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Taste Active Components in Thai Foods: A Review of Thai Traditional Seasonings

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Abstract

The cooking culture around the world is diverse depending parts of the world. Each region has used own traditional seasonings to add rich tastes and flavors for dishes. The fermented soy beans and fish sauce, garum, were used since 200 BC in China and ancient Rome, respectively, to impart the umami taste. In early 1900s, the umami taste, a pleasant savory taste imparted by substances such as glutamate, inosinate and guanylate, was recognized globally as the fifth basic taste which is independent and different from the other basic tastes. Past several years, besides the taste, glutamate-rich ingredients have also an ability to enhance sensory properties. Fermented products from fish, shellfish and soybean are rich in umami taste substances and have a long history, continuing today, in Southeast Asian countries including Thailand. Wide use of umami in daily dishes in every region of Thailand including north, northeast, central and south, by adding these fermented products as indispensable seasonings is common, despite of different methods. These suggest that umami taste compounds have generally presented in Thai foods and are important key taste active compounds for universal deliciousness.

Keywords: Umami; Seasonings; Glutamic acid

Introduction

In addition to sustain life, human also consumes diet to enjoy the taste of food. Food contains only small amount of taste and flavor substances but these can dramatically affect on overall consumer's acceptance. Moreover, culinary cultures varying in different part of the world have used many traditional seasonings to add rich flavor for their dishes to enhance the sensory properties. These seasonings, from fermented product such as soy bean, fish and shellfish, are glutamate-rich ingredients which convey umami taste and have had long history of use since 200 BC in China and ancient Rome [1,2]. Fermented product from fish or shell fish is the proteineous product obtained through natural hydrolysis by endogenous enzymes and microorganisms. Obviously, the major change during the fermentation period is the conversion of proteins to small peptides and free amino acids which can develop umami taste together with a typical flavor. Garum and liquamen were high-quality fish sauces used in Greece and ancient Rome. These first grade fish sauces were sold at same price as perfume whereas the fractions from the former residues, called allex and muria, were second grade fish sauces [3]. This long tradition of fermented fish seasonings also continues today in Southeast Asian countries, including Thailand.

The simple and inexpensive method for food preservation is salting which can prevents spoilage and allow fermentation of food product. The salting of fish is commonly used for making fermented fish seasonings in the Southeast Asia region. However, there are no Chinese historical credentials involving to the use of fermented fish products among Thai-Laotian peoples who lived in southern part of the Yangzte River. It may be speculated that the fermented fish production have originated independently in many different locations and the use of this products was adopted by early residents of these people after they entered the Indo-Chinese cape, where probably the fermented fish products had existed [4]. Among several fermented products, fish sauces are the most favored seasonings containing umami substances and they are the indispensable items for cuisine in this area. The sauce is known locally as Nuoc mam in Vietnam, Tuk trey in Cambodia, Patis in Philippines, Bakasang in Indonesia, Ngan-pya-ye in Burma and Nam pla in Thailand [2].

Thai food is unique because of a taste combination between sweet, salty, sour and umami together with flavors from spices and herbs. Thai cuisine is influenced by Chinese and Indian cuisines, for example, the form of stir-frying and curry, respectively. However, Thai cuisine have been adopted by using its own spices, herbs, vegetables, cooking techniques and traditional seasonings to incorporate its own taste, which is different and unique. Moreover, Thailand is divided into four main regions: North, Northeast, Central and South and each region has own traditional culinary by using local ingredients and own traditional seasonings. In this review, Thai traditional seasonings which frequently use in each region are discussed. The selected seasonings are only a part of the traditional seasonings for which analytical data, chemical compositions and amino acid content are available (Tables 1 and 2).

