VIETNAM AND FOREIGN BEERS: RELATIONSHIPS BETWEEN SENSORY ATTRIBUTES, GROSS COMPOSITIONAL CONSTITUENTS, AND CONSUMER ACCEPTANCE

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TÓM TẮT

Mục tiêu của nghiên cứu này là liên kết tính chất cảm quan, thành phần hóa học của bia và mức độ ưa thích của người tiêu dùng với nhau. Mẫu nghiên cứu gồm có 4 loại bia Việt Nam và 5 loại bia sản xuất theo công nghệ nước ngoài. Trước hết, một hội đồng gồm 7 người đã qua huấn luyện tiến hành một thí nghiệm phân tích mô tả để đưa ra những tính chất cảm quan tiêu biểu cho từng loại bia và cường độ của từng tính chất đó có trong sản phẩm. Song song đó, chúng tôi đã gửi những mẫu nghiên cứu này đi phân tích ở Viện rượu bia và nước giải khát Hà Nội, nhằm xác định hàm lượng của những hợp chất hóa học có khả năng ảnh hưởng lên mùi vị của bia như diacetyl, hợp chất đắng, etanol, v.v. Bên cạnh đó, một thí nghiệm thị hiếu cũng được tiến hành đồng thời trên 90 người tiêu dùng để khảo sát mức độ ưa thích đối với từng loại bia nghiên cứu. Kết quả cho thấy có mối tương quan chặt giữa các tính chất cảm quan với các hợp chất hóa học có trong bia, và cũng cho thấy người tiêu dùng có khuynh hướng ưa chuộng một sản phẩm bia có nguồn gốc xuất xứ cụ thể nào đó.

ABSTRACT

The aim of this study was to link sensory attributes, and chemical compositions to consumer liking in beers imported and/or produced by Vietnamese manufacturers. The beers studied were four Vietnamese products and five original foreign beers. A quantitative descriptive analysis was performed by a trained group to build up the sensory profiles of the beer samples. The physical and chemical analyses were carried out to determine the concentrations of some gross compounds such as: diacetyl, EBU, alcohol and so on, in beers. In consumer test, 90 consumers rated the pleasantness of appearance, flavour liking and overall liking on a structured nine-point scale (with 1-extremely dislike, 9-extremely like). The results showed the strong correlation between beer chemical compounds and sensory attributes, and also, the differences between sensory preferences and origin preferences of beers.

Keywords: beer, sensory evaluation, chemical compounds, consumer acceptance

1. INTRODUCTION

Beer acceptability is affected by a series of parameters which is important for the brewing industry. One of the essential characteristics of beer is flavour. Many components (850 components) affecting beer flavour have been completely identified, including ethanol, carbon dioxide, bitter compounds from hops, alcohol, ethylic, and esters (Grisby *et. al*., 1974; Irwing *et. al*., 1991). The previous studies showed a strong relationship between sensory properties and physicochemical composition (Foster *et. al.,* 2001). The aims of this study were to determine the correlation between chemical composition, sensory

properties and consumer acceptance. Therefore, three experiments were carried out: (1) physicochemical analyses (2) sensory profile, and (3) consumer preferences.

2. MATERIALS AND METHODS

2.1 Beer products

The samples used in this study were four Vietnamese beer products (Red Saigon, Ben Thanh, Hanoi, and 333) and five foreign beers (Carlsberg, Foster, Tiger, Laser, and Heineken).

2.2 Gross compositions

The gross chemical compounds could influence beer flavour, such as the content of diacetyl, bitterness, colour, alcohol, pH, acidity, polyphenol, and the degree of fermentation, were analysed by the Institute of Alcohol, Beer and Beverage in Hanoi.

2.3 Sensory profile (Mason *et. al*., 2002; Meilgaard *et. al*., 1997; Stone & Sidel, 2004)

The panel of 7 panellists (1 male and 6 females), selected on their ability to discriminate betweens products, their ability to verbalise their perceptions, and to work as a group, participated in three sessions of this experiment.

