Online : ISSN 2349-669X
Print : ISSN 0973-9874

J.Pharm.Chem

CODEN: JPCOCM

Journal of Pharmacy and Chemistry

(An International Research Journal of Pharmaceutical and Chemical Sciences) Indexed in Chemical Abstract and Index Copernicus (IC Value 5.28) ***www.stfindia.com***

www.jpc.stfindia.com

Journal of Pharmacy and Chemistry

(An International Research Journal of Pharmaceutical and Chemical Sciences)

Volume 14 • Issue 3 • July – September 2020

CONTENTS

Colour Chart For Kunda And Milk Sweet For Colour Measurement

AMOL VYAWAHARE[1], JAYARAJ RAO, K.[1]* PAGOTE, C.N[1].
JAYAVEERA, K.N[2] AND M.GOVINDARAJULU YADAV[3].

[1]*Dairy Technology Section, ICAR-National Dairy Research Institute, (Southern Regional Station), Adugodi, Bengaluru – 560 030, Karnataka, India*
[2]*Department of Chemistry, VEMU Institute of Technology, P. Kothakota (Near Pakala), Chittoor Dist, A.P., India*
[3]*Department of Food Technology and Process Engineering, college of Agro industrial technology, Arbaminch University; Swala campus, Ethiopia*

**** Corresponding Author E-mail**: jaysharm@yahoo.com*

Abstract

Colour charts are commonly used in various industries for comparing colours and choosing the appropriate colour of products by consumers. In foodstuffs also, colour is an important criterion for consumer acceptance. Though consumer may not mind slight variations in colour of foodstuffs they eat, manufacturers wish to keep uniform colour of products for all the batches and throughout the year for maintaining high quality standards. Instrumental methods are commonly employed for colour measurement, however, colour charts come in handy for matching the colours and for quick comparative evaluation. In this study, colour charts were developed for kunda and milk sweet both of which are heat desiccated dairy products and have typical colour. The intensity of their creamy white to brown colour varies depending on processing parameters and Maillard reactions. These charts will be helpful to determine if batch to batch production of kunda and milk sweet conform to same hue of colour. The charts of coated sheets consisted of colour circles with varying L, R, G and B values printed which fall within the acceptable range. Colour of surface of kunda and milk sweet may be determined by matching with the colour circles of the charts developed.

Keywords: Colour chart, kunda, milk sweet, lightness, red, blue, green

INTRODUCTION

Methods of colour measurement may be divided into subjective and objective tests. Subjective tests are based on sensory organs whereas objective tests are carried out by instruments. Both the methods have their advantages and disadvantages. However, they are useful if both the tests are correlated with each other satisfactorily. These correlations are important in all fields including colour evaluations. Colour is a visualization by brain of nerve messages from specialized cells called rods and cones. Rods and cones are sensitive to the visible spectrum of the light reflected from the surface of food materials on to the retina. By them, humans can perceive colour intensities and variations and possibly quantify them just like instruments do, though at lower accuracy levels. But, more than quantification, the subjective tests are a step ahead of objective tests as they can even decide the extent of acceptance by humans, which is something like the domain of brain that

instruments lack. Humans have the innate ability to compare colours and match the colours. Human brain can detect about two million different colours [1]. In fact, plethora of pleasing colours existing in various walks of life we encounter is the handiwork of brain itself. However, different instruments are used to measure and quantify colours of surfaces, viz. colourimeters, tintometers, hunter colour lab etc.

Along with instrumental methods, colour can be judged by subjective methods like sensory evaluation. By this method, Nair and Thompkinson [2] evaluated colour and appearance of direct acidified whey based *lassi* like beverage by sensory evaluation. Similarly, Bandyopadhyay et al. [3] used sensory evaluation method to elaborate colour while studying the effect of beet and honey on the quality of carrot fortified milk product. Dharayia [4] developed a colour chart for determination of the colour of basundi. In his study, market samples of basundi were collected and colour chart was prepared with the help of reflectance values determined by reflectance meter. The shades of brown colour resembling colour of basundi had colour combinations of Red: Green: Blue as 205: 150: 0. Vyawahare and Rao [5] and Vyawahare et al. [6] reported colour measurement aspects of kunda and milk-sweet by Scanner – Adobe Photoshop and Camera – Adobe Photoshop methods.

