

SENSORY PROPERTIES AND CONSUMER'S PREFERENCE FOR FONDUE CHEESES IN HANOI'S MARKET

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I. INTRODUCTION

The word “cheese” is commonly used as a collective term for widely variable products such as matured and non-matured cheese made with rennet, acid curd cheese, fresh cheese, and even processed cheese. Fondue cheese is made by grinding and blending cheese, adding “emulsifying salts”, heating while stirring to the proper temperature, stirring the melted mass for several minutes at that temperature, putting it into suitable containers, and cooling. Additionally, water, butterfat, whey powder, and/or caseinate are often added. The flavor of fondue cheese distinctly differs from that of cheese, partly due to the heat treatment, partly to the melting materials (P. Walstra, 1999).

In Vietnamese markets, the quantity and the variety of cheese are quite abundant. There are about 170 types of cheese sold in supermarkets and restaurants in Vietnam (Vu Te Xien, 2004). The quantity of cheese imported to Vietnam was 1,300 tons in 2003 and to Hanoi was about 365 tons with 125 types in the same year. Thirty percent of these cheeses was fondue cheese (mainly *La vache qui rit* – cheese made in France) and it makes up an essential part of the cheese market.

Despite the fact that there are many types of cheese sold in Vietnamese markets, the application of sensory evaluation is limited in grading some food products. This kind of sensory practice is based on expert opinion. However, the quality of food products is a complex issue, not to be defined by experts who search for the default of products or for subtleties that are of little interest to the consumer. Furthermore, sensory profiling is a powerful tool to aid in quality assurance and is essential for new product development (Bride R. Mc., 2001). Advances in methodology and the development of integrated experimental design and analysis offer a practical tool for specific use in profiling the sensory character of cheese. Thus, this study was aimed at evaluating sensory properties, and consumer preference for some cheeses sold in Hanoi's market, and helping cheese manufacturers to understand, control and optimize the sensory characteristics of cheese products.

II. MATERIALS AND METHODS

1. Subjects

Two groups of subjects participated in this study. The first group consisted of 8 students (5 males and 3 females ranging in age from 21 to 23 years old) from the Institute of Biological and Food Technology, Hanoi University of Technology. The panelists were enrolled in a training program from October, 1st 2005 to November, 15th 2005 (average 70h/panelist) to detect and identify sensory properties of Fondue cheeses and to evaluate the intensity of sensory characteristics of these cheese on a 10-point universal intensity scale. The second group consisted of 120 untrained subjects (55 males and 65 females, ranging in age from 18 to 65 years old). They were selected from staff and students at universities in Hanoi, according to the following criteria: they like fondue cheese.

2. Fondue cheeses

The cheeses used in 2 experiments were selected from Hanoi cheese markets. There were 6 kinds from French (included Bridel, Kiri, La vache qui rit, Party cubes, Picon and President) and one from Vietnam (“Bo deo no” – made in Vinamilk company). All of cheeses were preserved at 4 - 6°C before tasting. The maximum time of preservation (at the same temperature) recorded in the packaging is 6 months. The cheese samples were served for each assessor for tasting at 1 x 1 x 1 cm sized in covered glass containers at 20°C..

3. Methods

Descriptive analysis

This test aimed at pointing out the essential vocabulary needed for cheese product description, sensorial characteristics of each type of cheese and the relation between cheese samples and their attributes (Mc Bride R., Muir D., 2001).

All cheeses were evaluated by a panel using descriptive sensory profiling as described in ISO 6564:1985. The sensory panel consisted of 8 panelists selected and trained according to guidelines in ISO 8586-1:1993 and the laboratory was designed according to guidelines in ISO 8589:1988. Three replicates were performed for each cheese variety. The samples were served in a randomized order and replicated with respect to each assessor. The assessors were asked to evaluate the cheese attributes on a non-structural linear scale and to rinse out their mouth with water and eat cucumber between samples. The tasting duration of each type of cheese was about 20 minutes and the break time was 5 minutes. The total duration of a session was 2,5h. The average responses over replicates and assessors were used in the multivariate analyses (PCA, PLSR).

Consumer test

A total of 120 regular cheese consumers, who were “naïve” in that they had no training in sensory evaluation, expressed their preference for each of the seven fondue cheeses studied. The cheeses were evaluated for overall degree of preference of these cheeses on a 9-point hedonic scale anchored with “Like extremely” and “Dislike extremely” at either end. The cheeses were prepared at the standard described above. Spring water and cucumber were supplied for cleansing palates between samples. All the panels performed the tests in the sensory laboratory. No more information concerning the products or the experiment was given. All participants had answered a questionnaire about their age and gender. Additionally consumption data were also collected on all respondents.

