Mj. Int. J. Sci. Tech. **2007**, *01(2)*, 137-144

Maejo International

Journal of Science and Technology

ISSN 1905-7873

Available online at www.mijst.mju.ac.th

Full Paper

Preference direction study of Job's-tears ice cream

Waraluck Khongjeamsiri, Wiwat Wangcharoen*, Suthaya Pimpilai and Wichittra Daengprok

Department of Food Technology, Faculty of Engineering and Agricultural Industry, Maejo University, Chiangmai 50290, Thailand.

*Corresponding author, E-mail: wwwangcharoen@yahoo.com

Received: 9 July 2007 / Accepted: 27 July 2007 / Published: 6 September 2007

Abstract: Job's-tears (*Coix lachryma-jobi* L.) is a kind of cereal commonly used in Asia as food and medicine, but it is still not widely consumed in Thailand. Four prototype products of Job's-tears ice cream were developed by varying 2 levels of glucose syrup (16 and 32% of Job's-tears used) and coconut milk (50 and 100 % of Job's-tears used). Their sensory attribute profiles were evaluated by 3 groups of 10 selected panelists using Ratio profile test (RPT), and their acceptances, hedonic scores, were evaluated by 100 consumers. Results showed that there were significant effects of coconut milk quantity on several attributes, such as appearance (whiteness), texture (hardness, smoothness), and flavour (coconut milk aroma, sweetness, saltiness), but the effect of glucose syrup quantity was significant on hardness only. Acceptance data were analyzed by cluster analysis to find out the difference of preference directions and 3 clusters (n_1 = 39, n_2 = 25, n_3 = 36) were found. The first cluster preferred Job's tears ice cream containing high glucose syrup and low coconut milk, whilst the second preferred high level of only one of these two ingredients, and the third preferred high level of both ingredients. External preference maps were created from RPT and acceptance data to express the preference direction of each cluster.

Keywords: Job's-tears, ice cream, preference direction, ratio profile test, external preference map

Introduction

Job's-tears (*Coix lacryma-jobi*), coixseed, adlay, or adlai, is a tall grain-bearing tropical plant of the family Poaceae, or grass family [1]. It is listed as a serious weed in Polynesia, a principle weed in Italy and Korea, a common weed in Australia, Borneo, Burma, Cambodia, China, Congo, Colombia, Costa Rica, Dominican Republic, Fiji, Ghana, Guatemala, Hawaii, Honduras, Hong Kong, India, Iran, Iraq, Japan, Melanesia, Micronesia, Nepal, Pakistan, Peru, Philippines, Puerto Rico, Rhodesia, Senegal, South Africa, Sudan, Thailand, United States, and Venezuela [2]. Like other cereals, there are many cultivars of Job's-tears, including soft-shelled, easily-threshed types with a sweet kernel. In some, the hulled grain is adapted for parching or boiling like rice, while in others it can be milled, ground into flour and baked into bread. The grains are also utilized in soups, porridge, drinks and pastries. In India, the Nagas use the grain for brewing a beer called “Zhu” or “Dzu”. A Japanese variety called "Ma-Yuen" is brewed into a tea and an alcoholic beverage, and roasted seeds are made into a coffee-like drink [3]. In Korea, a thick drink called “Yulmu Cha” is made from powdered Job's tears. A similar drink, called “Yì Mí Shǔi”, also appears in Chinese cuisine, and is made by simmering whole polished Job's tears in water and sweetening the resulting thin, cloudy liquid with sugar. The grains are usually strained from the liquid but may also be consumed separately or together [1].

One hundred grams of Job’s-tears grain contain 380 calories, 11.2 g water, 15.4 g protein, 6.2 g fat, 65.3 g total carbohydrate, 0.8 g fiber, 1.9 g ash, 25 mg Ca, 435 mg P, 5.0 mg Fe, 0 µg beta-carotene equivalent, 0.28 mg thiamine, 0.19 mg riboflavin, 4.3 mg niacin, and 0 mg ascorbic acid [4]. According to Hager's Handbook [5], there are 50-60% starch, 18.7% protein (with glutamic acid, leucine, tyrosine, arginine, histidine, and lysine), and 5-10% fatty oil (with glycerides of myristic and palmitic acids).