Roland et al. [7] studied the influence of fat on the colour properties of low fat milk. A trained sensory panel assessed colour of milk, and compared the efficacy of the assessment with instrumental values. It was found that, there was a correlation of the instrumental L-value (whiteness), a-value (greenness), and b-value (blueness) of the milk with the subjectively perceived colour. With increase in fat content whiteness increased while green and blue value decreased. While studying colour and consistency of seven commercial samples of vanilla dairy desserts, Tárrega and Costell [8] compared sensory and instrumental values of colour. The positive correlation between sensory colour and parameter a* (red component) and significant negative correlations with parameters L* (brightness) and h* (hue) was reported in the study. In a similar work, differences in instrumental measurements of colour of milk and soybean vanilla beverages were analysed [9]. It was found that the instrumental measurement of colour relates well to the perceived differences in the colour of these products and thus the differences in consumer preferences were explained.

RGB model is an additive colour model that uses transmitted light to display colours in which red, green, and blue light are added together in various ways to reproduce a broad array of colours. The name of the model comes from the initials of the three additive primary colours, red (R), green (G) and blue (B). The model relates closely to the way human perceives colour on the retina. However, the model is device dependent, since its range of colours varies with the display device [10]. To form a colour with RGB, three coloured light beams (one red, one green and one blue) must be superimposed. Zero intensity for each component gives the darkest colour (no light, considered the black), and full intensity of each gives a white; the quality of this white depends on the nature of the primary light sources, but if they are properly balanced, the result is a neutral white. When the intensities for all the components are the same, the result is a shade of grey, darker or lighter depending on the intensity. When the intensities are different, the result is a colourized hue, more or less saturated depending on the difference of the strongest and weakest of the intensities of the primary colours employed. Using

the diodes (in computers), the value carried by the colour intensities are between 0 – 256.

In present study, the suitability of reflectance systems such as colour chart was studied to quantify the colours of heat desiccated products like kunda and milk sweet / kalakand.

MATERIALS AND METHODS

Kunda and milk sweet

Kunda and milk sweet required in the study were procured from the Institute's Experimental Dairy. Samples of kunda were also brought from the local market as and when required. Kalakand prepared in the Experimental Dairy of the Institute has been termed as milk sweet. It is similar to kalakand, but the only difference being that it is made from vacuum concentrated milk, hence whiter than kalakand available in market.

Instruments and equipments

Computer: Dell, Core 2 Duo, 4GB RAM
Scanner: Scanner: Hewlett-Packard Scan jet 5370c
Printer: Hewlett-Packard Desk jet 5100, with cartridge number – 57

Casein coated sheets:

Oddy High glossy coated A4 paper-180 GSM. Casein coated sheets were used for printing the colour circles of known LRGB values. 3

Measurement of colour parameters

Surface scanning of kunda and milk sweet

Kunda samples were conditioned at 30 ºC and blended properly in pestle and mortar. With the help of a spatula, the product was taken in a clean, scratchless petri dish. Care was taken to remove air gaps between bottom of petri dish and the sample. Enough pressure was applied so that the product spread uniformly at the bottom of the dish. The Petri plate with the prepared sample was placed on the flat bed scanner (Hewlett-Packard Scan jet 5370c). Scanning was performed and the image was saved as JPEG file.

Measurement of LRGB

Colour analysis software called Adobe Photoshop Version 8.0 [11], running under the Microsoft Windows XP environment, was used to extract and analyse colour information from the scanned image. The scanned image in JPEG format was opened with Adobe Photoshop (Fig.1a) and the following parameters were measured in RGB mode- Lightness, Red, green, and blue; Different portions of the image were selected using the "elliptical marquee tool" (Windows >Tool >Elliptical marquee tool). Appropriate mode was selected in 'Image' option and the parameters as listed above were recorded as indicated by Histogram menu command (Fig.1b).