4. Statistical analysis

The results were analyzed by Analysis of variance – ANOVA - (using SAS 8.1 for Windows) in order to determine whether originality of cheeses had significant effects on cheese profile and cheese preference. The ANOVA model was $S_8 * A_3 * B_7 * C_{25}$ (S: subject factor; A: replication factor; B: product factor; C: attribute factor). The *t-student* had been used to determine the difference of one attribute among the studied products. The means of the intensity of each attribute and each type of cheese were gathered a matrix T (m, n), where m is the number of product (m = 7) and n is the number of attribute (n = 25), was analyzed by Principal Components Analysis (PCA) and Hierarchical Classification Analysis (HCA) in order to specify the correlation among sensory properties and the correlation among these products. The Partial Least Squares Regression (PLS) had been used to figure out the relation between the descriptive data and the preference scores of consumers. All analyses were performed by SAS[®] version 8.1 and SPAD[®] version 4.5.

III. RESULTS

1. Profile of Fondue cheeses

a. Sensory vocabulary

The 38 sensory terms (sensory attributes) were collected from various materials and from the panels. After reductions, the remaining list of sensory attributes contained 25 terms. These terms were divided in 5 categories as follows: *Appearance* (Color, brightness, flexibility), *Odor* (Cream, milk, cooked, rancid, butter, lactic, overall odor intensity), *Taste* (sweetness, sourness, bitterness, saltiness), *Mouth-feel* (Firmness, solubility, fineness, stickiness, elastic, variety of aroma, fatness), *Aftertaste* (sweet, sour, bitter, salty).

b. Profile of fondue chesses

The profile of 7 studied cheeses is expressed in Figure 1. The ANOVA results showed a significant difference among the 7 cheeses ($F_{6,144} = 3.41$; $p < 0.01$). The results also indicated a stability of the panels through 3 replicates ($p < 0.001$).

Among the 7 cheeses studied, the overall odor intensity of *Bridel* was highest, *Kiri* was characterized by strong lactic and milk odor. *La vache qui rit* and *Picon* were the most salty and finest texture. The intensity of firmness, butter odor and sweetness of *Party cubes* was highest. *President* was characterized by fatness and “*Bo deo no*” by stickiness.

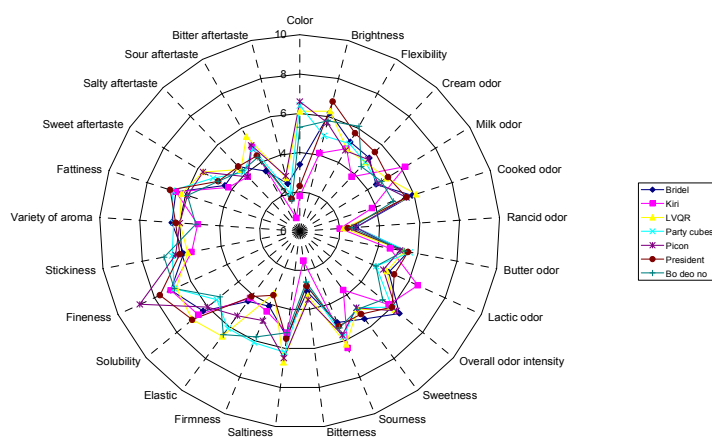


Figure 1. Conventional Profile scores of 7 fondue cheeses

A map of the Attributes of the 7 cheeses on the first plan of PCA (variance explained 62%) was expressed in Figure 2. The results showed that sensory properties of the 7 cheeses were classified into 4 opposite groups: Group 1 (milk odor, lactic odor), Group 2 (sourness, sour aftertaste, solubility), Group 3 (firmness, stickiness and flexibility), and Group 4 (included the remaining attributes, mainly odor attributes). There were close correlations among sensory attributes, for example milk odor and lactic odor; brightness, cream odor, butter odor and variety of aromas.

HCA analysis indicated that the 7 cheeses were principally classified into 4 groups (Figure 3). The numbers in Fig. 3 are expressed accumulated variances of classification of all products. The higher the number, the more significant the classification. The first group was *Kiri* (coded 2), the second group contained *Picon*, *Party cubes*, *La vache qui rit* (coded 5, 4, 3), the third group was “*Bo deo no*” (coded 7); and the last group was *President* and *Bridel* (coded 6, 1).

