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# Preference Direction Study of Sai Oua by External Preference Mapping and Modified Ratio Profile Test

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## ABSTRACT

To study the preference direction of consumers of the Thai traditional Northern-style sausage, Sai Oua, this study selected four products from fresh markets in Chiangmai and a fifth product was produced by the reseaech team. External preference mapping showed that 100 Thai consumers could be clustered into 2 main groups by preference direction. The first preference direction group preferred products which were high in tenderness and juiciness, but less in undesirable meaty and rancid flavours, whilst the second group preferred products which were high in curry paste, lemongrass, and bergamot leaf flavours, but less in saltiness. The result of modified ratio profile test also showed that another group of 100 Thai consumers could be clustered into 2 main groups. The first group preferred products which were high in tenderness, juiciness, and intensity of curry paste, but moderate in lemongrass and bergamot leaf flavours and saltiness, and low in undesirable meaty and rancid flavours. Another group preferred products which were very high in curry paste, lemongrass, and bergamot leaf flavours, tenderness, and juiciness, and low in undesirable meaty and rancid flavours. Even though the results of both methods were not exactly similar, some agreements were found.


**Key words:** preference direction, external preference mapping, ratio profile test, Sai Oua

## INTRODUCTION

Sai Oua is a Thai traditional northern-style sausage originated from the Chiangmai region of northern Thailand. It is one of the most popular food items requested by Thai visitors from other regions. This sausage has been popular because it is spicy, tangy and full of Thai curry paste flavours such as bergamot leaf, lemongrass, galangal, chili, and garlic. Sai Oua is made by mixing a typical Thai curry paste with ground pork then stuffing the mixture into a pork intestine and frying or grilling it to produce a spicy red sausage. It is traditionally served with sticky rice, and a side dish of cabbage, fresh chopped chilies, peanuts, coriander sprigs and raw sliced ginger.

Market opportunity for Sai Oua can be improved if producers know which product characteristics are important and how consumers could be satisfied. To identify important factors preference direction may be investigate using external preference mapping and the ratio profile test.

An external preference map is a picture that shows how products are perceived on specific features or attributes in 2 dimensions, and positions

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of products on the map are related to their liking or acceptance scores with a suitable model which it may be linear, quadratic, circular, elliptical, or etc (MacFie and Thomson, 1994). Many sensory and product development researchers have used this technique to identify sensory attributes that influences the acceptance of products. Some examples of recent publications using external preference mapping are Farley and Reed (2005), and Thompson *et al*. (2004).

The ratio profile test or ratio profile technique (RPT) it is a sensory method developed by Cooper *et al*. (1989). In this method, panelists rate the intensity of selected attributes of sample products on the line scale, and express the intensity of their ideal product for each attribute. The intensity of sample and ideal product ratio for each panelist shows the direction to develop products for them. A ratio mean close to 1.00 indicates that the attribute of sample is similar to what panelists desire (Pairoj, 2004). However, this technique may not be popular since it may be criticized about consumer panelists in three major cases including the ability to discriminate samples, the difference of using scale, and the difference of preference. For the ability to discriminate samples, there are a number of researches showing that consumers are able to distinguish the difference between products using line scales (Moskowitz 1996, 1997). In cases of the differences of using scale and preference, they could be solved by statistical methods. Transformation of data from each panelist to standard scores can make all data on the same basis, and cluster analysis can separate different consumer groups (Jacobsen and Gunderson, 1986). With above statistical methods, ratio profile test may be more reliable.

This research was aimed to apply external preference mapping and modified ratio profile test for studying the preference direction of Sai Oua, and to compare results.

## MATERIALS AND METHODS

### 1. Sample

Sai Oua from 4 fresh markets in Chiangmai were bought and used as samples together with a prototype product from the reduced fat Sai Oua project.

### 2. External preference mapping

#### 2.1 Data collection and preparation

Nine assessors were selected by taste and odour recognition test (modified from ISO 8586-1: 1993). They were requested to evaluate five selected Sai Oua for creating sensory quantitative descriptive analysis (QDA) data by developing vocabularies for describing Sai Oua sensory characteristics and rating intensity on a 15 cm line scale (modified from Stone, 1992). These QDA data were standardized and were then reduced by principal component analysis. A number of principal components (PCs) whose eigenvalues were over 1.00 were selected to be representatives of their highly related QDA data. Simultaneously, these five products were evaluated by 100 Thai consumers (18-50 year old people who frequently eat Sai Oua) to get their preference scores on 9-point hedonic scale. These hedonic scores were standardized and were then analyzed by cluster analysis to classify the difference of consumer preference.

