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Variance of Colour attributes of Kithul (*Caryotaurens*) flour from different growing areas in Sri Lanka

J A A C Wijesinghe*[1], I. Wicramasinghe[1] and K.H Saranandha[2]
[1]Department of Food Science and Technology, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

[2]Food Research Unit
Gannoruwa

*Corresponding author: lucky.research@yahoo.com

Abstract

Kithul (Caryotaurens) flour has great gelling properties compared to other flour from plant sources. The colour of flour samples collected from five main Kithul growing districts, namely Rathnapura, Kegalle, Kandy, Matale and Kurunegala district, was analyzed by two methods as Universal Colour Language (UCL) colour chart and Colorimeter (Konica Minolta colorimeter, sensing, Japan). Pale yellow (UCL 89) was the most common colour while yellowish white colour (UCL 92) was not present in Sabaragamuwa province. According to the readings, there were significant differences ($p < 0.05$) among flour samples from five different growing areas for L(lightness), a*(redness) values and b* (yellowness) values. Kandy (71.56) and Kurunegala (70.18) flours presented higher L* values than those of other flour treatments. Kithul flour samples from Matale district has the lowest L* value (65.58). The lowest a* value (4.54) was observed in Kandy flour samples while the highest values were reported from Kegalle (5.34) and Rathnapura (5.29). In the case of b* (yellowness) values presented the highest value was observed in flour samples from Kegalle (17.90). The lowest b* value was reported from Matale (14.29).From the results the flour samples Matale (ΔE=34.77) and Kegalle (ΔE=34.65) had a greater deviation from the standard colour value than the other samples.*

Keywords: Kithul flour, *Caryotaurens*, colour evaluation, L* a* b* values, colorimeter

1. INTRODUCTION:

The Kithul is a majestic palm found in natural forests of both intermediate and wet zones (Rajyalakshmi P,2004) in India, Malaysia, Myanmar, Nepal, and Sri Lanka as native palms (Orwa C *et al*,2009). Distribution of Kithul in Sri Lankan lowland rainforests is found to be less than 2 trees/ha, which shows its rarity in the wild (Orwa C *et al*,2009). However, island-wide distribution of the Kithul palm was 2,977,261 in 2009 (Ministry of Traditional Insdustries,2009). Being a multipurpose tree, it provides both edible and non-edible products. Edible products from Kithul tree include sweet toddy, Kithul treacle, kitul toddy and kitul jaggery as well as kitul flour (Rajyalakshmi P,2004). Palms are a good source of food products and medicine (Rajyalakshmi P,2004), and starch is a major renewable resource beside cellulose which forms the chief source of carbohydrate in the human diet (Rajyalakshmi P,2005). So Kithul flour, which is equal in quality to industrial sago obtained from *MetroxylanSaguRottb*, plays a very important role as a food source(Rajyalakshmi P,2005).

But the main problem with the Kithul flour for the industrial food production is its pinkish colour (Rajyalakshmi P,2004). During thermal processing colour intensifies(Anilakumai B and Rajyalakshmi P,2000) to dark brown which is not preferable for industrial applications. According to previous studies on

Metroxylonsagu, brown colour of the flour is caused by enzymatic browning (Onsa*et al* ,1998). Mechanical and physiological injury during the flour extraction leads to interaction of polyphenols with polyphenol oxidase. Further, catechins and ephicatechins, when present, may act as substrates for the browning reaction (Onsa*et al* ,1998). As per the Indian scientists, total polyphenol content of crude Kithul flour ranged from 52% to 63% (Anilakumai B and Rajyalakshmi P,2000). Being very interactive with sensory properties, colour of the Kithul flour is a very important factor in food processing. The main objective of this study was to compare the colour of the Kithul flour samples which were collected from five main growing areas in Sri Lanka for identification of regional-based significant differences.

