Investigation of monosodium glutamate and its substitutes from consumer perceptions, content of umami substances, and enhancement effects in chicken broth

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INTRODUCTION

Monosodium L-glutamate (MSG) is a flavor enhancer with umami/savory taste. This taste has the capability to enhance salty taste, food flavors, and overall palatability. MSG is commonly used in many processed food products in the U.S. like potato chips, pizza, and soup products because of its effectiveness in enhancing the overall flavor impact in foods.

Due to the controversy surrounding MSG and consumer demand for natural foods, some food manufacturers are replacing this ingredient by similar alternatives. However, there are no studies on U.S. consumers' perception about this ingredient and its replacement.

Besides consumer attitudes, enhancement effectiveness is another crucial consideration for MSG substitutes. Umami substances play an importance role in the enhancement effect. There are generally two types of umami substances: free umami amino acids and free 5'-ribonucelotides. Synergistic effects have been observed between these two types of umami substances. Currently, limited studies were found to compare the enhancement capability of MSG with its alternatives.

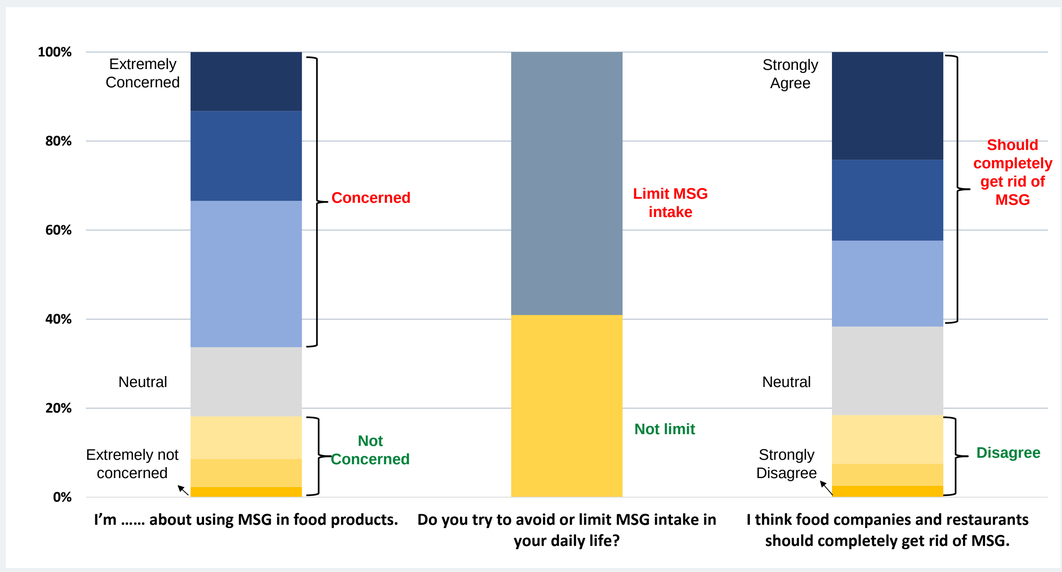
A total of three studies were included in this work to bridge the gaps.

STUDY 1

The first study was aimed to explore consumer perceptions about MSG and its substitutes. A total of 347 respondents participated in the survey across the U.S.

