

แผนภาพความชอบของถั่วงอกและทานตะวันงอกสำหรับผู้บริโภคที่อาศัย ในจังหวัดเชียงราย

PREFERENCE MAPPING OF MUNG BEAN SPROUTS AND SUNFLOWER SPROUTS FOR CONSUMERS LIVING IN CHIANG RAI

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บทคัดย่อ

ความสนใจของผู้บริโภคที่มีต่ออาหารเพื่อสุขภาพมีแนวโน้มเพิ่มมากขึ้นในหลายประเทศ รวมถึงประเทศไทย รั้วพืชงอกมีคุณสมบัติในการส่งเสริมสุขภาพและยังช่วยลดความเสี่ยงในการเกิดโรคต่างๆ แม้ทานตะวันงอกจะมีคุณค่าทางโภชนาการและมีประโยชน์ต่อสุขภาพแต่ปริมาณการบริโภคทานตะวันงอกในประเทศไทยยังคงมีจำนวนจำกัดเมื่อเทียบกับปริมาณการบริโภคถั่วงอก งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาการยอมรับของผู้บริโภคและวิเคราะห์ลักษณะบ่งชี้ความชอบที่มีต่อตัวอย่างถั่วงอกและทานตะวันงอกทั้งแบบสดและผ่านการลวก จำนวน 10 ตัวอย่าง ถูกทำการประเมินระดับการยอมรับจากการสอบถามผู้บริโภค จำนวน 114 คน ที่เคยรับประทานถั่วงอกทั้ง 2 ชนิด วิธีการวิเคราะห์ที่ใช้ประกอบด้วย การวิเคราะห์ด้วยการจัดกลุ่ม การสร้างแผนภาพความชอบภายใน และการวิเคราะห์แบบถดถอย จากผลการจัดกลุ่มผู้บริโภคด้วยคุณลักษณะทางประสาทสัมผัสต่างๆ ประกอบด้วย ความชอบโดยรวม ความชอบในลักษณะปรากฏ ความชอบในกลิ่นรส และความชอบในเนื้อสัมผัส พบว่าในทุกคุณลักษณะสามารถจัดกลุ่มผู้บริโภคได้จำนวน 3 กลุ่มเท่ากัน โดยในลักษณะความชอบโดยรวม ผู้บริโภค 2 ใน 3 กลุ่มชอบตัวอย่างทั้งถั่วงอกและทานตะวันงอก ขณะที่ผู้บริโภคในกลุ่มที่เหลือชอบตัวอย่างถั่วงอกแบบสดเท่านั้น สำหรับความชอบในลักษณะปรากฏพบว่าตัวอย่างทานตะวันงอกที่ผ่านการลวกเป็นตัวอย่างที่ผู้บริโภคทุกกลุ่มไม่ชอบ นอกจากนั้นยังพบว่าผู้บริโภคหนึ่งในสามกลุ่มชอบลักษณะปรากฏของตัวอย่างถั่วงอกทุกแบบมากที่สุด ขณะที่ผู้บริโภคในอีกกลุ่มให้คะแนนความชอบในลักษณะปรากฏในตัวอย่างทานตะวันงอกสดสูงกว่าตัวอย่างอื่นๆ และในกลุ่มผู้บริโภคกลุ่มที่เหลือชอบลักษณะปรากฏของทั้งถั่วงอกและทานตะวันงอก ในส่วนของความชอบต่อรสชาติพบว่าผู้บริโภคสองกลุ่มมีความชอบที่แตกต่างกันอย่างชัดเจน โดยผู้บริโภคกลุ่มที่หนึ่งชอบกลิ่นรสของตัวอย่างแบบลวกทั้งหมด ขณะที่ผู้บริโภคอีกกลุ่มชอบกลิ่นรสของตัวอย่างแบบสดทั้งหมด นอกจากนั้นในกลุ่มผู้บริโภคที่เหลือคือกลุ่มบริโภคที่ชอบกลิ่นรสของทานตะวันงอกทั้งในแบบสดและแบบลวก ในกรณีของความชอบในเนื้อสัมผัสพบแนวโน้มเช่นเดียวกันกับความชอบในกลิ่นรส โดยพบว่าผู้บริโภคในกลุ่มที่หนึ่งชอบเนื้อสัมผัสของตัวอย่างแบบลวกทั้งหมด และในทางตรงข้ามกลุ่มผู้บริโภคอีกกลุ่มกลับชอบลักษณะเนื้อสัมผัส