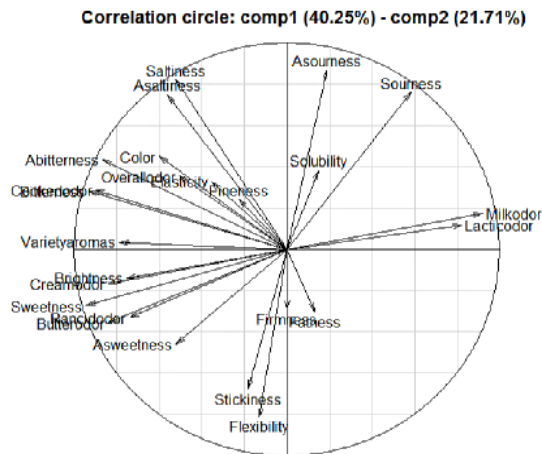


Figure 2. PCA-attribute map dimensions 1 and 2

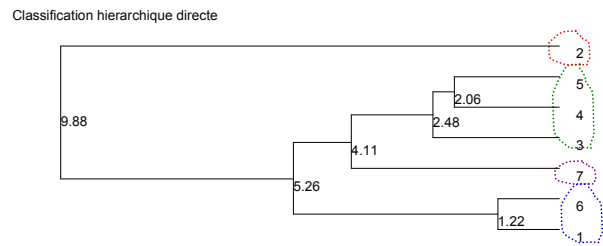


Figure 3. Cluster analysis of 7 fondue cheeses

Characteristic properties of each group of cheese are indicated in Figure 4. The characteristic property of *Bridel* was a sweet aftertaste and stickiness; *Kiri* was milk odor and lactic odor; *La vache qui rit* and *Picon* were fineness, elasticity, color, saltiness, salty aftertaste; *Party cubes* was butter odor, sweetness, cream odor, brightness and rancid odor; *President* was fatness, firmness, stickiness; and “*Bo deo no*” was stickiness, flexibility.

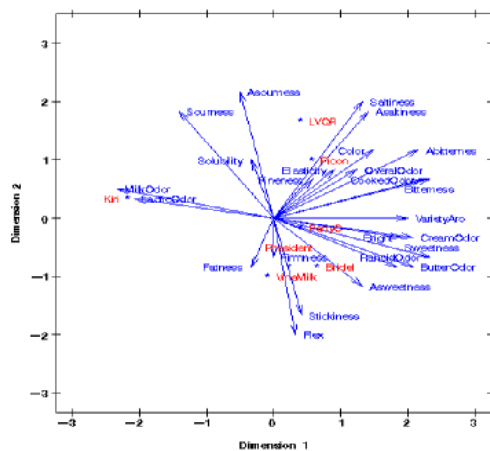


Figure 4. PCA biplot of sensory properties and cheese products

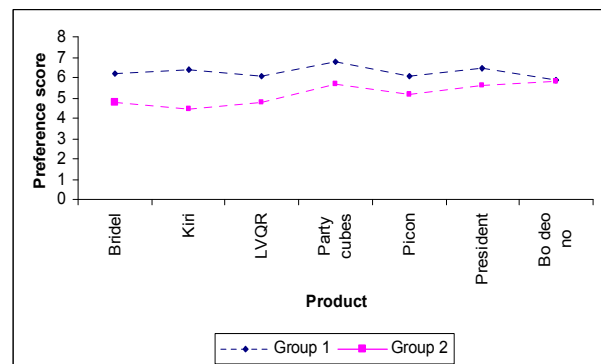


Figure 5. Overall degree of preference of 2 groups

2. Consumer preference

The Pearson correlations, among preference attributes, showed significant correlations ($P < 0.01$) between the overall degree of preference. Average preference of most cheeses was preferred at an above average level (from 5.70 to 6.51 points), and “*Bo deo no*” - cheese made in Vietnam - was preferred to *La vache qui rit* and graded at the same level with 3 types of cheese made in France.

Analysis clustering (HCA) and the result of the *t-student* analysis showed that the customers were principally classified into 2 groups with characters as follows:

- *Group 1*: 48.31% males and 51.69% females; young people (< 25 ages) were 49.44%; the frequency of using cheese was high

- *Group 2*: 32.26% males and 67.74% females; young people (< 25 ages) were 67.74%; the frequency of using cheese was lower than group 1.