For medicinal uses, the fruits are anodyne, anti-inflammatory, antipyretic, antiseptic, antispasmodic, hypoglycemic, hypotensive, sedative and vermifuge [4,6]. The seed, with the husk removed, is antirheumatic, diuretic, pectoral, refrigerant and tonic [4, 7, 8]. A tea from the boiled seeds is drunk as part of a treatment to cure warts [9]. It is also used in the treatment of lung abscess, lobar pneumonia, appendicitis, rheumatoid arthritis, beriberi, diarrhea, oedema and difficult urination [7].

In Thailand, Job’s-tears is used as an ingredient in a few recipes and usually consumed by some people. Two commercial drinking products, Pro-fit and P-life, are now available but they are still not popular enough. This work tried to develop a prototype product of Job’s tears-based ice cream and to study the preference direction of consumers for improving this product further.

Experimental Section

Ice cream preparation

The ice cream was prepared accordingly. Job’s-tears were washed and soaked in water for 2 hours. It was then boiled for 40 minutes and blended with water in a ratio 1:2 (boiled Job’s-tears: water). The total solid of blended Job’s-tears was adjusted to 12 % (w/v) with water. Blended Job’s-tears and the other ingredients for each treatment were mixed following the formulation given in Table 1. The resulting mixture was pasteurized at 79 °C for 25 seconds and then cooled rapidly. It was then stored

overnight in the refrigerator. The mixture was made into ice cream using an ice cream maker, then packed and kept in a freezer.

Table 1. Ingredients for preparing ice cream from 500 grams of blended Job's-tears**.**

Treatment	Ingredient (grams)				
	BlendedJob's-tears	Glucose syrup	Coconut milk	Sucrose	Salt
1	500	80	250	60	4
2	500	160	250	60	4
3	500	80	500	60	4
4	500	160	500	60	4

Sensory evaluation

1) Creating sensory attribute profile of 4 prototype products

Three groups of 10 selected panelists were trained to evaluate the products by Ratio profile technique (RPT) [10] before they were requested to taste and evaluate 4 prototype products on 18 sensory attributes created by our research team. The 10 cm-line scale with suitable descriptors at the two ends was used for rating the intensity of each sensory attribute.

2) Preference study of 4 prototype products

One hundred panelists (50 males and 50 females) were requested to express their preference by rating 4 prototype products on 9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely).

Statistical analysis

1) Identifying the difference of preference direction

Hedonic scores of each panelist were standardized. Their standard scores were differentiated by cluster analysis.

2) Analysis of variance

Effects of glucose syrup and coconut milk quantities on the intensity of each sensory attribute (from RPT) and hedonic scores (from each cluster) of 4 prototype products were analyzed by 2x2 Factorial design. All data were tested for normality and homogeneity of variance before analysis of variance was applied.

3) Creating external preference maps

The data reduction by Principal component analysis (PCA) was applied to RPT data, and the position of each sensory attribute and prototype product on each PC was estimated. Bivariate correlations between product positions and hedonic scores (from each cluster) were analyzed. Each

pair of related PCs was used to create an external preference map for each cluster. Finally preference direction of each cluster was created by regressing product positions and their hedonic score means.

Results and Discussion

The difference of preference direction

The result of cluster analysis showed that the difference of preference direction was found and 100 panelists could be separated into 3 different clusters (groups) depending on their preference direction. The number of member in cluster 1, cluster 2, and cluster 3 were 39, 25, and 36 persons, respectively.

Effect of glucose syrup and coconut milk quantities on the intensity of each sensory attribute.