2.3.1 **Session 1**: Generation of descriptors (ISO 11035:1994)

The panelists were exposed to all the beer products to be assessed. Each panelist individually listed as many descriptive words possible that described differences between the samples. Hedonic terms such as nice, good, bad, etc were not allowed. Through a group discussion, the list of descriptors was narrowed down to remove duplications and redundant terms until the standardized vocabulary was reached. Consequently, 27 descriptors were chosen, such as apple, fruit, banana, vanillin, foam properties (volume, size, stability), sweetness, sourness, aftertaste-sourness, yeast, almond, flavours of malt, caramel flavour, bitterness and aftertaste-bitterness, beer colour and so on.

2.3.2 Session 2: Training

The objective of this session was to produce a panel that can reach the consensus and repeatability in evaluation of beer flavour. The panelists participated in a training program to improve their ability in discrimination and verbalization. They had to pass some tests from basic to advance such as: ranking, matching, flavour detecting, flavour descriptive test and learning how to use the unstructured scale in assessing the sensory properties. After training session, the panelists took part in the final evaluations.

2.3.3 **Session 3**: Evaluation

Nine beer samples were served randomly in a monadic sequence in sensory booths. The panelist was asked to smell and taste the samples and mark the intensity of each descriptor on a 100 mm unstructured scale with the end anchors “very weak” and “very strong”. These scales were printed in the paper sheet. This task was carried out three times on three separated days. All sessions above were carried out in the sensory lab designed according to ISO 8589:1988.

2.4 Consumer test

The “true consumers”, who had little or no experience in description of beer flavour, participated in this test. Ninety consumers (ageing from 21 to 49) involved students, employees, and labours were asked to rate the degree of flavour liking and overall liking on a structured 9-point scale (1-extremely dislike, 9-extremely like). Before carrying out the test, the subjects were asked to fill out a questionnaire about their beer consumption habit. If one person answered “No” to the first question “Do you like to drink beer?” he or she couldn’t participate in this test.

2.5 Statistical analysis

Data obtained were analyzed using ANOVA (O’Mahony, 1986) and Principal Component

Analysis (PCA). All analysis was performed by SPAD 4.5 (Cisia, 1998) software.

3. RESULTS AND DISCUSSION

3.1 Chemical analyses

Tiger beer was the most bitter beer (22.1 ^{0}BU), and also its polyphenol content was found highest (194 mg/l) among 9 beers studied. Heineken, Carlsberg and Red Saigon had medium degree of alcohol, acidity level, and clarity properties. Furthermore, these beers had the lower level of diacetyl than the other beers.

3.2 Sensory profiles

The PCA (figure 1 – with PCA1 explained 25.14% and PCA2 explained 27.48% of variance) separated 9 beers in three groups as follow: **Group 1** included Heineken, Tiger, BenThanh; **Group 2** consisted of 333, Foster, Carlsberg, Red Saigon, Hanoi, and **Group 3** comprised only Laser beer. When combining figure 1 and figure 2, we observed that the **group 1** were characterised by flavours of apple, fruit, banana, and vanillin and foam properties (volume, size, stability). For **group 2**: the characteristics were clarity, sweetness, aftertaste-sweetness, sourness, aftertaste-sourness, peppery feeling, flavours of malt, inverted sugar, and yeast. Besides, Laser beer had remarkable characteristics of caramel flavour, bitterness and aftertaste-bitterness, beer colour, clarity, and colour.

