

# Formulation of flavor enhancer using locally available natural raw materials

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**Abstract-** Flavor enhancer plays a major role in many cuisines. The objective of the present study was to formulate of nutritive flavor enhancer using locally available natural raw materials. Mushroom, tomato, potato, garlic and salt were selected as the basic raw materials. The mushroom was blanched in 70°C water for 15 seconds, dried at 60°C for 10 hours, tomato was blanched at 90°C in hot water for 1 minute and dried at 60°C for 12 hours, Potato was blanched at 90°C in hot water for 5 minutes and dried at 60°C for 10 hours and Garlic was dried at 60°C for 8 hours. All raw materials were separately ground and sieved through 200 µm mesh sieve. The eight different formulations were tested by 30 untrained sensory panelists and formula 643 selected as the best formula with respect to all sensory properties. The comparative analysis was carried out to compare the newly developed flavor enhancer with commercially available flavor enhancer. There was a significantly higher preference for the taste in newly developed flavor enhancer and no significant difference was observed between two samples for the appearance, odor, mouth feel and overall acceptability. The final product was contained 14.028 ± 0.077% Moisture, 2.5103 ± 0.004% Total fat, 12.156 ± 0.041% Crude protein, 3.782% Crude fiber, 15.162 ± 0.115% Ash and 52.361% Carbohydrate. The results of the mineral availability of the final product revealed that 100g product contained 234.05mg of Na, 398.62mg of K, 11.24mg of Ca, 4.35mg of Fe, 3.30mg of Zn. The major fatty acid available in the final product was recorded as , 46.900% Linoleic acid, 31.667% Oleic acid and 21.431% Pentadecanoic acid. Sensory attributes, physiochemical properties (moisture content, pH) and microbiological properties (total plate count, yeast and mould count, coliform and e-coli) of the product were acceptable in triple laminated packaging material for two month time period. Finally the product can be considered as the nutritionally rich flavor enhancer.

**Index Terms–** Flavor enhancer with nutritive value, Natural flavor enhancer.

## I. INTRODUCTION

Flavoring systems are very important in food manufacturing. Flavorings can play an important nutritional role, particularly in foods that are not very flavorful, by providing the needed appeal [1]. Flavour enhancer (potentiator) is a substance that enhances the flavours of other substances without itself imparting any characteristic flavour of its own, which is the definition according to Food & Nutrition dictionary by Oxford University, 2005.

Foods and ingredients high in free amino acids or made up of protein hydrolysates have been used in cooking for many centuries, in many cultures, in order to enhance the sensory qualities of various foods [2]. Umami taste helps improve flavor in foods, by giving meaty and savory flavors. The most closely studied flavor enhancer is monosodium glutamate, the sodium salt of glutamic acid. Glutamate is a frequently used flavor enhancer in foods, enhances the savory flavors imparted by glutamic acid [3]. Other than the monosodium glutamate, there are some food additives which provide the umami taste are monoammonium glutamate, monopotassium glutamate, and ribonucleotides compounds, namely disodium 50-monoinosinate (IMP) and disodium 50-monoguanilate (GMP) [4].

Salts of glutamic acid were first discovered in 1908 when Professor Kikunae Ikeda, a Japanese scientist identified the unique taste of umami attributed by glutamic acid; he identified umami as fifth basic taste after sweet, sour, salty and bitter in the tongue, where umami receptor taste located. Professor Ikeda, also has extracted and identified glutamic acid from soup stock prepared from konbu seaweed as the source of the umami taste, which from then, umami is described as savory, or meat or broth-like taste means delicious in Japanese [5] [6].

Glutamate, one of the most common amino acids found in nature, is present in many proteins and peptides and most tissues. Glutamate is also produced in the body and binds with other amino acids to form a structural protein [7]. When glutamate binds to protein molecule, it is tasteless and does not provide umami taste to food. However, protein hydrolysis during fermentation, aging, ripening and heat cooking process will liberate free glutamate [8]. Although glutamate is naturally occurring in many foods, it is frequently added as a flavor enhancer. Foods containing large amounts of free glutamate, such as tomatoes, mushrooms and cheese are traditionally used to obtain savory dishes [9] [10].

