

Identifikasi Sumber Glutamat Bebas pada Menu Hidangan Indonesia

Determination of Free Glutamate Source in the Indonesian Dish Menus

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Abstract. *The study aimed to evaluate free glutamate content occurs naturally in prepared foods or dish menus. Fifteen selected Indonesian dish menus were categorized to three major groups, i.e. dish menu with monosodium glutamate (MSG) addition, dish menu with seasoning and/or condiment containing glutamate addition, and dish menu with MSG, seasoning and/or condiment containing glutamate addition. Each dish menu was prepared at the kitchen laboratory by standardizing the ingredients, composition and cooking process, followed by analysis of free glutamate content in dish menu, its raw material mix, and basic seasoning using HPLC method. The study results showed that raw materials such as chicken, fermented-tofu solid waste (oncom), meatball, cabbage, fried onion, tomato, and fried potato contributed to the free glutamate content in dish menus. Addition of MSG, seasoning and/or condiments definitely contributed to free glutamate content in the dish menus, ranged 9.8-142.9% for MSG added and 7.9-100% for seasoning and/or condiments added. The dish menus with MSG addition which contributed to higher free glutamate content were fried tempe, rice cake with vegetable soup in coconut milk, and spiced chicken soup. Meanwhile, the dish menus with seasoning/ condiment addition contributed to higher free glutamate content were stir-fry water crest, mixed vegetable in chicken soup, chicken rice porridge. Cooking practices could increase or reduce free glutamate content in dish menus, ranged from -86.2 to 43.3%.*

Keywords: *dish menu, free glutamate content, free glutamate source, prepared foods*

Abstrak. Studi ini bertujuan untuk mengevaluasi kandungan glutamat bebas yang ada secara alami dalam menu hidangan. Lima belas menu hidangan Indonesia dikategorikan menjadi tiga kelompok besar, yakni hidangan menu dengan penambahan monosodium glutamat (MSG), menu hidangan dengan penambahan bumbu yang mengandung glutamat, dan menu hidangan dengan penambahan MSG dan bumbu yang mengandung tambahan glutamat. Setiap menu hidangan disiapkan di laboratorium dengan menstandarisasi bahan, komposisi dan proses memasak, diikuti dengan analisis kandungan glutamat bebas dalam menu hidangan, campuran bahan baku, dan bumbu dasar menggunakan metode HPLC. Hasil penelitian menunjukkan bahwa bahan baku seperti ayam, oncom, bakso, kubis, bawang goreng, tomat, dan kentang goreng berkontribusi terhadap kandungan glutamat bebas dalam menu hidangan. Penambahan MSG dan bumbu yang mengandung glutamat pasti berkontribusi pada kandungan glutamat bebas dalam menu hidangan dengan kisaran 9.8-142.9% untuk penambahan MSG, dan 7.9-100% untuk penambahan bumbu. Menu hidangan dengan penambahan MSG yang memberikan kontribusi kandungan glutamat bebas yang tinggi adalah tempe goreng, lontong sayur dalam santan, dan sayur sup. Menu hidangan dengan penambahan bumbu berkontribusi terhadap kandungan glutamat bebas yang tinggi, yaitu tumis kangkung, sayur sup ayam, dan bubur ayam. Praktek memasak meningkatkan atau mengurangi kandungan glutamat bebas dalam menu hidangan dengan kisaran dari -86,2 hingga 43.3%.

Kata kunci: kandungan glutamat bebas, menu hidangan, sumber glutamat bebas

Practical Application: This study provided information on free glutamate content in several Indonesian dish menus that frequently consumed in urban and rural area of Indonesia. It also proved that raw food materials, addition of MSG, seasonings and/or condiments, and cooking processes affected the amount of free glutamate content in the dish menus. The methodology to determine the source of free glutamate content in dish menus was well-designed and can become a reference for other similar studies.

INTRODUCTION

Monosodium glutamate (MSG) is the sodium salt of the non-essential amino acid called glutamate which can be found naturally in food containing protein like meat, poultry, fish, dairy, and legumes. In early 1900s, MSG in its free form was identified as the major source of pleasant savory taste which is different from the four basic tastes; thus it is then named as an umami taste (Ikeda, 2002). MSG has been now used in foods as a flavor enhancer for more than a century to bring out the best flavor of foods. As flavor enhancer, free glutamate is deliberately added to foods as the purified monosodium salt (MSG), hydrolyzed vegetable protein (HVP), plant protein extract, yeast extract, autolyzed yeast, textured protein, malt extract, bouillon, flavoring (natural or beef or chicken).

