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THE IMPACT OF INDONESIAN *TERASI* IN THE BEEF CONSOMMÉ, A SENSORY ASSESSMENT

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ABSTRACT

The aim of this research was to investigate the impact of *terasi*, a traditional Indonesian condiment which is made from salted fermented seafood, on the sensory acceptance of beef consommé. Fifty four panelists compared the acceptance of beef consommé containing *rebon terasi* to the consommé containing fish *terasi*. The results showed that upon adjusting the salt content, the consommé containing *rebon terasi* was more preferred than the consommé containing fish *terasi.* By combining more strong spices or ingredients the acceptance of consommé might be improved while masking the pungent odor of *terasi*. In addition, six different types of *rebon terasi* varying in proximate composition, salt and water activity (a_w) were added to beef consommé and were evaluated by 10 trained panelists for their specific intensity of taste/flavor (saltiness, sourness, sweetness, bitterness, umami, fishy and *rebon*). Together with those samples, other consommés were also compared; however, the salt was also added to adjust with the highest salt content among six types of *terasi.* The results showed that variations of *terasi* influenced the sensory characteristics of consommé. The salt content of *rebon terasi* influenced the sourness, bitterness and saltiness in consommé, whilst the salt content should also reach the certain level to fit their acceptance. The distinct flavor from each *terasi* did have a profound effect on the sensory acceptability. The knowledge of the flavor characteristics of consommé and the role of *terasi* when mixed in consommé will help to improve the sensory acceptability and marketability of *terasi*.

Keywords: terasi, consommé, sensory analysis, flavor, taste

BACKGROUND

Terasi, a traditional condiment of Indonesia, is a salty fermented paste, consisting of underutilized seafood (although mainly made of planktonic shrimp, known as *rebon*). Seasoning products, similar to *terasi* are found throughout Asia, such as belacan in Malaysia; kapi in Thailand and Cambodia; bagoong-alamang in Philippines; Mam-ruoc or Mam-tom in Vietnam; jeotgal/jeot in Korea; and ngapi seinsa or hmyinnga-pi in Myanmar (Hajeb and Jinap 2015).

Salting and fermentation techniques influence the uniqueness of these products (Lee and Kim 2012), which are also associated with the variations of the local environment, monsoon climates, soil composition, and eating habits of rice-based diet people. During salting and fermentation, chemical and biochemical

reactions such as the protein and lipid oxidation, Maillard reactions, Strecker degradation, result in many flavor-active compounds that generate meaty, savory, amino acid/peptide flavors (Steinkraus, 2002).

Belacan contributes to the pleasant aroma of grilled prawn, smoke and *rebon* aroma, and salty, shrimpy and meaty tastes, although it depends on the type of food prepared with it (Jinap et al., 2010). The pungent odor of this fermented seafood (Park et al. 2001), sometimes discourages non-consumers from consuming it. However, by heating *terasi* (if cooked, roasted, or fried) the odor could be more neutral (Moeljohardjo, 1972). Adding stronger flavorful ingredients such as onion, chili, garlic, ginger and other spices, might also mask the odor of *terasi*, whilst the common use of *terasi* is to add into chili sauce (*sambal terasi*), or added to various dishes, either to rice in a complete meal, snacks, vegetables, or fruit dishes. This incorporation might give a very distinctive taste/flavor when compared to other Southeast Asian dishes (Owen, 2008).

Although commonly used, so far there is no study related to the role of *terasi* as flavor enhancer; especially towards beef consommé. The frequent use of monosodium glutamate, 5'nucleotides, or the addition of extra salt, sugar, and acid ingredients to Indonesian dishes makes it difficult to ascertain the role of *terasi* itself in the taste/flavor of the dishes. In addition, great variances of *terasi* were also found in the markets. Therefore, this research was carried out to evaluate the impact of variations of *terasi* on the sensory acceptance and the characteristics of *terasi* in beef consommé.

MATERIALS AND METHOD

Materials

For experiment 1, one type of fish *terasi* from South Sumatera, and one type of *rebon terasi* from East Java (in experiment 2 was coded as F), were used. For experiment 2, six different types of *terasi* were collected from six famous regions for *terasi* production and/or markets in Indonesia. They were coded as A (from West Java), B (from Jakarta), C (from North Sumatera), D (from Central Java), E (from West Kalimantan), and F (from East Java).

