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Free Glutamate Intake From Foods Among Adults: Case Study in Bogor and Jakarta

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Abstract *Monosodium glutamate (MSG) is a flavor enhancer which has been used for nearly a century to bring out the best flavor of food. Its principal component is an amino acid called glutamate or L-glutamic acid. Free glutamate also exists naturally in foods. The aim of the present study was to estimate the exposure of consumers to free glutamates from foods in Jakarta and Bogor, Indonesia. The study was conducted in Jakarta urban area and rural area of Bogor with 222 respondents above 19 years of age. The survey used Food Frequency Questionnaire to estimate the consumption of food predicted to contain free glutamate. The data of food consumption was used to design food samples to be taken from the survey site and analyze for free glutamate content. Analyses of free glutamate content in food were conducted using HPLC with fluorescent detector. The results revealed the most frequent and the highest amount of food consumed both in Jakarta and Bogor area was dish menus of cereal categories. The average food consumption, excluding rice, in Bogor was 816.73 g/cap/day, while in Jakarta was 823.82 g/cap/day with dish menus contribution accounted to more than 70%. Free glutamate content of food samples ranged from undetected to more than 6 mg/g. Free glutamate intake in Bogor was comparable with that of Jakarta, i.e. 2013.76 mg/cap/day and 2068.97 mg/cap/day respectively. The main source of glutamate intake in both in Bogor and Jakarta was dish menus contributing to more than 80% of the total free glutamate intake. Free glutamate intake from food prepared outside the household was comparable with that of food prepared at home.*

***Keywords**: free glutamate intake, free glutamate in foods, food consumption, dish menus, processed foods*

Abstrak. Monosodium glutamat (MSG) adalah zat penegas rasa yang lebih dari 100 tahun digunakan untuk melezatkan masakan. Senyawa utama yang terkandung dalam MSG adalah asam amino glutamat atau disebut juga L-asam glutamat. Asam glutamat bebas juga terdapat secara alami dalam bahan pangan. Tujuan penelitian ini adalah untuk mengkaji paparan asam glutamat bebas yang berasal dari pangan pada masyarakat. Kajian dilakukan di Jakarta (perkotaan) dan Bogor (pedesaan) dengan jumlah responden 222 orang berusia >19 tahun. Survei konsumsi pangan yang diduga mengandung asam glutamat bebas menggunakan *Food Frequency Questionnaire*. Data konsumsi pangan yang diperoleh digunakan untuk merancang pengambilan contoh di lokasi survei dan untuk analisis kadar asam glutamat bebas dalam pangan. Jumlah asupan atau paparan asam glutamat dihitung sebagai perkalian jumlah konsumsi pangan dengan kadar asam glutamat bebas dari berbagai sumber. Analisis asam glutamat bebas dilakukan dengan metode HPLC menggunakan detektor sinar fluoresen. Hasil kajian menunjukkan jenis pangan yang paling tinggi dikonsumsi adalah menu komposit kategori serealia. Rata-rata konsumsi pangan –tidak termasuk nasi– di Bogor dan Jakarta adalah 816.73 dan 823.82 g/kap/hari; serta menu komposit menyumbang lebih dari 70%. Kadar asam glutamat bebas pada pangan berkisar dari tidak terdeteksi hingga lebih dari 6 mg/g. Asupan asam glutamat bebas di Bogor hampir sama dengan di Jakarta yaitu masing-masing 2013.76 dan 2068.97 mg/kap/hari. Jenis pangan yang berkontribusi utama dalam asupan asam glutamat bebas adalah menu komposit yaitu sebesar leboh dari 80% dari total asupan asam glutamat bebas. Asupan asam gluta-mat bebas dari pangan jajanan (restoran) hampir sama dengan pangan yang dimasak di rumah tangga.

Kata Kunci: Asupan asam glutamat bebas, asam glutamat bebas dalam pangan, konsumsi pangan, menu komposit, pangan olahan

Practical Application: The present research finding provided a data base of food consumption including amount and frequency but excluding rice and drinks; and free glutamate content in foods, both processed food and dish menus that could be used as a reference for other studies. No recent studies on glutamate intake from foods based on food consumption have been published recently, hence this research finding updated the figures of glutamate intake from foods. Free glutamate intake obtained from this study was considered being more accurate than the estimation done in the previous studies.

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INTRODUCTION

Monosodium glutamate (MSG) has been used as flavor enhancer in food prepared at home, vendors, restaurants or food industries especially by the Asian. Glutamate is found naturally in protein containing foods such as meat, poultry and milk. However, free glutamate, not bound in protein, is the effective form to intensify, enhance or improve food flavors. In the early 1900s, glutamate was extracted from natural protein rich foods, such as seaweed and it was also prepared by the acid hydrolysis of wheat gluten or soybean protein which were expensive materials. Nowadays glutamate is produced mainly through microbial means using certain strains of bacteria, such as Corynebacterium sp. and Brevibacterium sp. Mollases, glucose or hydrolyzed starch is the usual carbon source (Sano, 2009).