The safety evaluation of MSG has been conducted extensively by trusted scientific communities including the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1971-1974 and 1987 (Walker and Lupin, 2000), the Scientific Committee for Food (SCF) of the European Commission in 1991 (Walker and Lupin, 2000); and the Federation of American Societies for Experimental Biology (FASEB) and the Federal Drug Administration in 1995 (FASEB, 1995). Those different scientific communities reported that glutamate was found to have a very low acute oral toxicity thus it is allocated an "acceptable daily intake (ADI) not specified" to glutamic acid and its salts including MSG.

Our previous study on free glutamate intake from foods both from processed foods and prepared foods (dish menus) among adults in rural (Bogor) and urban (Jakarta) area of Indonesia showed that those foods contain significant levels of free glutamate, both from natural sources and from added MSG (Nuraida et al., 2014). The study subsequently revealed that the main source of glutamate intake in both areas was from dish menus which contributed to more than 80% of the total free glutamate intake. Moreover, free glutamate intake from food prepared outside the home was comparable with that of food prepared at home. Of the survey on seasonings and condiments usage at households we also have conducted, it revealed that beside MSG several seasonings and condiments are also found as source of free glutamate in foods (Andarwulan et al., 2011). Sweet soy sauce and premix seasoning containing free glutamate were seasoning/condiments which were mostly used after MSG by the households (Andarwulan et al., 2011). The premix seasoning itself was the second highest seasoning with high free glutamate after MSG in its crystal form, followed by oyster and fish sauce and sweet soy sauce (Andarwulan et al., 2011).

The aims of this study were to evaluate free glutamate content occurs naturally in prepared foods (dish menus), and to determine the source of glutamate in those foods. The specific objectives were to determine free glutamate content in the selected dish menus with the addition of seasonings or condiments containing

glutamate; to determine free glutamate content in the selected dish menus without the addition of seasonings containing glutamate; to determine free glutamate content in raw materials mix including basic seasoning (seasoning without glutamate added) used to prepare the selected dish menus; and to estimate the contribution of raw materials and the effect of processing to the free glutamate content in dish menu by comparing the results from the above studies.

MATERIALS AND METHODS

Selected Dish Menus

The selected dish menus were categorized into three major groups to accommodate the objective of this study. Those three groups and their menu were: (A) Dish menu with/without addition of MSG only (fried tempe/ tempe goreng; fried mix vegetable and wheat flour based/ bakwan sayur; spiced chicken soup/soto ayam; fried tofu filled with mix vegetables and wheat flour based/ tahu isi; rice cake with vegetable soup in coconut milk/ lontong sayur; fried fermented-tofu solid waste press cake with flour/oncom goreng; and fried chicken; omelet/telur dadar), (B) Dish menu with/without addition of seasoning and/or condiment containing glutamate (stir fried water crest/tumis kangkung; and mixed vegetable in chicken soup/sayur sup ayam), and (C) Dish menu with/without addition of MSG, and seasoning and/or condiment containing glutamate (fried rice/nasi goreng; mixed vegetables sour soup/sayur asam; meatball with noodle and vegetable in soup/mie baso kuah; chicken noodle/mie ayam; and chicken rice porridge/ bubur ayam).

Standardizing Selected Dish Menus Ingredients and Cooking Methods

Each selected dish menu with and without addition of MSG, seasonings and/or condiments containing glutamate were prepared at the kitchen laboratory in duplicate. The recipes used to prepare the selected dish menus were followed the recipes of dish menu that usually cooked at home and/or outside the home. The type and composition of raw materials and basic seasoning used, and cooking process to prepare the selected dish menu were standardized. The cooked dish menu was then blended individually with a blender, and stored in freezer until used for analysis.

Free Glutamate Content Analysis

Samples for analyzing the free glutamate content in selected dish menus consisted of (1) dish menus with addition of MSG and/or seasoning and/or condiment containing glutamate, (2) dish menus without addition of MSG and/or seasoning and/or condiment containing glutamate, and (3) raw material mix including basic seasoning to prepare the dish menus. Samples were analyzed in duplicate for its free L-glutamic acid content using HPLC method (Rhys-Williams et al., 1982). Each

sample was extracted, dansylated, and analyzed by reverse phase high performance liquid chromatography (RP-HPLC).

