Original Research Article e-ISSN: 2349-0659 p-ISSN; 2350-0964

Sensory Evaluation of *Madhyama Paka* and *Khara Paka Katupila Taila* by Triangle Test

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Abstract

Sensory evaluation is a quantitative science in which numerical data are collected to establish lawful and specific relationships between product characteristics and human perception. Among the sensory methods available, Triangle test method was adopted. The purpose of this study was to differentiate *Madhyama Paka* and *Khara Paka Katupila Taila* with regard to smell and color. Forty pre-trained assessors were asked to identify the blindly coded sample analogous. The results were calculated using Python software and analyzed using receiver operating characteristics curve, area under curve (AUC), and d-prime (d') with the help of sensR package in R-studio ver. 1.0.143. For both attributes, both the samples were correctly identified with a significance level of $P < 0.001$ and AUC of 1 and 0.999 for each set, respectively. Thus, it can be concluded that sensory analysis method efficiently discriminated the *Madhyama Paka* and *Khara Paka Katupila Taila* samples and thus can serve as a cost-effective routine quality control tool.

Keywords: *Katupila taila, Securinega leucopyrus, Sneha Kalpana*, Sensory evaluation, Triangle test, *Sneha Paka*

Asian Pac. J. Health Sci., (2021); DOI: 10.21276/apjhs.2022.9.1.39

Introduction

Sensory evaluation is often described as a scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, and hearing.[1] In the early stages of product development, sensory testing can help identify the important sensory attributes driving acceptability across product category.[2] *Ayurveda* is a science of ancient wisdom and knowledge which provides treatment as well as prevention of various diseases. *Sneha Kalpana* is the most common formulation among *Bhaishjya Kalpana*. *Acharya Sharangdhar* had mentioned different types of *Paka* in *Sharangdhar Samhita viz Mrudu Paka, Madhyama Paka, Khara Paka, Dagdha Paka, Ama Paka, Gandha Pak*a, etc. Further, different uses of *sneha* according to its *paka* are mentioned in which *Madhyama Paka* and *Khara Paka* are stated to be used for internal (*Pana*) and external (*Abhyang*), respectively.[3] Differentiation between *paka* can be done on the basis of *Paka pariksha* such as *Mardanevartikotpatti* and *Ishtarasagandhvarnotpatti*.[4] Quality control and quality assurance of *Ayurvedic* drugs and formulation are difficult to establish due to various affecting factors, but it is the need of current era. Discrimination of the *paka* can be done using classical parameters which are all about perception. This cannot be justified by the means of modern parameters or in a numeric value. Thus, sensory-based evaluation was carried out to different *paka avastha* of *Katupila Taila*. No. of methods are available for sensory evaluation such as 2-AFC, Triangle test, A- NOT A, and Duo-Trio method.[5] Here, Triangle test was carried out for sensory evaluation due to its higher sensitivity.

Aim

The purpose of this study was to differentiate *Madhyama Paka* and *Khara Paka Katupila Taila* with regard to smell and color by Triangle test sensory method.

Materials and Methods

The study was primarily initiated to develop a sensory-based analytical method for discrimination of samples of *Madhyama Paka* and *Khara Paka Katupila Taila* on the basis of sensory attributes. Among the various sensory methods, "Triangle test" is one of the most powerful and sensitive tests which are employed to determine the odd sample from three samples.

Experimental Design

Preparation of samples: *Katupila Taila* was prepared as per the general method of *Sneha Paka*.[6]

The samples were coded, as shown in Table 1.

Training of Assessors

Forty volunteers were pre-trained on the attributes, depending on the test objective for about 1 h with 3 time exposures of both the samples.

Assessing Samples

Each assessor was at first presented with three random samples. The assessor was asked to tick right on front of the odd/different

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How to cite this article: Shah S, Bedarkar P, Shukla VJ, Patgiri BJ, Mehta M. Sensory Evaluation of *Madhyama Paka* and *Khara Paka Katupila Taila* by Triangle Test. Asian Pac. J. Health Sci., 2022;9(1):196-198.

Source of support: Nil

Conflicts of interest: None.

Received: 29/10/21 **Revised:** 27/11/21 **Accepted:** 04/12/21

sample with respect to smell and taste. All the assessors were given enough time for each attribute. The number of correct responses and the total number of responses were calculated.