Results (Table 2) showed that there were significant effects of coconut milk quantity on several attributes but the effect of glucose syrup quantity was significant only on hardness. If coconut milk quantity was increased, the product looked brighter, smoother, but lesser in quantity of blended Job's-tears. Also, the coconut milk odor would be stronger but Job's-tears taste, sweetness, and saltiness would be milder**.** Additionally, the product became harder and slower melting, but less in stickiness and teeth and tough sticking after swallowing. If glucose syrup quantity was added, the product became softer.

Effect of glucose syrup and coconut milk quantities on hedonic scores of each cluster.

The difference of three consumer clusters is shown in Table 3. Cluster 1 preferred Job's-tears ice cream containing high glucose syrup and low coconut milk (Treatment 2), whilst cluster 2 preferred high glucose syrup and low coconut milk (Treatment 2) or low glucose syrup and high coconut milk (Treatment 3), and clusters 3 preferred high levels of both glucose syrup and coconut milk (Treatment 4).

Creating external preference maps.

The principal component (PC) analysis reduced 18 sensory attributes into only 6 PCs with 66.4 % variance explained as shown in Table 4. Bivariate correlations showed that there was an optimum point of products on PC3 and PC6 for cluster 1 and it meant they wanted products with optimum texture (hardness, melting rate, and number of ice crystals) and coconut milk odour. The optimum point was also found on PC1, PC3, and PC5 for cluster 2. It meant products with optimum Job's-tears flavour and texture (hardness, melting rate, and number of ice crystal) would be preferred. For cluster 3, the direction of preference was found on PC2 (+) and PC4 (-). It meant that this cluster preferred smooth and rich, but not sticky and sweet products. External preference maps were created as shown in Figure 1, but the equation of preference direction could be created for cluster 3 only, because more

data points were needed for non-linear regression in case of cluster 1 and 2, who wanted optimum products. However, the optimum area might be considered from hedonic score means of products for cluster 1 and it should be located close to the origin point (0,0), but the optimum area for cluster 2 could not be identified because of the small difference between hedonic score means of products. The preference direction equation for cluster 3 was: Hedonic score = 6.61 - 2.26 PC2 - 2.76 PC4. This equation expressed that products located on quadrant 3 (-,-) would be preferred by this consumer cluster. This result did not agree with the bivariate correlation result for PC2 (smoothness and richness), and it meant that too smooth and rich products were not preferred by this cluster either.

Table 2. Intensity means of prototype products' sensory attributes at low and high levels of glucose syrup and coconut milk.

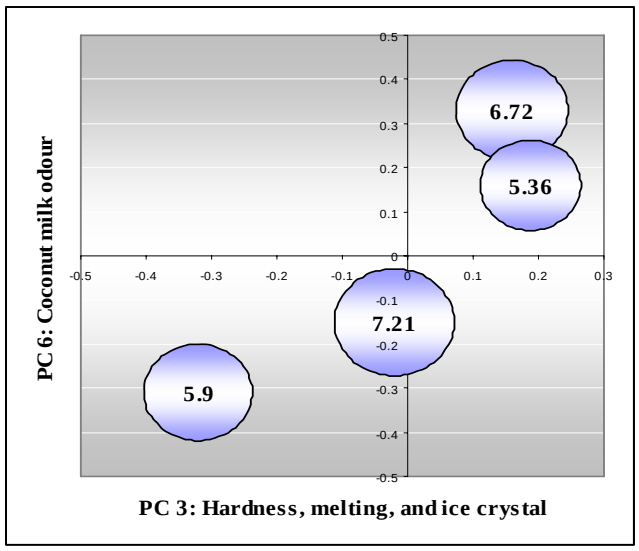
	Glucose syrup		Coconut milk	
	80 grams	160 grams	250 grams	500 grams
Appearance				
1. Whiteness (bright to dark)	5.42	5.01	6.87[a]	3.56[b]
2. Quantity of blended Job's-tears (least to most)	5.09	5.51	6.31[a]	4.29[b]
3. Smoothness by looking (least to most)	5.92	5.70	5.40[b]	6.22[a]
Odour				
4. Coconut milk odour (mild to strong)	5.30	5.32	4.69[b]	5.94[a]
5. Job's-tear odour (mild to strong)	4.31	4.38	4.61	4.08
Taste				
6. Coconut milk taste (least to most)	5.78	5.77	5.52	6.03
7. Job's-tear taste (least to most)	5.45	5.54	6.05[a]	4.94[b]
8. Sweetness (least to most)	4.87	4.96	5.29[a]	4.53[b]
9. Saltiness (least to most)	5.00	5.09	5.46[a]	4.63[b]
Texture				
10. Hardness (soft to hard)	5.91[a]	5.05[b]	4.87[b]	6.08[a]
11. Smoothness by taste (least to most)	5.39	5.03	5.29	5.13
12. Richness (least to most)	5.76	5.53	5.67	5.63
13. Stickiness (least to most)	4.81	5.14	5.58[a]	4.38[b]
14. Number of ice crystal (least to most)	4.61	4.17	4.18	4.60
15. Melting rate (fast to slow)	4.71	5.20	4.64[b]	5.26[a]
Others				
16. Off-flavour (least to most)	2.02	2.13	2.11	2.05
17. Teeth and tough sticking after swallow (least to most)	5.56	5.50	5.97[a]	5.09[b]
18. Mouth coating after swallow (least to most)	5.41	5.80	5.44	5.77