Sample extraction

Two grams of sample was added with 20 mL of deionized water and mixed for 15 min. Sample solution was added with 20 mL of dry acetone and 5 g of activated charcoal, and mixed for 5 min. The mixture was filtered through Whatman No. 1 filter paper, and the retentate was rinsed 6 times with 10 mL of acetone 50%. The filtrate was collected and evaporated (vacuum, 70°C) to a volume of 15 mL. Finally, the sample volume was made up to 25 mL by deionized water in a volumetric flask of 25 mL.

Dansylation

10 µL of extract was placed in 2mL amber vial and added with 50 µL of sodium hydrogen carbonate buffer at a concentration of 4 g/L and pH 10.0. After mixing, the solution was added with 100 µL of dansyl chloride and reacted in water bath 100°C for 10 min. After cooling, the derivate solution was added with 300 µL methanol and mixed well. This solution was then filtered through 0.45 µm Millipore membrane and subjected to HPLC analysis.

HPLC condition

HPLC model used was HP Series 1100 (Hewlett Packard) with RP-column C18 (5 µm, 15 cm x 4.6 mm i.d.), and fluorescence detector (excitation wavelength 328 nm, emission wavelength 530 nm). Sample injection volume was 20 µL, the mobile phase was 1% v/v glacial acetic acid in 45% methanol, and flow rate of mobile phase was 1.1 mL/min. The running time was 8 min. Standard solution of free L-glutamic acid was made at concentrations of 250, 1000, 4000, 9000, 10000 ppm. Free L-glutamic acid content (mg/g) in sample was then calculated by using the following formula:

$$\text{Free L-GLU} = w \frac{F(0.001)}{W}$$

where: w was free L-glutamic weight (µg) from standard curve; F was dilution factor (57,500); and W was sample weight (g). Standard curve was made for every two weeks. Each standard solution was analyzed in three replicates (from derivatization to HPLC analysis). Each area plotted for standard curve was an average of three measurements. The result was reported as an average of two measurements.

Moisture Content Analysis

Moisture content in samples was measured by gravimetric method following the AOAC method (AOAC, 1999). Sample was dried in the oven at 105 °C for 16-18 hours until constant weight obtained. The moisture content was calculated using formula as follows:

$$\text{Moisture (\% wet basis)} = \frac{w1-w2}{w1} \times 100\%$$

where: w1 was initial weight of sample, and w2 was dry weight of sample.

Data Analysis

The effect of cooking process and the contribution of MSG, seasonings and/or condiment containing glutamate, and raw materials to the free glutamate content in dish menu were evaluated by calculating the mass balance of free glutamate during cooking with and without addition of MSG, seasoning and/or condiment containing free glutamate.

RESULT AND DISCUSSIONS

The evaluation of free glutamate content in several selected dish menu was conducted by two approaches, i.e. free glutamic acid content by calculation based on standardized recipes and free glutamic acid content by analyses using HPLC in the laboratory. The free glutamate content in selected dish menu per gram and per portion was depicted on Table 1, and effect of addition of MSG, seasoning/condiments, raw material and cooking process to free glutamate content in dish menu was shown on Table 2.

Dish menu with/without MSG addition

Fried tempe (Tempe goreng)

Marinated tempe, spices, and cooking oil were not contributed to free glutamate content in fried tempe. Glutamic acid content contained in tempe (Astuti, 1994) and in soybean (Berk, 1992) is the highest among other amino acids but it is still in peptides form, and seemed that no glutamic acid was liberated from the soybean during fermentation. MSG addition was contributed to free glutamate content in fried tempe as of 142.9%. The predicted free glutamate content in fried tempe with MSG addition was 36.66 mg/portion; meanwhile free glutamate content by HPLC analyses was 25.66 mg/ portion or reduce to 42.9%. It was estimated that free glutamate from MSG was loss during frying.

Fried mix vegetable and wheat flour based (Bakwan sayur)

Cooking oil, flour dough, and spices were not contributed to free glutamate content in fried mix vegetable and wheat flour based without MSG addition. The contribution of MSG addition to free glutamate content in fried mix vegetable and wheat flour based was 86.1%. Free glutamate content in fried mix vegetable and wheat flour based by calculation was predicted as of 61.11 mg/portion. While by analyses, it was detected as much as 70.99 mg/portion or increased by about 13.9%. It was estimated that bond glutamate-form in raw materials, especially from cabbage and carrot, was hydrolized into free glutamate during frying.

