COLOUR SEGMENTATION AND L*A*B* APPROACH IN POWDER OF *BHAVITA* PALASHABEEJA CHURNA YOGA

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ABSTRACT

Samskara is an important concept led by ancient *Ayurveda* scholars and is defined as transformation (*Samskaro hi Gunantaradhanam uchyate*) of the inherent attributes (*Swabhavika Guna*) of a substance which leads to the addition of new properties. *Bhavana* is an important *Samskara* with the help of which, not only the potency of a drug can be altered, but is also capable to bring about changes in characteristics of drug viz. regulation, addition of new or deletion of undesirable characteristics. *Bhavana* is a unique pharmaceutical process in which a drug or mixture of drugs in powdered form is triturated with sufficient quantity of liquid media (swarasa, kwatha, etc. or animal products like milk, urine, etc.) till liquid portion gets absorbed completely. *Bhavana* facilitates in mixing of ingredients of mixture for *Bhavana* and may account several chemical interactions in between them. The changes made by *Bhavana* in nature of drug can be preliminarily and easily perceived at pharmacognostic as well as chemical level; however its utility will be majorly dependent on therapeutic actions. Thus, it plays a pivotal role in the alteration of *Gunas* (properties) of drugs so as to fulfill therapeutic requirements. Above change cause alteration in the sensory perception of the drug as well as it also alter visual perception of the drug as whole. During the process of manufacturing colour perception play major role to take decision of completion of process. L*a*b colour space is considered as very near to human visual perception. Hence the study was designed to trace out scope of visual perception discrimination using regular expression of L*a*b colour segmentation protocol of MATLAB on drug *Palasha beeja churna* and its *Bhavita* samples. In conclusion observed that the colour segment of raw drug is modulated to different colour space when exposed to *Amlaki swarasa* but exposure of *Ajadugdha* generate pool to ward green colour space, over and above sequential exposure of same material (vehical) shows different selectivity of chemical modulation hence resultant it shows different colour space in every *bhavana* completion. The colour space shows scope in SOP of drug production line up for consistence drug manufacturing.

KEYWORDS: Colour segmentation, L*a*b*, *Butea monosperma, Palasha beeja churna yoga*, *Bhavana*.

INTRODUCTION

Butea monosperma (Lam.) Taubert; belongs to family Fabaceae, popularly known as '*Dhank'* or '*Palasha'*, commonly known as flame of forest, *palasha, mutthuga, beejasneha, khakhara,* Bastard teak, Bengal *kino*[1] is very widely distributed in India and is used extensively in the folk medicine. Commonly *Butea monosperma* is used as tonic, astringent, aphrodisiac and diuretics.[2] The present work is planned to observe impact of *bhavana* on samples of *Ayurvedic* formulation *Palashabeeja churna yoga*. The samples were prepared by giving 14 alternate *bhavana* of *Amalaki swarasa* (*Emblica officinalis*

Gaertn) & *Ajadugdha* (Goat milk) to *Palasha beeja* (*Butea Monosperma* (Lam.) Taubert).[3] In this study *Palashabeeja churna* and 14 samples of *bhavita Palashabeeja churna* were subjected to colour segmentation using L*a*b* method.

CIE L*a*b* (CIELAB) is a colour space specified by the International Commission on Illumination (French *Commission internationale de l'éclairage*, hence its *CIE* initialism). It describes all the colours visible to the human eye and was created to serve as a device-independent model to be used as a reference. The three

coordinates of CIELAB represent the lightness of the colour ($L* = 0$ yields black and $L* = 100$ indicates diffuse white; specular white may be higher), its position between red/magenta and green (a*, negative values indicate green while positive values indicate magenta) and its position between yellow and blue (b*, negative values indicate blue and positive values indicate yellow). The asterisk (*) after L, a and b are pronounced *star* and are part of the full name, since they represent L*, a* and b*, to distinguish them from Hunter's L, *a*, and *b*, described below. Since the L*a*b* model is a three-dimensional model, it can be represented properly only in a three-dimensional space.[4] Two-dimensional depictions include chromaticity diagrams: sections of the colour solid with a fixed lightness. It is crucial to realize that the visual representations of the full gamut of colours in this model are never accurate; they are there just to help in understanding the concept. Because the red-green and yellow-blue opponent channels are computed as differences of lightness transformations of (putative) cone responses, CIELAB is a chromatic value colour space. A related colour space, the CIE 1976 (L*, u*, v*) colour space (a.k.a. CIELUV), preserves the same L* as L*a*b* but has a different representation of the chromaticity components. CIELAB and CIELUV can also be expressed in cylindrical form (CIELCH[5] and CIELCH$_{uv}$, respectively), with the chromaticity components replaced by correlates of chroma and hue. Since CIELAB and CIELUV, the CIE has been incorporating an increasing number of colour appearance phenomena into their models, to better model colour vision. These colour appearance models, of which CIELAB is a simple example,[6] culminated with CIECAM02.