#### 2.2 Data correlation

The bivariate correlations were used to obtain the relationships of selected PC and standardized hedonic data for each consumer preference group.

#### 2.3 Creation of external preference maps and preference directions

Each pair of PCs highly correlated to standardized hedonic data was used to create a map and the selected products were positioned on that map. The product positions and standardized hedonic scores were regressed to create an equation of preference direction for each consumer

preference group (MacFie and Thomson, 1994). Each preference direction equation could explain consumer preference.

**3. Modified ratio profile test**

**3.1 Attribute selection**

Highly related attributes to 4 PCs used to create external preference mapping (from 2.2 and 2.3) were selected.

**3.2 Data collection**

Another group of 100 Thai consumers (18-50 year old people who normally eat Sai Oua) were asked to rate the intensity of each selected attribute of 5 selected Sai Our products and their intensities which they preferred. A 10 cm line scale was used for rating each attribute and all consumers were instructed on how to use this scale before testing.

**3.3 Data analysis**

Each consumers data was transformed into standardized scores. Their standardized ideal scores were analyzed by cluster analysis and the ideal product for each preference group was computed to describe the characteristics of each ideal product compared to 5 experimental products.

## RESULTS AND DISCUSSION

Quantitative descriptive analysis showed that 5 selected Sai Oua products could be discriminated by 27 sensory attributes. These 27 sensory attributes could be reduced into 7 PCs with 74.70% explained variance by principal component analysis with quartimax rotation as shown in Table 1. The characteristics of each product are described in Table 2. In the preference study of these 5 selected Sai Oua products, one hundred Thai consumers could be clustered into 2 main groups ($n_1 = 53$, $n_2 = 37$) by considering from rescaled distance between group of cluster analysis. Their preference data in Table 3 showed that the first group preferred Product 2 and Product 4 but the second group preferred Product 2 and Product 5. The differences of Product 4 and Product 5 were the uniformity of stuffing, tenderness and juiciness, curry paste flavour, aftertaste, and saltiness as described in Table 2.

The bivariate correlations between PC and standardized hedonic scores in Table 4 showed that the overall liking of the first consumer group ($n_1 = 53$) was highly correlated with PC3 (tenderness and juiciness) and PC5 (undesirable meaty and rancid flavours), whilst the overall liking of the second one ($n_2 = 37$) highly was correlated with PC4 (quantity of curry paste, lemongrass flavour, bergamot leaf flavour, and intensity of curry paste) and PC7 (saltiness).

When each pair of PCs was used to create the position of 5 selected Sai Oua products on a preference map and the regression equation between coordinate position of products and hedonic standardized scores were created. It was found that the preference equations of the first ($n_1 = 53$) and the second ($n_2 = 37$) consumer groups were equations (1) and (2), respectively.

$$\text{Overall liking} = 0.643\ PC3 - 1.434\ PC5 \quad \text{..... (1)}$$
(Adjusted $R^2 = 0.869$)

$$\text{Overall liking} = 0.553\ PC4 - 0.936\ PC7 \quad \text{..... (2)}$$
(Adjusted $R^2 = 0.675$).

These two equations showed that consumers in the first group more concentrated in texture and off-flavours (undesirable meaty and rancid flavours) of products, but consumers in the second group more concentrated in curry paste, lemongrass and bergamot leaf flavours and saltiness of products. And the first consumer group preferred products which were tender and juicy but not undesirable meaty and rancid (Figure 1), whilst the second one preferred products which were more spicy but not salty (Figure 2).