Thai Traditional Seasonings

Nam pla (Thai fish sauce)

Nam pla, is local name of fish sauce in Thailand and found in almost Thai dishes and every region of the country. Thai fish sauce is prepared with fermented fishes such as *Cortica soborna, Stolephorus sp., and Clupeoides sp.* [5]. In fact, traditional fish sauce fermentation is an old technology and the origin of fish sauce has been presumed from a household recipe. However, the increasing of fish sauce demand progressively develops to industries. The fish sauce production in Thailand is mainly consumed locally and export comprises a minor quantity. It was reported that export of fish sauce was average 2,600

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Local Name	Nam Pla	Budu	Pla ra	Tua Nao	Nam Poo	Kapi
Type of seasonings	Fish sauce	Fish sauce	Fish sauce	Soybean paste	Crab paste	Shrimp paste
Region	All region	South	North East	North / North East	North	All region
Properties						
Main ingredients	Sea water fish : *Cortica soborna, Stolephorus indicus, Stolephorus commersonii and Clupeoides sp.*	Sea water fish : *Stolephorus indicus, Clupeoides sp. and Sardinella sp.*	Fresh water fish : *Trichogaster sp., Crossocheilus sp., Cyclocheilichthys sp., Labriobarbus leptocheilus, Puntius gonionotus*	Soy bean	Freshwater crab : *Sesarma mederi and Somanniathelpusa sp.*	Planktonic and *semi-planktonic saltwater shrimp : Acetes erythraeus, Acetes sp., and Mesopodopsis orientalis*
Fermentation Period	18 months	3-6 months	6- 10 months	3-4 days	1 day	4-6 months
Properties	Clear, yellow or brownish yellow color, salty and fishy aroma	A viscous brown liquid with grey colloidal fish flesh and salty	A Yellowish brown to dark brown liquid with fish flesh, salty and little sour with a strong and characteristic flavor	Brownish yellow paste or light brown dried chips with a little salty taste and strong smell	Thick black paste with a salty taste and very strond characteristic aroma	Dark color and strong smell paste with salty taste
Chemical Compositions						
Moisture (%)	70.6-76.7	58.7-74.4	28.9-68.3	13	20.8	26.6-55.0
Total Nitrogen g/100g						
Protein (%)	1.8-2.2	9.3-12.6	7.9-20.3	31.3	30	7.7-27.0
Fat (%)	0.7-4.7	0.9-2.2	trace-6.3	23.4	1.4	0.1-3.9
Fibre (%)	ND	trace-0.5	trace-5.6	15.7	0.6	trace-1.9
Ash (%)	25.6-29.4	15.3-25.7	12.5-28.0	9.1	21.5	17.5-48.7
NaCl (%)	22.8-26.2	13.2-24.8	11.5-23.9	5.1	10.3	14.0-40.1
Total invert sugar (mg %)	ND	0.1-2.3	trace-7.3	0.2	0	ND
Acidity as lactic acid	ND	0.8-3.8	0.5-2.0	3.3	1.1	trace-1.8
pH	5.7-6.0	4.2-6.9	4.1-6.9	5.6	6.6	4.0-8.2
				(one sample analysed)	(one sample analysed)	

Table 1: Thai traditional seasonings and chemical compositions.

metric tons of annum in the period of 1995-1999 [6] and was increasing to 38,800 metric tons in 2008 [7]. The production of fish sauce starts by washing and mixing fishes with salt in the container. The ratio of fish to salt is from 5:1 to 1:1 (w/w). Salt is important ingredient since it controls the type of microorganisms and retards or kills some pathogenic microbes during fermentation. In addition to the chemical composition of fish, microorganisms vary depending upon season, place, species, storage, and catching methods and also have a important role in the control of quality of fish sauces [3]. The salt saturated fish and salt mixture are usually packed tightly in the tank to allow a natural fermentation and topped with more salt to keep the fish below the brine all the time [5,6]. After 12–18 months of fermentation in order to complete protein hydrolysis, the supernatant is first filtrated and transferred from the fermentation tank to the ripening tank for 2-12 week. After ripening, first grade Nam pla is obtained whereas the residue is continually extracted up to 3-4 times for lower quality fish sauces [8].

Thai Public Health Ministry classified fish sauce in Thailand into 3 types based on the production process:

1. Pure fish sauce, which is obtained from fresh fish or fish residue fermented with salt or brine.
2. Hydrolyzed fish sauce can be derived from the fish hydrolysates or other kinds of animals, which are often, treated with hydrochloric acid (HCl) or other hydrolyzing processes that are approved by the Thai Public Health Ministry.
3. Diluted fish sauce, which is received from pure fish sauce or hydrolyzed fish sauce, but is diluted using approved additives or flavoring agents.