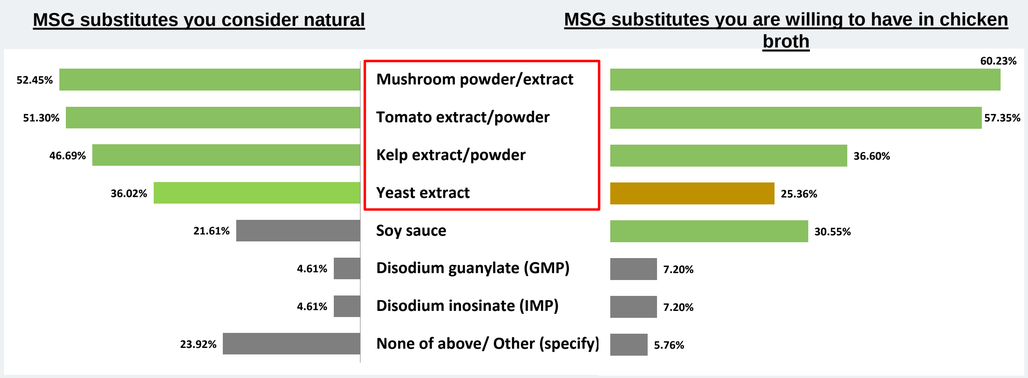
◆ Consumer' attitudes towards MSG

- In general, concern about MSG usage in food products was the dominant theme.



◆ Consumer's choice of MSG substitutes

- Consumers tend to prefer substitutes extracted from natural sources.



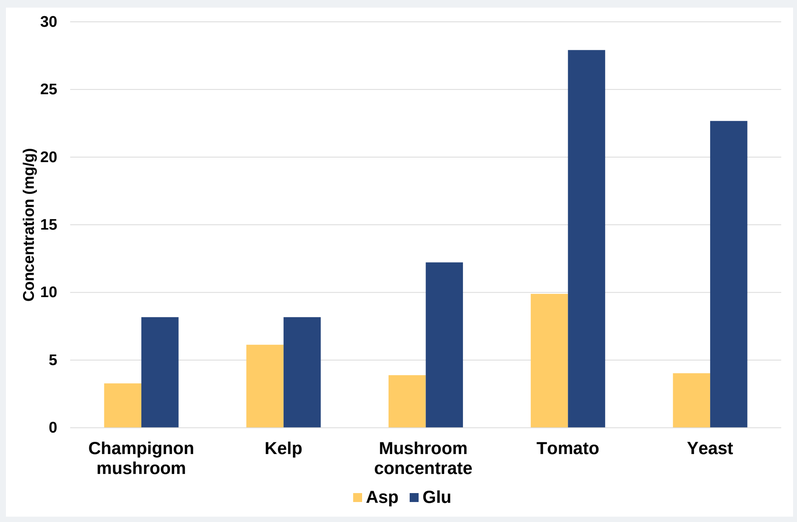
STUDY 2

In the second study, commercial yeast extract, tomato powder, champignon mushroom powder, mushroom concentrate, and kelp powder were obtained from respective ingredient companies as MSG substitutes. The purpose of this study was to compare their enhancement effect from a chemistry point of view based on umami substances.

High performance liquid chromatographic (HPLC) analyses were applied to detect the content of 5 umami substances: aspartate (Asp), glutamate (Glu), 5′-adenosine monophosphate (AMP), 5′-inosine monophosphate (IMP), and 5′-guanosine monophosphate (GMP).