The overall degree of preference of the 7 cheeses of 2 consumer groups was performed in Figure 5. The overall degree of preference of group 1 (> 6 points) was higher than degree of group 2 (< 6 points). These results suggested that the cheese preference might be proportioned to the frequency of cheese consumption. Besides, “*Bo deo no*” - cheese made in Vietnam - was rated quite highly by both groups at an above average level (5.8 points). This reflects that this product is suitable for Vietnamese consumers, irrespective of age or gender. This is good news for Vietnamese cheese producers.

PLS regression by overall degree of preference scores on data matrix showed that a linear model could explain the overall degree of preference from the answers of the study groups (120 people). The result was that the characteristics contributed positively to the preference of consumers in 2 groups were lactic odor, butter odor, and firmness. The attributes which reduced the consumer preference included bitterness and bitter aftertaste.

Furthermore, the results also indicated that butter odor, lactic odor, the variety of aromas, firmness and fatness correlated positively to the preference of the consumer in Group 1. Color, brightness, bitterness, elasticity, salty aftertaste and bitter aftertaste were negative attributes for this consumer group.

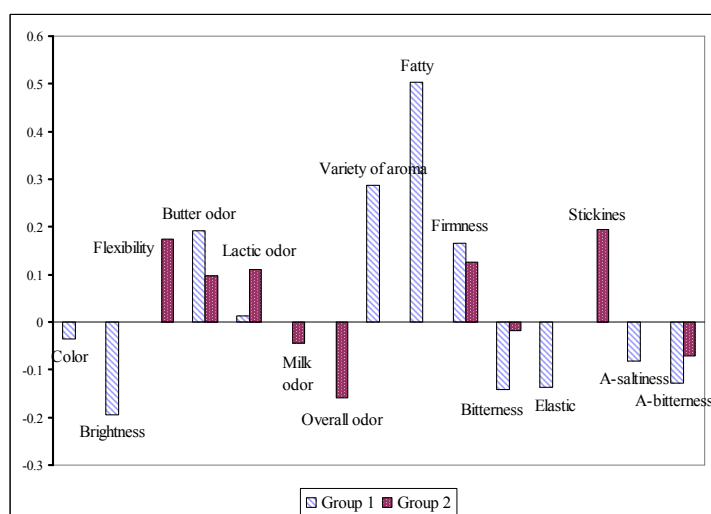


Figure 6. PLS regression of the descriptive profiling data and the preference scores for consumers

For group 2, the positive attributes were flexibility, butter odor, lactic odor, firmness and stickiness. Otherwise, milk odor, overall odor intensity, bitterness and bitter aftertaste diminished the individual's preference.

This result initiated a new approach to the ideal model of fondue cheese, for further research concerned with quality and the processing of cheese.

IV. CONCLUSION

In the summary, the study showed that 25 attributes are an essential part of the fondue cheese descriptions. Seven studied cheeses were classified in 4 groups with their corresponding characters: Group 1 (*Kiri*), Group 2 (*Bridel* and *President*), Group 3 (*La vache qui rit*, *Party cubes*, *Picon*) and Group 4 (*Bo deo no*).

The overall degree of preference of 7 cheeses was rather clear, at an above average level (> 5.7/9 points) and was graded according to degree of preference as follows: *Party cubes*, *President*, *Kiri*, *Picon*, *Bo deo no*, *Bridel* and *La vache qui rit*. The “*Bo deo no*” - cheese made in Vietnam – was highly rated at 5.86 points. The regression analysis indicated that the most preferred attributes of the 7 above cheeses were lactic odor, butter odor, and firmness. Vietnamese consumers disliked bitterness, and a bitter aftertaste in all studied products.

The results of this study initiated the new approach to the ideal model of fondue cheese for the other researches concerned with quality and the processing of cheese.

Acknowledgment. Special thanks for Nguyen Thi Lan Anh, Nguyen Thi Minh Tu, Nguyen Ba Thanh and Cung To Nga for their precious help in consumer tests and thanks to all assessors for their participation.

