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Sensory Evaluation Of The Selected Milk Products Using Fuzzy Set Theory

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Abstract:

Knowing the consume preferences and perceptions of the sensory evaluation of milk products are very significant to manufacturers and retailers. With no appropriate sensory analysis there is a high risk of market disappointment. This paper aims to rank the selected milk products and also to determine the best quality attribute through sensory evaluation using fuzzy decision making model. Three milk products were used for sensory evaluation. Data were collected from judges at a hypermarket. The judges were asked to specify their sensory evaluation in linguistic terms of the quality attributes of colour, smell, taste & mouth feel for each product and also the weight of each quality attributes. Five fuzzy linguistic terms represents the quality attributes. The membership function and the weights were compared to rank the products and also to determine the best quality attribute. The product of 'B' was judges as the first in ranking and "Taste" as the best quality attributes. These implicate the importance of sensory evaluation in identifying consumer's preferences and also the competency of fuzzy set theory in decision making.

KEYWORD:

Fuzzy decision making, Fuzzy linguistic, Membership function, Sensory evaluation.

INTRODUCTION

Sensory evaluation is one of the methods used in identifying the market acceptability especially in food or food based products. It is useful for product development and improvement since the most important factor for a particular market can be identified and improved [1], [2]. Influential factors are essential for consumers to get the best product and for manufacturers to develop and sell the best product. Sensory evaluation is also necessary to ensure that their products will be succeeding in the marketplace. Without appropriate sensory analysis, there is a high risk of market failure [3]. Sensory analysis is too commonly often overlooked as a requirement before product launched. The implications again back to the successfulness of product launched. The implications again back to the successfulness of product to survive in market. Today's consumers are discerning, demanding and more knowledgeable about milk products and expect products which are safe, good value and of high sensory quality. Therefore, knowing consumer's preferences and perceptions of the sensory characteristics of milk products is very important to manufacturers.

Sensory evaluation involves the measurement and evaluation of sensory properties of milk product. Human judges are used to measure the sensory characteristics of milk products. Sensory data such as colour, smell, taste and mouth feel are obtained through subjective evaluation. This type of evaluation data are normally analyzed statistically, but it is not possible to find out from such analysis the strength and weakness of specific sensory attribute, which is responsible for acceptance and rejection of the milk products. In statistical analysis of the sensory evaluation data, average score of attributes are generally calculated and compared with a certain significance level among the samples [4] [5]. An alternative way

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had been introduced by applying fuzzy sets instead of average scores to compare the samples attributes [6]. The fuzzy sets are not confined to a deterministic value, so they may have a merit in sensory evaluation because human expressions on feeling for milk products are fuzzy rather than deterministic. In fuzzy theory, a subject can be represented by fuzzy sets with a series of elements and their membership [7]. The concept of the membership given to each element makes it possible to represent fuzzy sets, 'very tasty' rather than a preference score of 79%. Such fuzzy sets provide the mathematical methods that can represent the uncertainty of human's expression.

Fuzzy approaches have been successfully applied in many experiments that involved sensory evaluation process [8], [9]. Used fuzzy logic for quality analysis of mango bar is a few of the examples of fuzzy approach in sensory evaluation. The quality attributes responsible for higher as well lower rank were identified for further improvement of the milk products. They were also used this method to compare his product with the similar products available in market. Zhang and Litchfied [1] and [2] used fuzzy model to determine the importance of individual factor to the overall quality of a product. Also by adjusting the 'weighting subset', a product can be tailored for specific consumer groups or geographic regions. There were many products involves in sensory evaluation experiments. It comes from food such as mango drinks, coffee products [9]. The similar experiment can also be extended to milk products. This paper focus on the popularity of milk products and the importance of consumer's preferences in choosing the product motivate and further explore these relations. The undeterministic sensory impacts of milk products will be evaluated using a fuzzy approach. Based on the above premises, the present study aims to rank of the selected milk products through sensory evaluation and find out the best of quality attribute using fuzzy decision making. It is hoped that the fuzzy approach can be used to determine the importance of individual attributes to the overall quality of a product.

2. FUZZY SET THEORY

Definition 2.1

Let 'U' be a universe set. A fuzzy set 'A' of U is defined by a membership function

$$\mu_{\tilde{A}}(x) \in [0,1], \text{ where } \mu_{\tilde{A}}(x) \in (0,1), \text{ indicates the degree of } x \text{ in } A.$$

Definition 2.2

Let 'A' be a given set of possible alternatives which contains a solution to decision making problem under consideration. A fuzzy goal 'G' is a fuzzy set on 'A' characterized by its membership function

$$\mu_{\tilde{G}}(x) \in [0,1]$$

This represents the degree to which the alternatives satisfy the specified decision goal. In general, a fuzzy goal indicates that a target should be obtained, but it also quantifies the degree to which the target is fulfilled.