**Table 1** Explained variance and highly related QDA attributes of each selected PC.

| PC | % Explained variance | Highly related QDA attributes |
|---|---|---|
| 1 | 26.66 | 1. Reddish brownness of casing, from bright reddish brown to dark reddish brown. |
| | | 2. Yellowness of casing, from pale yellow to intense yellow. |
| | | 3. Yellowness of stuffing, from pale yellow to intense yellow. |
| | | 4. Greenness of stuffing, from pale green to intense green. |
| | | 5. Brownness of stuffing, from pale brown to intense brown. |
| | | 6. Redness of stuffing, from pale red to intense red. |
| | | 7. Smoothness of casing surface, form rough to smooth. |
| | | 8. Firmness of stuffing, from loose to firm. |
| | | 9. Cohesiveness of stuffing, from loose mass to compact mass. |
| | | 10. Intensity of chili flavour, from none to very much. |
| | | 11. Intensity of hotness, from not hot to hot. |
| 2 | 13.37 | 12. Size of fat particle, from small to large. |
| | | 13. Distribution of fat particles, from none to very much. |
| | | 14. Distribution of curry paste, from none to very much. |
| | | 15. Uniformity of stuffing, from none to very much. |
| 3 | 8.09 | 16. Degree of tenderness, from none to very tender. |
| | | 17. Degree of juiciness, from none to very juicy. |
| 4 | 7.81 | 18. Quantity of curry paste, from none to very much. |
| | | 19. Intensity of overall curry paste, from none to very much. |
| | | 20. Intensity of lemongrass flavour, from none to very much. |
| | | 21. Intensity of Bergamot leaf flavour, from none to very much. |
| 5 | 6.50 | 22. Intensity of undesirable meaty flavour, from none to very much. |
| | | 23. Intensity of rancid flavour, from none to very much. |
| 6 | 6.46 | 24. Size (diameter) of casing, from small to large. |
| | | 25. Toughness of casing, from not tough to tough. |
| | | 26. Degree of aftertaste, from none to very much. |
| 7 | 5.81 | 27. Intensity of saltiness, from not salty to salty. |
| Total | 74.70 | |

**Table 2** Characteristics of 5 selected Sai Oua products.

| Product | Characteristics |
|---|---|
| 1 | Dark colour, not uniform, tender and juicy, low curry paste flavour, strong undesirable meaty and rancid, strong aftertaste, and salty. |
| 2 | Rather dark colour, not uniform, tender and juicy, moderate curry paste flavour, less undesirable meaty and rancid, moderate aftertaste, and not salty. |
| 3 | Moderate colour, uniform, less tender and juicy, moderate curry paste flavour, less undesirable meaty and rancid, low aftertaste, and less salty. |
| 4 | Rather bright colour, rather uniform, rather tender and juicy, moderate curry paste flavour, less undesirable meaty and rancid, moderate after taste, and salty. |
| 5 | Bright colour, not uniform, not tender and juicy, high curry paste flavour, less undesirable meaty and rancid, strong aftertaste, and less salty. |

**Table 3** Hedonic scores of two different consumer groups.

| Product | Overall liking scores (mean ± standard deviation) | |
|---|---|---|
| | Consumer group 1 ($n_1$ = 53) | Consumer group 2 ($n_2$ = 37) |
| 1 | 5.36 ± 1.89 [c] | 6.03 ± 1.44 [b] |
| 2 | 7.00 ± 1.24 [a] | 6.84 ± 1.42 [a] |
| 3 | 5.87 ± 1.29 [b] | 5.95 ± 1.27 [b] |
| 4 | 6.81 ± 1.11 [a] | 5.03 ± 1.34 [c] |
| 5 | 5.17 ± 1.46 [c] | 6.70 ± 1.39 [a] |

a, b , c are significantly different ($p \leq 0.05$).

1 = Dislike extremely, 5 = Neither like nor dislike, 9 = Like extremely.

**Table 4** Correlation coefficients between PC and standardized hedonic scores of two different consumer groups.

| Consumer group | PC1 | PC2 | PC3 | PC4 | PC5 | PC6 | PC7 |
|---|---|---|---|---|---|---|---|
| 1 ($n_1$ = 53) | 0.208 | 0.275 | 0.574 | 0.077 | -0.795 | -0.387 | -0.101 |
| 2 ($n_2$ = 37) | 0.055 | -0.455 | -0.310 | 0.794 | -0.275 | 0.370 | -0.866 |