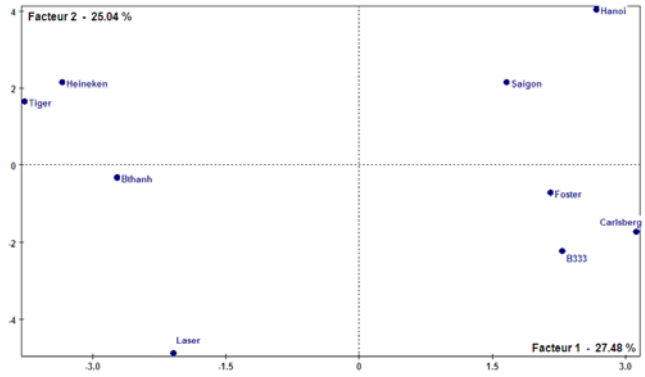

Figure 1: Sample beers derived from PCA of the sensory profile data

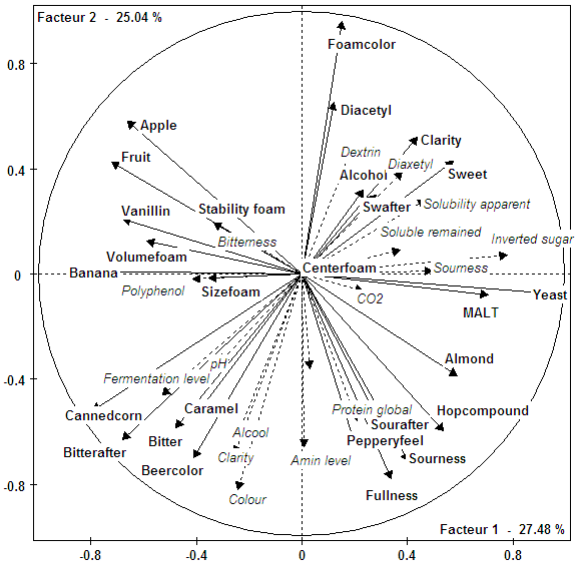

Figure 2: Correlation between sensory properties and chemical compounds of beers. *(The sensory properties were plotted in strain line arrow, and the physical-chemistry properties in dot line arrow)*

3.3 Correlation between physicochemical and sensory properties

The results showed (figure 2) positive correlations between the fullness of beer and the content of dissolved protein (R=0.60) and also the content of hop (R=0.45). The content of diacetyl obtained from chemical analyses was highly correlated with the intensity of diacetyl aroma obtained from sensory analyses (R=0.57). The sweetness was also positively correlated with the content of inverted sugar (R=0.61) and negatively correlated with fermentation level (R=-0.71), bitterness (R=-0.58). The beer color properties analysed by sensory panels was strongly correlated with clarity (R= 0.91) and colour (0.54) derived from chemical analysis.

3.4 Consumer test

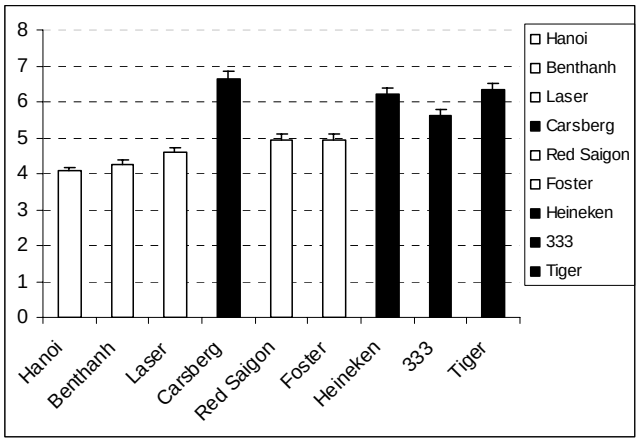

Figure 3: Degree of consumer preferences for 9 beers studied

The average degrees of preferences for 9 beers studied were presented in figure 3. The result of ANOVA showed that the overall liking degree of the beers were significantly different ($F=36.42$, $p<0.05$). Heineken, Tiger, Carlsberg (foreign-beers), and 333 beers (Vietnamese product) had the highest score on the liking scale and the least preferred beers were Ben Thanh and Hanoi. The results of internal preference mapping analysis (figure 4a & 4b) were consisted with the results above since most of consumer projections were laid on the left of figure 4a in the same side with the projections of Heineken and the other preferred beers on figure 4b. Therefore, the sensory and physicochemical properties preferred by consumers were fruity, alcohol degree, fullness and the least preferred properties were diacetyl, caramel, sourness and aftertaste-sourness, content of carbon dioxide, bitterness and aftertaste-bitterness (figure 4a).