MATERIALS AND METHODS
Sample preparation
Palashabeeja churna yoga was prepared by giving 14 alternate *bhavana* of *Amalaki swarasa* & *Ajadugdha*. Samples were collected after completion of each *bhavana* and stored in air tight container.

Colour segmentation L*a*b*
The Lab colour space describes mathematically all perceivable colour in the three dimensions *L* for lightness and a and b for the colour-opponents green-red and blue-yellow. The terminology "Lab" originates from the Hunter 1948 colour space.[7,8] Nowadays "Lab" is frequently mis-used as abbreviation for CIEL*a*b* 1976 colour space colour space (also CIELAB); the asterisks/stars distinguish the CIE version from Hunter's original version. The difference from the Hunter Lab coordinates is that the CIELAB coordinates are created by a cube root transformation of the CIE XYZ colour data, while the Hunter Lab coordinates are the result of a square root transformation. Other, less common examples of colour spaces with Lab representations make use of the CIE 1994 colour difference and the CIE 2000 colour difference.

The Lab colour space exceeds the gamuts of the RGB and CMYK colour models (for example, ProPhoto RGB includes about 90% all perceivable colours). One of the most important attributes of the Lab-model is device independence. This means that the colours are defined independent of their nature of creation or the device they are displayed on. The Lab colour space is used when graphics for print have to be converted from RGB to CMYK, as the Lab gamut includes both the RGB and CMYK gamut. Also it is used as an interchange format between different devices as for its device independency. The space itself is a three-dimensional real number space that contains an infinite number of possible representations of colours. However, in practice, the space is usually mapped onto a three-dimensional integer space for device-independent digital representation, and for these reasons, the L*, a*, and b* values are usually absolute, with a pre-defined range. The lightness, L*, represents the darkest black at $L* = 0$, and the brightest white at $L* = 100$. The colour channels, a* and b*, will represent true neutral gray values at $a* = 0$ and $b* = 0$. The red/green opponent colours are represented along the a* axis, with green at negative a* values and red at positive a* values. The yellow/blue opponent colours are represented along the b* axis, with blue at negative b* values and yellow at positive b* values. The scaling and limits of the a* and b* axis will depend on the specific implementation of Lab colour, as described below, but they often run in the range of ±100 or −128 to +127.

Both the Hunter and the 1976 CIELAB colour spaces were derived from the prior "master" space CIE 1931 XYZ colour space, which can predict which spectral power distributions will be perceived as the same colour, but which is not particularly perceptually uniform.[9] Strongly influenced by the Munsell colour system, the intention of both "Lab" colour spaces is to create a space that can be computed via simple formulas from the XYZ space but is more perceptually uniform than XYZ.[10] Perceptually uniform means that a change of the same amount in a colour value should produce a change of about the same visual importance. When storing colours in limited precision values, this can improve the reproduction of tones. Both Lab spaces are relative to the white point of the XYZ data they were converted from. Lab values do not define absolute colours unless the white point is also specified. Often, in practice, the white point is assumed to follow a standard and is not explicitly stated (e.g., for "absolute colorimetric" rendering intent, the International colour Consortium L*a*b* values are relative to CIE standard illuminant D50, while they are relative to the unprinted substrate for other rendering intents).[11]

Significance of Lab colour space
Lab colour space (also known as CIELAB or CIE L*a*b*) is designed to approximate human vision. It aspires to perceptual uniformity, and its L component

closely matches human perception of lightness. This is mostly used to quantify the visual differences.

Steps involved in colour segmentation by using L*a*b* colour space in MATLAB[12]

Step 1: Acquire Image
Acquer the image from mother source which is in JPEG formate, which is a fused image.

Step 2: Calculate Sample Colours in L*a*b* Colour Space for each region
Many colours can be seen in the image including background colour. The main approach is to choose a small sample region for each colour and to calculate each sample regions average colour in 'a*b*' space. Colour markers can be used to classify each pixel.

Step 3: Classify Each Pixel Using the Nearest Neighbor Rule
Each colour marker has as 'a*' and 'b*' value. Each pixel in the image can be classified by calculating the Euclidean distance between that pixel and each colour marker. The smallest distance represents the pixel most closely matches that colour marker. For example, if the distance between a pixel and the red colour marker is the smallest, then the pixel would be labeled as a red pixel.

Then an array that contains the colour labels can be created.

Step 4: Display Results of Nearest Neighbor Classification
The label matrix contains a colour label for each pixel in the image. The label matrix is used to separate objects in the original image by colour.

Step 5: Display 'a*' and 'b*' Value of the Labeled Colours
The nearest neighbor classification separated the different colour populations will be showed by plotting the 'a*' and 'b*' values of pixels that were classified into separate colour. For display purposes, each point will be labeled with its colour label. Finally the scatterplot of segmented pixels in a*b* space will be obtained.