ของตัวอย่างแบบสดเท่านั้น โดยกลุ่มผู้บริโภคที่เหลือเป็นกลุ่มที่ชอบเนื้อสัมผัสของถั่วงอกทั้งแบบสดและแบบลวก กลิ่นรสเป็นลักษณะที่เป็นตัวบ่งชี้ที่สำคัญที่สุดต่อระดับความชอบโดยรวม เนื้อสัมผัสเป็นตัวบ่งชี้ที่สำคัญในลำดับที่สอง และลักษณะปรากฏเป็นตัวบ่งชี้ที่มีความสำคัญน้อยที่สุดต่อระดับความชอบโดยรวม ข้อมูลที่ได้จากงานวิจัยนี้เป็นประโยชน์ต่อนักพัฒนาผลิตภัณฑ์และผู้ประกอบการที่ต้องการพัฒนาผลิตภัณฑ์อาหารที่มีส่วนผสมหลักเป็นธัญพืชงอกที่ได้รับการยอมรับจากผู้บริโภคในแต่ละกลุ่ม

คำสำคัญ: ถัวยี่หวี่, ทานตะวัน, ธัญพืชงอก, การยอมรับของผู้บริโภค, แผนภาพความชอบ

Abstract

Consumer interest in healthy diet has been increasing in many countries including Thailand. Sprouts exert health-promoting effects and lower the risk of various diseases. Despite their nutritional and health benefits, sunflower sprouts consumption in Thailand is still limited compared with mung bean sprouts. The objectives of this research were to study the consumer acceptance and to identify the driver of liking towards sprout samples. Ten samples of mung bean and sunflower sprouts in both fresh and blanched forms were evaluated by 114 consumers who ever consumed both types of sprouts by asking to rate their acceptance scores. Cluster analysis, internal preference mapping, and regression analysis were analyzed. Three clusters were all found when performing cluster analysis based on overall degree of liking, appearance liking, flavor liking, and texture liking. For overall degree of liking, consumers in 2 of 3 clusters preferred both mung bean and sunflower sprouts whereas consumers in the other cluster preferred only fresh mung bean sprouts. As for appearance liking, blanched sunflower sprouts were not liked by any consumers. It was also found that consumers in one cluster liked the appearance of all mung bean sprouts most while consumers in another cluster gave the higher appearance liking scores on fresh sunflower sprouts. The last cluster was a group of consumers who liked the appearance in both types of sprouts. For flavor liking, there were two big groups of consumers which had opposite flavor liking. One group of consumers liked the flavor of all blanched sprouts, while the other group of consumers preferred the flavor of fresh sprouts. The smallest cluster was the consumers who liked sunflower sprouts in both fresh and blanched forms. In case of texture liking, the same trend was found as flavor liking. One group of consumers liked the texture of blanched sprouts whereas another group liked only fresh sprouts. The other group was a group of consumers who liked the texture of mung bean sprouts in both fresh and blanched forms. Flavor was the most important driver of liking. Texture was the second most important driver of liking and appearance was the least important driver of liking. This work could be useful to product developers or entrepreneurs who want to develop sprout-based products that are acceptable to consumers in each group.

Keywords: Mung Bean, Sunflower, Sprout, Consumer Acceptance, Preference Map

Introduction

It has been noticed that today's consumer behavior has been gradually changed since last 10 years. Consumers, nowadays, concern their health by making their choices on fresh, natural, and minimally processed food products. Sprout is one of the most famous healthy choices that receives many good responses from the consumers due to their availability, safety, and nutritional benefits.

Sprouts are premature living shoots from germination process of seeds. Lighting, temperature, humidity, watering and time are all factors that have been considered for sprouting the plant seeds. Many types of seeds have been used to produce sprouts including grasses, grains and beans [1]. With the changes of chemical compounds during germination, consumers can have more bioavailability of nutrients and some health benefits from consuming sprouts such as vitamins, phytochemicals, minerals, antioxidants, and unique health enhancing constituents [2].