4. CONCLUSION

Descriptive analysis, physicochemical analyses and consumer preferences showed distinctive profile for foreign and Vietnamese beers and their relationship to beer acceptability. Furthermore, the results of present study showed a strong correlation between physicochemical and sensory properties. These results were observed not only for the properties in a family such as diacetyl content and diacetyl aroma, but also for the other characters such as fullness, content of protein and hop. The correlation between physicochemical and sensory properties also illustrated that the chemical compounds could have effect on many sensory properties and in reverse, the variation of sensory property could originate from many physicochemical attributes.

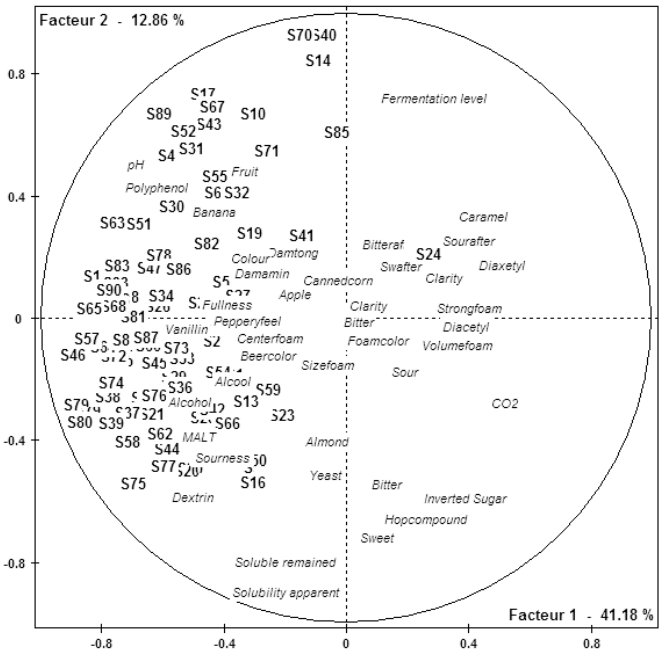

Figure 4a: Internal preference mapping: structural preference of sensory and physical chemistry properties

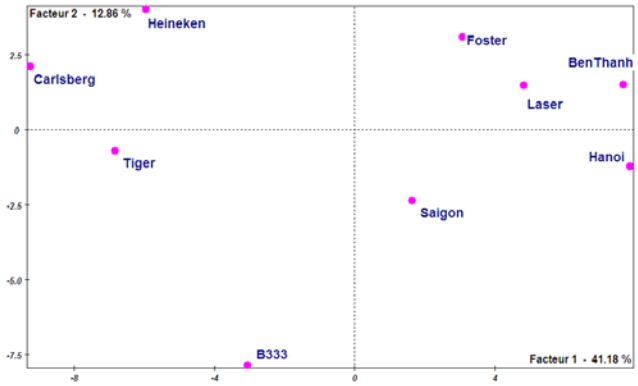

Figure 4b: Internal Preference Mapping: structural preference of 9 beers studied

Beer manufacturers now recognize the importance of understanding the relationships

between the manufacturing process as well as variances of this process, the beer compositions such as volatile compounds and gross compositional constituents, and the sensory characters of beer. Dissimilarity to the previous studies carried out in our laboratory, the preference mapping analyses showed that the foreign beer could satisfy all consumers for all attributes. Therefore, in the next study, more attention should be focused on the correlation between the volatile compounds and sensory properties to understand, to control and to optimize the sensory characteristics of beer products.

5. ACKNOWLEDGEMENTS

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