Definition 2.3

Let 'A' be a given set of possible alternatives which contains solution to a decision making problem under consideration. A fuzzy constraint 'C' is a fuzzy set on 'A' characterized by its membership function

$$\mu_{\tilde{C}}(x) \in [0,1]$$

This constrains the solution to a fuzzy region within the set of possible solution.

Definition 2.4

Let 'A' be a given set of possible alternatives which contains a solution to a decision making problem under consideration. Let 'G' be the set of fuzzy goals for the decision, represented by the membership function

$\mu_{\tilde{G}}(a), a \in A$, and let 'C' be the set of fuzzy constraints represented by membership

function $\mu_{\tilde{C}}(a), a \in A$. Then the fuzzy decisions 'F' result from the intersection of the fuzzy decision

goals and fuzzy constraints, i.e. $F = G \cap C$ the fuzzy decision is characterized by its membership function

$$\mu_{\tilde{F}}(a) = \mu_{\tilde{G}}(a) \cap \mu_{\tilde{C}}(a), a \in A$$

Where \cap denotes the minimum operation.

Definition 2.4

The optimal decision a^* in fuzzy decision making is the decision with the largest membership value, also called the *maximizing decision*, which is defined by $a^* = \operatorname{argmax}_{a \in A} \mu_{\tilde{G}}(a) \cap \mu_{\tilde{C}}(a)$ it is important to note that distinction

between the goals and constraints disappears in this model. Essentially, both the goals and the constraints are represented by membership function on the set of possible alternatives.

3. LINGUISTIC VARIABLES

Zadeh L.A [98] stated that traditional quantification methods had difficulty reasonably expressing the condition that were overtly complicated or hard to define, and thus linguistic sentiment offered a practical means of describing such situations. The theory of linguistic variable is given to express impression of spatial information and human cognition over the evaluation criteria. The linguistic variable is used to carry out the rating of the strategies with respect to the decided criteria.

4. FUZZY DECISION MAKING IN SENSORY EVALUATION

The model used for the analysis of sensory data was developed by Chen (1985). Fuzzy model for the present problem has two sets: Attributes set

U_f and Evaluation set V_f . The attributes set U_f includes all of the quality attributes such as Colour, Smell, Taste and Mouth feel of the product. The evaluation set V_f includes the linguistic term for each of the quality attributes, such as Excellent, good medium, fair and not satisfactory. Then numerical values were assigned to the linguistic terms S_f : Excellent=1, Good=0.9, Medium=0.7, Fair=0.4 and Not satisfactory=0.1. The steps in this analysis consist of the following calculations.

➤ *Fuzzy Membership Function, M_f*

Fuzzy membership was calculated by adding the individual linguistic term given to each of the quality attribute of the product and divided by the number of judges who tested the milk product.

$$M_f = \frac{\sum V_f}{\text{TotalofJudges}} \quad (1)$$

➤ *Normalized Fuzzy Membership Function* N_f

Normalized fuzzy membership function was calculated by multiplying each of the above membership function with the assigned numerical value of the respective linguistic term

$$N_f (M_f * S_f) \quad (2)$$

➤ *Normalized Fuzzy Membership Function Matrix*, O_f

Addition of the normalized fuzzy membership function of individual linguistic term of respective quality attributes for each the products given for sensory evaluation formed the elements of the normalized matrix were form and written in the form of a matrix called normalized fuzzy membership function matrix having its row as quality attributes and the columns as samples.

$$O_f = (N_f \text{foreachQualityattribute}) \quad (3)$$

➤ *Judgment Subset* Y_f

Judgment subset, Y_f was formed by averaging the numerical weights (as fraction obtained from the percentage of marks given for individual quality attribute) given by the judges for individual quality attributes like 'Colour', 'Smell', 'Taste', and 'Mouth feel'. Arithmetic mean method was employed to find the weights for each quality attributes.

$$Y_f = \frac{1}{N} \sum_{i=1}^N X_i \quad (4)$$

➤ *Quality ranking Subset* Z_f

The individual elements of the judgment membership function matrix X_f were compared with the respective elements of the judgment subset Y_f and the minimum of them was taken to form the quality ranking subset Z_f . The 'and' in fuzzy operations were applied in obtaining Z_f .

➤ *Ranking of the Sample*

From the values of each element in the quality ranking subset Z_f , the maximum values was taken and assigned as the rank one of the respective sample. Then the quality attribute, which gave the highest value, was considered as the reason for that sample to get the highest rank. The 'or' in fuzzy operation were applied in making the decision.