Preparation of colour charts

In this method, the objective was to create a chart printed with various circles of defined colour shades of kunda and milk sweet. The evaluator can see the sample and then choose the corresponding closely matched colour shade from the chart.

The scanned images of kunda as well as milk sweet/kalakand were opened with Adobe Photoshop 8.0. A uniformly coloured portion of the image was then selected with elliptical marquee tool (Window > Tool > elliptical marquee tool) and transformed by Free Transform command (Edit > Free Transform). Its size was then standardized, such that a circle of 1.5 inches can be cropped from the image of the product. Several samples of kunda and milk sweet were scanned and their images used for creating colour circles by recreating the RGB values. Out of these, colour circles that most closely match with kunda and milk sweet samples were chosen and

others were not considered. Thus, the colour charts are not the directly scanned images of the products, but recreated versions based on the observed RGB values. All such images with different colour values were arranged side by side on a new Adobe sheet (file > new) of A4 page size with RGB Mode. For kunda, 18 and for milk sweet 24 such images of same dimensions were arranged and printed on casein coated sheets (Oddy High glossy coated A4 paper) using an ink jet printer (Fig.2) (HP Desk jet 5160,) fitted with a new colour cartridge (cartridge number 57). Two separate colour charts as above were created one for kunda and one for milk sweet.

Measurement of colour of kunda and milk sweet using colour charts

Different batches of the products were collected from the Experimental Dairy and samples were also collected from market. The samples, a maximum of four numbers at a time, were served to judges who were asked to match the colour of the products with any of the colour circles provided in the respective charts. The corresponding colour parameters (R, G and B) were recorded for the given product, and expressed as range. The scientific, technical and other staff and students were involved in the above exercise for evaluation of colour.

RESULTS AND DISCUSSION

Colour charts

The batch to batch kunda / milk sweet samples were drawn and scanned as described earlier. Market samples were also drawn and scanned. The reproduced scan colours in the form of circles based on the RGB values were arranged as shown in Fig.1 (kunda) and 2 (milk sweet). The various LRGB values of colour circles of kunda and milk sweet are also shown alongside the corresponding colour circles. In the colour circle chart, it may be seen that the L, R, G and B values ranged from (for kunda, Fig.3) : 97 – 138; 131-263; 86-129; 33-81, respectively; (for milk sweet, Fig.4) 205 – 239; 236-254; 208-240;107-189. It may be observed that variations in colour parameters are more in kunda than in milk sweet except in blue value. This may be attributed to formation of more colour compounds during kunda manufacture than in milk sweet. It may be understood that kunda undergoes more heat treatment than milk sweet resulting in formation of more browning compounds. Wainwright and Hughes [12] developed colour charts for banana and Hernandez et al. [13] developed colour chart for capsicum, Obenland et al. [14] for oranges and Pedreschi et al. [15] for potatoes. All these reported charts, just like in the present study, were based on the CIE color Lab system, however in the present study, we used LRGB system.

Use of colour charts for dairy products is rare and few works on the subject have been reported so far. Webb and Holm [16] and Bell and Webb [17] measured the colour produced in the processing of evaporated milk by means of the Munsell system of disc colourimetry. This system was reported to be relatively convenient, inexpensive and fairly accurate in its specifications of colour. However, its lack of high sensitivity excludes it from the measurement of the minute changes in colour. These limitations also hold true for the colour charts reported in this study. Motonaga et al [18] developed a colour chart with colours, not in the form of circles but in the shape of the fruit itself. These colour charts helped not only in measuring colour, but also in evaluating the extent of ripening of the grapes (Aki Queen variety).

Colour parameters of kunda and milk sweet measured by colour charts

Separate colour charts were prepared for kunda and milk sweet (Fig. 3 and 4). The colour chart consisted

of printed circles of various colour shades of the product – lightest to darkest within the acceptable range. The corresponding L, R, G and B values of the colour shades were measured and recorded with the help of Adobe Photoshop. Samples of kunda and milk sweet / kalakand from four sources in market including Institute's Experimental Dairy were collected and their colour was matched with the colour shades in the respective colour chart. This exercise was done in day light by about 20 evaluators. The corresponding L. R, G and B values were recorded and expressed as mean values with standard deviation (Table-1).