Table 1. Free glutamate content in selected dish menus

No	Dish Menu	Free Glutamate Content by Calculation (Based on Standardized Recipes)				Free Glutamate Content by Analyses (HPLC)			Differences of Calculated and HPLC-Analyzed Free Glu, & Most Possibility of Reducing and Increasing Free Glu Content in Dish Menu (mg/portion)	
		MSG added (g)	Seasoning and/or condiment containing free Glu (g)	Free glu content (mg/g dish menu)	Material weight per portion (g)	Predicted Free glu content (mg/portion)*	Free glu content (mg/g)	Material weight per portion (g)		Free glu content (mg/portion)
A. Dish menu with/without MSG addition only										
1.	Fried tempe (<i>Tempe goreng</i>)	0	0	0	54	0	n.d	54	n.d	0
	Raw material (marinated tempe, spices & cooking oil without MSG)	0	0	0	33.5	0	n.d	33.5	n.d	0
	Fried tempe without MSG	0.05	0	1.09	33.5	36.66	0.77	33.5	25.66	25.66 – 36.66 = (-) 11.00 (42.9%)
2.	Fried mix vegetable and wheat flour based (<i>Bakwan sayur</i>)	0	0	0	138.3	0	n.d	138.3	n.d	0
	Raw material (cooking oil, dough ingredients, spices ingredients without MSG)	0	0	0.0=0	84.58	0	n.d	84.58	n.d	0
	Fried mix vegetable and wheat flour based without MSG	0.08	0	0.73	83.25	61.11	0.85	83.25	70.99	70.99 – 61.11 = (+) 9.88 (13.9%)
3.	Spiced chicken soup (<i>Soto ayam</i>)	0	0	0	196.31	0	n.d	196.31	n.d	0
	Chicken broth & spiced-soup ingredients without MSG (Raw)	0	0	0	160	0	n.d	160	n.d	0
	Chicken broth & spiced-soup without MSG (cooked)	0	0	0	89	0	0.88	89	78.74	78.74
	Cooked solid per portion	0.29	0	0.85	249	210.83	1.03	249	256.67	256.67-(210.83+78.74) = (-) 32.90 (12.8%)
4.	Spiced chicken soup with MSG									
	Fried tofu filled with mix vegetable and wheat flour based (Tahu isi)	0	0	0	70.36	0	n.d	70.36	n.d	0
	Raw material (tofu, sprout, carrot, cooking oil, spices and dough ingredients without MSG)	0	0	0	52.2	0	n.d	52.2	n.d	0
	Fried tofu filled without MSG	0.12	0	1.67	52.7	88	2.18	52.7	115.06	115.06 – 88.00 = (+) 27.06 (23.5%)
	Fried tofu filled with MSG									
5.	Rice cake with vegetable soup in coconut milk (<i>Lontong sayur</i>)	0	0	0	262.18	0	n.d	262.18	n.d	0
	Raw material (uncooked vegetables soup in coconut milk ingredients without MSG)	0	0	0	212.25	0	n.d	212.25	n.d	0
	Vegetable soup in coconut milk without MSG	0.32	0	1.1	211.75	233.49	1.01	211.75	215.57	215.57 – 233.49 = (-) 17.92 (8.3%)
	Vegetable soup in coconut milk with MSG	0.32	0	0.54	436.75	233.85	0.46	436.75	198.81	198.81 – 233.85 = (-) 35.04 (17.6%)
	Rice cake with vegetable soup in coconut milk with MSG									