MSG is a white crystalline powder and rapidly dissociates into free sodium and glutamates when dissolved in water. Free glutamate also present in many food additives such as hydrolyzed vegetable protein (HVP), plant protein extract, yeast extract, autolyzed yeast, textured protein, malt extract, bouillon, flavoring (natural or beef or chicken), seasonings and condiments. Recent study conducted in Bogor and Jakarta showed that among seasonings and condiments used in Bogor and Jakarta, premix contained the second highest of free glutamate after MSG, followed by oyster and fish sauce and sweet soy sauce (Andarwulan et al., 2012). MSG and premix seasoning were used by most households both in Bogor and Jakarta.

Based on extensive evaluation on the safety of MSG, its use has been confirmed to be safe by the different scientific communities including the Joint FAO/ WHO Expert Committee on Food Additives (JECFA) in 1988 (Walker and Lupin, 2000); European Scientific Committee for Food – Commission of the European Communities in 1991 (Walker and Lupin, 2000); and by the Federation of American Societies for Experimental Biology (FASEB) in 1995. In 1995 Center for Food Safety and Applied Nutrition (CFSAN) - Food and Drugs Administration (FDA) has also recognized that MSG and related substances are safe food ingredients for most people when eaten at customary levels (US Department of Health and Human Services, 1995). The JECFA has allocated an "acceptable daily intake (ADI) not specified" to glutamic acid and its salts (Walker and Lupin, 2000). This indicates no toxicological concerns associated with its use as a food additive. FAO/WHO regulates use of MSG in food in accordance with Good Manufacturing Practice (GMP). National Agency for Drug and Food Control (PerKBPOM No. 23, 2013) also regulated addition of MSG as flavor enhancer in food as under GMP.

Despite those findings and approval on the use of MSG as safe ingredient, there has been considerable debate regarding the use and safety of MSG. Different approach has been used to estimate MSG consumption. Geha et al. (2000) stated that the average daily intake of MSG is estimated to be 0.3–1.0 g in industrialized countries, but can be higher occasionally, depending on the MSG content of individual food items and an individual's taste preferences. Survey on consumption of MSG was done by Saidin et al. (1990) in three provinces (West Java, West Kalimantan and South Sulawesi) which were divided into 6 districts and involving 3063 households. The study revealed that the mean intake of MSG for infant was 0.1 g/day, children 0.22 g/day, pregnant woman 0.39 g/day and lactating mother 0.40 g/day. A recent survey conducted by Hardinsyah et al. (2005) involving 5040 households in 4 provinces (West Java, Lampung, South Sulawesi and East Nusa Tenggara) showed the prevalence of MSG consumption of mothers was 84.71%, while that of children was 80.39%. The later study also estimated a higher MSG intake than the result of the study by Saidin et al. (1990), i.e. 4.59 g/day for mother and 4.05 g/day for children. Study done by Andarwulan et al. (2012) in Bogor and Jakarta revealed that the average condiment/ seasonings usage in Bogor (5.39 g/cap/day) was lower than that in Jakarta (9.62 g/cap/day), but the free glutamate intake from condiment/seasonings in Bogor (847.04 mg/ cap/day) was higher than that in Jakarta (615.87 mg/ca p/day). This was due to the high contribution of MSG that used in higher amount in Bogor. In those studies, the estimation of MSG consumption did not consider free glutamate that may exist in foods. Therefore it is necessary to do a complete study on the total exposure of the consuming public to MSG and free glutamate containing foods in Indonesia. The aim of the present study was to determine food consumption pattern and to estimate the intake of free glutamate from foods taken at home or outside among adults with age of 19 years above.

METHODS

Study Area

The study was conducted in Jakarta as urban area and rural area of Bogor district in Java Island with 222 respondents of adults aged 19 years above. The respondents in Bogor were considered as poor family, while the rest was considered as non-poor family. The number of respondent in each area (N) is calculated using following formula:

$$N = \frac{1.69^2 \times P\,(1\text{-}P)}{d^2}$$

where 1.96 was Z value for p = 0.05 or 95% confidence limit; P was estimated prevalence of free glutamate consumption (0.5); d was desired precision 0.1 for ±10%. Required number of each group = 96 approximately 100. By taking that calculation, the respondent of urban (Jakarta) was 112 respondents and that of rural (Bogor) was 110 respondents.

