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Original Article

IDENTIFICATION OF DIFFERENT SAMPLES OF GUGGULU THROUGH SENSORY EVALUATION TECHNIQUE

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ABSTRACT

Objective: Present study is aimed to evaluate an efficacy of the two-Alternative Forced Choice (2-AFC) sensory methods in detecting differences between Fresh and old samples of *Guggulu*.

Methods: Both samples of *Guggulu* were evaluated through 2-AFC method.

Results: 2-AFC method for this purpose was sensitive but specificity to identify the sample was less.

Conclusion: 2-AFC method is sensitive to differentiate two samples of *Guggulu* i.e. fresh and old.

Keywords: 2-alternative forced choice, *Commiphora wightii,* Fresh *Guggulu,* Old *Guggulu*, Sensory evaluation.

INTRODUCTION

Identification of medicinal plant products is an essential aspect under quality control. The characters emphasized in ancient times were used not only to identify the genuineness, but also to evaluate the quality of material [1]. Acceptable qualities of plant materials are also described in ayurvedic literature [2]. *Guggulu* (*Commiphora wightii* (Arn.) Bhandari.) belongs to family Burseraceae is olio-gum-resin and widely used plant in Ayurvedic field. Numbers of research works were carried out to evaluate its pharmacological activity since 1966 [3].

Bhavaprakasha, one of the classical ayurvedic texts mentioned two types of *Guggulu* i.e. fresh (*Naveena*) and old (*Purana*) which is based on its storage time. Characteristics of both varieties of *Guggulu* are also described in classics. *Guggulu* that is unctuous (*Snigdha*), golden yellow in colour (*Kanchana shankasha*), with balsamic odour (*Sugandhiyukta*) and sticky (*Pichchila*) considered as fresh while *Guggulu* with dry texture (*Shushka*), bad odour *(Durgandhayukta*) and discoloured (*Anyavarnaka*) is considered as old[4]. These characteristics are truly sensory in nature. Pharmacological actions of both samples are also different. Fresh sample is attributed with *Bhrimhana* (body mass increase) quality, while old sample with *Lekhana* (scarificant) [5].

Sensory evaluation techniques are widely used in food industry and also in the medical field. It is a quantitative science in which numerical data are collected to establish lawful and specific relationships between product characteristics and human perception. Sensory tests provide useful information about the human perception of product changes due to ingredients, processing, packaging, or shelf life [6].

In ayurveda, selection and rejection criteria (*Grahya-Agrahytva*) of drug used in formulations are described on the basis of sensory parameters. Here an attempt was made to validate organoleptic parameters to differentiate fresh and old samples of *Guggulu* by sensory evaluation techniques.

Objectives

The purpose of this study is to evaluate an efficacy of the 2 Alternative Forced Choice (2-AFC) sensory methods in detecting differences between two samples of *Guggulu*. Additionally, to determine if a difference exists between two samples of *Guggulu* with regard to intensity of odour, texture and lustre.

MATERIALS AND METHODS

As classical differentiation of fresh and old *Guggulu* is explained through parameters like color, odour, and texture; specific discrimination method test was decided for study. The two alternative forced choice (2-AFC) test is one of the most powerful and sensitive difference tests [7] and used when differentiation vary in intensity of the attributes in question. So, sensory evaluation for the comparison of two different samples of *Guggulu* was done by 2-AFC method [8].

Experimental design

Questionnaire

Special proforma was prepared for evaluating intensity of fragrance, stickiness and lustre.

Training of assessors

30 volunteers were pre-trained on the attributes, depending on the test objectives for about 2 h in three time exposures of the standard sample.

Sample preparation and coding

Guggulu cultivated at Dwaraka Forest Range, Gujarat was collected from Gujarat State Forest Development Corp. Ltd., Vadodara during February 2011(Batch no. B 05, code-148600). This sample was preserved under identical conditions to make it old. Though, specific time period is not mentioned for *Guggulu* to become old; the sample stored for one year is considered as old sample based on the general terminology [9]. Another sample of fresh *Guggulu* was collected in the same manner during February 2012 (Batch no. B 01, code-128500). Both the samples are blindly coded as 'A' and 'B'.

Assessing samples

Assessors were presented with two blind coded samples**.** In first experiment, participates were asked to identify the sample having more intensity of odour and write down the code of sample in proforma. For second attribute, participants were asked to identify stickier sample and for colour attribute, they were asked to differentiate bright or dull samples. All participates were given enough time for each task.

Data analysis

Critical value table for paired comparison, Receiver Operating Characteristic (ROC) curve, d' calculation methods was used to analyse sensory panel results.

In manual calculation, the larger number of responses for one sample was compared with statistical tables (Table-1). The table states the minimum number of responses required before a significant difference can be concluded from the test. The significance level of the test must also be specified (typically 5%).