In many Asian countries including Thailand, the most famous type of sprouts that people consume regularly is mung bean sprout. Asian people use mung bean sprouts as a raw material in various dishes from fresh form as the side dish or salad to cooked form in stir-fried dishes, noodle, or some types of soup. Blanching is the cooking technique that is commonly used by consumers due to its convenience. Sunflower sprout is a new type of sprouts that has recently introduced to Thai consumers. However, the popularity of sunflower sprouts is very limited. Besides

the marketing factors, sensory characteristics might affect to consumer acceptance.

In order to obtain the consumer acceptance data, some sensory analysis techniques are selected and used. A consumer acceptance study by rating degree of liking on overall, appearance, flavor, and texture is conducted by using 9-point hedonic scale anchored from "dislike extremely (1)" to "like extremely (9)". Some multivariate analysis techniques including cluster analysis, internal preference mapping, and partial least square regression are also utilized to provide graphical representations of consumer responses.

Objectives

The objectives of this study were to study the consumer acceptance and to identify the drivers of liking towards mung bean and sunflower sprouts.

Methods

Materials

Two varieties of sunflower sprouts; oil seed and non-oilseed/snack varieties and one variety of mung bean were used entire the study. Fresh sunflower sprouts (oilseed variety) from two sunflower sprout producers were purchased from wholesale market, another fresh sunflower sprout sample (non-oilseed/snack variety) was purchased directly from the local sprout producer, and mung bean sprouts from two vendors were purchased from local market in Chiang Rai, Thailand.

Sample preparation

All sprouts samples were stored in a

refrigerator at 4°C immediately after purchase to prevent discoloration. Afterward, each type of sprout was washed completely to remove dirt and contaminants and then rinsed. For cooked samples, water was boiled (94–96°C) in cooking pot. Mung bean sprouts samples were blanched for 10 seconds and sunflower sprout samples were blanched for 45 seconds in boiling water and drained in a sieve (according to preliminary study of blanching process, sunflower sprout samples were needed longer time for blanching in order to prevent browning reaction and maintain the bright green color of leaves and stems). Blanched sprouts were moved from the sieve to a separate bowl filled with cold water (0–4°C) to stop the cooking process. For serving, sprouts were picked and pat dried to remove residual water as much as possible before putting them in coded sampling cups. Each sprout sample was weighed approximately 5 grams and was given to panelist for tasting at room temperature. Each

cup of sample was coded with a 3-digit random number. A glass of pure water, and white bread were served to clean the palate between samples. All ten sprouts samples were divided into 3 sets (3 samples in the first and the third set, and 4 samples in the second set) and were served to each consumer on a plastic tray. Consumers were requested to take a 3-minute break between sets of samples. The order of sample presentation was completely randomized to balance out any potential serving order or carry-over effects. All sprout samples were subjected to a consumer acceptance test with 114 consumers who were living in Chiang Rai and ever consumed both mung bean sprout and sunflower sprout. The consumers were asked to rate their overall degree of liking, liking of appearance, flavor, and texture by using 9-point hedonic scale anchored from “dislike extremely” to “like extremely” [3]. The detailed information for each sample is given in Table 1.

Table 1. Information of 10 sprout samples

Type of sprout samples
1. Mung bean sprouts: vendor A (Fresh Mung A)
2. Mung bean sprouts: vendor A (Cooked Mung A) Blanched in boiling water for 10 seconds
3. Mung bean sprouts: vendor B (Fresh Mung B)
4. Mung bean sprouts: vendor B (Cooked Mung B) Blanched in boiling water for 10 seconds
5. Sunflower sprouts: non-oil seed variety (Fresh Sun Snack)
6. Sunflower sprouts: non-oil seed variety (Cooked Sun Snack) Blanched in boiling water for 45 seconds
7. Sunflower sprouts: oil seed variety brand A (Fresh Sun Oil A)
8. Sunflower sprouts: oil seed variety brand A (Cooked Sun Oil A) Blanched in boiling water for 45 seconds
9. Sunflower sprouts: oil seed variety brand B (Fresh Sun Oil B)
10. Sunflower sprouts: oil seed variety brand B (Cooked Sun Oil B) Blanched in boiling water for 45 seconds

Statistical analysis

Multivariate statistics including internal preference mapping, cluster analysis, and partial least square regression (PLS) were used to interpret consumer acceptance data. Internal preference mapping derives a multidimensional representation of products and consumers. This technique is based on a PCA (Principal Component Analysis) which performed on consumer acceptance data, as observations of the products, and as variables of the consumers [4]. Cluster analysis was used to segment consumers into subsets based on degree of similarity among their liking ratings for a set of products [5]. The Euclidean dissimilarity matrix and Ward's method of agglomerative hierarchical clustering technique were used. Consumer liking scores were further analyzed by Partial Least Square Regression (PLS) (XLSTAT version 2012, Addinsoft, Paris, France). Overall degree of liking was predicted from appearance liking, flavor liking, and texture liking as predictors. The regression coefficients expressed numerically the link between variations in the predictors and variation in the responses. Weighted regression coefficients (i.e. coefficients weighted by the variable mean value) were used to express their relative influence independently of differences in preference intensities.