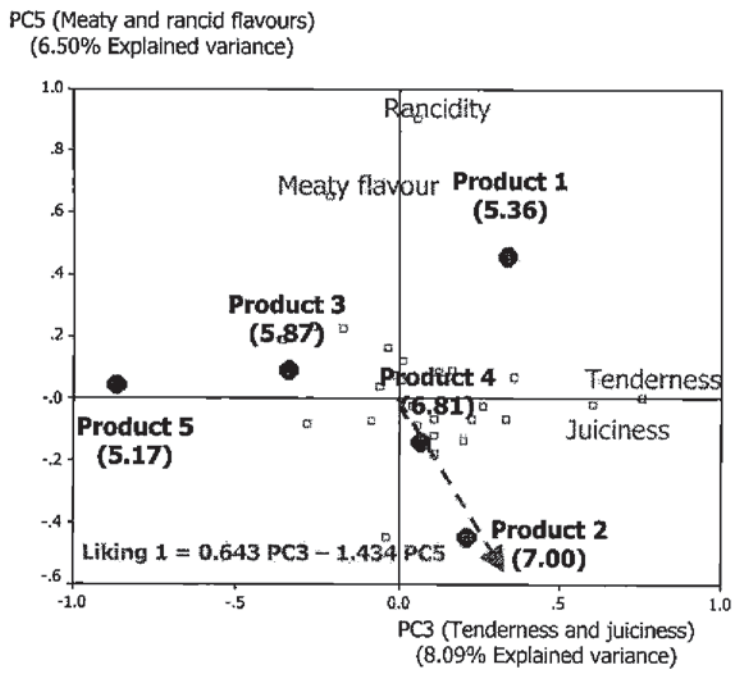


**Figure 1** Preference map of the first consumer group ($n_1$ = 53).
(PC3 represents tenderness and juiciness, whilst PC5 represents undesirable meaty and rancid flavours. Small squares without labels are other QDA attributes which are not highly related to PC3 and PC5. The Arrow and Liking 1 equation show preference direction of this consumer group, and a value below each product label is its overall liking mean score.)

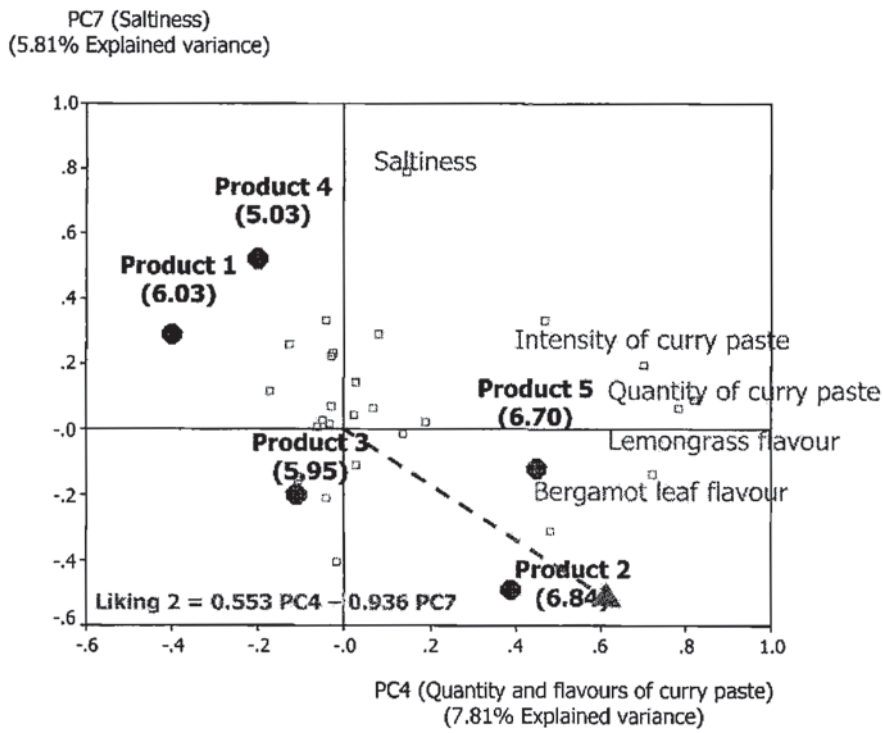


**Figure 2** Preference map of the second consumer group ($n_2$ = 37).
(PC4 represents intensity and quantity of curry paste, and lemongrass and bergamot leaf flavours, whilst PC7 represents saltiness. Small squares without labels are other QDA attributes which are not highly related to PC4 and PC7. The Arrow and Liking 2 equation show preference direction of this consumer group, and a value below each product label is its overall liking mean score.)

For modified ratio profile test, 9 attributes which were highly related to PC3 (tenderness, and juiciness), PC5 (undesirable meaty and rancid flavours), PC4 (quantity of curry paste, lemongrass flavour, bergamot leaf flavour, and intensity of curry paste) and PC7 (saltiness), were selected for product testing by another 100 Thai consumers. They were asked to rate the intensity of these attributes of 5 selected Sai Oua products, and to express the intensity of each attribute as preferred. Each consumer's data were standardized, and their standardized ideal data were clustered. The result showed that these 100 Thai consumers could be clustered into 2 main groups ($n_1$= 35, $n_2$ = 49) by considering from rescaled distance between group of cluster analysis. Both standardized ideal scores for each attribute were computed and compared to standardized scores of 5 selected products as shown in Table 5. It was found that the first consumer group preferred products with moderate quantitys of curry paste, lemongrass flavour, bergamot leaf flavour, and saltiness, but with a high intensity of curry paste, tenderness and juiciness. The second group preferred products which were more intense than 5 selected products in quantity of curry paste, lemongrass flavour, bergamot leaf flavour, intensity of curry paste, tenderness, and juiciness. Both consumer groups preferred products that minimized undesirable meaty and rancid flavours.