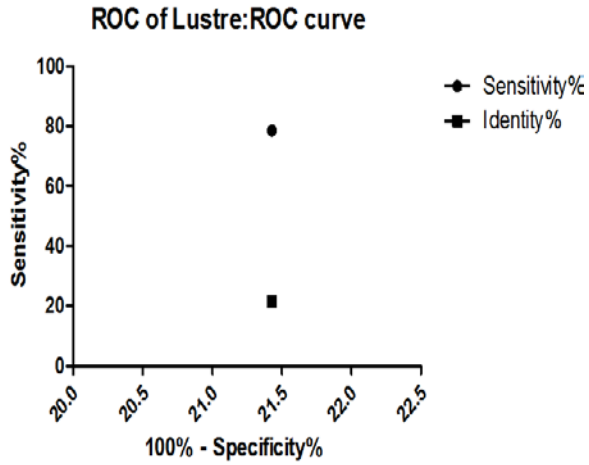
Table 1: Critical values table for paired comparison and paired difference test (two tailed)

N	Significance (%)			n	Significance (%)		
	5	1	0.1		5	1	0.1
5	-	-	-	31	22	24	25
6	6	-	-	32	23	24	26
7	7	-	-	33	23	25	27
8	8	8	-	34	24	25	27
9	8	9	-	35	24	26	28
10	9	10	-	36	25	27	29
11	10	11	11	37	25	27	29
12	10	11	12	38	26	28	30
13	11	12	13	39	27	28	31
14	12	13	14	40	27	29	31
15	12	13	14	41	28	30	32
16	13	14	15	42	28	30	32
17	13	15	16	43	29	31	33
18	14	15	17	44	29	31	34
19	15	16	17	45	30	32	34
20	15	17	18	46	31	33	35
21	16	17	19	47	31	33	36
22	17	18	19	48	32	34	36
23	17	19	19	49	33	34	37
24	18	19	21	50	33	35	37
25	18	20	21	52	34	36	39
26	19	20	22	56	36	39	41
27	20	21	23	60	39	41	44
28	20	22	23	64	41	43	46
29	21	22	24	68	43	46	48
30	21	23	25	70	44	47	50

Alternatively, software packages calculate the probability of making a type I error should it be concluded that a significant difference exists between the samples. In this, two methods i.e. ROC curve and SDT [Signal Detection Theory] were taking for calculation of d'(d prime), C and confidence intervals from 2AFC response data.

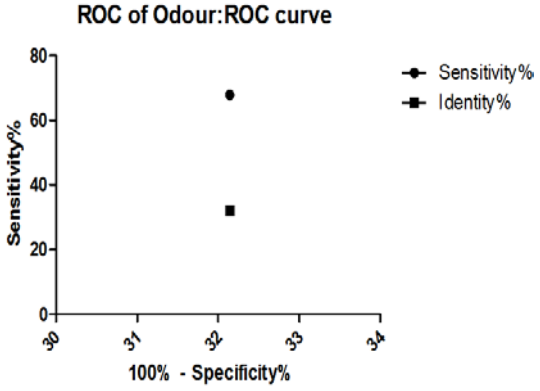
RESULTS

From the table 1, for a panel of 29, the minimum number of identical responses required to determine that a difference exists at 5% significance level (p<0.05) is 21. Here insignificant level [>0.05] was found in all attributes.



Graph 1: ROC curve for lustre attribute

Result of ROC curve shows Area under ROC curve was found 0.78 and P value<0.001 for Lustre attribute. [table 2] and ROC curve graph shows 21.42% specificity and 78.57% sensitivity for Lustre [Graph-1].

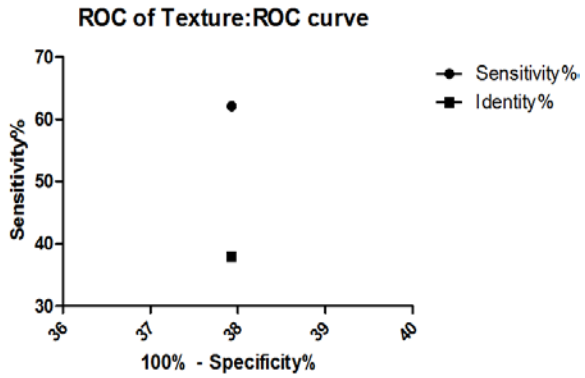


Graph 2: ROC curve for odour attribute

Table 2: Area under the ROC curve for lustre attribute

Area under curve	
Area	0.7857
Std. Error	0.06388
95% confidence interval	0.6605 to 0.9109
P value	0.0002445
Data	
Group A	28
Group B	28
Missing Group A	1
Missing Group B	1

For odour attribute, Area under ROC curve was found 0.67 and P value>0.05 [Table-3] and ROC curve graph shows 32.14% specificity and 67.85% sensitivity for odour [Graph 2].