Although the composition data were not shared by the producers, *terasi* D, and F contained salt, and *rebon*; while *terasi* A was also composed of small fish and rice bran. While *terasi* B, C, and E were taken from markets, without detailed information about their ingredients except a label stating it contained *rebon* and salt. Samples were selected amongst 82 samples from previous experiments of clustering the profiles of free amino acids content, contributing to the flavor of foods. Prior to this experiment, the protein, fat, moisture, ash, NaCl (salt) content, and the water activity ($_a$w) were determined. The results can be found in Table 1. Samples were derived from the same batch of production.

Table 1. Proximate composition, salt (g/100g; wet basis) and water activity (a_w) of *terasi*

Parameter	Rebon terasi (experiment 2)						Fish terasi
	A	B	C	D	E	F**	**
Moisture	27.0 ± 0.2^{a}	30.9 ± 0.0^{b}	32.2 ± 0.3^{b}	27.5 ± 0.2^{a}	37.4 ± 0.4^{c}	35.2 ± 0.1^{c}	36.4 ± 0.4
Protein	22.6 ± 0.0^{a}	37.0 ± 0.2^{c}	$31.5 \pm 0,1^{b}$	42.8 ± 0.4^{e}	41.6 ± 0.5^{e}	38.7 ± 0.0^{d}	36.6 ± 0.4
Fat	2.3 ± 0.1^{a}	3.9 ± 0.2^{b}	$2.2 \pm 0,5^{ab}$	4.5 ± 0.4^{c}	3.6 ± 0.1^{bc}	3.8 ± 0.1^{bc}	3.5 ± 0.1
Ash	43.4 ± 0.1^{f}	24.7 ± 0.2^{d}	30.9 ± 0.5^{e}	17.9 ± 0.1^{b}	11.9 ± 0.2^{a}	19.1 ± 0.3^{c}	21.9 ± 0.2
Carbohydrate	4.7 ± 0.1^{c}	3.5 ± 0.2^{b}	3.2 ± 0.8^{a}	7.3 ± 0.65^{d}	5.5 ± 0.2^{c}	3.2 ± 0.1^{ab}	1.6 ± 0.2
Salt	32.8 ± 0.2^{f}	11.8 ± 0.0^{c}	22.7 ± 0.2^{e}	10.3 ± 0.0^{b}	4.6 ± 0.0^{a}	13.1 ± 0.0^{d}	15.6 ± 0.0
Aw*	0.7 ± 0.0^{b}	0.7 ± 0.0^{a}	0.7 ± 0.0^{ab}	0.7 ± 0.0^{a}	0.8 ± 0.0^{c}	0.7 ± 0.0^{a}	0.8 ± 0.0

All data are expressed as the mean ± SD from three independent replications. Means with different letters are significantly different ($p < 0.05$) for each parameter (row); *: no unit; ** used in experiment 1

Consommé Preparation for Experiment 1 and 2

A base of beef consommé was prepared by extracting beef short ribs with water together with spices such as nutmeg, cinnamon, clove, garlic, onion, ginger, lemon grass, black paper, palm sugar with continuous simmered for three hours. The extract was strained and cooled down overnight in the refrigerator and further filtered to get a clarified broth (consommé). The consommé was added with 2% dry matter (DM) of *terasi* and then heated to boiling temperature and after it had cooled down, filtered through a 0.45 µm pore size PTFE syringe filter. For the experiment 1 salt was added to adjust the salt content of consommé containing *rebon terasi* as it salt content was less than the consommé containing fish *terasi* and for the experiment 2 there was no salt addition but more spicy ingredients were added to reduce the pungent odor of *terasi.*

Experiment 1: comparison between rebon terasi with fish terasi

This sensory analysis was done to ensure whether the variations between *rebon terasi* and fish *terasi* would give an impact towards the sensory acceptance of consommé. The acceptability/liking of consommés containing *terasi* was evaluated by 54 untrained panelists, by using a hedonic scale, namely, 1 (dislike very much); 2 (dislike moderately); 3 (dislike slightly); 4 (neither dislike nor like); 5 (like slightly); 6 (like moderately); 7 (like very much) towards attributes of taste/flavor (sweetness, saltiness, sourness, bitterness, umami, *rebon*, and fishy) and overall taste/flavor. Panelists were students and staff of UPH Karawaci (43 females; aged between 18-43 years); and had participated in similar tests of other food products. They had no respiratory problems and did not consume any food at least 30 minutes before sensory testing. They were served individually with 10 ml of each consommés sample on small shot plastic container, coded with a random three-digit number. They each tasted a 0.5-1 ml sample of consommé using a tea spoon, in a sensory panel booth at 24°C, red lighted room. Plain crackers and water were prepared to rinse the palate.