a, b ; Mean pairs with different letters were significantly different ($p<0.05$).

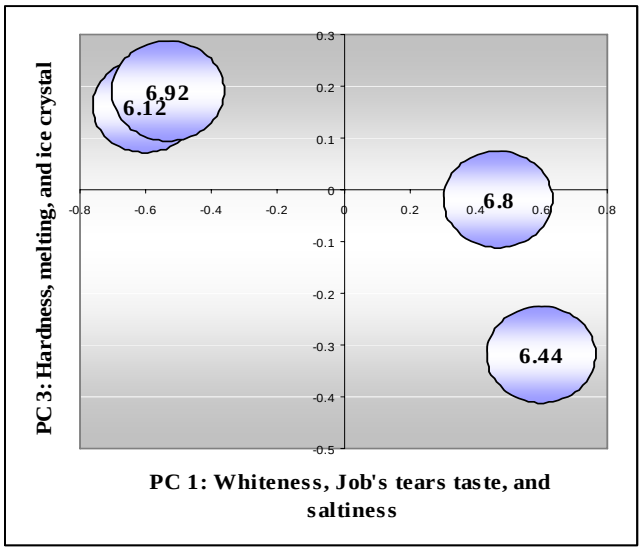
Table 3. Hedonic score means for 4 prototype products of each consumer cluster**.**

Treatment	Cluster 1 (n_1 = 39)	Cluster 2 (n_2 = 25)	Cluster 3 (n_3 = 36)
1	5.90 ± 1.45^{c}	6.44 ± 0.87^{bc}	6.61 ± 1.10^{b}
2	7.21 ± 1.06^{a}	6.80 ± 1.00^{ab}	5.97 ± 1.28^{c}
3	5.36 ± 1.44^{d}	6.92 ± 1.00^{a}	6.69 ± 1.12^{b}
4	6.72 ± 1.07^{b}	6.12 ± 1.13^{c}	7.22 ± 1.10^{a}