No	Dish Menu	Free Glutamate Content by Calculation (Based on Standardized Recipes)					Free Glutamate Content by Analyses (HPLC)			Differences of Calculated and HPLC-Analyzed Free Glu, & Most Possibility of Reducing and Increasing Free Glu Content in Dish Menu (mg/portion)
		MSG added (g)	Seasoning and/or condiment containing free Glu (g)	Free glu content (mg/g dish menu)	Material weight per portion (g)	Predicted Free glu content (mg/portion)*	Free glu content (mg/g)	Material weight per portion (g)	Free glu content (mg/portion)	
6.	Fried fermented-tofu solid waste press cake with flour (<i>Oncorn goreng</i>) Raw material (<i>oncom</i> , cooking oil, spices ingredients without MSG) Fried soybean press cake without MSG Fried soybean press cake with MSG	0 0 0.12	0 0 0	0 0 1.34	97.69 68 68	0 0 90.98	1.63 1.57 2.88	97.69 68 68	158.81 106.54 195.72	158.81 106.54-158.81 = (-) 52.3 (49.1%) 195.72-(90.98+158.81) = (-) 54.1 (27.6%)
7.	Fried chicken (<i>Ayam goreng</i>) Raw material (chicken, cooking oil, spices ingredients without MSG) Fried chicken without MSG Fried chicken with MSG	0 0 0.1	0 0 0	0 0 1.28	174.13 52.33 57.17	0 0 73.33	1.74 2.84 3.54	174.13 52.33 57.17	303.54 148.66 202.36	303.54 148.66-303.54 = (-) 154.9 (104.2%) 202.36-(303.54+73.33) = (-) 174.5 (86.2%)
8.	Omelet (<i>Telur dadar</i>) Raw material (chicken egg, cooking oil, spices ingredients without MSG) Omelet without MSG Omelet with MSG	0 0 0.07	0 0 0	0 0 1.14	53.6 43.67 42.83	0 0 48.89	n.d 0.44 2.01	53.6 43.67 42.83	n.d 19.14 86.19	0 19.14 86.19 - 48.89 = (+) 37.3 (43.3%)
B. Dish menu with/without addition of seasoning and/or condiment containing glutamate										
9.	Stir fry water crest (<i>Turnis kangkung</i>) Raw material (water crest, quail egg, cooking oil, water, spices ingredients without premix seasoning powder) Stir fry water crest without premix seasoning powder Stir fry water crest with premix seasoning powder	0 0 0	0 0 0.1	0 0 N.A	103.27 75 75	0 0 N.A	n.d n.d 0.71	103.27 75 75	n.d n.d 53.11	0 0 53.11
10.	Mixed vegetable in chicken soup (<i>Sayur sup</i>) Raw material (chicken, vegetables, and spices ingredients without premix seasoning cube) Mixed vegetable in chicken soup without premix seasoning cube Mixed vegetable in chicken soup with premix seasoning cube	0 0 0	0 0 0.21	0 0 N.A	295.31 200 200	0 0 N.A	n.d 0.01 0.12	295.31 200 200	n.d 1.77 23.59	0 1.77 23.59 - 1.77 = (+) 21.8 (92.5%)
C. Dish menu with/without addition of MSG and seasoning and/or condiment containing glutamate										
11.	Fried rice (<i>Nasi goreng</i>) Raw material (rice, chicken egg, and spices ingredients without MSG and sweet soy sauce) Fried rice without MSG and sweet soy sauce Fried rice with MSG and sweet soy sauce	0 0 0.3	0 0 6	0 0 0.81	318.7 270.5 270	0 0 219.99	n.d n.d 1.16	318.7 270.5 270	n.d n.d 312.09	0 0 312.09 - 219.99 =

No	Dish Menu	Free Glutamate Content by Calculation (Based on Standardized Recipes)					Free Glutamate Content by Analyses (HPLC)			Differences of Calculated and HPLC-Analyzed Free Glu, & Most Possibility of Reducing and Increasing Free Glu Content in Dish Menu (mg/portion)
		MSG added (g)	Seasoning and/or condiment containing free Glu (g)	Free glu content (mg/g dish menu)	Material weight per portion (g)	Predicted Free glu content (mg/ portion)*	Free glu content (mg/g)	Material weight per portion (g)	Free glu content (mg/ portion)	
12.	Mixed vegetable sour soup (<i>Sayur asam</i>) Raw material (water, vegetables, and spices ingredients without MSG and shrimp paste) Mixed vegetable sour soup without MSG and shrimp paste Mixed vegetable sour soup with MSG and shrimp paste	0 0 0.19	0 0 0.37	0 0 0.68	370 200 200	0 0 135.8	n.d n.d 1.09	370 200 200	n.d n.d 218.49	0 0 218.49 - 135.80 = (+) 82.69 (37.8%)
13.	Meat ball with noodle and vegetable in soup (<i>Mie baso kuah</i>) Raw solid (meat ball, cooked noodle, Chinese cabbage & sprout per portion) Broth without MSG and condiment Meat ball with noodle and vegetable in soup with MSG, sweet soy sauce, and chili sauce Chicken noodle (<i>Mie ayam</i>)	0 0 0.5	0 0 15	0 0 0.85	194 222.25 431.8	0 0 366.65	15.86 n.d 8.66	194 222.25 431.8	3077.46 n.d 3737.98	3077.46 0 3737.98-(366.7+3077.5) = (+) 293.87 (7.9%)
14.	Raw material (cooked noodles & Chinese cabbage, chicken oil per portion) Stir fry chicken fillet without sweet soy sauce Stir fry chicken fillet with sweet soy sauce Chicken noodle with MSG, sweet soy sauce, salty soy sauce, and chili sauce Chicken rice porridge (<i>Bubur ayam</i>)	0 0 0 0.2	0 0 6.93 19.5	0 0 N.A 0.66	152 50 50 221.7	0 0 N.A 146.66	n.d 2.2 2.67 1.38	152 50 50 221.7	n.d 109.9 133.32 306.13	0 109.9 133.32 - 109.90 = (+) 23.42 (17.6%) 306.13-(146.66+109.90) = (+) 49.6 (16.2%)
15.	Raw material (Uncooked broth and spices ingre-dients without MSG, sweet soy sauce, and salty soy sauce per portion) Cooked broth without MSG, sweet soy sauce, and salty soy sauce Cooked broth with MSG, sweet soy sauce, and salty soy sauce Fried chicken Chicken rice porridge with MSG, sweet soy sauce, and salty soy sauce	0 0 0.02 0 0.02	0 0 8 0 8	0 0 0.51 0 0.04	25.09 25 33.02 20 365	0 0 15.55 0 15.55	n.d n.d 2.37 2.84 0.42	25.09 25 33.02 20 365	n.d n.d 78.2 56.8 152.2	0 0 78.20 - 15.55 = (+) 62.65 (80.1%) 56.80 - 0.00 = 56.80 152.20-(56.80+15.55) = (+) 79.9 (52.5%)