In every Thai dish, Nam pla is an indispensable ingredient in Thai cuisine and imparts a unique character to Thai food. It is used for its saltiness and typical flavors or also used to make a dipping sauce with other ingredients. Proteins in fish are hydrolyzed into small peptides and amino acids. The specific aroma and flavors in fish sauces are contributed from small peptides, free amino acids, ammonia, and trimethylamine (TMA) and the cheesy aroma is caused by low molecular weight volatile fatty acids, especially ethanoic and n-butanoic acids [9]. According to the Thai Industrial Standard, NaCl content in Nam pla should be more than 200 g/L and total nitrogen content must be more than 20 g/L. The pH value of Nam pla should be between 5.0 and 6.0. Amino acid nitrogen content is between 40–60% of the total nitrogen. Glutamic acid content per total nitrogen should lie between 0.4 and 0.8 [10].

The most abundant total amino acids present in Nam pla are glutamic acid, lysine and alanine, respectively, whereas the most abundant free amino acids are glutamic acid, lysine and aspartic acid, respectively, (Table 2, Figure 1A and 2A) [2,11]. Together, they comprise about 40% of free amino acid content. However, in 1961, it was reported that the taste quality of Nam pla was mainly based in glutamic acid, histidine and proline [2]. Accordingly, the chemical sensory factors which imparted typical good taste in fish sauce relate to umami taste substance.

The study from 102 families in north and north east of Thailand found that fish sauce consumption was 13.4 ± 10.8 ml/person/day [12] while another study revealed that fish sauce consumption in Thai population was estimated 17-20 ml/person/day [6]. These suggest that glutamic acid consumption from fish sauce in Thai people is approximately 320-390 mg/person/day and 130-160 mg/person/day in free form (calculated from specific gravity of fish sauce: 1.19-1.24 [5]).

Table	Nam pla		Budu		Fermented Fish		Fermented bean		Kapi	
Country	Thailand	Thailand	Thailand	Malaysia	Thailand (Plara)	Cambodia (Plahoc)	Thailand (Tua nao)	Japan (Natto)	Thailand	Thailand
Amino acids (mg/100g)	Total amino acids	Free amino acids	Total amino acids	Free amino acids	Total amino acids	Free amino acids	Total amino acids	Free amino acids	Total amino acids	Free amino acids
Asp	662	760	520	362	486	481	4475	33	1880	1047
Thr	503	460	257	229	330	308	1513	48	955	104
Ser	283	360	132	163	233	230	2088	57	578	84
Glu	2345	950	1259	620	745	1579	7728	136	3061	1647
Pro	339	230	273	0	345	0	2391	1	810	412
Gly	356	340	287	174	599	179	1676	26	1041	764
Ala	796	700	374	406	589	661	1833	48	1201	1186
Val	699	590	308	373	300	638	1674	73	1091	667
Cys	72		59	97	75	0	455	0	234	744
Met	271	230	173	220	143	408	559	40	412	349
Ile	405	360	297	318	327	408	1622	67	1178	565
Leu	543	450	537	464	512	968	3078	177	1570	946
Tyr	84	50	144	157	455	0	1450	139	708	597
Phe	393	310	249	174	315	0	2347	207	917	425
Trp	68	90	78	0	110	0	552	24	33	0
Lys	1013	890	628	556	530	812	2263	90	1591	1099
His	378	320	418	190	250	280	1081	53	442	132
Arg	0	0	130	15	310	0	2403	24	530	39
Total	9180	7090	6123	4518	6654	6952	39188	1243	18529	10807
Ref.	[11]	[2]	[11]	[2]	[11]	[2]	[11]	[2]	[11]	[2]

Table 2: Amino acids in traditional seasonings.