## II. MATERIALS AND METHODS

**Preparation of raw materials:** The raw materials for the preparation of flavor enhancer were american oyster mushroom (*Pleurotus ostreatus*), tomato (*Solanum lycopersicum*), potato (*Solanum tuberosum L.*) and garlic (*Allium sativum L.*) and salt powder. Mushrooms were blanched at 70°C for 15 seconds and blanched mushroom were dried at drying oven at 60°C for 10hours. Tomatoes were blanched at 90°C water for 1minute and dried at drying oven at 60°C for 12hours. Potatoes were blanched in 90°C water for 5minutes and dried at drying oven at 60°C for 10hours. Garlic was dried at drying oven at 60°C for 8hours without prior blanching. Then all the ingredients were ground and sieved (by 200 µm mesh sieve) to obtain powders.

**Selection of best formula for the product:** Mushroom powder, tomato powder, potato powder, garlic powder and salt were mixed indifferent formulation to obtain eight different formulations. Sensory properties were considered to obtain the best formula for the final product. The untrained thirty panelists were participated to the sensory evaluation and the samples were given for analyze the appearance, taste, odor, mouth feel and overall Acceptability. Results of the sensory evaluation were analyzed using the computer software MINITAB 14, Kruskal wallis non parametric analysis under the confidence interval of 95%. Through the comparison the most preferred sample was selected as final product.

**Comparison of developed product with commercially available flavor enhancer:** Two fried rice samples were made using selected best formula and the commercially available monosodium glutamate. The untrained thirty panelists were participated to the sensory evaluation and the appearance, taste, odor, mouth feel and overall Acceptability were tested. Results of the sensory evaluation were analyzed using the computer software MINITAB 14. Mann-Whitney test under the confidence interval of 95%. Hypothesis was taken as  $H_0: n_1 = n_2$  versus  $H_1: n_1 \neq n_2$ , where n is the population median.

**Determination of Nutritional profile of the final product:** Moisture content, fat content, crude protein content, crude fibre content, free fat content, reducing sugar content and mineral content were calculated as nutritional parameters of the product. Moisture content was determined by oven drying method according to the AOAC Official Method 925.10. Crude protein content was determined according to the AOAC Official Method 960.52 using Kjeldhal digestion kit (VELP scientific F30200120). Total fat content was determined according to the AOAC Method 922.06 using majonnier ether extraction method and free fat content was determined according to the soxhelt extraction method described in Pearson's chemical analysis of food, 8<sup>th</sup> edition. Crude fibre content of the product was determined according to the AOAC Official Method 978.10. Total ash content was determined according to the AOAC Official Method 923.03. Reducing sugar content of the sample was determined according to the method describe by Lane, J.H., Eynon, L. [11]. Determination of mineral content was carried out by Atomic Absorption Spectrophotometer (AAS) (Hitachi model 170-10) for the sodium, potassium, calcium, iron and zinc minerals.

**Determination of fatty acid profile of the final product:** Fatty acid profile of the product was measured using Gas Chromatography method by preparing the fatty acid methyl esters (FAMES). The preparation of FAMES was done according to the method introduced by ITI (Anonymous, n.d., Method manual for preparation of fatty acid methyl esters, ITI, Sri Lanka). FAMES were identified on Gas Chromatograph (GC) model-7890 A, Agilent technologies equipped with Mass Spectrometer (MS) model-5975 C inert XL EI/CI MSD with triple-axis

detector. Nitrogen was used as the carrier gas with a flow rate of 1ml/min. A polar capillary column RTX-5, 0.32 mm internal diameter, 30 mm length and 0.25µm film thickness (Restex Corp., Bellefonte, PA, USA) was used for the separation of FAMES, The injection volume of the sample was 2µl and it was injected at a temperature of 270°C. The initial column temperature was 100 °C programmed by 20 °C/min until 170°C(hold time 0 min), then 2 °C/min until 230 °C (hold time 0 min) & finally 5°C/min until 280 °C (hold time 16.5 min). The total run time of the sample was 60 min. The percentage of fatty acids was calculated as the ratio of the partial area to the total peak area of FAMES.

**Determination of commercial sterility of the product:** To determine the shelf life of the final product, the pH value (method SLS-144; 1972), peroxide value (AOCS Official method, Cd 8b, 1999) and moisture content variation were carried out. To select the best packaging material triple laminated (BOPP-30Mic, PET-10Mic, LDPE-40Mic) packing material and polypropylene (Guage 150) packing material were tested. Within two months of time period above parameters were tested for both packaging material in order to select the suitable packaging material and determine the commercial sterility of the product.