Survey Method

Crosssectional survey of Food Frequency Survey (FFS) was conducted using the questionnaire of Food Frequency Questionnaire (FFQ) which covered the information on how frequent and how much the consumption of food predicted containing free glutamate or added MSG,

oth for prepared at home and outside home. The foods ere categorized into 6 categories as follows: (1) cereals nd cereals products (cereals, legumes, roots and tubers), 2) bakery wares, (3) meat and meat products including oultry and game, (3) fish and fish products including ıollusks, crustacean, and echinoderms (5) ready to eat avories, and (6) composite foods. Category 1 to 5 was rocessed food, while all dishes menu was categorized as omposite foods and they were further sub-categories into ı) fruits and vegetables, (b) cereals and cereal products, :) bakery wares, (d) meat and meat products, (e) fish and sh products and (f) egg and egg products.

ata Survey Analyses

Data survey analyses were started from data verifiation and input. Based on the data obtained, the onsumption of each food group was calculated for total espondent. Total consumption per capita of each age roup and each area and frequency of consumption were lso calculated.

aboratory Analysis

Sampling plan. The sampling plan was developed ased on percentage of consumption of each food subroups. The criteria used for foods to be sampled were 1) contribute to total consumption of more than 0.5% otal consumption or (2) consumed by more than 40% espondents although their consumption <0.5%. Sample or analyses was prepared as composite sample calcuated based on min. 90% of the total proportion of each ood consumed in each area. Total sample for free glutaate analyses in food were 49 samples taken from Bogor nd 57 samples taken from Jakarta.

Sampling methods for processed foods and omposite foods (dish menus). Foods of rural were purhased from food stalls in Bogor, whereas those of urban ere purchased from restaurants in Jakarta. The foods ere immediately brought to laboratory and blended ndividually with a blender, then stored in freezer until eighed. Before weighing, the thawing was done by llowing the foods in refrigerator for 1 to 5 hours. Each ample of foods was made by weighing them according to he sample proportion of sampling plan. The final samples single or composites) were then stored in freezer until sed for analysis.

Analysis method of free L-glutamic acid content. ree L-glutamic acid content was determined by the nethod of Williams and Winfield (1982) as described y Andarwulan et al. (2012). The method consisted of hree steps, i.e. extraction, dansylation and analysis by everse phase high performance liquid chromatography RP-HPLC). Each sample of food was analyzed in two eplicates (from extraction to derivatization-HPLC nalysis). The result was reported as an average of two neasurements.

Analysis method of moisture content. Moisture ontent was measured by gravimetric method following the AOAC method (AOAC, 1999).

Data Analysis and Estimation of Total Exposure to Free Glutamate

Data analyses were done using SPSS (Statistical Package for the Social Sciences) version 13.0 for Windows. It included coding, editing, entry, and analyses. Before analyses proceeded, the data were evaluated for their distribution to determine if the data follow normal distribution. Data distribution was tested using normality data test (Kolmogorov-Smirnov). The test used significance value (Sig.). If $t > 0.05$ the data considered as normal data, but if $t < 0.05$ the data considered as not distributed normally. Data distributed normally was tested using t-test to differentiate between 2 variables and analysis of variance (ANOVA) to differentiate between several variables. The abnormally distributed data was tested using non-parametric analyses with two independent sample test (Mann-Whitney U), test for several independent samples (Kruskal-Wallis H), and two related samples tests (Wilcoxon). Free glutamate intake was estimated using data obtained from the survey and laboratory analysis. The Mann-Whitney U test was used to evaluate the difference in food consumption and free glutamate intake from foods. Kruskal-Wallis H test was used to evaluate the difference in food consumption and free glutamate intake based on respondent charac-teristics in rural (Bogor) and urban (Jakarta). While Wilcoxon test was used to determine the relation between food consumption and free glutamate intake from food, with parameter analyses on the difference between processed food and dish menu, and between food prepared outside and at home.

RESULTS AND DISCUSSION

Characteristics of Respondents

The age of respondents was between 19 and more than 60 years old with the dominant was below 50 years old (Table 1). Female respondent was higher than male respondent both in Bogor and Jakarta area. Based on the poverty status (determined based on National Standard/ National Family Planning Board (BKKBN) standard), more than 60% of respondent in Bogor were categorized as "poor family". Meanwhile, more than 70% of respondent in Jakarta area came from "non-poor family".

Table 1. Characteristic of respondents in Bogor and Jakarta area based on age and sex

Age Group (years)	Bogor Area			Jakarta Area		
	Male	Female	Total	Male	Female	Total
19 - 29	6	39	45	11	16	27
30 - 39	5	38	43	11	26	37
40 - 49	2	9	11	5	15	20
49 - 59	4	7	11	3	13	16
> 60	0	0	0	2	10	12
Total	17	93	110	32	80	112

Table 2. Frequency of food consumption (times/cap/month) of each food group for adult in Bogor and Jakarta area