Budu

Budu is another fermented fish product and widely use in Malaysia and southern part of Thailand. It was prepared by fermentation of fishes such as *Stolephorus sp, Clupeoides sp. and Sardinella sp.*, with salt in the proportion of 3:1 to 2.5:1 (w/w) in the earthen jar. The jar is topped with more salt to press fishes in order to enhance osmotic dehydration and covered with a bamboo mat [5]. The rate of fermentation and end product formation are different from Nam pla. After 3-6 months, raw Budu is filtrated before bottling. This product is turbid with heavy sediments and has a darker appearance than Nam pla. The study of biochemical changes in Budu from Malaysia demonstrated that protein conversion rate increased dramatically in the first 60 days of fermentation and then became quite constant over the period of 100-200 days of fermentation. Amino acid nitrogen changed from 36.3 to 66.3% within a 5-month fermentation period. There was 1.77% of total-nitrogen (organic) and 1.17% of amino-nitrogen in Budu [13]. Unfortunately, the information about biochemical changes and free amino acid profile in Thai Budu has been limited. However, the preparation and main ingredients of Budu in Thailand and Malaysia are quite similar [6]. The total amino acids in Thai Budu and free amino acids in malaysian Budu are much lower than in Nam pla as shown in Table 2 [2,11]. Nevertheless, similar to Nam pla, the most abundant amino acids in Budu is glutamic acid in both of total and free amino acids as shown in Table 2, Figure 1B and 2B [2,11]. These suggest that the taste active components are also related to umami taste substance as same as in Nam pla.

Budu is used as seasonings and eaten by adding chili, shallots, sugar and lime juice in the southern part of Thailand whereas, in the central region, it is boiled with lemongrass, galangal and bitter orange leaves, then poured out and consumed with rice and various vegetables [5].

Pla ra

Pla ra is traditional fermented fish product which is popular in every region of Thailand, especially, in the northeastern and northern parts of Thailand. This fermented fish product also generally use in Lao and Cambodia known as Pa-dag and Pa-hoc, respectively [14]. Mostly Pla-ra is prepared from fresh water fish such as *Trichogaster sp., Crossocheilus sp., Channa striaus, Cyclocheilichthys sp., Labriobarbus leptocheillus, and Puntius gonionotus*. Fishes were scaled; excrement and the insides of the fish were removed and then washed them thoroughly in clean water. After drained, salt is added in the ratio 3:1 to -5:1 (w/w). Higher salt content gives a longer fermentation period, longer storage life and a better taste and smell whereas lower salt content gives a rapid fermentation but strong smell. Afterward, salted fish is mixed with one part of roasted or normal rice in the ratio 10:1 whereas, in the northeastern part, rice bran is often used in the ratio 5:1. Then, the mixed fish is packed in narrow neck earth ware jar and leave to ferment for at least 6 months under shade [5,15]. All of the ingredients give a characteristic flavor and color of product. Rice or rice bran serves as a source of carbon for fermenting microorganisms; in addition, it caused brown color from the non-enzyme maillard reaction which is the reaction of amine and amino acid with reduced sugar group [16]. The final product should have no fishy flavor and should have a typical odor and flavor of Pla ra [17].

Pla ra is eaten as condiments, together with shallots, lemongrass and chili, with vegetables and rice. It is also use as seasoning to make soup or salad. It was reported that Pla ra had greater content of calcium and phosphorus than fresh fish because of decomposition process of fish bone and another structures by microorganisms during fermented process [15,18]. Unfortunately, the free amino acid profile in Pla ra has been limited. The total amino acid profile in Pla ra was not related to free amino acid profile in Pla hoc (fermented fish product in Cambodia) which could explain by the different raw materials, only salt was added during fermentation and some different processes in pla hoc preparation. However, glutamic acid is the most abundant of both total amino acids in Pla ra and free amino acids in pla hoc as shown in Table 2, Figure 1C and 2C [2,11]. These suggest that the preferred typical taste

