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Research Article

SENSORY ATTRIBUTES OF MANGO SHAKE PREPARED FROM SKIM MILK WITH DIFFERENT RATIO WITH DIFFERENT VERITY

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ABSTRACT

In the present study skim milk based mango shake was developed using two varieties separately, viz. Dashahri and Safeda. The skim milk mango shake was prepared by incorporating mango pulp into the skim milk in the following ratios, i.e. 2:3, 1:1, 3:2. Sensory evaluation by trained panel members was conducted to determine the most acceptable product base on colour, taste, aroma and mouth-feel. Fuzzy logic analysis was employed to evaluate and analyze the sensory scores of the various mango shake developed and rank the samples according to their sensory qualities. Fuzzy analysis showed higher acceptance for the S_4 prepared using safeda mango and skim milk in the ratio of 2:3 whereas the least preference was observed for S_3 which was prepared using Dashahri and skim milk in the ratio of 3:2 The quality properties was also ranked in the order mouth-feel>taste>colour>aroma determining mouth-feel as the most important attribute followed by taste whereas least preference was given to aroma.

INTRODUCTION

Mango (*Mangiferaindica* L.), also called the 'king of fruits', is a tropical fruit, belonging tothe family Anacadiaceaethat originated in India and Southeast Asia. It is an important fruit for human nutrition and is widely accepted by consumers throughout the world for its succulence, sweet taste and exotic flavour. Commercial mango production is reported in more than 87 countries, India being the largest producing country in the world followed by China, Thailand, Indonesia, Philippines, Pakistan, and Mexico (Sivakumar *et al*., 2011). Mango fruit has potential health benefits owing to their ascorbic acid, carotenoids, polyphenolic compounds, and other dietary antioxidants content (Varakumar *et al*., 2011; Naresh *et al*., 2014a, 2014b) as well as high content of vitamins A, C and E. Ripe mango pulp has 50% of total carotenoid and 2.0% (w/w) pectin which is a soluble dietary fiber (Ramulu and Rao, 2003). Mostly, mangoes are either consumed fresh or are used in the food industry for the production of jam, pulp, concentrated juice, canned fruit, nectar, powder, canned mango slices in syrup, chutneys, pickles (Tharanathan *et al*., 2006). Being seasonal fruits, processing is needed for value addition, to increase variety of products,preservation and to reduce postharvest losses. Mango shake is one such kind of product which can be easily prepared at household or industrial level and is highly acceptable by consumers worldwide. Generally, mango shake is prepared from whole milk. However, no attempt has been made earlier on preparation of mango shake from skimmed milk. With growing concerns over coronary diseases, substitution of whole milk with skim milk poses as a beneficial effect to control such diseases (Steinmetz *et al*., 1994).

One of the biggest challenges for product development is the acceptability by the consumers. Therefore, sensory test is required to predict the consumer acceptability and success of the product in the market. The sensory test for colour, smell, taste and mouth feel are obtained through subjective evaluation. These 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 mango shake. On the other hand, fuzzy logic is an important decision-making tool that can be applied toanalyze sensory data so that important conclusions can be drawn relating to acceptance, rejection as well as ranking of strong and weak attributes of the food (Kaushik *et al*., 2015). In fuzzy modelling, linguistic variables, viz. like, like very much, neither like nor dislike, dislike, dislike very much, are used for developing relationship between independent variables (eg. colour, flavour, appearance, taste, texture, etc.) and dependent variables (e.g., overall acceptance,

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rejection, ranking, as well as evaluating the strong and weak attributes of food) (Das, 2005). Thus using fuzzy logic has an upper hand wherein important information are provided on the strength and weakness of particular attribute which may be important for acceptance or rejection of the food. Keeping this in mind, the present investigation was conducted to evaluate sensory attributes of skimmed milk mango shake samples using fuzzy logic.

MATERIALS AND METHODS

Raw material

Two varieties of mango Dashahri and Safeda were purchased from local market Kundli, Sonepat, Haryana. Skim milk powder was purchased from Gulati and Co. Delhi and was reconstituted with sterile distilled water.