RESULTS AND DISCUSSION
As mentioned in material and method the colour segmentations of the coarse powdered samples was done and the result obtained are shown as below. Colour segmentation of the JPG photographs of samples were done by using the MATLAB software. The scatterplot of segmented pixel in a*b* space is represented into the Figure no. 1 to 30.
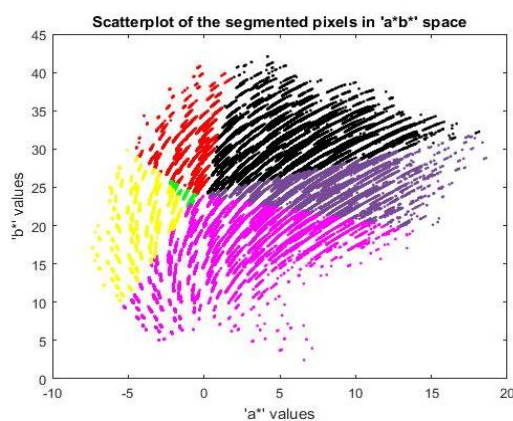

Fig. 1 Coarse powder sample of PBC

Fig. 2 Scatterplot of segmented pixel of PBC in a*b* space

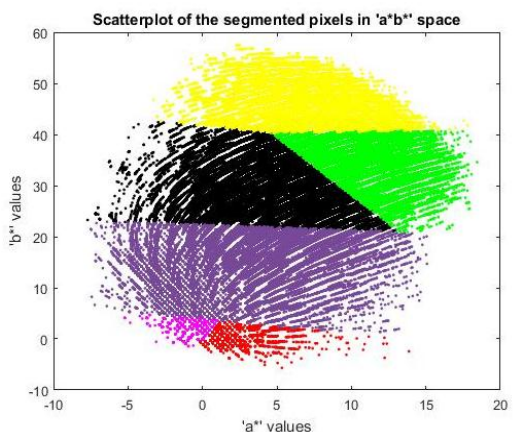**Fig. 3 Coarse powder sample of ASBPBC$_1$**

Fig. 4 Scatterplot of segmented pixel of ASBPBC$_1$ in a*b* space

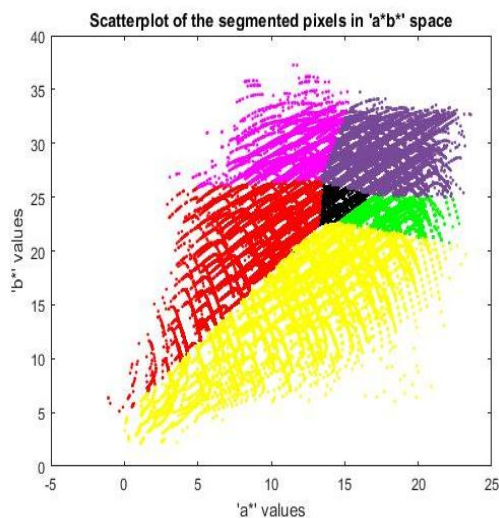Fig. 5 Coarse powder sample of ADBPBC$_2$

Fig. 6 Scatterplot of segmented pixel of
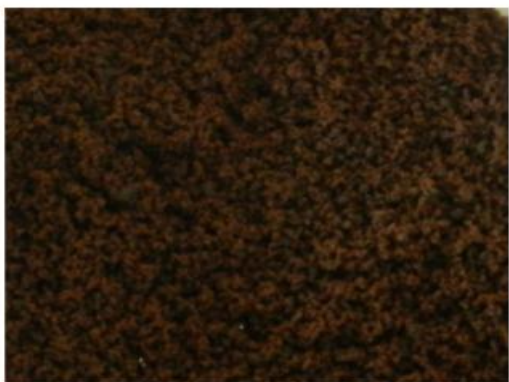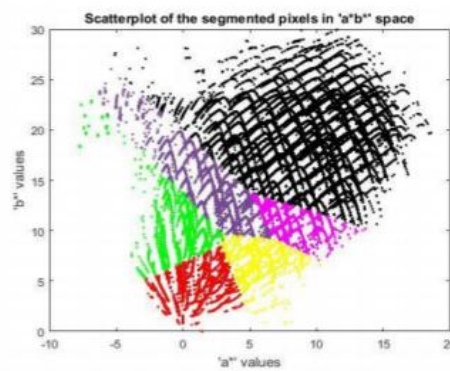ADBPBC$_2$ in a*b* space