Data Analysis

Receiver operating characteristic (ROC) curve, area under curve (AUC), and d-prime (*d'*) statistical calculations were used to analyze the sensory analysis results with the help of sensR package in R-studio software ver. 1.0.143.[7,8]

Results

The panel for sensory analysis consisted of 40 assessors. Each assessor was asked to identify the odd sample on the basis of color and odor. In case of color, out of total 40 responses, 40 responses and, in odor, 38 responses were correctly identified, respectively which are shown in Tables 2 and 3. In both the attributes, samples were correctly identified with a significance level of $P < 0.001$. While, the results of *d'* for Attribute-1 and Attribute -2 are shown in Table 4. Confused matrix was applied for the attributes Colour & Odour on the basis of responses. The results are shown in Table 5.

From the results of *d'*, ROC curve was generated [Figures 1 and 2] and AUC was calculated. The results of AUC are shown in Table 6.

Discussion

Sensory evaluation is an important tool to comply with need of consumer and quality product. Sensory analysis is based on organoleptic attributes, namely, color, odor, taste, touch, texture, and noise. These methods include a panel of human assessors, precise, and controlled experimental protocols along with statistical techniques for processing the results.[9] Among all the sensory attributes, color and odor were chosen for assessment – *Katupila Taila Khara Paka* was darker in color than *Madhyama Paka* and *Katupila Taila Khara Paka* was having slightly burnt smell. In both the attributes, namely, color and odor, both samples were correctly differentiated with a significance level of $P < 0.001$. *d'* or sensitivity index is a dimensionless statistic, it shows the discrimination between the two samples. If *d'* is low, then it means that there is low discriminability and vice-versa. Both the samples showed higher *d'* value for both attributes. Thus, indicating that the *Madhyama Paka* and *Khara Paka* can be competently differentiated from each other by color and smell. Further from the results of *d'*, ROC curve was generated and AUC was calculated. ROC curve is a graphical representation between false positive and true negative using an epidemiological language.[10] If two tests are to be compared, it is desirable to compare the entire ROC curve rather than a particular point.[11] While, a common method to represent ROC performance is to calculate the AUC. It measures the discrimination, that is, ability of the test to correctly classify the target class as follows: •0.90–1: Excellent, •0.80–0.90: Good, •0.70–0.80: Fair, •0.70–0.60: Poor, and •0.60–0.50: Fail. The AUC for color and odor was 1 and 0.999, respectively. The maximum AUC = 1 means that the sensory evaluation test is perfect in the differentiation between the *Madhyama Paka* and *Khara Paka*

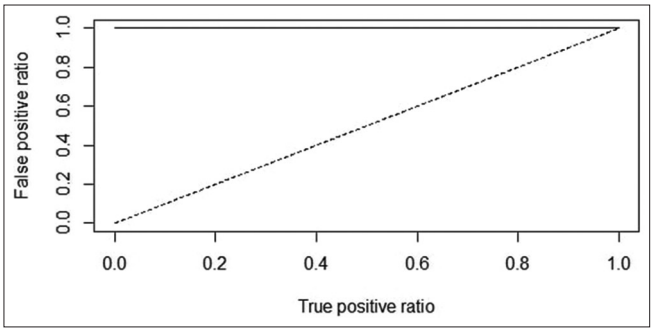

Figure 1: Receiver operating characteristic curve of Attribute 1 (color)

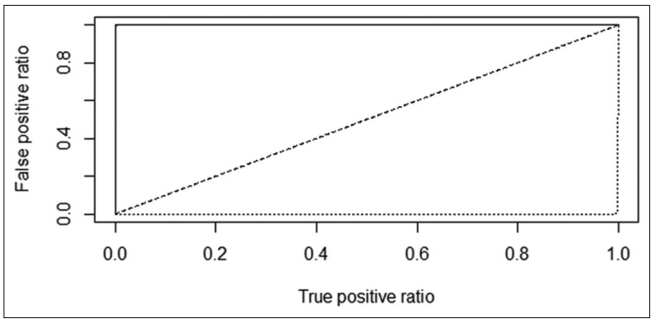

Figure 2: Receiver operating characteristic curve of Attribute 2 (odor)