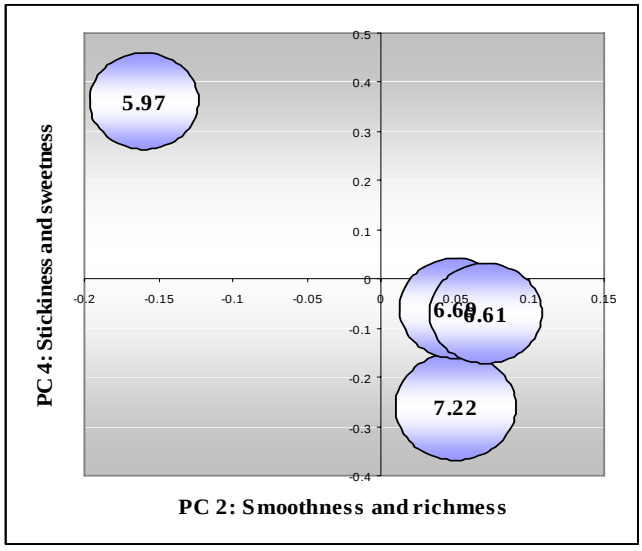
a, b,.. ; Means with different letters in each column were significantly different ($p<0.05$).



Cluster 1: Product located on the origin point (0,0) area would be preferred..



Cluster 2: Area of preferred products could not be identified for this cluster since there was a small difference between hedonic scores of all products (6.12 – 6.92).



Cluster 3: Product located on the minus area of both PC2 and PC4 would be preferred. (Hedonic score = 6.61 - 2.26 PC2 - 2.76 PC4**)**

Figure 1. External preference maps created from the results of the principal component analysis

Table 4. Results of the RPT data reduction by Principal component analysis**.**

PC	% Variance explained	Highly related attributes
1	15.4	Whiteness (+), quantity of blended Job's-tears (+), Job's-tears taste (+), saltiness (+), and teeth and tough sticking after swallowing (+).
2	14.2	Smoothness by looking (+), smoothness by tasting (+), richness (+), and mouth coating after swallowing (+).
3	10.1	Hardness (+), melting rate (+), and number of ice crystals (+).
4	9.7	Stickiness (+), sweetness (+), and off-flavour (+).
5	8.7	Job's-tears odour (+), and coconut milk taste, (-).
6	8.3	Coconut milk odour (+).
Total	66.4	

Conclusion

The study on the difference of preference direction could provide more information about consumers' preference to the developed product. It guided the direction to improve products for each target consumer group. This work also showed the opportunity to develop Job's tears-based ice cream for cluster 1 and cluster 2, but for cluster 3 Job's-tears flavoured ice cream seemed to be more interesting to them.

Acknowledgements

This work is a part of a research project supported by Faculty of Engineering and Agro Industry, Maejo University, Chiangmai, Thailand.

References

1. A. Pink, "Gardening for the million", EText-No. 11892**, 2004**; Retrieved Feb 20, 2007, from: http://www.gutenberg.org/etext/11892.
2. L. G. Holm, J. V. Pancho, J. P. Herberger, and D. L. Plucknett, "A geographical atlas of world weeds", John Wiley & Sons, New York, **1979.**
3. A. Arber. The Gramineae--A Study of Cereal, Bamboo, and Grass. Wheldon & Wesley, New York, **1965.**
4. J. A. Duke and E. S. Ayensu, "Medicinal plants of China", Reference Publications, Michigan, **1985.**
5. P. H. List and L. Horhammer, "Hager's handbuch der pharmazeutischen praxis", Vol. 2-6, Springer-Verlag, Berlin, **1969-1979.**
6. D. Bown, "Encyclopaedia of herbs and their uses", Dorling Kindersley, London, **1995.**
7. H. Yeung, "Handbook of Chinese herbs and formulas", Institute of Chinese Medicine, Los Angeles, **1985.**
8. R. N. Chopra, S. L. Nayar, and I. C. Chopra, "Glossary of Indian medicinal plants" (including the supplement), Council of Scientific and Industrial Research, New Delhi, **1986.**
9. Brooklyn Botanic Garden, "Oriental herbs and vegetables", Vol. 39 (No. 2), New York, **1986.**
10. H. R. Cooper, M. D. Earle, and C. M. Triggs, in "Ratios of ideals–a new twist to an old idea", (Ed. L. S. Wu : Product testing with consumers for research guidance), American Society for Testing and Materials (ASTM), Philadelphia, **1989.**