Fig. 7 Coarse powder sample of
ASBPBC$_3$

Fig. 8 Scatterplot of segmented pixel
of ASBPBC$_3$ in a*b* space
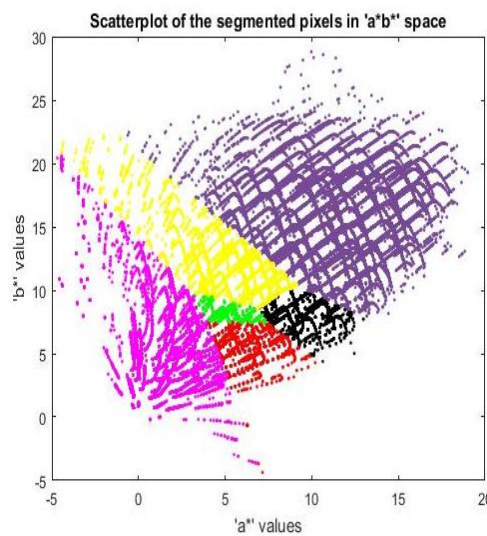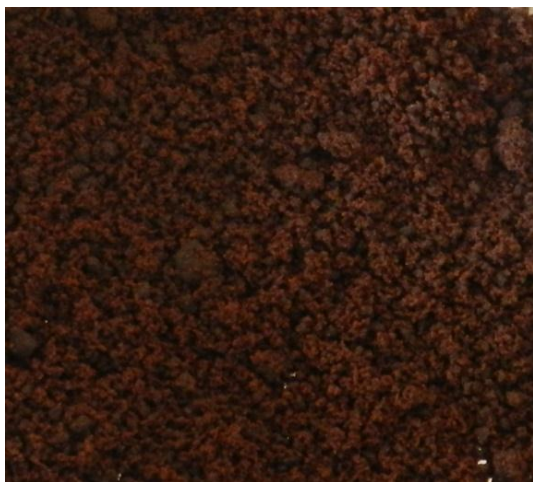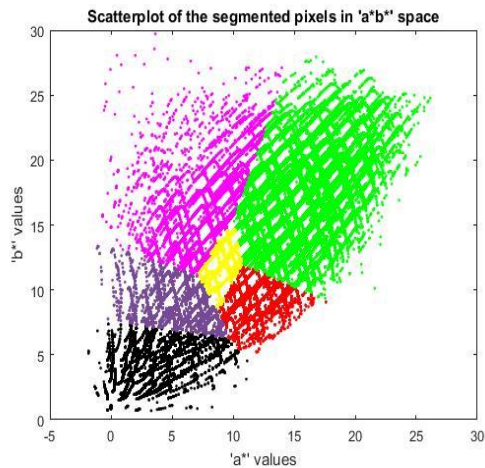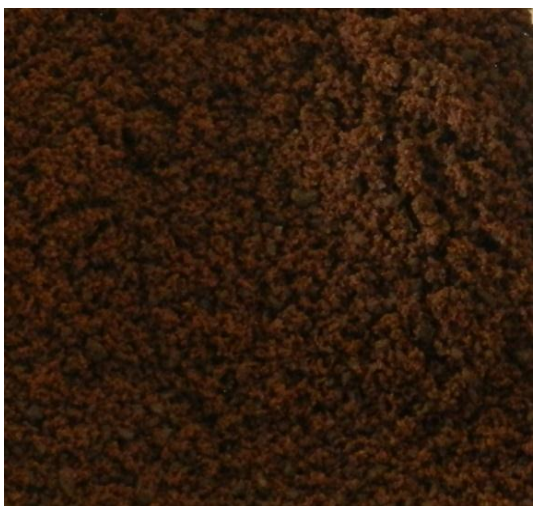

Fig. 9 Coarse powder sample of ADBPBC$_4$

Fig. 10 Scatterplot of segmented pixel of
ADBPBC$_4$ in a*b* space

Fig. 11 Coarse powder sample of ASBPBC$_5$

Fig. 12 Scatterplot of segmented pixel of ASBPBC$_5$ in a*b* space
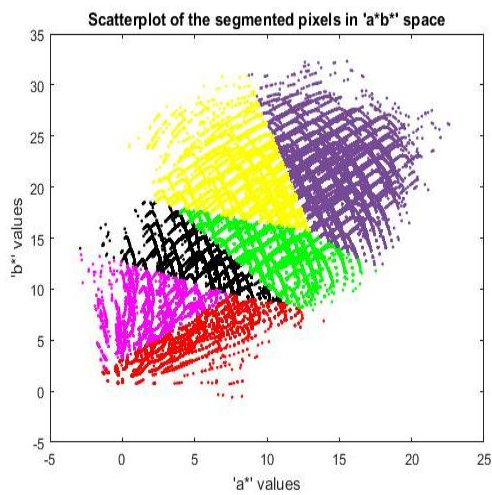

Fig. 13 Coarse powder sample of ADBPBC$_6$

Fig. 14 Scatterplot of segmented pixel of ADBPBC$_6$ in a*b* space
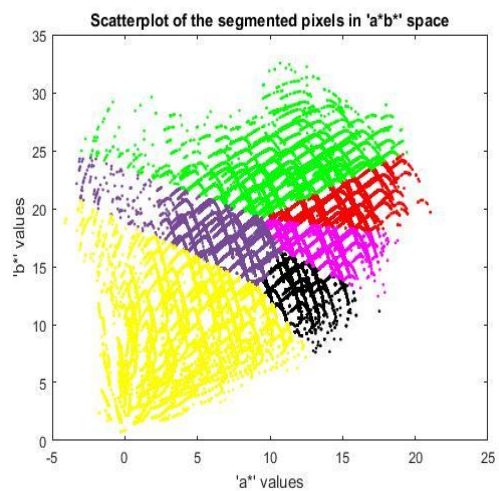