The average 'L', 'R', 'G' and 'B' values for all the batches were 112.86 ± 9.62, 151.27 ± 10.81, 105.08 ± 12.77 and 52.75 ± 12.15, respectively (Table-1). From the table, it can be seen that standard deviations were higher as compared with methods of scanner and camera method reported earlier [5]. This may be attributed to variations in colour perception from one evaluator to the other during colour matching exercise.

Table-2 shows the average colour values of lightness, R, G and B value for all the batches of milk sweet. In case of milk sweet, the overall average values for 'L', 'R', 'G' and 'B' were 222.23, 247.57, 224.78 and 139.55, respectively. The standard deviation for milk sweet ranged from 4.65 to 9.84 which was much low as compared to corresponding values for *kunda*. This may be because *milk sweet* is lighter than *kunda* and has less variation in colour as compared to *kunda*. This variation could be ascribed to variations among judges, non-uniform surrounding light, batch variations and granular texture of product. The higher L values show that milk sweet is a 'whiter' product than kunda. However, the accuracy of the method can be improved by training judges for colour evaluation, and maintaining light of constant luminance in sensory evaluation room. It may also be seen that all the products prepared could be matched with the colour circles of the charts successfully and fell within the range given in the charts.

Actually, instrumental colour evaluations were developed based on the visual colour perceptions of human sensory organs. Very useful systems existed for measuring colour, for example, Munsell Systems, the Donaldson instrument and Lovibond tintometers [19]. Maerz and Paul [20] made a similar kind of colour chart for comparing colours of tree leaves, bare stem and seeds. These colours have been defined by CIE terms and may be converted to Munsell values. Goemley [21] several years ago stated that it was difficult to make a colour book encompassing all the possible colours in foodstuffs, but opined that three or four charts covering the relevant colour range could be made. In the present study, one chart for each of two products kunda and milk sweet was prepared.

CONCLUSION

Colour charts can be used to visually compare the colour intensity and to quantify /measure the colour intensity of kunda and milk sweet. These are helpful to know the colour variations in kunda or milk sweet from batch to batch. Such colour charts could be developed for other products also and kept by the industry to record variations in colour of the products produced by them.

REFERENCES

[1] Gouras P. Colour vision. In: "Encyclopedia of neuroscience", vol 1., (Ed. Squire, L.R.), Academic Press, New York, 2009; p.1123.

[2] Nair K, Thompkinson DK. Optimization of ingredients for the formulation of a direct acidified whey based *lassi*-like beverage. Int J Dairy Technol 2008; 61(2): 199-205.

[3] Bandyopadhyay M, Chakraborty R, Raychaudhuri U. Effect of beet and honey on quality improvement and carotene retention in a carrot fortified milk product. Inn Food Sci Emerg Technol 2007; 9(1): 9-17.

[4] Dharaiya CN. Quality evaluation of basundi marketed in Bangalore city. M. Tech.Thesis, Bangalore: National Dairy Research Institute, 2006.

[5] Vyawahare AS, Rao KJ. (2011) Application of computer vision systems in colour evaluation of kunda: a heat desiccated dairy product. Int J Dairy Sci 2011; 6(4): 253-266.

[6] Vyawahare AS, Jayaraj Rao K, Pagote CN. Govindarajulu Yadav, M., Yogananda Reddy, K. and Jayaveera, K.N. (2012) Application of computer vision systems in colour evaluation of kalakand (milk sweet): a heat desiccated dairy product. Res Rev: J Food Dairy Technol 2012; 1 (1): 16-22.

[7] Roland AM, Phillips LG, Boor KJ. Effects of fat content on the sensory properties, melting, color and hardness of ice cream. J Dairy Sci 1999; 82(1):32-38.

[8] Tárrega A, Costell E. (2007) Colour and consistency of semi-solid dairy desserts: Instrumental and sensory measurements. J Food Engg 2007;78(2): 655-661.