Preparation of Mango Shake

For preparation of mango shake (Fig.1) mango pulp was extracted by hand and mixed with reconstituted skim milk to produce a mixture having TSS of 10°B. Then sugar 10% (by weight) was added and mixed uniformly in mixer (Philps HL1606/03) for 5min. Six samples were prepared as per the following:

S_1= Sample prepared by dasahri mango with skim milk with ratio 2:3 by weight
S_2= Sample prepared by dasahri mango with skim milk with ratio 1:1 by weight
S_3= Sample prepared by dasahri mango with skim milk with ratio 3:2 by weight
S_4= Sample prepared by safeda mango with skim milk with ratio 2:3 by weight
S_5= Sample prepared by safeda mango with skim milk with ratio 1:1 by weight
S_6= Sample prepared by safeda mango with skim milk with ratio 3:2 by weight

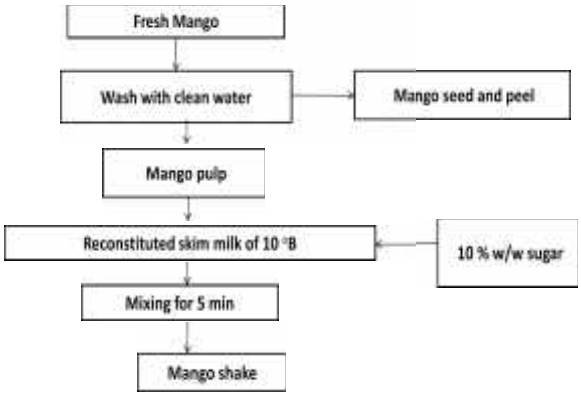

Fig. 1 Process flow chat for mango shake

Sensory evaluation of mango shake

Sensory evaluation of Mango shake was done using fuzzy logic technique with 11 numbers of judges of the student and Faculty of the National Institute of Food Technology Entrepreneurship and Management (NIFTEM), Kundli, India with age between 20 to 50 years. The panellist were instructed to use fuzzy logic scale (1= Not satisfactory, 5= excellent) to evaluate the acceptability of sensory attributes such as colour, taste, aroma and mouth feel. Judges were asked to give their response after tasting Mango shakeand give tick mark to each sample as per their own feeling. This method hasbeen successfully applied for mango drinks (Jaya and Das, 2003), soy fortified paneer (Uprit and Mishra, 2002), dahi powder (Routrayand Mishra, 2011), instant green tea powder (Sinija and Mishra, 2011), extra-virgin olive oil (Bevilacqua *et al*., 2012) and millet-based bread (Singh *et al*., 2012).

Triplets for sensory score of the samples

In Fig.2 five point linguistic scales distribution pattern is represented. For example, triangle abc represents membership function for poor/not at all important category, triangle gij represents distribution function for excellent/extremely important category, etc. Triangular membership function distribution pattern of sensory scale can be represented by set of triplets. First number of triplets denotes the coordinate of the abscissa at which the value of the membership function is 1. Second and third numbers of triplet designate the distance to the left and right, respectively of the first number where the membership function is 0 and Triplets associated with sensory scales in table 1.

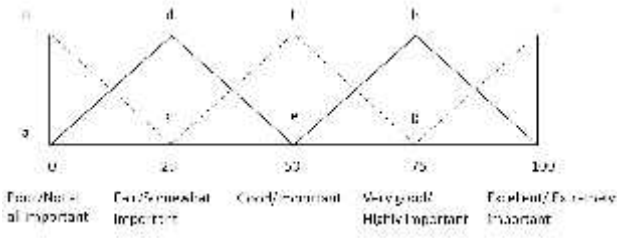

Fig. 2 Triplets associated with the five-point linguistic scale

Triplets for sensory score of quality attributes

The triplet for the sensory scores for a particular quality attribute of every sample was obtained from the sum of sensory scores, triplets associated with sensory scale and the number of judges. For example, in case of colour attributes of a sample, when total number of judges is ($n_1 + n_2 + n_3 + n_4 + n_5$) and n_1 judges give "Not satisfactory" score, n_2 judges give "fair" score, n_3 judges give "Medium" score n_4 judges give the score as "Good" and n_5 judges give "Excellent," the triplets for sensory scores for the colour will be calculated as follows:

$$S_i C = \frac{n1(0\,0\,25) + n2(25\,25\,25) + n3(50\,25\,25) + n4(75\,25\,25) + n5(100\,25\,0)}{n1 + n2 + n3 + n4 + n5} \quad (2.1)$$