Food categories /groups	Bogor			Jakarta		
	Prepare at Home	Prepare Outside	Total	Prepare at Home	Prepare Outside	Total
I. Processed Foods						
• Cereal and Cereal Product (Cereal, Legumes, root, Tubers)	2.57	18.47	21.05	5.13	6.02	11.14
• Bakery Wares	0.01	1.11	1.12	0.49	3.71	4.20
• Meat and Meat Product including Poultry and Game	0.08	0.37	0.45	1.65	3.18	4.83
• Fish and Fish Product including Mollusks, Crustaceans, and Echinoderms	0.75	1.18	1.94	0.46	0.53	0.98
• Ready to Eat Savouries	3.00	26.15	29.15	1.44	23.42	24.86
II. Dish Menus						
• Fruit and Vegetables	61.50	2.17	63.67	40.66	3.96	44.63
• Cereals and Cereals Product (Cereal, Legumes, Root, Tubers)	57.20	56.61	113.81	43.14	60.89	104.04
• Bakery Wares	0.00	0.05	0.05	0.01	0.95	0.96
• Meat and Meat Product including Poultry and Game	11.69	10.07	21.76	16.76	9.58	26.34
• Fish and Fish Product including Mollusks, Crustaceans, Echinoderms	41.06	3.58	44.65	23.14	6.26	29.40
• Eggs and Egg Products	18.19	0.22	18.41	14.13	0.31	14.44

Table 3. Food consumption in Bogor and Jakarta area

Food Groups/Categories	Bogor		Jakarta	
	Consumption (g/cap/day)	% Consumption	Consumption (g/cap/day)	% Consumption
Processed Foods				
• Cereal and Cereal Product (Cereal, Legumes, root, Tubers)	136.10	16.66	75.67	9.18
• Bakery Wares	1.83	0.22	9.75	1.18
• Meat and Meat Product including Poultry and Game	0.60	0.07	5.72	0.69
• Fish and Fish Product including Mollusks, Crustaceans, and Echinoderms	2.66	0.33	1.72	0.21
• Ready to Eat Savouries	25.22	3.09	20.22	2.45
Total Processed Foods	**166.40**	**20.37**	**113.08**	**13.71**
Dish menus				
• Fruit and Vegetables	150.02	18.37	131.25	15.93
• Cereals and Cereals Product (Cereal, Legumes, Root, Tubers)	327.82	40.15	396.23	48.10
• Bakery Wares	0.18	0.02	4.54	0.55
• Meat and Meat Product including Poultry and Game	95.64	11.71	100.30	12.18
• Fish and fish Product including Mollusks, Crustaceans, Echinoderms	43.57	5.33	49.91	6.06
• Eggs and Egg Products	33.03	4.04	28.52	3.46
Total Dish Menus	**650.33**	**79.63**	**710.75**	**86.29**
Total	**816.73**	**100**	**823.82**	**100**

Frequency of Consumption

The FFQ survey revealed that fruit and vegetables category was not found in processed foods consumed by the respondents. Hence the processed foods consisted of 5 categories, while dish menus consisted of 6 categories (Table 2). Dish menus were the most frequent consumed by the respondents both in Bogor and Jakarta. Within the dish menus, cereals and cereal products was the most frequent consumed followed by fruits and vegetables (Table 2). Food prepared at home was the most frequent consumed. In Jakarta slightly different figure for processed food under category cereals and cereal products

which the respondent more frequently consumed those ods prepared outside home, mean-while in Bogor for is category, the frequency of consumption food prepared home was almost similar to that prepared outside home. mong processed foods, fish and fish product was the ast frequent consumed in Jakarta, while among dish enus, bakery wares was the least. In Bogor, the least equent foods consumption was meat and meat products nong processed foods, while bakery wares was among sh menus. The frequency of consumption of bakery ares; meat and meat products were higher in Jakarta an in Bogor.

verage of Consumption

Food consumption in Bogor and Jakarta are pre-nted in Table 3, 4, 5 and 7. Total food consumption, cluding rice, in Jakarta and Bogor were almost similar, . 816.73 g/cap/day and 823.82 g/cap/day respectively. he dish menus were the main contributor to food nsumption both in Jakarta and Bogor, i.e. 79.63% id 86.29% respectively (Table 3) and significantly fferent with processed foods (Table 7). Respondent in karta consumed more dish menus than those in Bogor. ased on the source of foods, in Bogor the respondents nsumed more food prepared at home, while in Jakarta, e respondents consumed more food prepared outside Table 7).

Cereals and cereal products both in Bogor and Jakarta as the highest amount consumed among processed ods and dish menus, i.e. 327.82 g/cap/day (40.15% of tal consumption) and 396.23 g/cap/day (48.10% of total nsumption). Among processed food under category ereal and cereal products, noodles type products was e most contributor to food consumption figures both in ogor and Jakarta (Table 4 and 5). Type of foods under ereals and cereal products in the dish menus group ere different with the processed foods. Within cereals nd cereal products of dish menu, traditional cakes and nacks was the highest foods consumed, both in Bogor nd Jakarta, followed by tempe and tofu base products. ish and fish products, meat and meat products, and egg nd egg products were consumed to a lesser extend both n Bogor and Jakarta.