Results

Cluster analysis

Due to the fact that each consumer has own preference and his/her preference is not identical, drawing conclusions just

from averaged liking scores from the whole population seems to be biased because the information about the groups of people that can prefer some products over others is overwhelmed by averaged data [6]. Consumer segmentation would be used to target the consumers according to their preference. Three clusters were all revealed on the basis of overall degree of liking, appearance liking, flavor liking, and texture liking result. (Figure 1-4.) To see the distribution of consumer preferences and samples, internal preference maps were created based on the cluster analysis results.

Internal Preference Map

Internal preference maps were plotted to provide graphical representations of consumer responses and sample coordinates with the clusters derived from the cluster analyses.

According to a plot of overall degree of liking (Figure 1.), consumers in cluster 1 (n=41) preferred mung bean sprouts in both fresh and blanched forms. They also favored blanched sunflower sprout oilseed variety (Cooked Sun Oil B), however, many sunflower sprout samples were less preferred by this group of consumers. In contrast, consumers in cluster 3 (n=38) liked almost sunflower sprout in both fresh and blanched forms. Consumer in cluster 2 (n=35) liked fresh mung bean sprouts only.

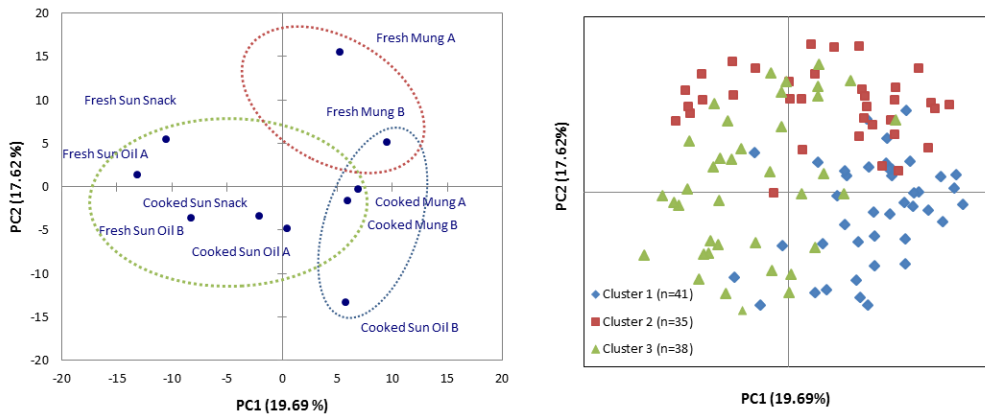


Figure 1. Internal preference map on principal component 1 and 2 for overall degree of liking (n=114).

In the appearance liking plot (Figure 2.), consumers in cluster 1 (n=42) liked the look of mung bean sprouts in both fresh and blanched forms. Consumers in cluster 2 (n=41) liked the appearance of fresh sunflower sprouts in both oilseed and non-oilseed varieties. Any other sprouts were less preferred in the appearance by this group of consumers. Consumers in cluster 3 (n=31) preferred the appearance in both mung bean and sunflower sprouts but blanched mung bean sprout and fresh sunflower sprout were the samples that were liked by consumers in cluster 3. Interestingly, all 3 blanched sunflower sprout samples were the least preferred by consumers in all 3 clusters. Many possible reasons might affect to consumers' appearance liking. Firstly, it is clear that the appearance of mung bean sprouts and sunflower sprouts is totally difference. Mung bean sprouts are expected from the consumers that they would have straight white stem and some yellow tiny leaves while consumers would like to consume sunflower sprouts as fully developed green tiny plants