◆ Content of umami amino acids

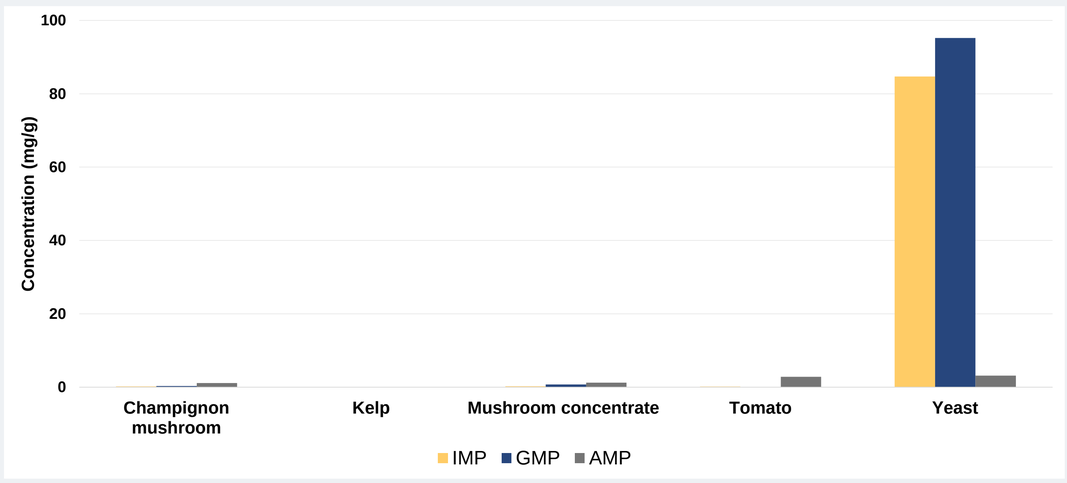
- Tomato powder had the highest level of Glu among MSG substitutes, followed by yeast extract.
- Asp possesses 7.7 % of umami potency of glutamate (Yamaguchi and others, 1971). Tomato powder contained significantly higher level ($p < 0.05$) of Asp than all other ingredients.



STUDY 2

◆ Content of umami 5'-ribonucelotides

- The umami intensity relative to IMP is reported as 2.3 for GMP and 0.18 for AMP (Yamaguchi and others, 1971).
- Yeast extract had significantly ($p < 0.05$) higher 5′-ribonucleotides than all the other ingredients. No nucleotides were detected from kelp powder.
- Mushroom concentrate powder had significantly larger amount ($p < 0.05$) of AMP than Champignon mushroom powder.



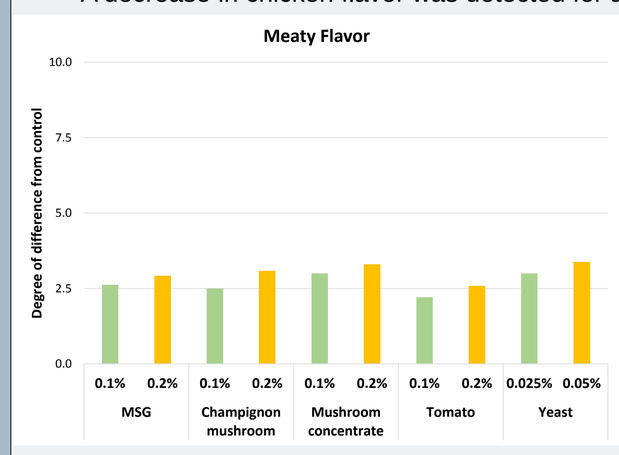
STUDY 3

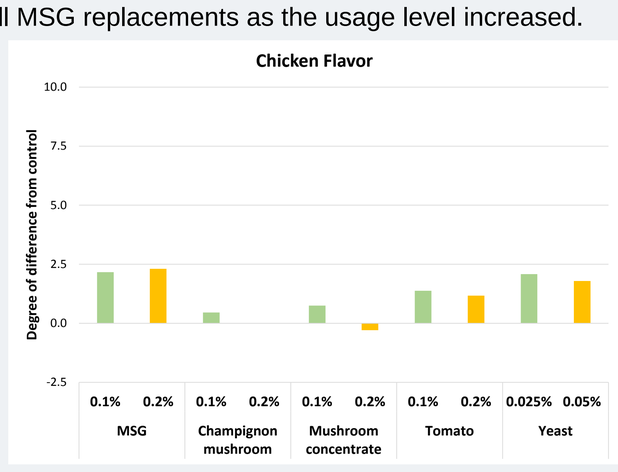
In the third study, MSG and 4 substitutes were added individually at two different levels to chicken broth with 0.4% sodium chloride. Degree of difference testing was used to compare the enhancement effect of MSG and its alternatives in chicken both. Chicken broth with 0.4% salt was used as control.