* Free glutamic acid from MSG added
N.A = Not Analyzed;
n.d = not detected

Table 2. Effect of addition of MSG, seasoning/condiments, raw material and cooking process to free glutamate content in dish menu

No	Dish menu	% Effect of MSG addition to free glutamate in dish menu	% Effect of seasoning/condiment addition to free glutamate in dish menu	% Effect of raw material to free glutamate in dish menu	Effect of cooking process	
					Method	% Reducing/ increasing of free glutamate in dish menu
A. Dish menu with/without addition of MSG only						
1.	Fried Tempe (<i>Tempe goreng</i>)	142.9	-	-	marinating; frying	(-) 42.9
2.	Fried mix vegetable and wheat flour based (<i>Bakwan sayur</i>)	86.1	-	-	frying	(+) 13.9
3.	Spiced chicken soup (<i>Soto ayam</i>)	82.1	-	30.7	frying; stewing	(-) 12.8
4.	Fried tofu filled with mix vegetables and wheat flour based (<i>Tahu isi</i>)	76.5	-	-	frying	(+) 23.5
5.	Rice cake with vegetable soup in coconut milk (<i>Lontong sayur</i>)	117.6	-	-	stewing	(-) 17.6
6.	Fried fermented-tofu solid waste press cake with flour (<i>Oncorn goreng</i>)	46.5	-	81.1	frying	(-) 27.6
7.	Fried chicken (<i>Ayam goreng</i>)	36.2	-	150.0	frying; stewing	(-) 86.2
8.	Omelet (<i>Telur dadar</i>)	56.7	-	-	frying	(+) 43.3
B. Dish menu with/without addition of seasoning and/or condiment containing glutamate						
9.	Stir fry water crest (<i>Tumis kangkung</i>)	-	100.0	-	stir frying	-
10.	Mixed vegetable in chicken soup (<i>Sayur soup</i>)	-	92.5	-	stewing	(+)7.5
C. Dish menu with/without addition of MSG and/or condiment containing glutamate						
11.	Fried rice (<i>Nasi goreng</i>)	70.5	29.5	-	frying	-
12.	Mixed vegetable sour soup (<i>Sayur asam</i>)	62.2	37.8	-	stewing	-
13.	Meatball with noodle and vegetable in soup (<i>Mie baso kuah</i>)	9.8	7.9	82.33	portion	-
14.	Chicken noodle (<i>Mie ayam</i>)	47.9	16.2	35.9	portion	-
15.	Chicken rice porridge (<i>Bubur ayam</i>)	10.2	52.5	37.3	portion	-
Range (Minimum to – Maximum)		9.8 – 142.9	7.9 – 100.0	30.7 – 150.0		(-) 18.2 – (+) 43.3

Spiced chicken soup (Soto ayam)

Free glutamate from cooked solid of shredded chicken, tomato, fried potato, celery, and fried onion was detected as much as 78.74 mg/portion (30.7%). The addition of MSG was contributed to free glutamate content in spiced chicken soup as much as 82.1%. The predicted and the HPLC-analyzed free glutamate content in spiced chicken soup were 289.57 mg/portion and 256.67 mg/portion respectively. Free glutamate content in spiced chicken soup reduced by about 12.8%.