as micro greens. Generally, the germination process of mung bean sprouts takes a few days in dark condition whereas sunflower sprouts take at least a week to germinate and then they must be exposed to sunlight for starting the photosynthesis. This makes sunflower sprouts have green color on leaves and stems. Thus, consumers who preferred the appearance of mung bean might like some sensory characteristics such as white round fat and straight stem. On the contrary, green color in both stems and leaves, slender and curvy-shaped stem might be the appearance that makes some consumers liked the look of sunflower sprouts more than mung bean sprout. Secondly, it can be observed that sunflower sprouts are shinny than mung bean sprouts. This might be due to the difference of cutin composition and structure in each type of seed. Cutin is a natural wax layer produced during the plant growth. Cutin increases in age from the base to the tip making the surface of fruit and vegetable looks shinny [7]. Lastly, it was interesting that all blanched sunflower sprout samples were the samples

that had the least appearance liking scores. Effect of heat treatment would be the result in this case. It was noticed that blanched sunflower sprouts had a darker green color when compared with the fresh sunflower sprouts. Heat treatment causes the color change. During blanching, Magnesium molecule in chlorophyll would be substituted by hydrogen molecule leading chlorophyll a and b change to pheophytin a and b [8]. This reaction creates the darker green color in all blanched sunflower sprout

samples. Another possibility would be the phenolic compounds found in sunflower sprout samples [9]. Enzymatic browning can be observed in many fruits and vegetables that contain high amount of phenolic compounds. Brown pigments are developed by the reaction of phenolic compounds, oxygen, and polyphenol oxidase [10]. Normally, thermal process is applied to prevent enzymatic browning reaction such as blanching but in this study sunflower sprouts might need longer blanching time to prevent brown appearance.

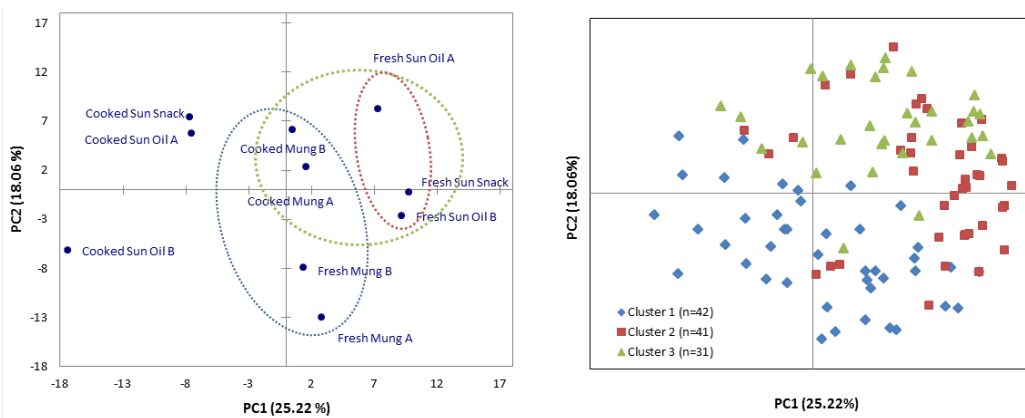


Figure 2. Internal preference map on principal component 1 and 2 for appearance liking (n=114).

In the flavor preference map (Figure 3.), the contrast result is observed between the flavor preference of consumers in cluster 1 and cluster 3. Consumers in cluster 1 (n=42) favored all blanched sprout samples in both sunflower and mung bean sprouts whereas all fresh sprout samples (both sunflower and bean sprout samples) were liked by consumers in cluster 3 (n=48). Cluster 2 (n=24) was the smallest cluster among 3 clusters in flavor preference map. The consumers in this cluster liked the flavor of sunflower sprout samples in both fresh and

blanched forms. Thermal process seems to be the main factor leading to the difference of flavor liking among consumers. Silva and others [11] found that there was a positive correlation between hexanal and isoflavone with cooked grain aroma. These two chemical compounds might be the possible driver of liking for consumers who like cooked sprout samples. Further analysis on correlation of chemical compounds and cooked grain/cooked vegetable is needed. According to sensory descriptive analysis results [12], mung bean sprouts were described as the sample that

had high intensity on “bean sprout identity aroma”, “yam bean-like aroma”, and “beany aroma”. All unique aromas would be related to the chemical reactions in the seeds. Chow and other [13] reported that changes of polyunsaturated fatty acids to aldehydes and alcohol by lipoxygenase would be the main factor of aroma production in bean and

bean products. On the other hand, the same set of sensory panel also mentioned that sunflower sprouts had stronger in “sunflower identity aroma” and “sunflower oil flavor” attribute. Both sensory attributes might be link to chemical substances including 3-methyl-1-butanol, α -pinene, and (E)-2-heptenal which were found mainly in sunflower oil [14].