[9] Villegas B, Carbonell I, Costell E. (2007) Colour and viscosity of milk and soybean vanilla beverages- instrumental and sensory measurements. J Sci Food Agri 2007; 88(3): 397-403.

[10] Poynton CA. Digital video and HDTV: algorithms and interfaces. Morgan Kaufmann. ISBN 1558607927. URL: http://books.google.com/books?id=ra1lcAwgvq4C*and*pg=RA1PA234*and*dq=wavelength+beams+additive*and*lr=*and*as_brr=3*and*ei=Pj_fR_uSFYbktAPs_rHxAQ*and*sig=1FcBF7Soo3r8ZHG1gS75fDDGjX8.2003.

[11] Adobe Systems. Adobe PhotoShop 8.0 User Guide, San Jose: Adobe Systems Inc, 2002; CA .

[12] Wainwright H, Hughes PA. Objective measurement of banana pulp colour. Int J Food Sci Technol 1989; 24(5): 553-558.

[13] Hernández B, Sáenz C, Alberdi C, Alfonso S, Berrogui M, Dineiro JM. Design and performance of a color chart based in digitally processed images for sensory evaluation of piquillo peppers (*Capsicum annuum*). Color Research & Application: Endorsed by Inter-Society Color Council, The Colour Group (Great Britain), Canadian Society for Color, Color Science Association of Japan, Dutch Society for the Study of Color, The Swedish Colour Centre Foundation, Colour Society of Australia, Centre Français de la Couleur 2004; 29(4): 305-311.

[14] Obenland D, Collin S, Mackey B, Sievert J, Fjeld K, Arpaia ML. Determinants of flavor acceptability during the maturation of navel oranges. Postharvest Biol Technol 2009; 52(2): 156–163.

[15] Pedreschi F, Bunger A, Skurtys O, Allen P, Rojas X. Grading of potato chips according to their sensory quality determined by color. Food Bioprocess Technol 2012; 5: 2401- 2408.

[16] Webb BH, Holm GE. Color of evaporated milks. J Dairy Sci 1930; 13: 25-39.

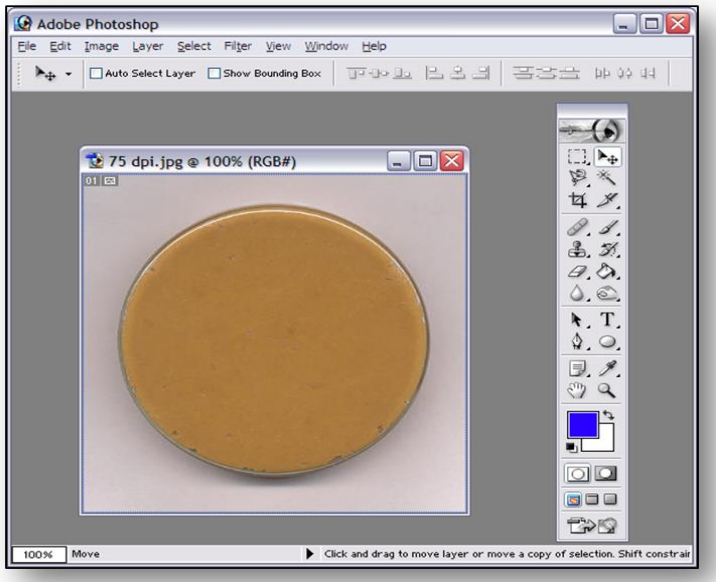
[17] Bell RW, Webb BH. The relationship between high temperature forewarming and the color and heat stability of evaporated milk of different solids content. J Dairy Sci 1943; 26: 579-585.

[18] Motonaga Y, Hiroya K, Atsushi H, Takaharu K. A method of making digital fruit color charts for cultivation management and quality control. J Food Agri Environ 2004; 2 (3&4): 160-166.