Among processed food, the least foods consumed in Bogor were meat and meat products; while in Jakarta were sh and fish products. Meanwhile among dish menus, akery wares were the least consumed both in Jakarta and Bogor (Table 3).

ree Glutamate Content in Foods

Free glutamate content of food samples were epicted in Table 4 and 5. The free glutamate content of ereals and cereals products ranged from 0.60 to 2.83 ng/g. Table 4 and 5 show that instant noodle consumed s drained noodle, had glutamate content about 3-4 times igher than noodle soup. No free glutamate was detected n samples of bakery wares. Free glutamate content of neat and meat products ranged from 1.26 to 3.04 mg/g. Free glutamate content in fish and fish products ranged from 0.55 to 7.04 mg/g. Free glutamate content in canned sardines was 9 to 11 times lower than in other products. Relative high free glutamate content ranged from 5.22 to 9.78 mg/g was found in ready to eat savories.

Within dish menus, free glutamate content in fruits and vegetables ranged from not detected to 7.83 mg/g. In Bogor, the highest glutamate content was found in dish menu of stir fried leaf vegetables (7.83 mg/g). In Jakarta, the highest glutamate content was found in dish menu of stir fried sprout (vegetables) (7.40 mg/g). Free glutamate content in cereal and cereal products ranged from not detected to 7.93 mg/g in Bogor, and to 6.74 mg/g in Jakarta. The highest glutamate content was found in fried wheat flour based-noodle in Bogor, and in *oncom* based dish menu in Jakarta. No glutamate content was found in pizza samples, however, the glutamate content was found in burger and hotdog samples at a significant level of 2.05 mg/g.

The free glutamate content in meat and meat products in Bogor ranged from 0.96 to 8.46 mg/g which is higher than in Jakarta ranging from 0.22 to 3.36 mg/g. Within meat and meat products of dish menus, in Bogor, the dish menu with the highest glutamate content was found in fast food, whereas in Jakarta found in chicken soup. The free glutamate content in fish and fish product of dish menus ranged from not detected to 4.87 mg/g. No glutamate can be detected in egg dish menus of Bogor, but that of Jakarta had glutamate at a range of 2.85 to 8.85 mg/g. Typical Chinese restaurant meal contains between 0.1 and 15 mg of MSG per g (Freeman, 2006). The free glutamate content in the dish menus obtained in the present research was within this range and the maximum content was lower.

Estimation of Free Glutamate Intake from Foods

Total free glutamate intake from foods was 2,013.76 mg/cap/day in Bogor and 2,068.97 mg/cap/day in Jakarta. Those figures show no significant free glutamate intake between Bogor and Jakarta. The free glutamate intake estimated in the present research was higher than the survey results of Muhilal *et al.* (1988) with estimation of intake of MSG for infant of 0.1 g/day, children 0.22 g/day, pregnant woman 0.39 g/day and lactating mother 0.40 g/day. In this survey, the MSG intake was calculated based on the food consumed and the MSG used for cooking the corresponding food. The results of the present study, however, lower than estimation done by Hardinsyah (2005) i.e. 4.59 g/day for mother and 4.05 g/day for children. The discrepancies were due to the method of estimation.

The present survey was considered to provide more accurate figures as the estimation was done based on the food consumption and the free glutamate content in the corresponding foods. In Japan and Korea, the estimated average MSG intake in the 1990s was 1.2–1.7 g/d, however it is speculated that the average daily MSG intake may be up to 10 g/d (He *et al.*, 2011). This figures were

Tabel 4. Food Consumption, glutamate content and free glutamate intake from food in Bogor area