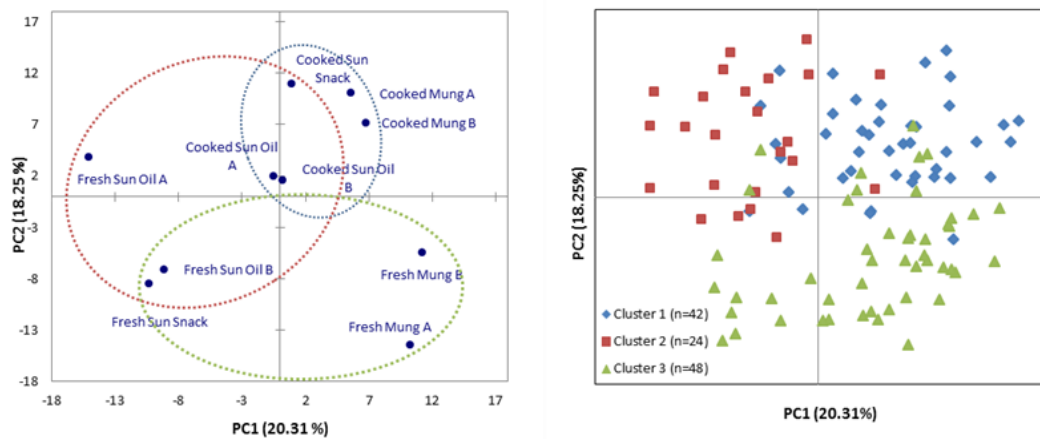


Figure 3. Internal preference map on principal component 1 and 2 for flavor liking (n=114).

In case of texture liking (Figure 4.), it was found the similar trend as shown in flavor liking plot. Consumers in the biggest cluster (cluster 1; n=47) liked the texture of all blanched sprouts in both sunflower and mung bean sprouts while another group (n=29) liked only fresh sprout samples (both mung bean and sunflower sprouts). The other group (n=38) was a group of consumers who liked the texture of mung bean sprouts in both fresh and blanched forms. Fresh sunflower oilseed variety was the least preferred sample by consumers in all 3 clusters. It was clear that 2 big groups of consumers liked the sprout samples differently.

Consumers in one group preferred the texture of blanched sprout samples; in contrast, the other group of consumers liked only the fresh sprouts. Thus, thermal process was the key issue for this difference. Crunchiness and juiciness would be two sensory attributes affecting the texture liking. Heat treatment changes the structure of the sprout samples. Proteins in cell membrane denature and coagulate during heating causing loss of osmotic pressure [15]. Then, air, water, and soluble compounds expose from inner side of cell to outer side of cell resulting in the soft texture and high amount of water in sample’s structure.

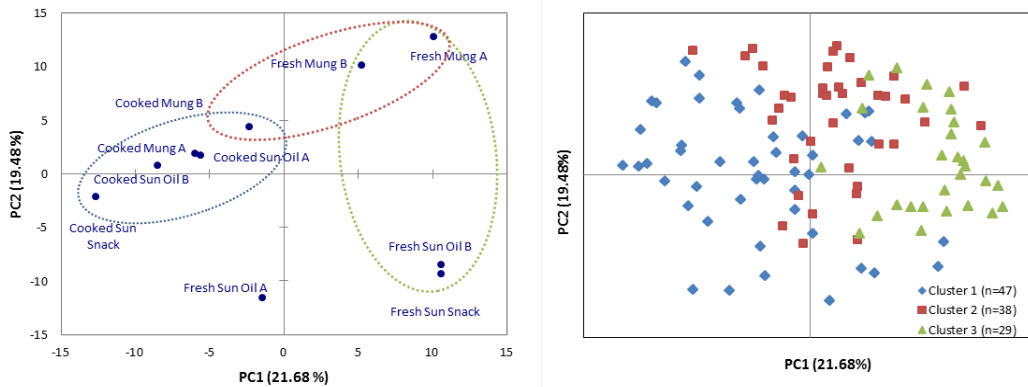


Figure 4. Internal preference map on principal component 1 and 2 for texture liking (n=114).