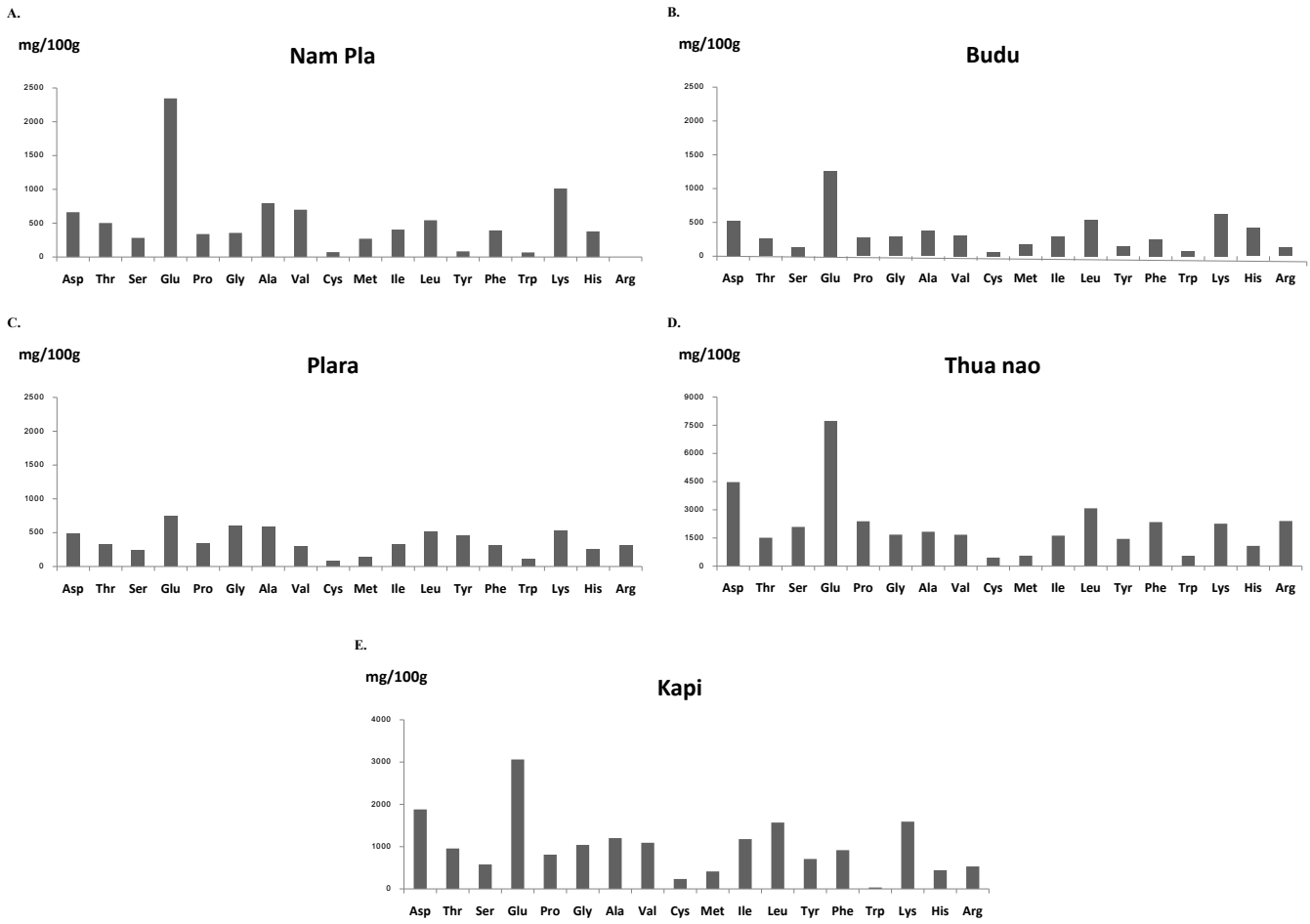

Figure 1: Total amino acids in Thai traditional seasonings.

in these fermented fish products are also related to umami substance as same as in Nam pla and Budu.

Thua nao

Thua nao is a Thai fermented product from soybean by *Bacillus* and it has a special flavor and aroma. It is generally produced in the north of Thailand. The process began with washing the soybean and soaked overnight. The day after, the washed soybeans were then boiled for 3-4 hours to soften the seeds and the water was drained off after boiling. The cooked beans were spread on a layer of banana leaves on a bamboo tray and also cover or be wrapped with the leaves. It leaves to ferment for 3-4 days in a sunny place for fermentation. After fermented process, the fermented beans are ground to the paste and, then, mixed with a small amount of salt, minced garlic and pepper. In the northern part, the paste may be spread in small thin patches and sundried to form chips. These sundried products sometimes also are roasted and ground into powder [5,19].