5. NUMERICAL EXAMPLE

Three milk products used in sensory evaluation were 'A', 'B' and 'C'. Residents of city were selected as judges on the level of preferences for three milk products. Approximately 250 ml of samples were prepared in a small paper cup and presented to the judges. They were asked to judge the samples quickly but not hurry and take two short sniffs of the samples before testing the samples and gives score for

quality attributes in the scorecard. The judges were asked to give tick mark in the respective fuzzy linguistic terms on their own criteria and likings regarding milk products. Each judge need to choose one of the fuzzy linguistic terms 'Excellent' (EX), 'Good' (GD), 'Medium' (MD), 'Fair' (FR), and 'Not satisfactory' (NS), to show how much each sensory attributes generally contributes to the overall acceptability. The quality attributes selected for the sensory evaluation were colour, smell, taste, and mouth-fell of the milk products. After testing the samples, they were asked to give marks for each of the quality attributes out of 100 based on their own taste regarding milk products. These marks were called as weight of each attribute. Data of sensory evolution were collected from home to home. The data were analyzed using fuzzy decision making method. The results are presented as follows.

Fuzzy membership function M_f and Normalized Fuzzy Membership function N_f were calculated using the equation (1) and (2). These two membership function led to calculation of Normalized Fuzzy Membership function Matrix O_f using equation (3). The results are presented in table 1.

Table 1: Normalized Fuzzy Membership Function N_f For Quality Attributes Of milk products and Normalized Fuzzy Membership Function Matrix O_f

Quality attributes	N_f		
	A	B	C
Colour	0.82	0.88	0.64
Smell	0.77	0.69	0.66
Taste	0.78	0.95	0.70
Mouth feel	0.79	0.93	0.67
O_f	3.17	3.72	2.68

The matrix O_f was converted to Judgment Membership Function matrix X_f by using equation (4). The value of X_f and their corresponding quality attributes are shown in table 2.

Table 2: Judgment Membership Function X_f for Quality Attributes of Milk Products.

Quality attributes	X_f		
	A	B	C
Colour	0.22	0.23	0.172
Smell	0.20	0.25	0.178
Taste	0.21	0.25	0.188
Mouth feel	0.21	0.24	0.182

Judgment subset Y_f was formed using the step in equation (5). The values of the judgment membership function X_f were then compared with the weights Y_f given by the judges for each of the quality attributes. Based on this, the quality ranking subset values Z_f were calculated. The rank of a sample was assigned from the maximum of quality ranking subset value Z_f and ranking according to their quality attributes and products are presented in table 3.

Table 3: Quality Ranking Subset value Z_f of milk products and Ranking

Quality attributes	Y_f	Z_f		
		A	B	C
Colour	0.91	0.173	0.173	0.172
Smell	0.25	0.20	0.23	0.178
Taste	0.35	0.21	0.25	0.188
Mouth feel	0.20	0.18	0.18	0.180
Ranking	Taste	II	I	III

The results show that sample of coffee product 'B' recorded the highest ranking followed by 'A' and 'C'. For the best quality attribute, interestingly to note that 'Taste' was chosen as the best quality attribute for all the sample milk products.

6. CONCLUSION

Competition in marketing to fulfill customers needs, the cost of failure is so high. In an effort to avoid market disappointment. One of the options to be considered is probing for customer satisfaction through sensory evolution. In this study, the selected judges expressed their sensory evolution toward the three milk products in linguistic terms by choosing the number from provided scales. Fuzzy decision making was adopted in the in the analysis of sensory evaluation data for milk products. Preference degrees for sensory attitudes of colour, smell, taste and mouth feel have represented in fuzzy linguistic terms and the overall acceptability can be inferred from them by fuzzy decision making. There were seven steps before approaching to decide the rank of best milk products as well as the best quality attribute. The result show that the sample of product 'B' was the highest rank followed by 'A' and 'C'. For the best quality attribute, all the obtained quality-ranking values agreeably to the quality of 'Taste'. The results may not only offer a meter to consumers to make the best selection but more importantly how manufacturers react to these findings in an effort to meet customer's choice. Altogether, customers have played their part in making the availability of the best products in the market.

REFERENCES

- 1.Q. Zhang and J.B Litchfied., Applying fuzzy mathematics to product development and comparison., Food Tech, Vol. 45, no. 7,108-11, 1991.
- 2.M.A. Lazim and M. Surini, Sensory evaluation of the selected coffee products using fuzzy Approach, Word Academy of science & Tech, Vol. 70, 717-720
3. H.J. Zimmermann, Fuzzy set theory and its applications, Kluwer: Academic Publication, 1991.
- 4.R.E. Bellman and L.A. Zadeh, Decision making in a fuzzy environment., Management Science, Vol. 17, No. 4, 141-164, 1970.

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