Where, 'i' is the serial no. of samples

Triplets for relative weight age of quality attributes

Similar triplet values were obtained for each of the quality attributes of all the samples, and the triplet for the sensory score of the quality attributes e.g. QC (colour), QT (Taste), QA(Aroma) and QM (Mouth feel) were calculated from the general weight-age given by the judges to quality attributes of the sample in general. In order to find out triplets for the overall sensory score of the samples, it was necessary to find out the relative weight age of the quality attributes. For this, sum (Q_{sum}) of the first digit of triplets of QC, QT,QA, and QM was obtained. Triplet for the relative weightage of quality attributes e.g. color was

$$QC_{rel} = QC/Q_{sum} \quad (2.2)$$

Similarly, relative weightage of the other quality attributes, viz., Taste (QT), Aroma (QA) and Mouth feel (QM) could be evaluated.

Triplets for overall score of the sample

Triplet for sensory score for each quality attributes was multiplied with the triplet for relative weightage of that particular attributes, and the sum of the resultant triplet values for all attributes was taken to find out the triplet for the overall sensory score of the samples. In this, overall sensory score can be presented as shown in Eqn. 2.3

$$SO_i = S_iC \times QC_{reL} + S_iT \times QT_{rel} + S_iA \times QA_{rel} + S_iM \times QM_{rel} \quad (2.3)$$

Where, each of the term on right hand side of the equation represents a triplet. The multiplication of triplet (a b c) with (d e f) can be done using Eqn. 2.4

$$(a\ b\ c) \times (d\ e\ f) = (a \times d\ \ a \times e + d \times b\ a \times f + d \times c) \quad (2.4)$$

Estimation of Membership Function for Standard Fuzzy Scale

The triangular distribution pattern of 6-point scale, which is referred to as standard fuzzy scale, where symbols F1, F2, F3, F4, F5 and F6 represent sensory scales. The membership function of each of the sensory scale follows triangular distribution pattern where the maximum value of membership is 1. The values of which are defined by a set of 10 numbers shown in equation 2.5.

$$\left.\begin{array}{l} F1 = (1, 0.5, 0, 0, 0, 0, 0, 0, 0, 0) \\ F2 = (0.5, 0.5, 0, 0, 0, 0, 0, 0, 0, 0) \\ F3 = (0, 0, 0.5, 1, 1, 0.5, 0, 0, 0, 0) \\ F4 = (0, 0, 0, 0.5, 1, 1, 0.5, 0, 0, 0) \\ F5 = (0, 0, 0, 0, 0, 0, 0.5, 1, 1, 0.5) \\ F6 = (0, 0, 0, 0, 0, 0, 0, 0, 0.5, 1) \end{array}\right\} \quad (2.5)$$

Computation of Overall Membership Function of Sensory Scores on Standard Fuzzy Logic Scale

Figure 3 represents graphical representation of membership function of a triplet (a, b, c) and triplet associated with overall sensory scores, which was calculated using Eq. 2.6, where for a triplet (a, b, c), the value of membership function is 1 when the value of abscissa is a, and is zero when it is less than a–b or greater than a + c. For a given value of x, on abscissa:

$$Bx = \frac{x - (a - b)}{b}, for\ a - b < x < a$$
$$= \frac{a + c - x}{c}, for\ a < x < a + c \quad (2.6)$$

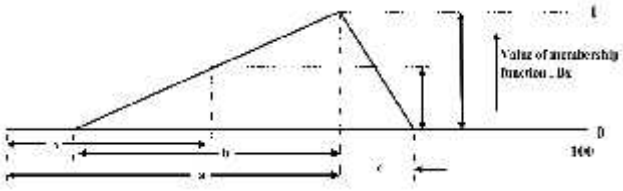

Fig. 3 Graphical representation of triplet (a, b, c) and its membership function (Das 2005).

Estimation of Similarity Values and Ranking of the Mango shake

After getting the B values for each of the samples on standard fuzzy scale as a set of 10 values, the similarity values for each sample was obtained by the equation:

$$Sm\ \ F, B = \frac{F * B'}{Max\ \ F * F' and B * B'} \quad (2.7)$$

Thus, for the first sample Sm (F1, B1), Sm (F2, B1), Sm (F3, B1), Sm (F4, B1), Sm (F5, B1) and Sm (F6, B1) values were calculated using the rules of matrix multiplication, and then the category under which each sample got the maximum similarity value was found out and accordingly, the samples and their overall quality were graded.

