56, 519-523, 2002.

Bellisle, F. Effects of monosodium glutamate on human food palatability. Annals of the New York Academy of Science, 855: 438-441, 1998.

Carter, BE, Monsivais, P, Drewnowski, A. The sensory optimum of chicken broths supplemented with calcium di-glutamate: A possibility for reducing sodium while maintaining taste. Food Quality and Preference, 22: 699-703, 2011.

Chi, SP and Chen TC. Prediction optimum monosodium glutamate and sodium chloride concentrations in chicken broth as affected by spice addition. Journal of Food Processing and Preservation, 16: 313-326, 1992.

Dos Santos, B. A., Campagnol, P. C. B., Morgana, M. A. & Pollonio, M. A. R., Monosodium glutamate, disodium inosinte, disodium guanylate, lysine and taurine improve the sensory quality of fermented cooked sausages with 50% and 75% replacement of NaCl with KCl. Meat Science, 96: 509-513, 2014.

Jinap, S., Hajeb, P., Karim, R., Norliana, S., Yibadatihan, S. & Abdul-Kadir, R., Reduction of sodium content in spicy soups using monosodium glutamate. Food & Nutrition Research, 60(1), 2016.

Kawano, R., Ishida, M., Kimura, E., Matsumoto, H. & Arai, H., Pilot intervention study of a low-salt diet with monomagnesium di-L-glutamate as an umami seasoning in psychiatric inpatients. Pyschogeriatrics, 15(1):38-42, 2015.

Mozaffarian D., Fahimi, S., Singh, G. M., Micha, R., Khatibzadeh, S., Engell, R. E., Lim, S., Danaei, G., Ezzati, M. & Powles, J. for the Global Burden of Diseases Nutrition and Chronic Diseases Expert Group (NUTRICODE). Global Sodium Consumption and Death from Cardiovascular Causes. The New England Journal of Medicine, 371(1): 624-634, 2014

Quadros, D. A., Oliveira Rocha, I. F., Ferreira, S. M. R. & Bolini, H. M. A., Low-sodium fish burgers: Sensory profile and drivers of liking. LWT – Food Science and Technology, 63:236-242, 2015.

Please Reply To
IGTC:
Avenue Jules Bordet 142,
B-1140 Brussels, Belgium
Tel: +81-80-3258-1900
FAX: +81-3-5250-8403
E-mail: secretariat@e-igtc.org

Rodrigues, J. F., Gonçalves, C. S., Pereira, R. C., Carneiro, J. D. S. & Pinheiro, A. C. M., Utilization of temporal dominance of sensations and time intensity methodology for development of low-sodium Mozzarella cheese using a mixture of salts. Journal of Dairy Science, 97: 4733-4744, 2014.

Rodrigues, J., Junqueira, G., Gonçalves, C. S., Carneiro, J. D. S., Pinheiro, A. C. M. & Nunes, C. A., Elaboration of garlic and salt spice with reduced sodium intake. Annals of the Brazilian Academy of Science, 86(4): 2065-2075, 2014.

Roininen, K., Lahteenmaki, L., & Tuorilla, H. Effect of umami taste on pleasantness of low-salt soups during repeated testing. Physiology & Behaviour, 60: 953-958, 1996.

Woodward, DR, Lewis, PA, Ball, PG and Beard TC. Calcium glutamate enhances acceptability of reduced-salt sausages. Asia Pacific Journal of Clinical Nutrition, 12, Suppl S35, 2003

Yamaguchi, S and Takahashi, C. Interactions of monosodium glutamate and sodium chloride on saltiness and palatability of a clear soup. Journal of Food Science, 49(1): 82-85, 1984.

Institute of Medicine of the National Academies, National Academies Press Washington, DC. "Taste and Flavor Roles of Sodium in Foods: A Unique Challenge to Reducing Sodium Intake", pp.65-86, in Strategies to Reduce Sodium Intake in the United States, edited by Henney J.E. *et al*,. 2010.

World Health Organization. Diet, nutrition and the prevention of chronic diseases – report of a Joint WHO/FAO Expert Consultation. WHO Technical Series 916, 2003.