Six experienced trained panelists were recruited. For each attribute, panelists firstly rated the testing sample on a comparison scale to determine the direction of difference compared to control, then the degree of difference was evaluated on a 10-point anchored intensity scale. The serving temperature was at ~ 50±2 ℃.

◆ Meaty and chicken flavor

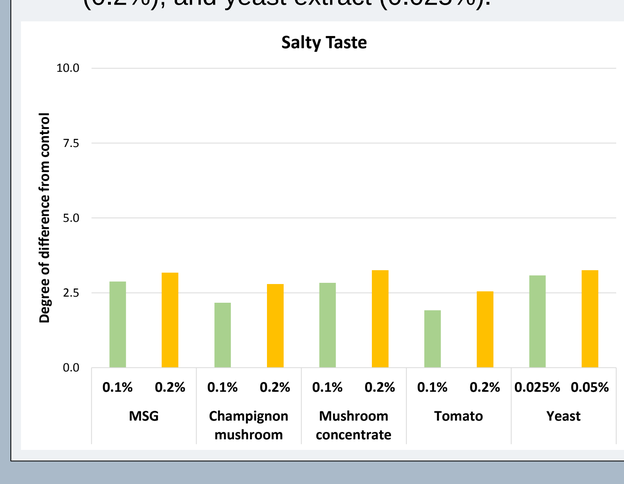
- There was no statistical difference ($p > 0.05$) in meaty flavor for MSG (0.1%, 0.2%), Champignon mushroom powder (0.1%, 0.2%), mushroom concentrate (0.1%), tomato powder (0.2%), and yeast extract (0.025%).
- A decrease in chicken flavor was detected for all MSG replacements as the usage level increased.

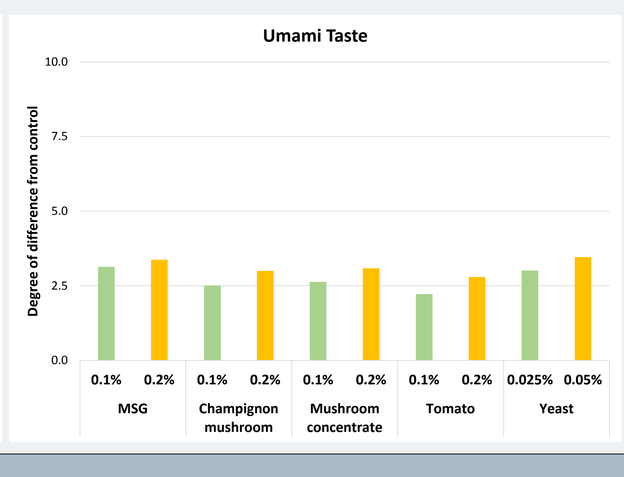




◆ Umami and salty taste

- The enhancement effect on salty and umami taste increased as the usage level.
- Statistically same ($p > 0.05$) degree of enhancement on salty and umami taste was detected for MSG (0.1%), Champignon mushroom powder (0.2%), mushroom concentrate (0.1%), tomato powder (0.2%), and yeast extract (0.025%).





CONCLUSION

- In study 1, US consumer generally had a negative attitude towards MSG usage by the food industry and they tend to prefer natural extracts as MSG replacement.
- In study 2, the HPLC analyses of the five umami substances showed that yeast extract had the largest amount of umami compounds, followed by mushroom concentrate and tomato powder. Due to the low amount of umami substances, kelp powder was removed from later tests.
- MSG (0.1%), yeast extract (0.025%), Champignon mushroom powder (0.2%), mushroom concentrate (0.1%), and tomato powder (0.2%) had similar enhancement effect on meaty flavor, salty and umami taste of chicken broth added with 0.4% salt. However, the suppression of the chicken flavor was detected for all the MSG substitutes as the dosage levels increased.

REFERENCE

Yamaguchi and others. 1971. Measurement of the relative taste intensity of some L-α amino acids and 5'- nucleotides. J Food Sci 36 (6): 846–849.