Similarity Values for Quality Attribute Ranking of the Mango shake in General

The same method as described previously was used for quality attribute ranking of the drinks in general and also for quality attribute ranking of individual Mango shake sample. MATLAB 7.1 program (The Mathworks Inc., Natick, MA) was used for the fuzzy logic evaluation of sensory data (Das, 2005).

RESULTS AND DISCUSSION

Jaya and Das, (2003) Stated that fuzzy logic can be applied to treat uncertain phenomena mathematically, i.e., expressing the degree of ambiguity in human thinking and relating it to a real number. The fuzzy logic technique converts the linguistic sensory responses obtained from the judges into numerical values which can be applied for comparison of similar products. Table1 shows the sum of the number of judges with different preference levels for the different quality attributes of the samples with the triplets associated with sensory scales and the sensory scores given by the judges, using the Eq. 2.1for example, triplets associated with the quality attribute colour of sample S_1 were calculated as S_1C = (52.27, 25, 22.72) similarly triplets value for sample S_1 with the quality attributes taste, aroma and moutfeel are respectively S_1T, S_1A and S_1M and same for other samples with the quality attributes given in Table 1. The sum of the judges with different preference levels (sensory scales) of the quality attributes is presented in Table 2. Triplets for sensory scores of quality attributes, which were colour, taste, aroma and mouthfeel for the mango shake, in general and triplets for relative weightage of quality attributes, were calculated in Table 3, using Eq. 2.2.

Overallsensory scores of each of the sampleswas calculated by multiplication of triplets with Eq. 2.3, which were the values of triplets forsensory scores of mango shake samples as calculated (Table 1) and triplets for relative weightage of qualityattributes calculated in Table 2. Triplets for overall sensory scores of Samples are:

SO1=	11.33, 9.44, 8.21
SO2=	8.86, 8.07, 7.99
SO3 =	4.43, 5.02, 6.70
SO4 =	16.75, 11.36, 8.31
SO5 =	13.30, 10.13, 8.78
SO6 =	6.40, 6.21, 7.27

Overall Membership Functions

Six-point sensory scale designated as F1, F2, F3, F4, F5 and F6, respectively, was used in evaluation of sensory scores as mentioned before, whose membership function values for the standard fuzzy scale have been presented in Eq. 2.5. Values of overall membership function of sensory scores of the samples on standard fuzzy scale, B_x, were calculated using Eq. 2.6 as mentioned before are shown in Table 3.

Similarity Values of Mango shake Samples and Their Ranking

Similarity Values of Mango shake Samples and their Ranking are shown in Table 5, were calculated using Eq. 2.7. For Sample 1, similarity values under "Not satisfactory," "Fair," "Satisfactory," "Good," "Very Good" and "Excellent" were 0.083, 0.083, 0.866, 0.577, 0.113 and 0 respectively. The highest similarity value0.866 was under the "Satisfactory" category; this implied that the overall quality of Sample S_1 was "Satisfactory". Proceeding in the same fashion, the overall quality of Samples S_2, S_3 and S_6 were "Satisfactory", while that of Sample S_4 and S_5 were "good ". The order of the samples can be written as:

Sample S_5 (Good) >Sample S_4 (Good) > Sample S_6 (Satisfactory) > Sample S_1 (Satisfactory) > Sample S_2 (Satisfactory) > Sample S_3 (Satisfactory)

Quality Ranking of Mango shake

For different types of food, quality attributes play an important role, in the case of mango shake colour, taste, aroma and mouthfeel were chosen. Table 5 shows the similarity values and ranking for quality attributes of the mango shake in general. For colour similarity values under "Not at all necessary," "Somewhat necessary," "Necessary," "Important," "Highly important" and "Extremely important" were 0, 0, 0.036, 0.501, 0.731 and 0.191 respectively. The highest similarity value, 0.731 was under the "Highly Important" category so, the quality attributes of colour was "HighlyImportant". Same for other quality attributes of mango shake in general taste, aroma and mouthfeel comes under category with similarity value were Extremely important, Important and Extremely important respectively. The overall ranking of the quality attributes of Mango shake, as per the results is;