The study was based on two types of colour comparison: Universal Color Language (UCL) colour chart and CIELAB system. The UCL was defined by the Inter-Society Color Council - National Bureau of Standards in 1946. Each of the 267 UCL colour names gives an idea of the named color without reference to colour chips, by combining a very few standard and well known colour terms (Azelea society,2007). The International Commission on Illumination (CIE) serves to define the location of any colour in uniform space by correlating the L*,a* and b* or CIE LAB colour metric space (1976) (CIE ,2004) which can be measured using a Chromameter. This instrument enables users to directly determine the colour on the flour (Konica Instrument Manual) by generating L*, a* and b* values. This readings subjective for the sensorial are brightness, lightness, hue, saturation, Chroma and colourfulness(Macdougall D B,2002) , (Hutching J R and Luo W ,2002). L^* is a function of measure of the brightness from black (0) to white (100) while a^* presents a function of the red-green difference. It varies between -60 to +60 while -a* goes from green and +a* goes towards red. b* is functioning for the green-blue difference. Positive b^* indicates yellowness and varies from -60 to +60, with -b* and +b* go towards blue and yellow, respectively (Oliver *et al* ,1992). This measurements of the L^*,a^*,b^* system presents the same perception of colour difference (Konica Instrument Manual) by excluding human errors.

2. MATERIALS AND METHOD:

2.1 Sample Collection: Five districts, namely Kurunegala (North-western province), Matale and Kandy (Central province), and Kegalle and Rathnapura (Sabaragamuwa province), were selected for the study as the five main growing areas in Sri Lanka. Six Kithul flour samples were collected from each district from both household and commercial markets.

2.2 Sample preparation and Storage: Samples were sifted through a 355μm sieve and packed in air-tight containers, then stored in refrigerator (5 °C) until further analysis.

2.3 UCL Colour Chart: Colour of the Kithul flour samples was analyzed using Universal Colour Language (UCL) colour chart. The UCL was defined by the Inter-Society Colour Council (ISCC) and the United States Department of Commerce's National Bureau of Standards (NSB) (present it is the National Institute of Standards and Technology) in 1946. Because of this reason this colour language is called ISCC-NBS Method of Designating Colours(Hutching J R and Luo W ,2002). Each of the 267 UCL colour names gives an idea of the named colour without reference to colour chips, by combining a very few standard and well known colour terms (CIE,2004).

2.4Chroma meter Minolta (CR 400) colourimeter:

The instrumental measurement of Kithul flour colour was carried out with a Chroma meter Minolta CR-400 (Konica Minolta colourimeter, sensing, Japan) and the results were expressed in accordance with the CIELAB system.

The meter was calibrated with white tile (L* = 93.30, a* = 0.32 and b* 0.33). The samples were poured into glass dish (6.4 mm diameter diaphragm with an optical glass), with the surface of the sample was manually made a flat and the measuring head of the meter was carefully placed on three different locations on the petri dish. The measurements were determined in triplicates and mean and standard deviations determined. The colour attributes were determined by colour coordinates of L^* (L^* = 0 [black] and L^* =

100 [white]), a^* ($-a^*$ = greenness and $+a^*$ = redness), and b^* ($-b^*$ = blueness and $+b^*$ = yellowness).ΔE value which defines the size of the total colour difference, but does not give information about how the colours differ was determined (Morrison W R and Laignelet B,1983).

ΔE is defined by the following equation:
$\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}$
(Morrison W R and Laignelet B,1983).

2.5 Statistical Analysis: Results were analyzed using one-way analysis of variance (ANOVA) at 0.05 probability level, pearson correlation and cluster analysis with MINITAB software package (version 17 for Windows).

3. RESULTS AND DISCUSSION:

3.1 Colour Variation of Kithul Flour by using UCL Color Chart:

The colour of the flour directly affects the colour of the finished product. Therefore colour specifications are required by manufacturers. Colour of Kithul flour samples was differentiated according to the graph (Figure 1). Pale yellow (UCL 89) was the most common colour among all studied samples with the highest contribution in Kegalle as 83.3%. Pale orangish yellow colour (UCL 73) was the second common Kithul colour and the highest percentage of 66.6% was recorded in flour samples obtained from Matale.