Thua nao is a proteolytic fermentation of soybeans which is similar to Japanese fermented whole soybean, called natto. However, Thua nao has a different aroma, which comes from ammonia. Since Thua nao is still made by traditional method with a mixed natural microflora whereas natto is now fermented by pure culture of *Bacillus subtilis*. Although, natto is eaten uncooked as a relish with rice, Thai fermented soybean is used generally as seasonings for enhancing flavor in soups, curries or as a substitue for shrimp paste in north of Thailand [19]. As shown in Table 2 and Figure 1D, the most abundant amino acids in Thua nao are glutamic acids (7,728 mg/100g) [11]. Unfortunately, the free amino acid profile in Thua nao has been limited. Moreover, the most abundant free amino acids in Natto are phenylalanine, leucine tyrosine and glutamic acid as shown in Table 2 and Figure 2D [2]. These suggest that the good taste in Thua nao might relate to umami substance.

Nam poo

Nam poo is traditional crab paste and generally used in northern part of Thailand. It is prepared by fresh water crab such as *Sesarma mederi and Somanniathelpusa sp*. The living crabs are washed and put them in a mortar to grind and mix with a little of water and some herbs such as lemongrass, galangal and guava in order to mask the fishy smell of crab. Then, the mixture is pressed to obtain the first liquid portion though a bamboo sieve with mesh about 2-3 mm. The solid portion is returned to the mortar and, then small amount water is added in order to extract the second and third liquid portions. All liquid portions are pooled together and leave to ferment overnight. The next morning, this liquid is gently cooked at low temperature with salt until it turns to a final product as dark paste [5]. People from north of Thailand use Nam poo as seasonings in salad and dipping sauce in the same way as Pla ra in northeastern region in order to obtain the distinctive flavor.