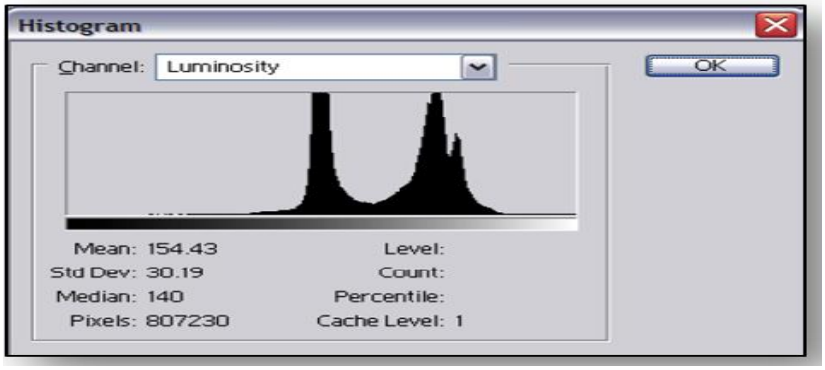
[19] Jacobs MB. The chemical analysis of food and food products. Third Edition, CSB New Delhi: Publications and Distributors, 1999.

[20] Maerz A, Paul MR. Dictionary of colour. Second edition, McGraw-Hill, Inc., New York: USA, 1950.

[21] Goemley TR. Colour and its measurement in foods. Food Progr 1975; 2: 2.



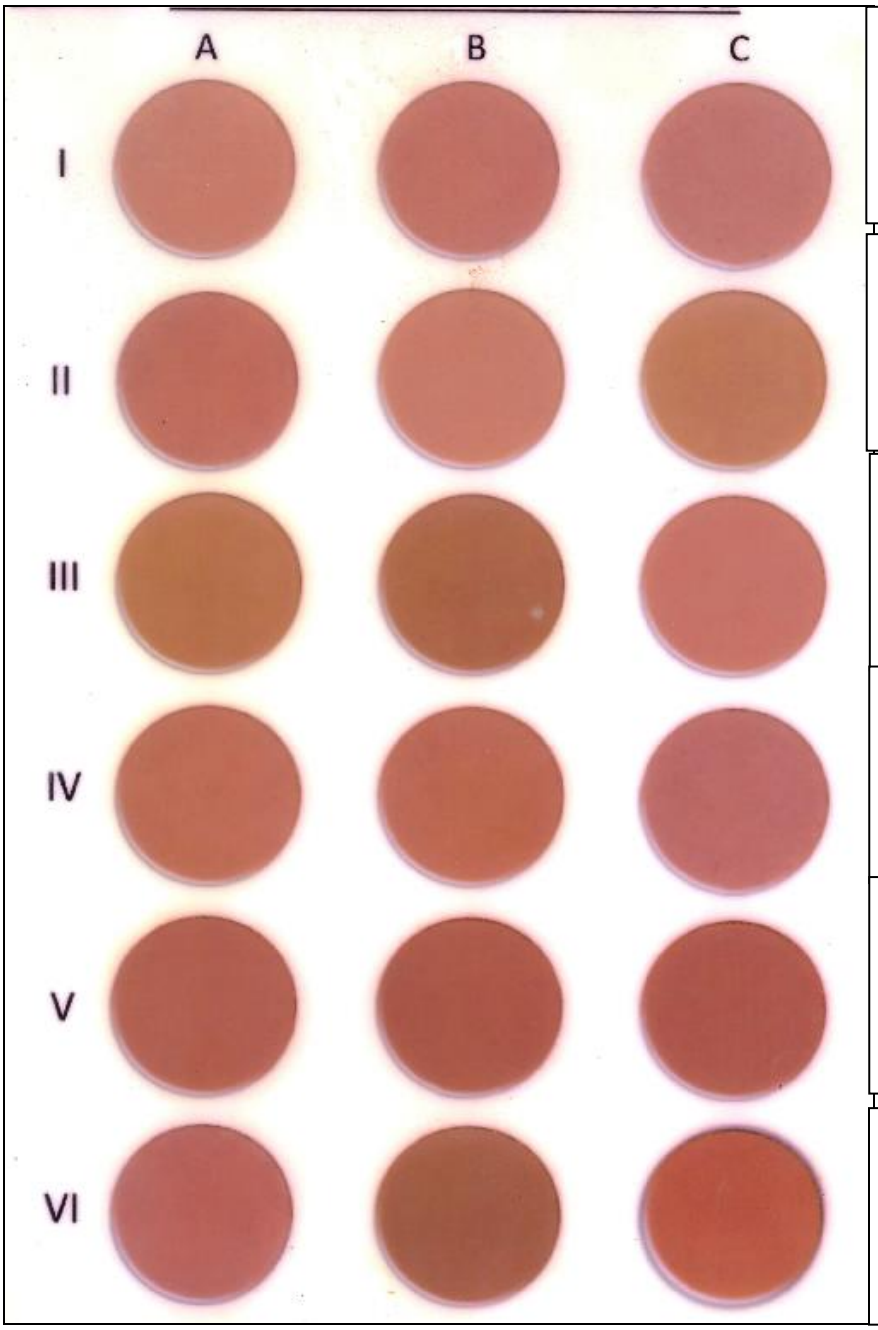
(a)