Fig. 15 Coarse powder sample of ASBPBC$_7$

Fig. 16 Scatterplot of segmented pixel of ASBPBC$_7$ in a*b* space
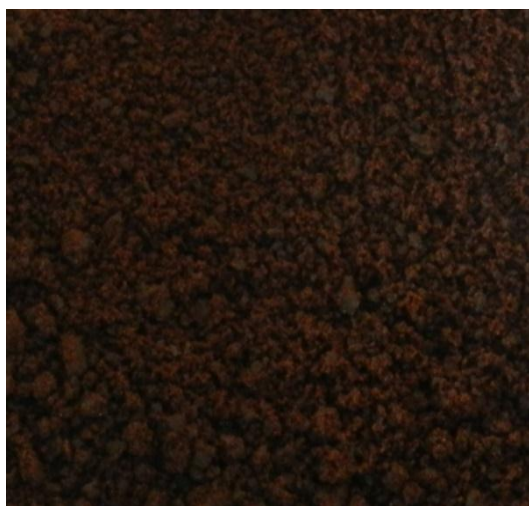
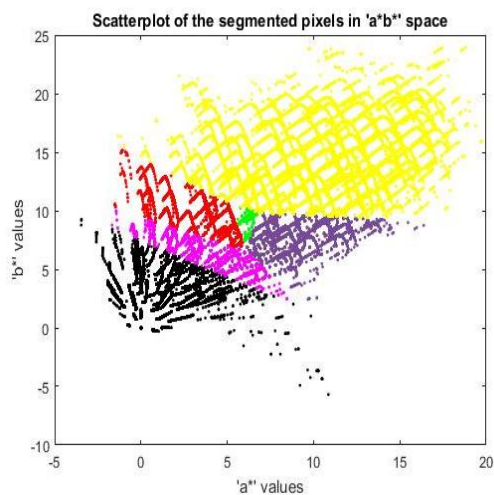**Fig. 17 Coarse powder sample of ADBPBC₈**

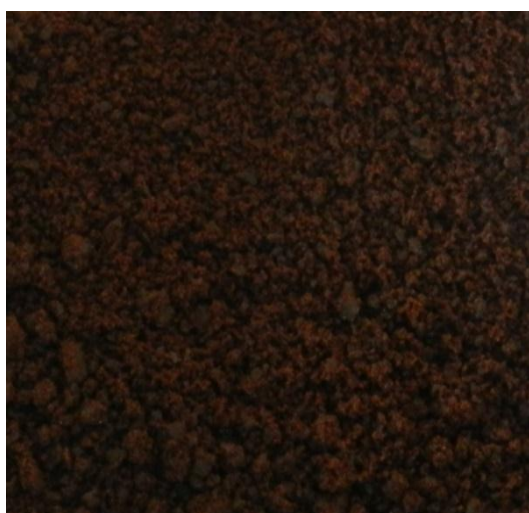**Fig. 18 Scatterplot of segmented pixel of ADBPBC₈ in a*b* space**
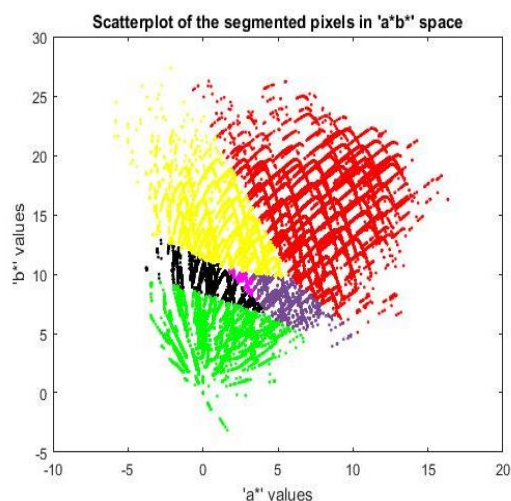