Food Groups	Food consumption (g/cap/day)	% Consumption	Free glutamate content (mg/g)	Free glutamate intake (mg/cap/day	% Glutamate Intake
A. **Processed Foods**					
Cereal and Cereal Product (Cereal, Legumes, root, Tubers)	**136.10**	**16.66**		**169.76**	**8.43**
Instant, Noodles, Drained	35.04		2.83	99.17	
Instant, Noodles, Soup	96.41		0.60	57.85	
Instant, Glass Noodle, Soup	0.12		0.60	0.07	
Instant, Macaroni	4.53		2.80	12.68	
Bakery Wares	**1.83**	**0.22**		**0.00**	**0.00**
Bread	1.69		n.d	0.00	
Crakers	0.14		n.d	0.00	
Meat and Meat Product including Poultry and Game	**0.60**	**0.07**		**1.23**	**0.06**
Processed/Composite Meat (Dendeng and Abon)[1]	0.09		1.26	0.11	
Processed/Composite Meat (Sausage and Corned)[1]	0.15		2.07	0.30	
Processed/Composite Chicken Meat	0.36		2.27	0.82	
Fish and Fish Product including Mollusks, Crustaceans, and Echinoderms	**2.66**	**0.33**		**3.02**	**0.15**
Processed/Composite (Sarden)	2.46		0.66	1.63	
Processed/Composite (Fish Ball and Kaki Naga)	0.20		7.04	1.39	
Ready to Eat Savouries	**25.22**	**3.09**		**137.37**	**6.82**
Extrudates	2.00		8.09	16.19	
Chips	23.22		5.22	121.18	
Total Processed Foods	**166.40**	**20.37**		**311.39**	**15.46**
B. **Dish Menus**					
Fruit and Vegetables	**150.02**	**18.37**		**327.14**	**16.25**
Bulb Vegetables, Stir Fry	5.74		2.68	15.37	
Fruit Vegetables, Stir Fry	8.54		6.53	55.75	
Fruit Vegetables, Soup	10.01		1.66	17.65	
Leaf Vegetables, Stir Fry	17.16		7.83	134.36	
Leaf Vegetables, Soup	24.57		0.36	8.85	
Mix All Vegetables, Stir Fry	4.04		3.38	13.66	
Mix All Vegetables, Soup	62.57		0.81	50.68	
Mix All Vegetables, Steam	4.78		n.d	0.00	
Mushroom, Stir Fry	0.55		7.83	4.33	
Mushroom, Soup	1.13		1.66	1.87	
Sprout Vegetables, Stir Fry	6.00		1.39	8.35	
Legume Vegetables, Stir Fry	4.93		3.44	16.96	
Cereals and Cereals Product (Cereal, Legumes, Root, Tubers)	**327.82**	**40.15**		**786.43**	**39.05**
Tempe based	39.92		5.82	232.33	
Tofu based	34.42		1.66	57.13	
Oncom based	16.35		4.61	75.38	
Peanut and others	24.60		3.93	96.67	
Traditional Cakes and Snacks	85.05		0.60	51.03	
Glass Noodle, Fried	7.99		4.42	35.32	
Glass Noodle, Soup[1]	1.32		0.61	0.81	
Noodle Wheat Flour Based, Fried	10.10		7.93	80.06	
Noodle Wheat Flour Based, Soup	8.14		0.61	4.96	
Noodle, Rice Flour Based, Fried	0.09		7.93	0.69	
Noodle, Rice Flour Based, Soup	0.12		0.61	0.07	
Wheat Flour Dishes	4.28		1.03	4.41	
Rice Cake With Vegetables	9.24		n.d	0.00	
Rice Porridge	28.15		1.80	50.66	
Fried Rice	25.27		1.83	46.24	
Spicy Steam Rice	17.58		n.d	0.00	
Steam Rice With Fish/Chicken/Beef/Egg/Vegetables	5.44		3.50	19.05	
Spaghetti and others	0.40		2.47	0.99	
French Fries	0.47		0.44	0.20	
Noodle Wheat Flour Based with meat balls, Soup (bakso campur)	3.66		4.66	17.07	
Noodle Wheat Flour Based with meat balls, Soup (bakso malang)	5.33		2.51	13.37	
Bakery Wares	**0.18**	**0.02**		**0.23**	**0.01**
Pizza	0.07		n.d	0.00	
Burger, Hot Dog	0.11		0.44	0.23	
Meat and Meat Product including Poultry and Game	**95.64**	**11.71**		**520.00**	**25.82**
Chicken, Fried, Steamed	19.74		1.56	30.79	
Chicken, Soup	23.11		5.09	117.65	
Chicken, Grilled	4.21		2.52	10.60	
Chicken Offal, Fried, Steamed	2.43		0.96	2.33	

abel 4. Food Consumption, glutamate content and free glutamate intake from food in Bogor area (continue...)

Food Groups	Food consumption (g/cap/day)	% Consumption	Free glutamate content (mg/g)	Free glutamate intake (mg/cap/day	% Glutamate Intake
Beef, Fried, Steamed	1.48		0.90	1.33	
Beef, Soup	2.17		2.66	5.78	
Beef Offal, Fried, Steamed	0.19		0.90	0.17	
Beef Offal, Soup	0.35		2.66	0.93	
Lamb, Soup	0.28		0.32	0.09	
Lamb, Grilled	0.36		2.52	0.90	
Fast Food, meat products	41.30		8.46	349.41	
Lamb, steamed	0.01		0.90	0.01	
ish and fish Product including Mollusks, Crustaceans, Echinoderms	**43.57**	**5.33**		**68.57**	**3.41**
Aquacultures Fish	8.78		1.11	9.75	
Catch fish, Salted	20.02		1.33	26.62	
Catch fish, Unsalted	7.02		2.21	15.50	
Crustaceans, Salted	0.64		4.87	3.11	
Crustaceans, unsalted	5.58		1.91	10.66	
Mollusks, Unsalted	1.53		1.91	2.92	
ggs and Egg Products	**33.03**	**4.04**		**0.00**	**0.00**
Eggs, Boiled	0.07		-	0.00	
Eggs, Fried	17.59		n.d	0.00	
Eggs, Spicy	15.37		n.d	0.00	
otal Dish Menus	**650.33**	**79.63**		**1,702.37**	**79.63**
Total	**816.73**	**100**	**NA**	**2,013.76**	**100**

abel 5. Food Consumption, glutamate content and free glutamate intake from food in Jakarta area