### III. MICROBIOLOGICAL ANALYSIS

To analyze the microbial sterility of the product, total plate count, yeast and mould count and presumptive coliform were tested. Yeast and mould content of the sample was determined according to the SLS 516: Part 2:1991. Total plate count microbial test was carried out according to the SLS 516 Part 1:1991. Presumptive Coliform test was carried out according to the method SLS 516 Part 3:1982.

### IV. RESULTS AND DISCUSSION

**Selection of best formulation for the product:** According to the overall sensory evaluation results, formulation sample 643 can be considered as the most consumer preferred sample with respect to all the sensory attributes. Therefore ingredient recipe of sample 643 was taken as the final product formulation. Sample 643 contained mushroom: tomato: potato: garlic: salt ratio was 2: 1: 2:1: 0.75. But in all the eight samples, garlic and salt contents were kept as constant ratios. The difference of the

sample 643 than other samples was highest mushroom and potato content with low tomato content. Therefore this combination was caused to highest preference in all the sensory attributes.

#### **Sensory evaluation of newly developed product with commercially available flavour enhancer:**

When consider the overall results of the sensory evaluation for the newly developed flavor enhancer and commercially available mono-sodium glutamate, consumer preference for the taste was higher for the newly developed flavor enhancer than commercially available flavour enhancer. There is no significant between two samples for the appearance, odor, mouth feel and overall acceptability.

When consider the commercially available MSG, it contains 99% mono-sodium glutamate. But the newly developed flavor enhancer contains the combination of flavor profiles of dried mushroom, tomato, potato, garlic along with the salt. Mushroom is one of the main raw material in this product, predominant flavor of mushrooms is the umami taste, by monosodium glutamate (MSG) [12]. As well as it contains flavor compounds like soluble sugars, polyols, organic acids, free amino acids, and 5'-nucleotides. Reference [13] findings reveal that major taste-active components in common mushrooms are mannitol, oxalic, malic, citric, aspartic, glutamic acids, glycine, threonine, alanine, 5'-inosine monophosphate (5'-IMP), 5'-guanosine mono phosphate (5'-GMP), and 5'-xanthosine mono phosphate (5'-XMP). Tomato also comprise with Glutamic acid, g-aminobutyric acid, glutamine, and aspartic acid as about 80% of the total free amino acids in tomatoes. Other flavor compounds include Sugars, organic acids, free amino acids, and salts are the main components contributing to tomato taste [14]. The flavor compounds in potatoes predominantly include aldehydes, alcohols, ketones, acids, esters, hydrocarbons, amines, furans and sulphur compounds [15]. Garlic contains sulfur compounds like aliin, allicin, ajoene, allylpropl, diallyl, trisulfide, sallylcysteine, vinylidithiines, S-allylmercaptocystein. Besides sulfure compounds garlic contains amino acids and their glycosides, arginine and others [16]. Combination of these flavor compounds along with umami compounds give excellent flavor profile. This may cause to highest preference for the taste attribute of newly developed flavor enhancer than commercially available mono-sodium glutamate in sensory analysis.