(b)

Figure 1: (a) Scanned image of kunda opened in Adobe Photoshop programme and (b) Histogram window for the corresponding kunda sample in Adobe Photoshop 8.0

Figure 2: Printing of colour chart using Hewlett-Packard Desk jet 5100 printer



	IA	IB	IC
L	138	127	130
R	177	166	166
G	129	118	122
B	81	72	77

	IIA	IIB	IIC
L	124	137	124
R	263	175	159
G	114	129	120
B	68	76	55

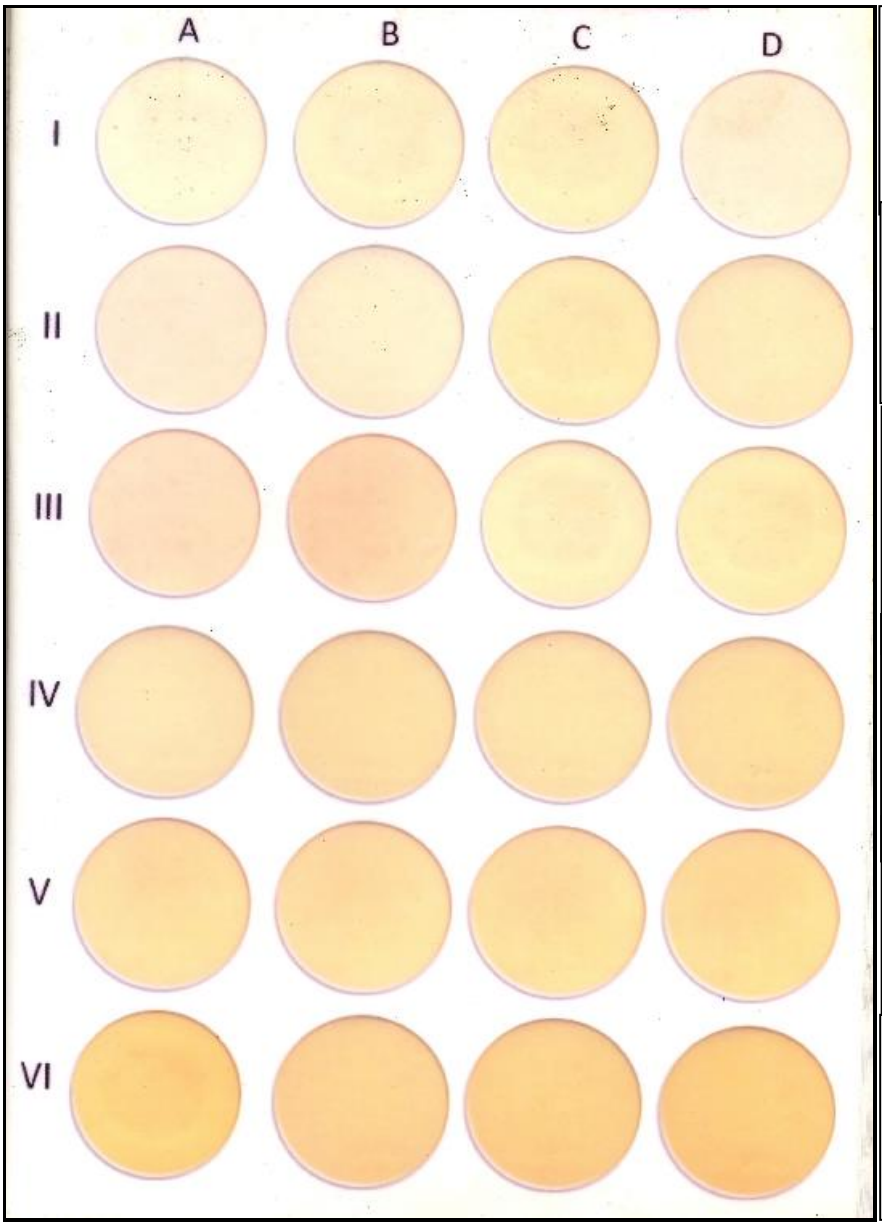
	IIIA	IIIB	IIIC
L	119	109	125
R	154	143	164
G	113	102	116
B	51	46	66