Experiment 2: the effect of different type of terasi on the consommé sensory characteristics

This sensory analysis was done to profile the sensory characteristics of consommés especially towards the impact of *terasi* variations. Trained panelists were served individually the consommés as described in the experiment 1. Panelists rated the intensity of the consommés for each respective taste/flavor using 15-cm unstructured line scales (0: absence of taste/flavour, 15: the maximum taste/flavor).

Selection of panelists and training panelists

Ten trained panelists (9 females, aged between 23-43 years), were selected from 72 panelists (students and staff at UPH), based upon 75% accuracy through a series of basic taste test identification and simple difference test. All of them had experience in sensory analysis techniques and underwent subsequent training in sensory evaluations. They were non-smokers; had no allergic reactions towards seafood; were not using dentures, perfumed cosmetics, or medications during tasting. They were trained six times during a two-hour session, and practiced triangular tests, and same different tests; taught and familiarized about the sensory vocabularies of consommé and rated the intensity of the sensory attributes using 15-cm unstructured line scales.

A consensus was reached through group discussions towards the sensory attributes and reference materials used during the training, i.e. sweetness (sucrose), saltiness (NaCl), sourness (vinegar), bitterness (caffeine), umami (monosodium glutamate), *rebon* (dried *rebon*), and fish (dried anchovies), as well as the scores. After each training session, the panelists had a feedback discussion to improve and standardize the scores (intensity) for each attribute of taste/flavor.

Data Analysis

SPSS 22 (IBM, New York, USA) was used for the statistical analyses and was set to a 5% confidence level. Raw (non-normalized) sensory data were used. The Spearman's correlation test was done to link the possible relationship to each taste/flavor of the consommés.

RESULTS AND DISCUSSIONS

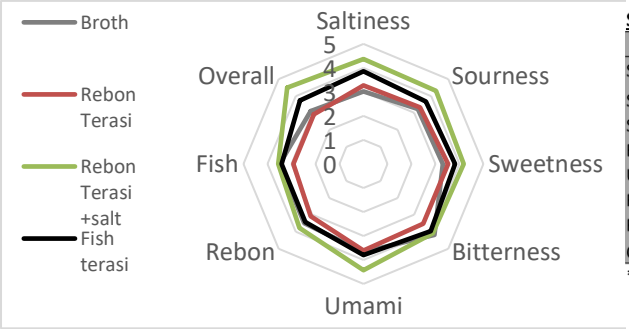
Experiment 1: Comparison between Rebon Terasi with Fish Terasi

The hedonic sensory results indicated differences in the acceptance for consommé containing the fish or *rebon terasi* ($p<0.05$). Figure 1, left, shows that the addition of *terasi* generally improved the acceptance of consommé. The consommé itself was prepared with less spicy ingredient to ensure the specific effect of *terasi* itself towards the consommé, which probably one of the reasons of its low hedonic scores. Without the addition of salt, consommé containing *rebon terasi* was less preferred compared to the fishy *terasi*, probably the saltiness intensity was not strong enough to satisfy panelists. And upon salt addition, adjusted to the same salt content of the fish *terasi*, the consommé was better accepted and enhanced than the consommé containing fish *terasi* ($p<0.05$), overall taste/flavor became richer. For a certain degree, there might be a certain acceptable level for saltiness for consommé and below that level the overall taste/flavor would be plain, salt harmonized taste/flavor. This also in line with the correlations (Figure 1, right), showing that all tastes and flavors were positively correlated each other, especially the overall taste/flavor to the saltiness and umami tastes.