As presented in all four internal preference maps, the direction of the preference was clearly illustrated. However, the relative importance of sensory parameters (appearance, flavor, and texture) towards overall degree of liking was not discovered yet. Thus, partial least square regression (PLS) is analyzed.

Prediction of overall degree of liking from appearance liking, flavor liking, and texture liking

Overall degree of liking was predicted by modeling methods using consumer liking of appearance, flavor, and texture as predictors. The regression coefficients expressed numerically the link between variations in the predictors. Weighted regression coefficients (i.e. coefficients weighted by the variable mean value) were used to express their relative influence independently of differences in sensory parameters. Figure 5–7. are plots of weighed regression coefficients for a model predicting overall degree of liking.

Flavor was the most important sensory characteristics for all three clusters based on overall degree of liking result. For consumers in cluster 1, texture was the second most important predictor affecting overall liking but texture showed negative effect to overall degree of liking. Appearance was the least important predictor. Like in cluster 1, consumers in cluster 2 perceived that texture was the second most important predictor following with appearance but both texture and appearance had positive effect to overall degree of liking. Result of consumers in cluster 3 shows that all three sensory predictors had almost the same level of importance.

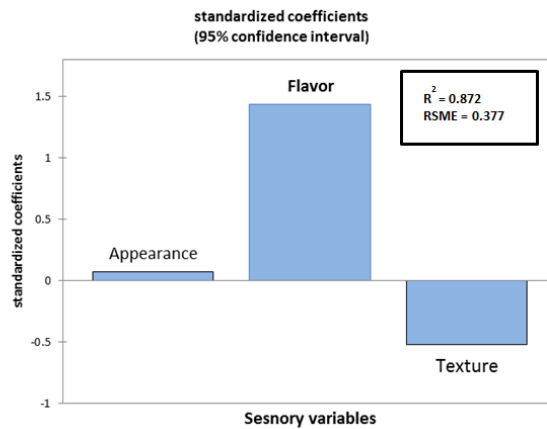


Figure 5. Weighted regression coefficients of prediction model of overall liking of consumers in cluster 1.

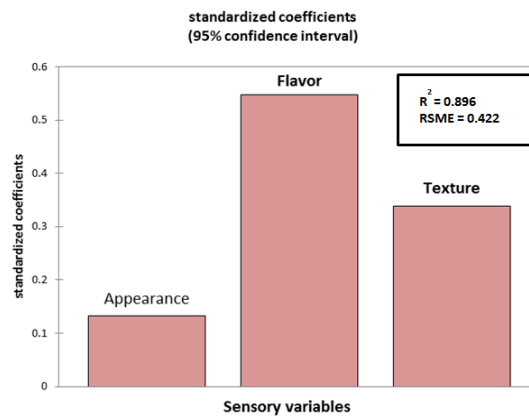


Figure 6. Weighted regression coefficients of prediction model of overall liking of consumers in cluster 2.

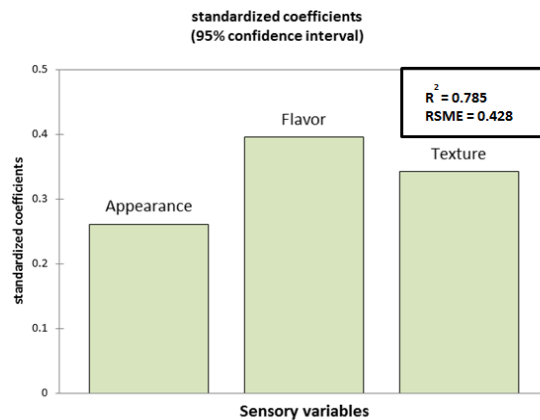


Figure 7. Weighted regression coefficients of prediction model of overall liking of consumers in cluster 3.

Conclusions and Discussion

Consumers who were living in Chiang Rai had different preference on overall degree of liking, appearance liking, flavor liking, and texture liking. Most of sunflower and mung bean sprouts were accepted by consumers with different patterns. Flavor was the key driver towards overall degree of liking in consumers of all 3 clusters. Further study would be conducted on the specific sensory attributes influencing overall degree of liking. Non-sensory factors such as marketing factors

and consumption behavior are also needed to investigate for having insight information on the consumer preference towards the sprout consumption.

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