Fig. 19 Coarse powder sample of ASBPBC₉

Fig. 20 Scatterplot of segmented pixel of ASBPBC₉ in a*b* space

Fig. 21 Coarse powder sample of ADBPBC₁₀

Fig. 22 Scatterplot of segmented pixel of ADBPBC₁₀ in a*b* space

Fig. 23 Coarse powder sample of ASBPBC₁₁

Fig. 24 Scatterplot of segmented pixel of ASBPBC₁₁ in a*b* space

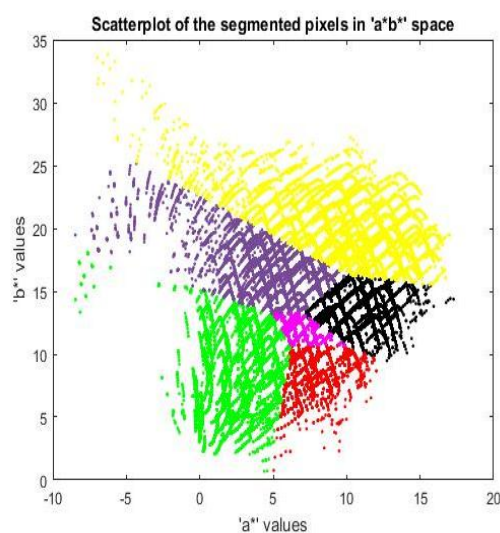**Fig. 25 Coarse powder sample of ADBPBC₁₂**

Fig. 26 Scatterplot of segmented pixel of ADBPBC₁₂ in a*b* space

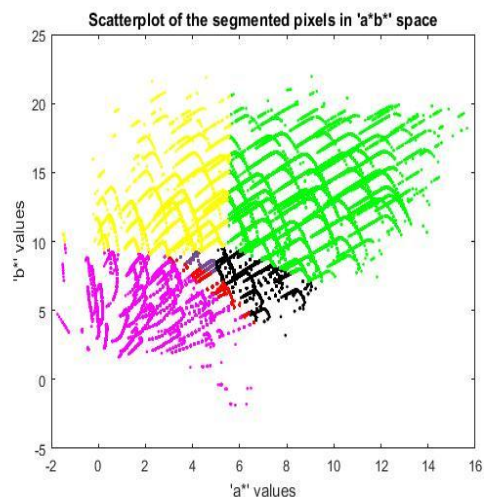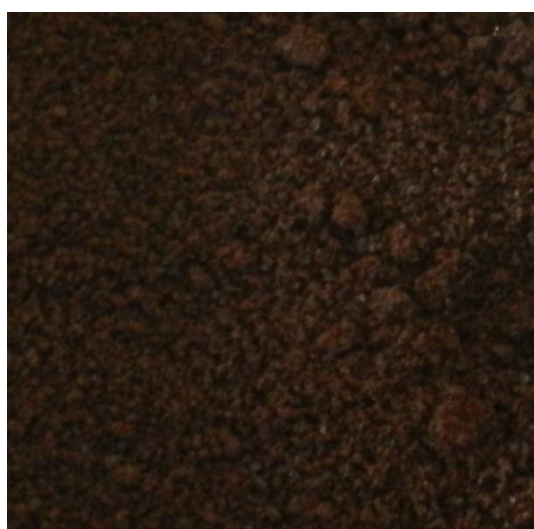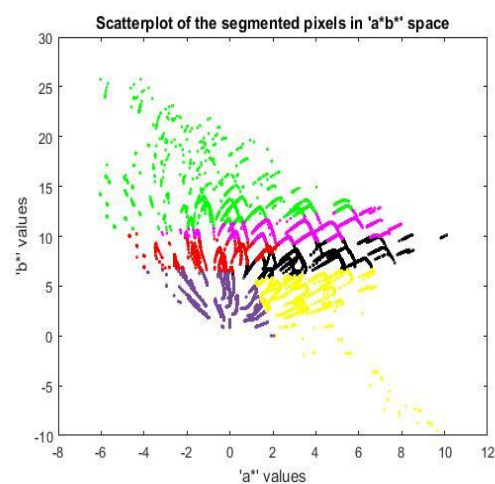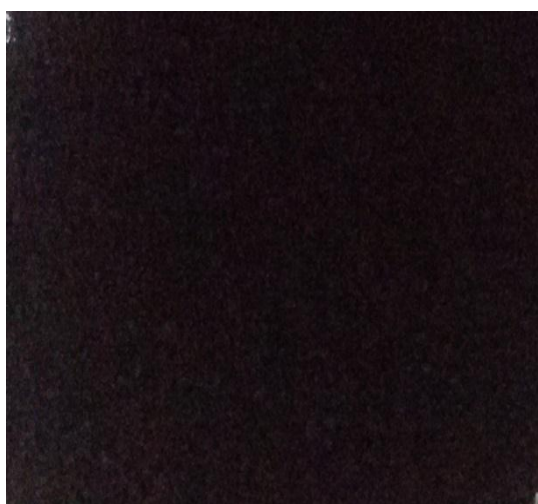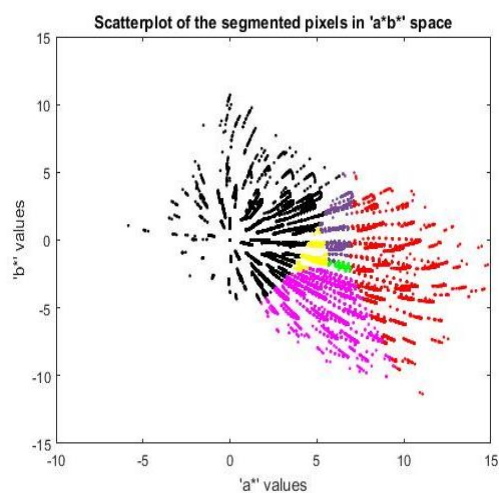**Fig. 27 Coarse powder sample of ASBPBC₁₃**