Food Groups	Food consumption (g/cap/day)	% Consumption	Free glutamate content (mg/g)	Free glutamate intake (mg/cap/day	% Glutamate Intake
A. **Processed Foods**					
ereal and Cereal Product (Cereal, Legumes, oot, Tubers)	**75.67**	**9.18**		**123.19**	**5.95**
Instant, Noodles, Drained	24.02		2.80	67.26	
Instant, Noodles, Soup	49.40		1.04	51.37	
Instant, Glass Noodle, Fried	0.17		2.80	0.46	
Instant, Glass Noodle, Soup	2.84		1.04	0.87	
Instant, Macaroni	1.04		2.80	2.92	
Instant, Rice and Porridge	0.08		1.04	0.08	
Instant, Pasta	0.05		2.80	0.14	
Instant, soup	0.07		1.04	0.07	
akery Wares	**9.75**	**1.18**		**0.00**	**0.00**
Bread	9.67		n.d	0.00	
Crakers	0.08		n.d	0.00	
leat and Meat Product including Poultry and Game	**5.72**	**0.69**		**9.59**	**0.46**
Processed/Composite Meat (Dendeng and Abon)	1.27		1.26	1.61	
Processed/Composite Meat (Sausage and Corned)	0.74		2.07	1.54	
Processed/Composite Chicken Meat	3.70		1.74	6.44	
ish and Fish Product including Mollusks, rustaceans, and Echinoderms	**1.72**	**0.21**		**2.99**	**0.14**
eady to Eat Savouries	**20.22**	**2.45**		**119.26**	**5.76**
Extrudates	1.88		9.78	18.40	
Chips	18.34		5.50	100.86	
otal Processed Foods	**113.08**	**13.71**		**255.02**	**12.33**
B. **Dish Menus**					
ruit and Vegetables	**131.25**	**15.93**		**355.92**	**17.20**
Bulb Vegetables, Stir Fry	3.73		4.11	15.32	
Fruit Vegetables, Stir Fry	3.06		6.53	20.00	
Fruit Vegetables, Soup	7.65		1.48	11.32	
Leaf Vegetables, Stir Fry	7.12		6.93	49.36	
Leaf Vegetables, Soup	22.98		0.43	9.88	
Mix All Vegetables, Stir Fry	5.46		5.59	30.52	
Mix All Vegetables, Soup	65.32		2.83	184.87	
Mix All Vegetables, Steam	9.28		n.d	0.00	
Mushroom, Stir Fry	0.16		6.93	1.13	
Mushroom, Soup	0.77		1.48	1.13	
Sprout Vegetables, Stir Fry	3.40		7.40	25.12	
Legume Vegetables, Stir Fry	2.12		3.44	7.28	
Fast Food, vegetables and fruits salad	0.21		-	0.00	
ereals and Cereals Product Cereal, Legumes, Root, Tubers)	**396.23**	**48.10**		**940.65**	**45.46**
Tempe based	40.99		1.68	68.86	
Tofu based	36.46		4.75	173.17	
Oncom based	4.12		6.74	27.74	

Tabel 5. Food Consumption, glutamate content and free glutamate intake from food in Jakarta area (continue..)

Food Groups	Food consumption (g/cap/day)	% Consumption	Free glutamate content (mg/g)	Free glutamate intake (mg/cap/day	% Glutamate Intake
Peanut and others	20.94		3.34	69.92	
Traditional Cakes and Snacks	55.15		0.92	50.74	
Glass Noodle, Fried	10.95		0.45	4.93	
Glass Noodle, Soup	1.87		2.56	4.78	
Noodle Wheat Flour Based, Fried	13.94		3.35	46.70	
Noodle Wheat Flour Based, Soup	10.72		2.56	27.43	
Noodle, Rice Flour Based, Fried	0.96		3.35	3.23	
Noodle, Rice Flour Based, Soup	0.74		2.56	1.88	
Wheat Flour Dishes	12.07		0.13	1.57	
Rice Cake With Vegetables	13.32		5.64	75.11	
Rice Porridge	30.62		0.43	13.17	
Fried Rice	33.29		3.13	104.21	
Spicy Steam Rice	25.89		0.06	1.55	
Steam Rice With Fish/Chicken/Beef/Egg/Vegetables	39.02		0.41	16.00	
Spaghetti and others	6.48		2.47	16.01	
French Fries	3.02		0.44	1.33	
Noodle Wheat Flour Based with meat balls, Soup	35.69		6.51	232.31	
Bakery Wares	**4.54**	**0.55**		**5.72**	**0.28**
Pizza	1.75		n.d	0.00	
Burger, Hot Dog	2.79		2.05	5.72	
Meat and Meat Product including Poultry and Game	**100.30**	**12.18**		**215.44**	**10.41**
Chicken, Fried, Steamed	31.21		2.11	65.86	
Chicken, Soup	31.80		3.36	106.86	
Chicken, Grilled	7.88		1.18	9.29	
Chicken Offal, Fried, Steamed	4.19		0.22	0.92	
Chicken Offal, Soup	0.01		3.36	0.04	
Beef, Fried, Steamed	4.13		0.90	3.72	
Beef, Soup	4.26		2.66	11.33	
Beef Offal, Fried, Steamed	2.03		0.90	1.83	
Beef Offal, Soup	1.78		2.66	4.73	
Lamb, Fried, Steamed	0.04		0.90	0.03	
Lamb, Soup	5.60		0.32	1.79	
Lamb, Grilled	2.60		1.18	3.06	
Fast Food, meat products	4.78		1.25	5.97	
Fish and fish Product including Mollusks, Crustaceans, Echinoderms	**49.91**	**6.06**		**113.75**	**5.50**
Aquacultures Fish	17.50		n.d	0.00	
Catch fish, Salted	5.07		3.50	17.76	
Catch fish, Unsalted	18.37		3.42	62.82	
Crustaceans, Salted	0.06		4.87	0.29	
Crustaceans, unsalted	8.36		3.66	30.61	
Mollusks, Unsalted	0.34		3.66	1.25	
Fast Food, fish products	0.20		4.99	1.02	
Eggs and Egg Products	**28.52**	**28.32**		**182.48**	**8.82**
Eggs, Boiled	0.72		-	0.00	
Eggs, Fried	17.21		8.85	152.29	
Eggs, Spicy	10.59		2.85	30.19	
Total Dish Menus	**710.75**	**86.29**		**1,813.96**	**87.67**
Total	**823.82**	**100**	**NA**	**2,068.97**	**100**