**Table 5** Standardized score of five selected Sai Oua products and ideal products of two consumer groups.

| | Product 1 | Product 2 | Product 3 | Product 4 | Product 5 | Ideal 1 ($n_1$ = 35) | Ideal 2 ($n_2$ = 49) |
|---|---|---|---|---|---|---|---|
| Quantity of curry paste | - 0.85 | - 0.03 | 0.02 | 0.27 | 0.18 | 0.05 | 0.53 |
| Lemongrass flavour | - 0.90 | - 0.26 | - 0.02 | 0.43 | 0.31 | - 0.03 | 0.56 |
| Bergamot leaf flavour | - 0.52 | - 0.02 | - 0.07 | - 0.08 | 0.26 | - 0.11 | 0.55 |
| Undesirable meaty flavour | 0.60 | 0.40 | - 0.04 | - 0.23 | - 0.09 | - 0.35 | - 0.96 |
| Rancid flavour | 0.30 | 0.29 | 0.13 | 0.00 | 0.00 | - 0.44 | - 0.95 |
| Intensity of curry paste | - 0.51 | - 0.38 | - 0.17 | - 0.09 | 0.43 | 0.33 | 0.87 |
| Saltiness | - 0.41 | - 0.34 | 0.21 | - 0.01 | 0.31 | 0.12 | 0.19 |
| Tenderness | 0.51 | 0.45 | - 0.82 | - 0.59 | - 0.21 | 0.44 | 0.84 |
| Juiciness | 0.42 | 0.47 | - 0.85 | - 0.56 | - 0.07 | 0.44 | 0.79 |

Standardized scores in Table 5 show the comparison within 5 selected Sai Oua and ideal products. (Minus value = low / less, Zero = moderate, Plus value = High / strong)

Results of both methods were not exactly similar but some agreements could be found. The first cluster of both methods preferred tender and juicy products without undesirable meaty and rancid flavours, and the second cluster of them preferred spicy products. In addition, the modified ratio profile test seemed to be more useful because the result of external preference mapping showed only direction of preference for attributes which was highly related to 2 PCs but the one of modified ratio profile test explained the ideal value of any attributes compared to the studied products. These standardized product and ideal scores could be related to instrumental or other analytical data of products to get the characteristics which ideal product should be, later.

Results of this study agreed with previous research which showed that the most preferred qualities of pork products are colour, juiciness, tenderness, and flavours (both desirable and undesirable flavours) (Støier, 2001, and Simm *et al*., 2004). Results of this study, suggest that desirable flavours include an lemongrass flavour, bergamot leaf flavour, intensity of curry paste (PC4), whilst undesirable flavours include an undesirable meaty and rancid flavours (PC5). For quantity of curry paste, it could be considered as a visually desieable appearence. Undersirable meaty and rancid flavours result from lipid oxidation which is a major cause of deterioration in the quality of meat and meat products (Fennema, 1996). Lipid oxidation in meat can occur in uncooked meat when muscle membranes are broken by mechanical manipulation and processing and after cooking (Frankal, 1998) and during storage (Li and Ockmann, 1997). Consumers were able to discriminate between "normal" and "rancid" sausages and this rancidity did influence consumer preference (Bryhni *et al*., 2002). For colour, it might be attractive to consumers before eating products but after tasting products, most consumers were more interested in flavour and texture. In addition, Sai Oua was a common product whose meat colour was covered by colours of casing and spices.

## CONCLUSION

This work showed the possibility to study the preference direction of food products by the external preference mapping and modified ratio profile test. Both techniques showed that Sai Oua products should be developed for two different consumer groups. The first group preferred tender and juicy products with low undesirable meaty and rancid flavours, and rather moderate in spicy

flavours. The second group preferred very spicy products which were not much salty and might be tender, juicy, and low in undesirable meaty and rancid flavours. Modified ratio profile test might be easier to understand because ideal products' scores suggested, but their information should be related to other analytical data of products to indicate the real value of each ideal score. However, both techniques could be useful for both consumers and producers, because they gave producers the direction to design and produce products which consumers really want to be served.

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