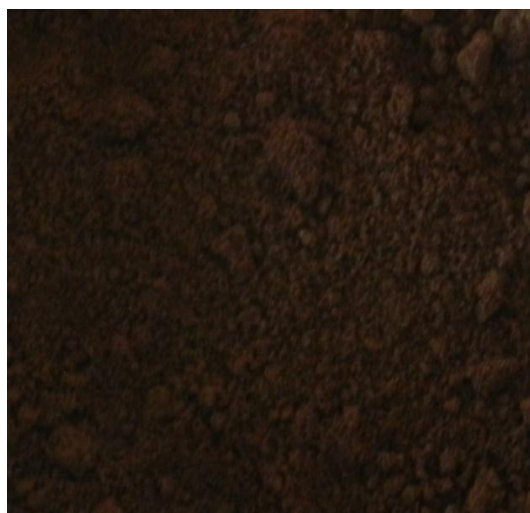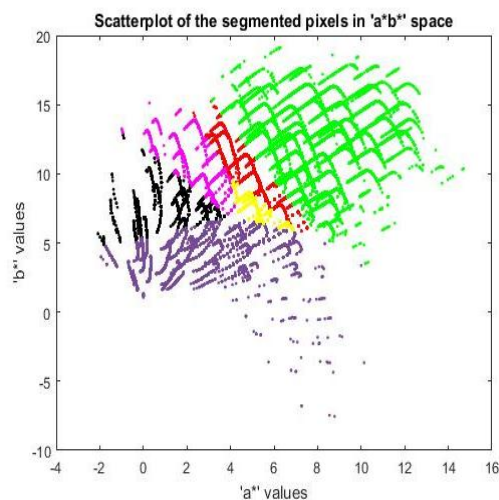**Fig. 28 Scatterplot of segmented pixel of ASBPBC₁₃ in a*b* space**

Fig. 29 Coarse powder sample of ADBPBC$_{14}$

Fig. 30 Scatterplot of segmented pixel of ADBPBC$_{14}$ in a*b* space

Table no. 1: Showing result of colour segmentation of coarse powdered samples

Sr. No.	Sample	Total no. of colour	Colours obtained	Domain colour
1.	PBC	6	Green, Red, Yellow, Purple, Black, Pink	Pink
2.	ASBPBC$_1$	6	Pink, Red, Green, Yellow, Black, Purple	Purple
3.	ADBPBC$_2$	6	Black, Green, Purple, Pink, Red, Yellow	Yellow
4.	ASBPBC$_3$	6	Pink, Yellow, Red, Green, Purple, Black	Black
5.	ADBPBC$_4$	6	Green, Black, Red, Yellow, Pink, Purple	Purple
6.	ASBPBC$_5$	6	Yellow, Red, Purple, Black, Pink, Green	Green
7.	ADBPBC$_6$	6	Black, Pink, Green, Red, Yellow, Purple	Purple
8.	ASBPBC$_7$	6	Black, Pink, Red, Purple, Green, Yellow	Yellow
9.	ADBPBC$_8$	6	Green, Pink, Red, Purple, Black, Yellow	Yellow
10.	ASBPBC$_9$	6	Pink, Purple, Black, Green, Yellow, Red	Red
11.	ADBPBC$_{10}$	6	Pink, Red, Black, Purple, Green, Yellow	Yellow
12.	ASBPBC$_{11}$	6	Purple, Red, Black, Pink, Yellow, Green	Green
13.	ADBPBC$_{12}$	6	Red, Purple, Pink, Black, Yellow, Green	Green
14.	ASBPBC$_{13}$	6	Green, Yellow, Purple, Pink, Red, Black	Black
15.	ADBPBC$_{14}$	6	Yellow, Red, Pink, Black, Purple, Green	Green