Yellowish white colour (UCL 92) was only present in samples from Central province and North-western province, but not in samples from Sabaragamuwa province. The crude Kithul flour has a considerable amount of phenols, 52.0 ±0.06 %, when compared to white coloured corn flour, which has no phenols(Ahilakumai B and Rajyalakshmi P,2000).Variations of the phenolic content could be the main cause for these colours in Kithul flour samples.

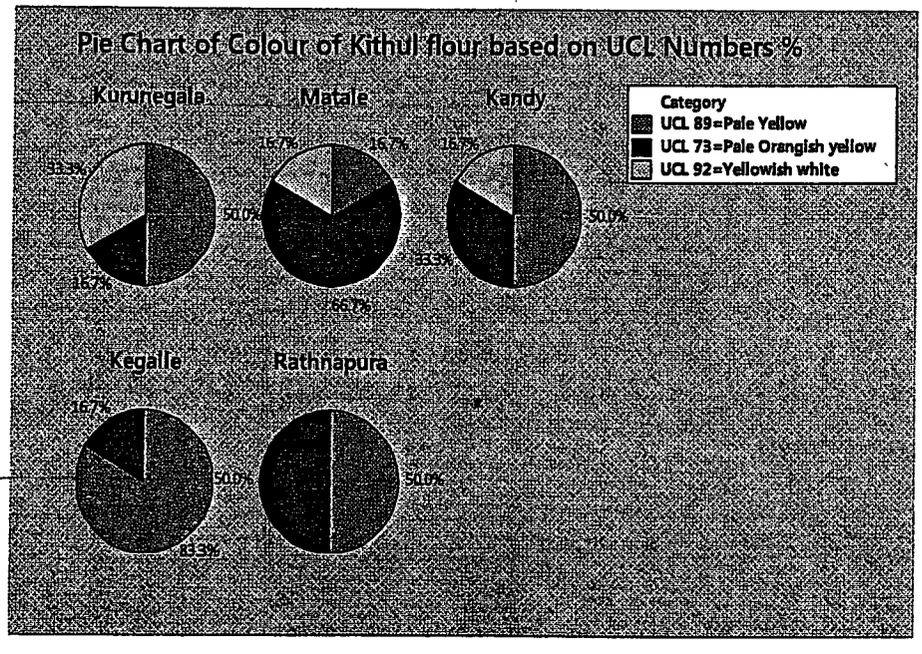

Figure 1.Pie chart for colour comparison of Kithul flour samples collected from five different districts by using UCL (Universal color language) colour codes (Graphed by Using MINITAB 17 Software).

3.2Comparison of Colour variations of the flour by using Chroma meter Minolta (CR 400) colorimeter:

Table 1:Variations in Colour properties of Kithul flour collected from five districts in Sri Lanka

Sampling Area	L*	a*	b*	ΔE
Kandy	71.56±3.07[a]	4.54±0.64[b]	16.50±0.82[ab]	30.24±2.71[c]
Kegalle	67.40±1.28[bc]	5.34±0.40[a]	17.90± 2.01[a]	34.65± 1.34[a]
Kurunegala	70.18±5.36[ab]	4.71±1.17[ab]	14.66± 1.58[cd]	30.72± 5.13[bc]
Matale	65.58±3.95[c]	5.16±0.89[ab]	14.29± 1.04[d]	34.77± 3.90[a]
Rathnapura	67.41±2.78[bc]	5.29±0.54[a]	15.93±1.97[bc]	33.81±2.33[ab]
Mean	68.43±4.09	5.01± 0.82	15.85 ± 2.01	32.84 ± 3.82

[a,b,c]Dissimilar letters indicate differences in treatment means within the same column ($p < 0.05$)

The colour attributes of the Kithul flour treatments from five different growing areas in Sri Lanka is shown in Table 1. According to the readings, there were significant differences($p < 0.05$) among flour samples from five different growing areas for L*(lightness), a*(redness) values and b* (yellowness)values.
Kandy (71.56) and Kurunegala (70.18) flours presented higher L* values than those of other flour treatments. Kithul flour samples from Matale district has the lowest L* value (65.58). The lowest a* value (4.54) was observed in Kandy flour samples while the highest values were reported from Kegalle (5.34) and Rathnapura (5.29).In the case of b* (yellowness) values presented the highest value was observed in flour samples from Kegalle (17.90). The lowest b* value was reported from Matale (14.29). The mean L* value for Kithul flour is 68.43 while means of a* and b* values were 5.01 and 15.85, respectively. Coordinates of these three colour attributes of Kithul flour among the sampling districts is shown in Figure 2.