Fried tofu filled with mix vegetables and wheat flour based (Tahu isi)

Raw tofu, sprout, carrot, cooking oil, spices and flour dough were not contributed to free glutamate content in fried tofu filled with mix vegetables and wheat flour based without MSG addition. The contribution of MSG addition to free glutamate content in this dish menu was 76.48%. The HPLC-analyzed free glutamate content in the dish menu was 115.06 mg/portion or increased by about 23.5% of its predicted free glutamate content (88.00 mg/portion). It was estimated that bond glutamate-form in raw material especially from tofu and carrot was hydrolyzed into free glutamate during frying.

Rice cake with vegetable soup in coconut milk (Lontong sayur)

All raw materials used were not contributed to free glutamate content in rice cake with vegetables soup in coconut milk without MSG addition. MSG addition was contributed to free glutamate content in rice cake with vegetable soup in coconut milk as much as 117.60%. The free glutamate content in the dish menu was detected as much as 198.81 mg/portion or underwent 17.6% reduction of its predicted free glutamate content (233.85 mg/portion).

Fried fermented-tofu solid waste press cake with flour (Oncom goreng)

Fermented-tofu solid waste (oncom) was contributed to free glutamate content in fried soybean press cake without MSG addition as much as 81.1%. MSG addition was contributed to free glutamate content in fried soybean press cake as much as 46.5%. The HPLC-analyzed free glutamate content (195.72 mg/portion) in this dish menu reduced by about 27.6% of the predicted free glutamate content (249.79 mg/portion). It might be due to free glutamate from MSG and oncom was leached during frying.

Fried chicken (Ayam goreng)

Chicken was contributed to free glutamate content on fried chicken as much as 150.0%. The contribution of MSG addition to free glutamate content in fried chicken was 36.2%. The predicted free glutamate content in fried chicken was calculated as much as 376.87 mg/portion but the measured free glutamate content was detected as much as 202.36 mg/portion or reduced by about 86.2%. It was probably due to free glutamate content was leached

during frying. From the previous study, it was reported that free glutamate content of fried chicken consumed in rural and urban area (Bogor and Jakarta) ranged from 1.56 to 2.11 mg/g (Nuraida et al., 2014).

Omelet (Telur dadar)

Although chicken egg has natural free glutamate content by about 23 mg/g (Loliger, 2000), it did not contribute to free glutamate content in omelet, as well as other ingredient of cooking oil and spices. MSG addition was contributed as much as 56.7% to free glutamate content in omelet. The measured free glutamate content in this dish menu was 86.19 mg/portion or increased by about 43.3% of the predicted free glutamate content (48.89 mg/portion). Bond glutamate-form from the chicken egg was probably hydrolyzed during frying.

Dish menu with/without addition of seasoning and/or condiment containing glutamate

Stir fry water crest (Tumis kangkung)

Raw materials (water crest, quail egg, cooking oil, water, and spices) and stir fry water crest without premix seasoning addition was not detected. Thus the free glutamate content (53.11 mg/portion) in this dish menu was 100% derived from premix seasoning addition.

Mixed vegetables in chicken soup (Sayur sup)

Free glutamate content in materials and ingredients (chicken, vegetables, spices ingredients without premix seasoning cube) in their raw form was not detected, but after stewing it detected as much as 1.77 mg/portion. When the dish menu cooked with premix seasoning cube addition, free glutamate content increased as much as 23.59 mg/portion which mean seasoning addition was contributed to free glutamate content in this dish menu as much as 92.5%. The contribution of cooking process to free glutamate content in mixed vegetable in chicken soup was 7.5%. Of the previous study by Nuraida et al. (2014), free glutamate content in chicken soup ranged from 3.36 to 5.09 mg/g.

Dish menu with/without addition of MSG, and seasoning and/or condiment containing glutamate

Fried rice (Nasi goreng)

Raw rice, chicken egg, spices, and ingredients excluded MSG and sweet soy sauce were not contributed to free glutamate content in fried rice. The predicted and HPLC-analyzed free glutamate content in fried rice were 219.99 mg/portion and 312.09 mg/portion respectively. The difference of free glutamate content obtained (92.10 mg/portion) was from sweet soy sauce which mean that sweet soy sauce was contributed to 29.5% of free glutamate content in fried rice and MSG contributed to 70.5%. There was no contribution of cooking process to free glutamate content in fried rice. Nuraida et al. (2014) reported free glutamate content in fried rice which consumed in rural area (Bogor) and urban area (Jakarta) ranged from 1.83 to 3.13 mg/g.