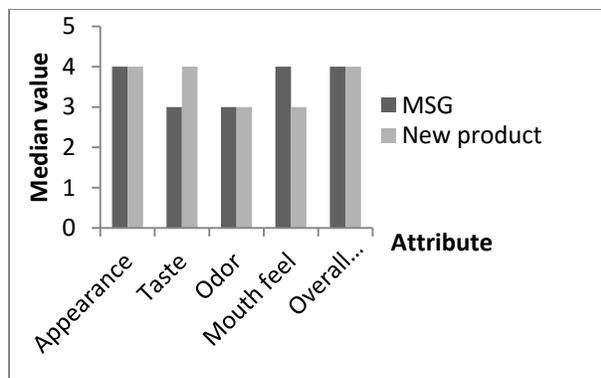


Figure 01: Results of the sensory evaluation

**Nutritional profile of the final product:** The average nutritional content of the final product was presented for 100g of the product on wet basis. The results obtained showed that this flavor enhancer has high carbohydrate content. It was low in fat as compared to protein and mineral content. The study reveals the percentage moisture content averaged value was  $14.028 \pm 0.0778\%$ . This may be an advantage in terms of shelf life of the product. Fat content obtained in this study was  $2.5103 \pm 0.00445\%$  and the free fat content was  $1.3904 \pm 0.00527$ . Crude protein content of the sample was  $12.156 \pm 0.0410\%$  and Crude fiber average content was  $3.7825 \pm 0.0300\%$ . The ash content average value  $15.162 \pm 0.115\%$  was obtained in the sample and the carbohydrate content of the sample was  $52.3613\%$ . According to the reducing sugar test results, percentage of reducing sugar in the sample was  $6.06\%$ .

**Mineral content of the final product:** Final product contained high amount of sodium, potassium and considerable amount of calcium, iron and zinc. The sodium and potassium content of the 100g of final product were  $234.05\text{mg}$  and  $398.62\text{mg}$  respectively. Calcium content was  $11.24\text{mg}$ , iron content was  $4.35\text{mg}$  and zinc content was  $3.30\text{mg}$ .

**Fatty acid profile of the final product:** Fatty acid methyl esters of newly developed flavor enhancer were analyzed by using Gas chromatograph and the percentage of fatty acids were calculated as the ratio of the partial area to the total peak area of FAMES. According to the results, three fatty acids were identified in the product, which are pentadecanoic acid, linoleic acid and oleic acid. Linoleic acid was the main identified fatty acid ( $46.9\%$ ) followed by

oleic ( $31.66\%$ ) and pentadecanoic acid ( $21.43\%$ ) possesses the 2<sup>nd</sup> and 3<sup>rd</sup> respectively.

#### Commercial sterility and selection of packaging material:

With the time there were different moisture content increments with the two packaging materials.  $14.027 \pm 0.001$ -  $14.099 \pm 0.001$  moisture content increments can be seen in the triple laminated packaging material and  $14.027 \pm 0.001$  -  $14.353 \pm 0.001$  moisture content increments can be seen in the polypropylene packaging material during two months of time period. With the time there were different pH decline with the two packaging materials.  $5.08 \pm 0.06$  -  $4.91 \pm 0.06$  pH decline can be seen in the triple laminated packaging material and  $5.08 \pm 0.06$  -  $4.56 \pm 0.00$  pH decline can be seen in the polypropylene packaging material. Decrease of the pH indicates the increase of the acidity of the product.

Peroxide value was not detected during the two month time period in both flavor enhancer samples which were packed in triple laminated and polypropylene packaging materials. According to the results, zero value indicates, there was a high-quality, no off-flavor fat containing food (AOCS Method Cg 3-91). Therefore during 2 months time period the flavor enhancer was not oxidized and off flavors hasn't formed in both packaging materials. According to the statistical analysis results for moisture content variation, pH value variation and peroxide values, triple laminated packaging material was better than polypropylene packaging material.

**Microbiological analysis:** According to the Food Administration Manual, total plate count should not exceed the  $5.0 \times 10^5$  cfu/g, yeast and mould should be lower than  $1.0 \times 10^2$  cfu/g and maximum coliform limit is  $1.0 \times 10^2$  cfu/g for spices. The total plate count and yeast and mould count of the final product was lower than this limit during two month time period in both packaging materials. For the enumeration of total presumptive coliform, MPN test was used and after incubation period no positive tubes were presented. According to the results of microbiological quality of the product in both packaging material were highly acceptable. Therefore within two month time of period the product was microbiologically stable in both packaging material at the room temperature.

## V. CONCLUSION

A nutritive natural flavor enhancer was developed using american oyster mushroom (*Pleurotus ostreatus*), tomato (*Solanum lycopersicum*), potato (*Solanum tuberosum L.*) and garlic (*Allium sativum L.*) and salt powder.

Ingredient	(W/W %)
Mushroom powder	29.6
Tomato powder	14.8
Potato powder	29.6
Garlic powder	14.8
Salt	11.2

Considering the nutritional profile of the final product it can be recommended as the nutritionally rich natural flavor enhancer which was in highly satisfactory levels in nutritionally with other flavor enhancer available in the market. The product is microbiologically stable and safe within two month of time period in triple laminated packaging material at the room temperature.

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