considered were underestimated as it was not included the MSG content in processed foods. In 1991, the average intake of MSG in United Kingdom was 580 mg/day for general population individual and 4.68 g/day for extreme users (Husarova and Ostatnikova, 2013). Estimation done by expert in Germany in a consensus meeting, in EU countries the mean intake ranges from 0.3 to 0.5 g/day; in Asian countries people consume in average 1.2–1.7 g/day (Beyreuther et al. 2007). The individual glutamate intake from food additives shows broad variations; high consumers in Europe may reach up to 1 g/day, in Asian countries 4 g/day. The expert also estimated total intake of glutamate from food in European countries being estimated ranged from 5 to 12 g/day consisting of free glutamate ca. 1 g, protein-bound ca. 10 g, and added as flavor ca. 0.4 g.

Similar to food consumption, the dish menus were e most contributors to free glutamate intake both in ogor and Jakarta (Table 4, 5) and significantly different ith the intake from processed foods (Table 7). Free utamate intake from dish menus in Jakarta was signi-antly higher than in Bogor. Within food categories, reals and cereal products both in processed foods and sh menus were the most contributors to free glutamate take. These figure correlated with the amount of food nsumed under this food categories. Within processed od, ready to eat savories was the second contributor to ee glutamate intake.

Within dish menus, cereals and cereal products was e highest contributor to total free glutamate intake both Bogor and Jakarta and correlated with the amount of od consumed of this category; while the second highest ntributor was different between Bogor and Jakarta. In ogor the second highest contributor to free glutamate take from dish menus was meat and meat products. lthough of meat and meat products in Bogor was lower an consumption of dish menus of fruit and vegetables, owever, high content of free glutamate in meat and meat oducts consumed in Bogor has made this group of food ntribute quite significant to free glutamate intake. In karta, the second highest contributor to free glutamate take from dish menus was fruit and vegetables that rrelate with the amount of consumption of this food roup.

Of processed foods, food prepared outside home ntributed higher to free glutamate intake, in contrast to ish menus in which foods prepared at home contributed igher to free glutamate intake than those prepared utside (Table 6). However, overall in Bogor, free gluta-ate intake from food prepared outside was comparable ith that from food prepared at home. Different figure bserved in Jakarta where food prepared at home contri-uted to free glutamate intake significantly higher than od prepared outside (Table 7). Free glutamate intake om food prepared at home in Jakarta was significantly igher than in Bogor. This figure was consistent with the ee glutamate intake from dish menus.

CONCLUSION

The most frequently consumed food and the highest mount food consumed in Bogor and Jakarta was dish enus of cereals and cereal products, followed by fruits nd vegetables dish menus. Dish menus were the highest mount of food consumed in Bogor and Jakarta and con-istently provided highest contribution to free glutamate ntake in Bogor and Jakarta. In Bogor, respondents onsumed more food prepared at home, in contrast to espondent in Jakarta who consumed more foods pre-ared outside home. Within the dish menus, cereals and ereal products provided the highest contributors to free lutamate intake. Free glutamate intake from foods of espondents in Bogor and Jakarta was almost similar, i.e. ,013.76 mg/cap/day and 2,068.97 mg/cap/day. Foods prepared at home contributed to free glutamate intake in respondent in Jakarta higher than food prepared outside. However, in Bogor, free glutamate intake from food prepared outside was similar to that of food prepared at home.

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