Mixed vegetables sour soup (Sayur asam)

Water, vegetables, and spices, and ingredients without MSG and shrimp paste were not contributed to free glutamate content in mixed vegetables sour soup. The HPLC-analyzed free glutamate content (218.49 mg/portion) in this menu was higher than the predicted one (135.80 mg/portion). The differences of free glutamate obtained was from shrimp paste thus it can be calculated that MSG and shrimp paste were contributed to free glutamate in mixed vegetable sour soup as much as 62.2% and 37.8% respectively. No contribution of cooking process to free glutamate content in this menu.

Meatball with noodle and vegetables in soup (Mie bakso kuah)

Raw solids of meatball, noodle, Chinese cabbage, and sprouts were detected to contain free glutamate as much as 3077.46 mg/portion (82.33%). The high free glutamate content derived from the meatball. By calculation, free glutamate content in meatball with noodle and vegetable in soup with MSG, sweet soy sauce, and chili sauce was predicted as much as 3444.11 mg/portion. While by analyses, it was detected as much as 3737.98 mg/portion. The differences of free glutamate (293.87 mg/portion) was from chili sauce and sweet soy sauce; thus the contribution of MSG and condiments to free glutamate in this menu was 9.8 and 7.9% respectively.

Chicken noodle (Mie ayam)

Free glutamate content of cooked noodle, Chinese cabbage, chicken oil, and stir fry chicken fillet excluded sweet soy sauce was 109.90 mg/portion (35.9%). Chicken was identified as main contributor of free glutamate. There was a positive difference of the HPLC-analyzed and predicted free glutamate content in this menu with MSG, sweet soy sauce, and salty soy sauce addition which it came from MSG (47.9%) and condiments of sweet soy sauce and salty soy sauce (16.2%).

Chicken rice porridge (Bubur ayam)

Cooked solid (chicken) was detected to contain 56.80 mg/portion (37.7%) of free glutamate. The predicted and HPLC-analyzed free glutamate in chicken rice porridge with MSG, sweet soy sauce and salty soy sauce were 72.35 mg/portion and 152.20 mg/portion respectively. The contribution of MSG and condiments (sweet soy sauce and salty soy sauce) to free glutamate content in chicken rice porridge was 10.2% and 52.5% respectively.

Overall, it was known that raw materials like chicken, cabbage, carrot, tomatoes, potato, and onion have natural glutamate content. It was reported that tomatoes has natural free glutamate content of 246 mg/100g, onion (51 mg/100g), chicken (44 mg/100g), carrot (30 mg/100g), and potato (10 mg/100g) (Selamat and Hajeb, 2010; Loliger, 2000). Fermented-tofu solid waste (oncom) and meatball were also raw food materials contained free glutamic acid. Nuraida et al. (2014) reported that free glutamate content of meatballs with noodle wheat flour based and soup ranged 4.66-6.51 mg/g. The MSG itself

contained 733 mg/g of free glutamate content; meanwhile seasoning/condiment like premix seasoning, sweet soy sauce, fermented fish/ shrimp paste, and chili sauce contained free glutamate ranged from 0.31 to 70.77 mg/g (Andarwulan et al., 2011).

In some selected dish menus that were cooked with heating process like frying, free glutamate content in dish menu reduced from its calculated content, it is considered that free glutamate of MSG and/or seasonings addition and raw materials containing natural free glutamate decomposed and reacted with reducing sugars to form Maillard browning products during frying (Pokorny, 1998).

We also found an interesting phenomenon on dish menu with coconut milk as one of its raw material. Coconut milk could reduce free glutamate content on dish menu. The assumption that there was an interaction between coconut milk and free glutamate after cooking process which made free glutamate content reduced. This phenomenon is needed to be further investigated to have better understanding of the reaction occurred during cooking process using coconut milk.

CONCLUSION

Free glutamate content varied in selected Indonesian dish menus. It was affected by many factors, i.e. raw material and its composition, the addition of MSG and seasoning and/or condiments containing glutamate, as well as cooking process. Raw materials that had effect to free glutamate content in prepared foods were chicken, fermented-tofu solid waste (oncom), meatball, cabbage, fried onion, tomato, and fried potato. The dish menus with MSG addition only contributed to higher free glutamate content was fried tempe, rice cake with vegetable soup in coconut milk, and spiced chicken soup; and dish menus with seasoning/condiments containing glutamate addition contributed to higher free glutamate content was stir fry water crest, mixed vegetable in chicken soup, chicken rice porridge. Cooking process affected the free glutamate content in the dish menus; it can reduce or increase the free glutamate in the food. The same cooking process can give different result of free glutamate content in foods when the cooking procedures applied were different.

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