The typical *terasi* flavor, either *rebon* or fishy flavor, was a dominating factor in the acceptance of consommé. Some panelists were dissatisfied and considered them as too strong and becoming off flavor to the consommé. Köster (2003) and Cardello (1995) found that personal experiences and familiarisation toward a certain food influence the consumer judgement and choice. The familiarity may relate to a particular substance and the frequency of its consumption (Rozin and Fallon 1986). The fishy odor, resulted from the reaction between lipid autoxidation of polyunsaturated fatty acids with trimethylamine and dimethylamine (Durnford and Shahidi 1998), decreases *rebon* flavour. No matter *terasi* was made from *rebon*, fishy flavor will always be present. Avoiding this fishy odor formation during fermentation and storage is impossible, although reducing its intensity is still possible by maintaining the quality of fresh ingredient and reducing the aging process. Choi, Kobayashi and Yamanishi (1983) found that fermentation could increase 4-fold the amount of odor concentrates of fresh *rebon Acetes japonicas*. The cooked fresh *rebon* mainly contained thialdine, isovaleraldehyde + ethanol and pyrazine, while the cooked fermented *rebon* mainly contained pyrazines, isovaleraldehyde + ethanol and furfuryl alcohol. These products were decomposed during fermentation from amino acids with other decomposed compounds. These compounds could mask the fishy odor in the fermented product. As the fermentation, raw material, aging process might be different for each *terasi*, the perceived fishy or *rebon* flavor tended to be varied. These flavors might lead to rejection of foods (Köster 2003).

The use of spicy ingredients might also mask the taste/flavor. Some panelists said that the spicy ingredients were not strong enough to mask the fishy flavor, therefore, experiment 2 used more powerful spices. Takahashi, Nagayama and Mori (2004) found that even spicy ingredients could mask the spoiled food smell. The addition of spices increased the hedonic acceptance (Chi and Chen 1992) and satiety for short-term intake (Westerterp-Plantenga et al. 2005). Overall, there are numerous characteristics of a product which significantly influence food acceptability (Cardello 1995). Future researchers would fare better to differentiate between the regular consumers of consommé and the non-regular consumers; and the specific cuisine preferences

within different cultures. This differentiation will link to the target taste preferences of consumers (market segmentation). Thereafter, target links to consumerability can be made.



Spearman's rho correlation

	Saltiness	Sourness	Sweetness	Bitterness	Umami	Rebon	Fishy	Overall
Saltiness	1							
Sourness	,545**	1						
Sweetness	,540**	,598**	1					
Bitterness	,338**	,390**	,494**	1				
Umami	,616**	,529**	,559**	,453**	1			
Rebon	,381**	,307**	,394**	,249**	,525**	1		
Fishy	,348**	,422**	,440**	,406**	,478**	,618**	1	
Overall	,653**	,515**	,544**	,397**	,650**	,561**	,538**	1

** Correlation is significant at the 0.01 level (2-tailed).

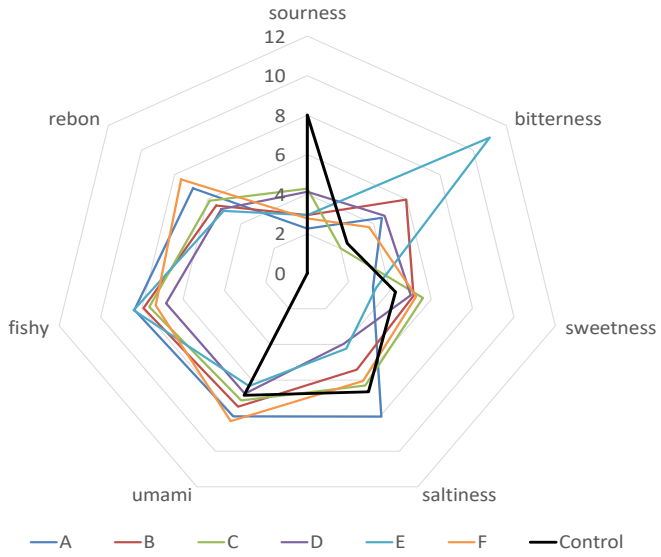
Figure 1. The comparison between the acceptance of consommé containing *rebon terasi* with fish *terasi* (left) and the correlation among the acceptance of each taste/flavor (right)

Experiment 2: The Effect of Different Type of Terasi on the Consommé Sensory Characteristics