Mouthfeel (Extremely Highly important) >Taste (Extremely Highly important) >Color (HighlyImportant) > Aroma (Important)

CONCLUSION

In the present study it was observed that on decreasing the ratio of mango pulp, preference of the mango shake is decreased as well. Safeda mango pulp showed higher acceptance than Dashury mango pulp for manufacturing of mango shake. Fuzzy analysis showed higher acceptance for the S_4 prepared using safeda mango and skim milk in the ratio of 2:3 whereas the least preference was observed for S_3 which was prepared using Dashahri and skim milk in the ratio of 3:2. Quality attributes of mango shake were ranked in the order of mouth-feel > taste > colour > aroma.

References

Das, H. (2005). Food processing operations analysis (1st ed.). New Delhi, India: Asian Books Private Limited.

Jaya, S., & Das, H. (2003). Sensory evaluation of mango drinks using fuzzy logic. *Journal of Sensory Studies*, 18(2), 163-176.

Kaushik, Neelima., Gondi, Anusha Reddy., Rana, Rachna.,& Rao, P. Srinivasa.,2015. Application of fuzzy logic technique for sensory evaluation of high pressure processed mango pulp and litchi juice and its comparison to thermal treatment. Innovative Food Science and Emerging Technologies 32, 70–78.

Naresh, K., Varakumar, S., Variyar, P. S., Sharma, A., & Reddy, O. V. S. (2014a). Enhancing antioxidant activity, microbial and sensory quality of mango (Mangiferaindica L.) juice by γ irradiation and its in vitro radioprotective potential. *Journal of Food Science and Technology*., http://dx.doi.org/10.1007/s13197-1014.

Naresh, K., Varakumar, S., Variyar, P. S., Sharma, A., & Reddy, O. V. S. (2014b). Impact of γ-irradiation on antioxidant capacity of mango (Mangiferaindica L.) wine from eight Indian cultivars and the protection of mango wine against DNA damage caused by irradiation. Process Biochemistry, 49, 1819–1830.

Ramulu, P. & Rao, P.U., 2003, Total, insoluble and soluble dietary fiber contents of Indian fruits. Journal of Food Composition and Analysis, 16: 677–685.

Rao, P. K., & Das, H. (2003). Fuzzy logic based optimization of ingredients for production of mango bar and its properties. *Journal of Food Science and Technology*, 40(6), 576-581.

Routray, W., & Mishra, H. N. (2011). Sensory evaluation of different drinks formulated from dahi (Indian yogurt) powder using fuzzy logic. *Journal of Food Processing and Preservation*, http://dx.doi.org/10.1111/j.1745-4549.2011.00545.x.

Singh, K. P., Mishra, A., & Mishra, H. N. (2012). Fuzzy analysis of sensory attributes of bread prepared from millet-based composite flours. LWT - Food Science and Technology, 48, 276-282.

Sinija, V. R., & Mishra, H. N. (2011). Fuzzy analysis of sensory data for quality evaluation and ranking of instant green tea powder and granules. Food Bioprocess Technology, 4(3), 408-416.

Sivakumar, D., Jiang, Y., & Yahia, E. M. (2011). Maintaining mango (Mangifera indica L.) fruit quality during the export chain. Food Research International, 44, 1254–1263.

Steinmetz, K A., Childs, M T., Stimson, C., Kushi, L H., McGovern, P G., Potter, J D and Yamanaka, W K., 1994. Effect of consumption of whole milk and skim milk on blood lipid profiles in healthy men. *Am J Clin Nutr*, 59(3), 612-618.

Tharanathan, R. N., Yashoda, H. M., & Prabha, T. N. (2006). Mango (Mangifera indica L.), "The king of fruits"—An overview. Food Reviews International, 22, 95–123.

Uprit, S., & Mishra, H. N. (2002). Fuzzy multi-attribute decision making approach for development and comparison of soy fortified paneer. *Journal of Sensory Studies*, 17, 163-176.

Varakumar, S., Kumar, Y. S., & Reddy, O. V. S. (2011). Carotenoid composition of mango (Mangifera indica L.) wine and its antioxidant activity. *Journal of Food Biochemistry*, 35, 1538–1547.

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