Graph 3: ROC curve for texture attribute

Table 3: Area under the ROC curve for odour attribute

Area under curve	
Area	0.6786
Std. Error	0.07270
95% confidence interval	0.5360 to 0.8211
P value	0.02182
Data	-
Group A	28
Group B	28
Missing Group A	1
Missing Group B	1

Table 4: Area under the ROC curve for Texture attribute

Area under curve	
Area	0.6207
Std. Error	0.07420
95% confidence interval	0.4752 to 0.7662
P value	0.1145
Data	
Group A	29
Group B	29
Missing Group A	0
Missing Group B	0

Results of ROC curve was found 0.62 and P value>0.05 for Odour attribute [Table-4] and ROC curve graph shows 37.93% specificity and 62.06% sensitivity for Texture [Graph 3]

The d' values for three attributes are given in table 5. Also given are the significance levels, the probabilities that the differences indicated by the d' values were merely due to chance. Results of for Lustre attribute showed 0.214 Hit rate for Group A and 0.78 hit rate for Group B. Hit Rate for Odour attribute was found 0.67 for group A and 0.32 for group B. For Lustre attribute, hit rate was found 0.57 and 0.62 for group A and b respectively.

DISCUSSION

Sensory evaluation is often described using the definition of Institute of Food Technology–a scientific method used to evoke, measure, analyse and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing [10]. Sensory evaluation is a science of measurement like other analytical test procedures [11]. It involves measurement, quantification and interpretation of the sensory characteristics of foods and consumer products through the use of human subjects acting as a judge [12].

In this experiment, our analysis focused on identification of Fresh *Guggulu* from Old one. For that, three attributes (sensory measures) given in classics to indentify differences between them were used. They were lustre, odour and texture [13]. In these three measures of sensitivity, fresh should have intense odour, good lustre and more sticky texture than old sample.

Discrimination tests are some of the most common methods employed in sensory science. They are used to determine if a difference (or similarity) exists between two or more samples. Two samples differ in a specific sensory attribute, then the two-alternative forced choice (2-AFC) method is used [14]. Sensory difference tests are designed to measure small differences among samples, without the need for extensive training. These tests are sensitive and compensates for the lack of intensive training required for descriptive analysis [15]. Considering this, Two-alternative forced choice (2-AFC) method (type of Discrimination method) was adopted for Sensory evaluation in this current study.

Critical value table of paired comparison is the manual method. In this insignificant [>0.05] result was found.

The receiver operating characteristic or ROC curve is one way to see the connection. This curve defines a person's detection ability across different settings of the criterion. In the ROC curve, hit rate in different situations is plotted as a function of false alarm rate. As criterion shifts, the performance moves along the characteristic curve for that observer and for those particular stimuli.

The level of discrimination, then is proportional to the area under the ROC curve (to the right and below), a measure that is related to *d*'. Correspondence between the area under the ROC curve (which is proportional to *d*') and the performance we would expect in a 2-AFC or paired comparison test is seen by d'.

Area covered under ROC curves gives sensitivity for attributes, where identification is given by specificity for attributes. ROC curve graph shows 78.57%, 67.85% and 62.06% sensitivity and 21.42%, 32.14 % and 37.93% specificity for lustre, odour and texture respectively. For lustre attribute, area under ROC curve was found 0.78 that is considered to be 'Fair' at separating fresh from old. Where, for odour and texture, area under ROC curve was found 0.67 and 0.62. Both are considered to be 'Poor' at separating fresh from old [table 6].

Table 5: Recognition results and signal detection indexes for attributes

Attribute	Samples	Hit rate	False rate	*D'*	*Pr*	*Br*
Lustre	Fresh	0.214	0.786	0.266	0.214	-1.120
Odour	Fresh	0.679	0.321	0.246	0.679	0.656
Texture	Fresh	0.621	0.379	0.237	0.621	0.435

D' = Difference between Hit rate and false rate, *Pr* = probability, *Br* = measure of bias.

Table 6: Sensory evaluation of Fresh *Guggulu* using ROC curve method

No.	Parameter	Sensitivity	Specificity
1	Lustre	78.57143	21.42857
2	Odour	67.85714	32.14286
3	Texture	62.06897	37.93103

It was observed by this method that, sensitivity of this method (2-AFC) is high in this experiment, but specificity for the attribute is less then sensitivity.

In d' calculation, hit rate for old *Guggulu* was found higher than fresh sample in lustre and texture attributes. But for odour attribute, hit rate is higher in the fresh sample. Overall d' value is insignificant for all attribute. The d' is the difference between hits (i.e. responding fresh sample when perceived characteristics of fresh sample) and False (i.e. responding old sample, when perceived characteristics of fresh sample). *Br* is a measure of bias, defined as the probability of responding "Fresh" despite uncertainty. As can be seen in table, Participates generally performed better response in odour in relation to the remaining attributes.

All calculations suggest that, the 2-AFC method for this purpose was sensitive but specificity to identify Fresh sample as 'Fresh' was less. For this problem, large panel size, scrutinizing of trainees, increased training period is necessary for accurate identification. Many times identification of herbs given in Ayurveda classics is totally depended on sensory characteristics which giving primary idea about the quality of different formulations without using chemical tests. Sensory evaluation technique can become the useful tool to differ the samples for Ayurveda research scholar also.

CONCLUSION

Though, the difference by Assessors was found poor in identification of samples, Two alternative forced choice method would be helpful to discriminate the difference between samples by increasing panel size and training period.

CONFLICT OF INTERESTS

Declared None

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