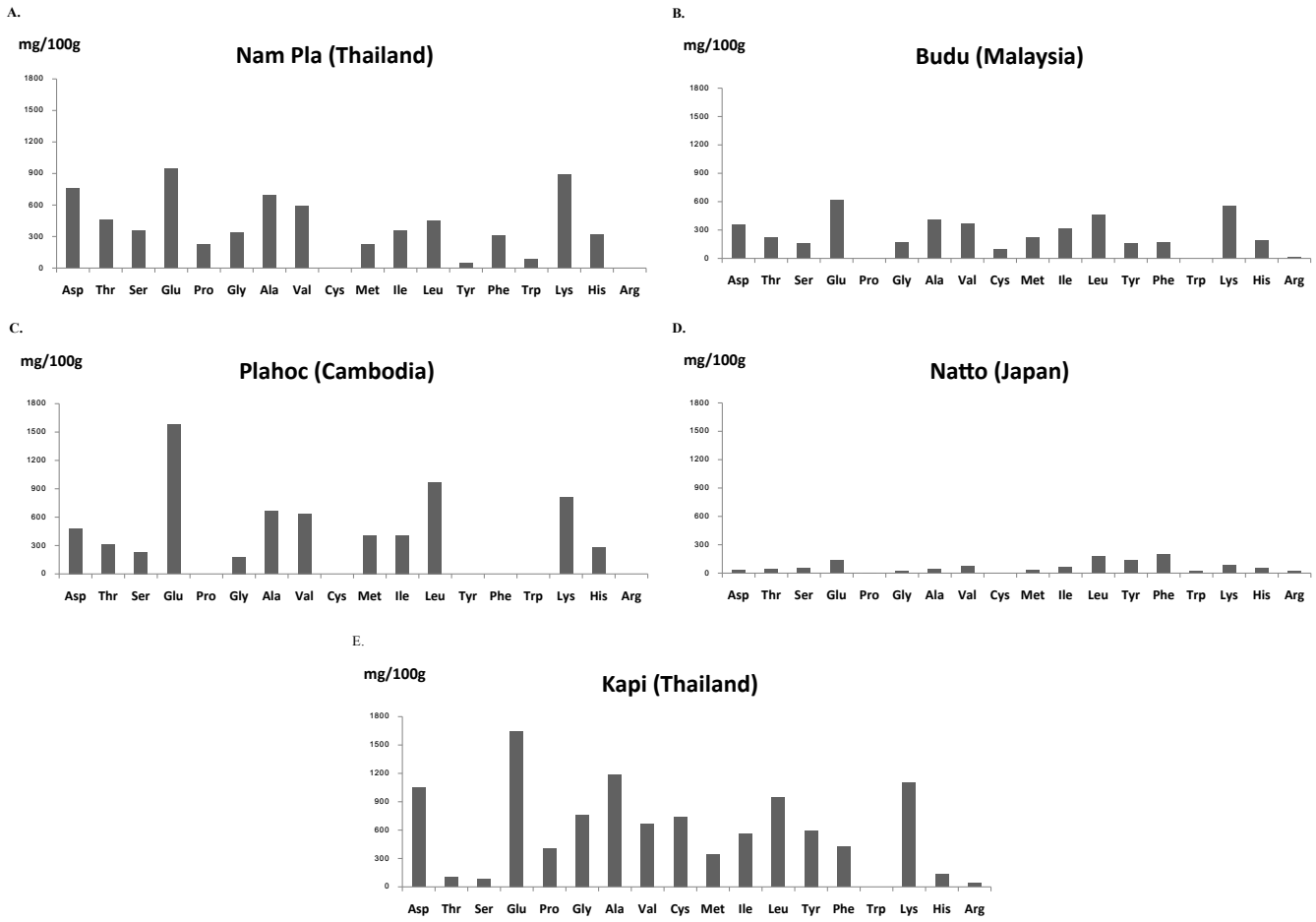

Figure 2: Free amino acids in seasonings from fermented products.

Disappointingly, the information about amino acid profile in Nam poo has been limited.

Kapi

Kapi is a typical fermented shrimp paste and commonly used in Thai cuisine in every region of country. The color of Kapi diverges slightly depending on the raw materials used. It is generally prepared from planktonous shrimp *(Acetes erythraeus, Acetes sp., and Mesopodopsis orientalis)* with salt at a ratio 5:1-3:1 (w/w). The mixture is reduced the moisture content by sundry and then minced thoroughly until it becomes sticky paste. This paste is tightly packed in the earthenware jar. Afterward, it is allowed to ferment at least 4 months until the desired aroma has developed [5,20]. During fermentation, Protein hydrolysis of shrimp paste is mediated by microbial or indigenous proteases. Consequently, short chain peptides and free amino acids are released, resulting in the formation of typical flavor and taste [21].

Kapi has been consumed extensively as condiment in Thailand. It is also main ingredient used for flavoring dished and in various spicy soups in Thai cuisine. Kapi is also applied to make a condiment mixed with garlic, chili and lime juice or tamarind in various dipping sauces for vegetables [5]. Moreover, the amino acid profile, as shown in Table 2, revealed that glutamic acid was the most abundant amino acid, found in Kapi, in both total amino acids and free amino acids (Figure 1E and Figure 2E) [2,11]. These data demonstrate that Thai traditional shrimp paste is rich in umami substance. Apart from serving as a good source of proteins, this shrimp paste also use for rendering the characteristic flavor and taste in daily dishes.

Conclusion

Thai cuisine is unique and has a combination of various tastes. These tastes are mainly mediated by raw materials and traditional seasonings which are glutamate-rich ingredients. Umami taste components are not only glutamate, nucleotides such as inosinate and guanylate also convey umami taste. Unfortunately, study of nucleotide contents in Thai traditional seasonings has been limited. However, these suggest that Thai people from different regions use traditional seasonings as indispensable items in order to add the rich flavors and tastes, especially umami taste, in their daily dishes, despite of different methods. Umami taste, a pleasant savory taste, might be the limiting factors for food acceptability and imparted a unique character of Thai food. Umami taste has also an ability to enhance food palatability and sensory properties [22]. However, awareness of umami taste might be difficult in Thai people. Since Thai food has a variety of tastes and umami could harmonize with other tastes. In addition, Thai food has strong flavors from herbs and many dishes are also spicy from chili. Nonetheless, the effect of spicy on umami sensation remains unclear and further study to understand the relation between spicy and umami awareness are required.

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