PBC – *Palasha beeja churna*, ASBPBC$_1$ – *Amalaki swarasa bhavita palasha beeja churna* (1 = first *bhavana*), ADBPBC$_2$ – *Ajadugdha bhavita palasha beeja churna* (2 = second *bhavana*), ASBPBC$_3$ – *Amalaki swarasa bhavita palasha beeja churna* (3 = third *bhavana*), ADBPBC$_4$ – *Ajadugdha bhavita palasha beeja churna* (4 = forth *bhavana*), ASBPBC$_5$ – *Amalaki swarasa bhavita palasha beeja churna* (5 = fifth *bhavana*), ADBPBC$_6$ – *Ajadugdha bhavita palasha beeja churna* (6 = sixth *bhavana*), ASBPBC$_7$ – *Amalaki swarasa bhavita palasha beeja churna* (7 = seventh *bhavana*), ADBPBC$_8$ – *Ajadugdha bhavita palasha beeja churna* (8 = eighth *bhavana*), ASBPBC$_9$ – *Amalaki swarasa bhavita palasha beeja churna* (9 = ninth *bhavana*), ADBPBC$_{10}$ – *Ajadugdha bhavita palasha beeja churna* (10 = tenth *bhavana*), ASBPBC$_{11}$ – *Amalaki swarasa bhavita palasha beeja churna* (11 = eleventh *bhavana*), ADBPBC$_{12}$ – *Ajadugdha bhavita palasha beeja churna* (12 = twelfth *bhavana*), ASBPBC$_{13}$ – *Amalaki swarasa bhavita palasha beeja churna* (13 = thirteenth *bhavana*), ADBPBC$_{14}$ –

Ajadugdha bhavita palasha beeja churna (14 = fourteenth *bhavana*).

L*a*b* (CIELAB) is the most complete colour space specified by the International Commission on Illumination (French Commission International de l'eclairange, hence it's CIE). It describes all the colours visible to the human eye and was created to serve as a device independent model to be used as a reference.[10]

In the present study, JPG photographs of coarse powder of *Palashabeeja churna* & *bhavita* coarse powder of *Palashabeeja churna yoga* samples were converted from RBG to CMYK colour space, the colour segmentation was done using MATLAB software were each pixel in the segmented pixels in a*b* space of PBC showed a mixture of 6 colours namely green, red, yellow, purple, black and pink. Among these pink was the domain colour. On ASBPBC$_1$ sample pink, red, green, yellow, black and purple colours were obtained. Here purple was domain one. ADBPBC$_2$ sample showed mixture of 6

colours namely black, green, purple, pink, red and yellow. Here yellow colour was domain one. Sample of $ASBPBC_3$ showed pink, yellow, red, green, purple and black like 6 colour mixture. Here black colour was domain one. $ADBPBC_4$ sample showed green, black, red, yellow, pink and purple colours. Here purple colour was domain one. Sample of $ASBPBC_5$ showed mixture of 6 colours namely yellow, red, purple, black, pink and green. Here domain colour was green. $ADBPBC_6$ sample black, pink, green, red, yellow and purple colours were obtained. Here purple was domain one. Sample of $ASBPBC_7$ showed black, pink, red, purple, green and yellow colours. Here domain colour was yellow. $ADBPBC_8$ sample showed colours namely green, pink, red, purple, black and yellow. Here yellow colour was domain one. Sample of $ASBPBC_9$ showed mixture of 6 colours namely pink, purple, black, green, yellow and red. Here red colour was domain one. Sample of $ADBPBC_{10}$ pink, red, black, purple, green and yellow colures were obtained. Here yellow colour was domain one. $ASBPBC_{11}$ sample showed colours namely purple, red, black, pink, yellow and green. Here green colour was domain one. Sample of $ADBPBC_{12}$ showed colours like red, purple, pink, black, yellow and green. Here domain colour was green. Sample of $ASBPBC_{13}$ showed colours green, yellow, purple, pink, red and black. Here black colour was domain one. Sample of $ADBPBC_{14}$ showed colours namely yellow, red, pink, black, purple and green. Here green colour was domain one.

CONCLUSION
As among all the organoleptic characters it is the colour – the first sensation that a person perceives and use as a tool to accept/reject. Moreover colour changes during processing may be indicative. It can be used as a process control variable in thermal processes. The colour is generally measured in units of L*a*b* were L* is luminosity layer, chromaticity layer a* indicates where the colour falls along red-green axis and chromaticity layer b* indicates where the colour falls along blue-yellow axis. All of the colour information is in the a*b* layers. the domain colour found in the fifteen scatterplots of samples of *Palashabeeja churna* and *bhavita palasha beeja churna* serves as a distinguishing characters. The domain colour in the scatterplot was alien to the colour of the dried samples i.e. PBC, $ASBPBC_1$, $ADBPBC_2$, $ASBPBC_3$, $ADBPBC_4$, $ASBPBC_5$, $ADBPBC_6$, $ASBPBC_7$, $ADBPBC_8$, $ASBPBC_9$, $ADBPBC_{10}$, $ASBPBC_{11}$, $ADBPBC_{12}$, $ASBPBC_{13}$ and $ADBPBC_{14}$ respectively. Powdering gives rise to slight change in colour. Thus L*a*b* colour space is an effective tool. It serves to differentiate the samples from one another more by sensory evaluation. The colour segment of raw drug is modulated to different colour space when exposed to *Amalaki swarasa* but exposure of *Ajadugdha* generate pool to ward green colour space, over and above sequential exposure of same material shows different selectivity of chemical modulation hence resultant it shows different colour space in every *bhavana* completion. The colour space shows scope in SOP of drug production line up for consistence drug manufacturing.

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