REFERENCES

1. International Standard, ISO 6564:1985 - Sensory analysis – Methodology – Flavour profile methods.
2. International Standard, ISO 8586-1:1993 - Sensory analysis – General guidance for the selection, training and monitoring of assessors.
3. International Standard, ISO 8589:1998 - Sensory analysis – General guidance for the design of test rooms.
4. B. A. Law - Technology of cheese making, CRC Press, Sheffield, England, 2002.
5. R. Mc Bride, D. D. Muir - The grading and sensory profiling of cheese, CRC Press, Sheffield, England, 2001.
6. J. M. Murray, C.M. Delahunty, and I. A. Baster - Descriptive sensory analysis: past, present and future, Food research International **34** (2001) 461-471.
7. H.D. Nguyen, Ha D.T., and D. Luu - The role of sensory evaluation in food quality management and development, Proceedings of the 8th Asian Food Conference, Hanoi, 2003, 862-866.
8. C. Salles, S. Dalmas, and C. Septier - Production of a cheese model for sensory evaluation of flavor compounds, Le Lait **75** (6) (1995).
9. P. Walstra, T. J. Geurts, A. Noomen, A. Jellema, and Van Boekel - M. A. J. S., Dairy Technology: Principles of Milk, Properties and Processes, USA, 1999, 539-708.
10. T. X. Vu - The habit of using cheese of customers in Ha Noi and Ho Chi Minh City, Industrial Journal **22** (2004) 37-39.

SUMMARY

The objective of this study was to analyze the sensory properties and to assess the preference of consumer in Hanoi for 7 types of fondue cheese (*Bridel*, *Kiri*, *La vache qui rit*,

Party cubes, Picon, President and “Bo deo no”). Two tests have been carried out: the descriptive test and the preference test. In the former, a trained panel of 8 members indicated that there were 25 profiled attributes of fondue cheese which have been used with high frequency and described exactly sensory quality of these types of cheese. The results of univariate and multivariate data analyses showed a significant difference among the cheese samples, and the 7 evaluated types of cheese could be separated into 3 groups with their characterized properties. In the preference test, a consumer panel of 120 assessors assessed the consumer preference of these 7 types of cheese on a 9-point scale (1-extremely dislike, 9-extremely like). The result was that these 7 types of cheese were preferred at an above average level. Hierarchical Classification Analysis (HCA) indicated that there were 2 consumer groups with different preferences and the overall preference of the consumer depended on the frequency of product use. Partial Least Squares Regression Analysis (PLS) showed the correlation between sensory properties and the consumer preference for a class of fondue cheese. An ideal model of fondue cheese for Vietnamese consumers had been initiated in order to aid in studies of consumer acceptability.

Key words: descriptive analysis, fondue cheeses, consumer preference

NGHIÊN CỨU TÍNH CHẤT CẢM QUAN VÀ THỊ HIỂU NGƯỜI TIÊU DÙNG ĐỐI VỚI PHO MÁT NÓNG CHẢY TẠI THỊ TRƯỜNG HÀ NỘI

Nghiên cứu này tập trung phân tích các tính chất cảm quan và thị hiếu của người tiêu dùng Hà Nội đối với 7 loại pho mát nóng chảy (Bridel, Kiri, La vache qui rit, Party cubes, Picon, President và Bò deo no). Hai phép thử cảm quan đã được thực hiện là phép thử mô tả và phép thử thị hiếu. Thông qua sự phân tích của hội đồng gồm 8 thành viên đã qua huấn luyện, chúng tôi đã tìm được 25 thuộc tính cảm quan của pho mát nóng chảy được sử dụng với tần suất cao nhất và mô tả chính xác tính chất cảm quan của nhóm pho mát này. Kết quả phân tích số liệu đơn và đa biến đã chỉ ra rằng các mẫu pho mát khác nhau có nghĩa, và 7 mẫu này có thể được phân chia thành 3 nhóm với các tính chất cảm quan đặc trưng. Trong phép thử thị hiếu, chúng tôi mời 120 người thử, tham gia đánh giá mức độ ưa thích đối với 7 sản phẩm trên thang thị hiếu 9 điểm (với 1 là cực kì không thích và 9 là cực kì thích). Kết quả phân tích cho thấy cả 7 sản phẩm đều được đánh giá trên mức độ trung bình (5 điểm). Phép phân tích phân nhóm theo thứ bậc (HCA) chỉ ra rằng có 2 nhóm người tiêu dùng có mức độ ưa thích khác nhau và mức độ ưa thích chung đối với sản phẩm của họ phụ thuộc vào tần suất sử dụng sản phẩm. Kết quả của phân tích hồi quy bán phần nhỏ nhất (PLS) chỉ ra mối tương quan giữa tính chất cảm quan và mức độ ưa thích của người tiêu dùng đối với các sản phẩm pho mát nóng chảy. Mô hình lí tưởng của pho mát nóng chảy của người tiêu dùng Việt Nam đã bước đầu được hình thành, kết quả này sẽ góp phần hỗ trợ những nghiên cứu về mức độ chấp nhận của người tiêu dùng đối với sản phẩm.

Địa chỉ:

Đại học Bách khoa Hà Nội.

Nhận bài ngày 12 tháng 4 năm 2004