	IVA	IVB	IVC
L	119	116	118
R	158	156	154
G	110	107	108
B	57	55	67

	VA	VB	VC
L	110	100	98
R	149	139	138
G	99	91	88
B	54	45	43

	VIA	VIB	VIC
L	114	97	98
R	154	131	144
G	104	91	86
B	62	40	33

Figure 3: Colour chart of kunda with colour circles along with corresponding L, R, G and B values



	IA	IB	IC	ID
L	238	232	239	235
R	251	250	244	253
G	240	235	232	235
B	189	172	161	186

	IIA	IIB	IIC	IID
L	231	233	226	224
R	252	247	248	243
G	231	236	229	227
B	175	183	150	156

	IIIA	IIIB	IIIC	IIID
L	225	221	229	226
R	251	251	249	248
G	220	220	232	227
B	146	146	161	156

	IVA	IVB	IVC	IVD
L	223	221	219	216
R	243	242	241	240
G	224	224	222	219
B	146	146	142	133

	VA	VB	VC	VD
L	225	226	221	221
R	253	254	253	253
G	226	225	223	223
B	138	134	126	126

	VIA	VIB	VIC	VID
L	212	218	209	205
R	244	239	237	236
G	214	215	212	208
B	108	124	116	107

Figure 4: Colour chart of milk sweet with colour circles along with corresponding L, R, G and B values

Table 1:

Colour values† of kunda in RGB mode determined by colour chart

Sample	L	R	G	B
1	119.66 ± 8.45	156.54 ± 9.15	112 ± 7.15	59.81 ± 14.26
2	114.93 ± 10.84	152.22 ± 14.61	109.25 ± 14.25	56.08 ± 12.26
3	96.87 ± 8.15	132.91 ± 9.14	88.67 ± 8.65	42.21 ± 11.11
4	113.04 ± 9.2	153.58 ± 13.18	104.11 ± 8.81	50.22 ± 7.5
AVERAGE	112.86 ± 9.62	151.27 ± 10.81	105.08 ± 12.77	52.75 ± 12.15

† Mean ± SD of 5 batches

Table 2:

Colour values† for milk sweet in RGB mode determined by colour chart

Sample	L	R	G	B
1	222.81 ± 3.67	250.11 ± 5.40	224.57 ± 3.38	137.68 ± 6.27
2	225.06 ± 3.58	246.92 ± 3.54	227.37 ± 4.23	152.83 ± 5.52
3	219.26 ± 4.69	245.64 ± 4.59	222.41 ± 4.59	131.00 ± 6.66
4	221.21 ± 5.27	247.21 ± 4.80	224.32 ± 4.80	133.67 ± 6.79
AVERAGE	222.23 ± 5.10	247.57 ±4.65	224.78 ± 4.65	139.55 ± 9.84

† Mean ± SD of 5 batches