Although all six *terasi* were made from *rebon* and containing similar base of consommé, the sensory profile of all consommés, tended to be different (Figure 2, above), indicating some interactions between *terasi* and the consommé. The interactions were probably shown through the correlation among each taste/flavor (Figure 2, bottom). This experiment showed the impact and the complexity of *terasi* although only added at 2% to the consommé. The intensities perceived of saltiness, sweetness and bitterness were greatly varied among consommés. Although there is no correlation between sweetness and bitterness, it is commonly found that sweetness and bitterness were acting conversely, however the saltiness tended to counteract the bitterness in consommé. This is indicated by the negative correlation. The salt content was also confirmed to have significant impact to the sensory characteristics of consommés (p<0.05) (data not shown). The highest bitterness from consommé containing *terasi* E was probably due to the lowest salt content of *terasi* E. Salt even stood out more than the umami in the high concentration of NaCl and glutamic acid mixture (Ikeda 2002), showing that the salt role in the sensory cannot be fully replaced. Manabe et al (2009) found that the fishy flavor could enhance the saltiness intensity of food containing seafood. This is confirmed by the correlation of *rebon* flavor which was positively correlated to saltiness. *Rebon* also positively correlated to umami and fishy flavor and negatively correlated to the sourness. Therefore, the more pronounced the *rebon* is perceived the stronger will be the saltiness, umami and fishy flavor of consommé. This experiment is also in line with experiment 1, indicating the intangible role of *terasi* to give the congruent taste/flavor to reach the minimum acceptance level of consommé. The distinct flavor from each *terasi* did also have a profound effect on the sensory acceptability.

In the former research, similar six *terasi* were also added to chili sauce to produce *sambal terasi*. The free amino acids in *terasi* were found contributing to the taste/flavor of *sambal terasi*. These free amino acids (data not shown) were also indicated from the protein content, which were found to be higher and varied than other major compositions of *terasi*. Free amino acids were suggested to be the major contributor to the taste/flavor of seafood (Konosu, 1979) and also in their fermented products (Yoshida, 1998), like *terasi*. The major

contributors were generally derived from the glutamic acid, alanine, glycine, leucine, and lysine. In addition, the presence of calcium, magnesium and potassium in *terasi*, which significantly differ within *terasi* samples (p<0.05) (data not shown) might also contribute to the sensory characteristics of consommé, especially their saltiness and bitterness. These salts vary in bitterness and/or aftertaste, beside other congruent taste(s), resulting in more complex taste/flavor (Young and Lawless 2005). People sometimes add sour tasting ingredients to improve the overall taste/flavor of consommé; however, the correlation (Figure 2, bottom) showed tricky options as sourness tended to decrease the umami taste, the expected taste in consommé. On the other hand, the sourness tended to decrease the bitterness, fishy and *rebon*, the unexpected taste/flavor in consommé. The sourness also tended to enhance the sweetness of consommé thereby this sweetness might enhance the umami taste in consommé. Bellisle (1999) found that umami sometimes is linked to the balance of sweetness and saltiness which still in line with this correlation. Umami along with the actual flavor of compatible foods increases the mouth-fullness of food, giving a more pleasant taste (Yamaguchi and Ninomiya 2000).



Spearman Correlations

	Sourness	Bitterness	Sweetness	Saltiness	Umami	Fishy	Rebon
Sourness	1						
Bitterness	-,406**	1					
Sweetness	,277*	-	1				
Saltiness	-	-,437**	-	1			
Umami	-,286*	-	,337**	,560**	1		
Fishy	-,567**	,435**	-	-	,313**	1	
Rebon	-,601**	-	-	,279*	,527**	,429**	1

Correlation is significant at ** the 0.01 level (2-tailed); * the 0.05 level (2-tailed).

Figure 2. The effect of different type of *terasi* on the consommé sensory characteristics (above) and their correlation among each taste/flavor (bottom)

CONCLUSION

Differences in the types of *terasi*, either from raw material or salt content, were found to cause different sensory acceptance and characteristics of beef consommé. The distinct flavor from each *terasi* did have a profound

effect on the sensory acceptability. Thereby to a certain degree, additional salt and more powerful spices ingredients tended to improve the overall taste/flavor of consommé.

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