Table 1: Sample codes for sensory analysis

S. No.	*Sample*	*Code*
1	*Katupila Taila Madhyama Paka*	296, 303, 408, 630, 810
2	*Katupila Taila Khara Paka*	202, 345, 450, 608, 909

Table 2: Range and class of discrimination on the basis of color

n=40	*Predicted: No*	*Predicted: Yes*
Actual: No	0 (FN)	0 (TN)
Actual: Yes	0 (FP)	40 (TP)

Table 3: Range and class of discrimination on the basis of odor

n=40	*Predicted: No*	*Predicted: Yes*
Actual: No	0 (FN)	0 (TN)
Actual: Yes	2 (FP)	38 (TP)

Table 4: Results of d' of Attribute 1 and Attribute 2

Attributes>	*Attribute1 (color)*	*Attribute 2 (odor)*
Total responses	40	40
Correct responses	40	38
Estimate	Inf	4.801
Standard error	NA	0.7225
Lower	4.1767	3.3611
Upper	Inf	6.7156

Table 5: Result of confused matrix applied on attributes (color and odor) of formulations

Discrimination attributes >	*Color*	*Odor*
Accuracy	1	0.95
Misclassification rate	0	0.05
Precision	1	0.95
Recall	1	1
F1 score	1	0.97
Specificity	0	0
Micro F1	1	0.95
Macro F1	1	0.95

Table 6: Results of AUC for attributes color and odor

Sample attributes	*AUC*
Attribute 1 (color)	1
Attribute 2 (odor)	0.999

Katupila Taila by their color. This happens when the distribution of test results of two samples does not overlap.[12]

Conclusion

Henceforth, it can be concluded that Triangle test can efficiently discriminate *Madhyama Paka* and *Khara Paka Taila* on the basis of color and odor. By applying Triangle test, *Madhyama Paka* and *Khara Paka Taila* can be perfectly differentiated on the basis of color which can be practiced for in-process as well as finished product analysis. The method can be further validated by population study and thereby can be used in routine quality control analysis of *Taila*. Thus, study also directs to the fact that sensory analysis can turn out to be a cost-efficient tool for quality control for analysis of Ayurvedic drugs and various formulations.

References

1. Stone H, Sidel JL. Sensory Evaluation Practises. 3rd ed. San Deigo: Academic; 2004.
2. Sarah EK, Tracey H, Joanne H. Sensory Evaluation A Practical Handbook. United States: Wiley Blackwell Publication; 2009.
3. Adhamala SS, Shastri K. Madhyam khanda. In: Sharangdhar Samhita of Sharangdharacharya. Varanasi: Chukhambha Orientalia; 2016. p. 215.
4. Adhamala SS, Shastri K. Madhyam khanda. In: Sharangdhar Samhita of Sharangdharacharya. Varanasi: Chukhambha Orientalia; 2016. p. 214.
5. Sarah EK, Tracey H, Joanne H. Sensory Evaluation A Practical Handbook. New Jersey, United States: Wiley Blackwell Publication; 2009.
6. Shah S, Bedarkar P, Shukla VJ, Patgiri BJ, Mehta M. Pharmaceutico analytical standardization of katupila taila; An Ayurvedic dosage form from ethnobotany; *Securinega leucopyrus*. Int J Ayurvedic Med 2021;12:109-14.
7. Brockhoff PB, Chirstensen RH. Thrustonian models for sensory discrimination tests as generalized linear models. Food Qual Pref 2010;21:330-8.
8. Bi J. The double discrimination methods. Food Qual Pref 2001;12:507-13.
9. Swets JA. ROC analysis applied to the evaluation of medical imaging techniques. Invest Radiol 1979;14:109-21.
10. Karimollah HT. Receiver operating characteristic (ROC) Curve Analysis for medical diagnostic test evaluation. Caspian J Intern Med 2013;4:627-35.
11. Piana ML, Oddo LP, Bentabol A, Bruneau E, Bogdanov S, Declerck CG. Sensory analysis applied to honey: state of the art. Apidologie 2004;35 Suppl 1:S26-37.
12. Gonclaves L, Subtil A, Oliveira MR, Bermudez PZ. ROC curve estimation: An overview. Rev Stat J 2014;12:1-20.