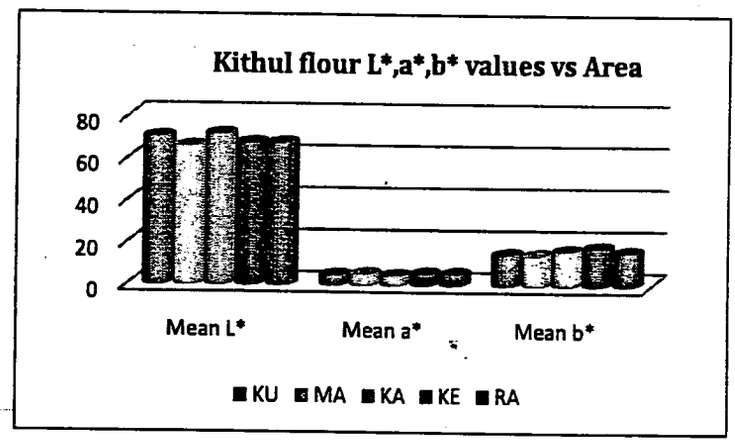

Figure2Variations in Colour attributes as means of L* a* and b* of Kithul flour collected from five districts in Sri Lanka.

The differences in colour could be characterized to the variety, age and also on different processing procedures for flour. The larger the ΔE value represents , the larger the colour difference(Morrison W R and Laignelet B,1983).The estimation of ΔE, indicate the extent of deviation of colour of samples from the standard tile colour used (L*=97.63, a*=- 0.48, and b*=+2.12). From the results the flour samplesMatale (ΔE=34.77) and Kegalle (ΔE=34.65) had a greater deviation from the standard colour value than the other

samples. Kandy area presented the least deviation from standard as ΔE=30.24 at the initial stage. Behaviour of Colour difference with area comparison according to the Figure 3.

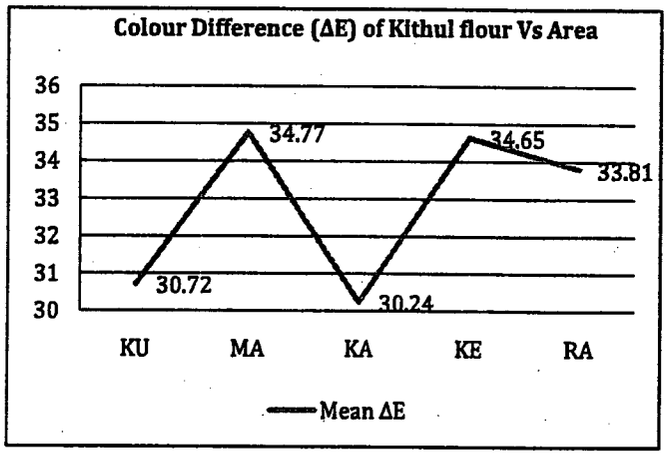

Figure 3 Variations in Colour difference (ΔE) of Kithul flour collected from five districts in Sri Lanka. .

There was a strong,negative ,significantcorrelation ($r = -0.974$; $p < 0.05$) between L* and ΔEvalues, which indicates that, as L* increase, ΔE decreases.There were another two correlationswere identified as moderate relationships. There was another negative ,moderate correlation showed with significant difference($r = -0.721$; $p < 0.05$) among L* and a* values.And next correlation was positive as well as moderate with significant difference($r = 0.774$; $p < 0.05$) between ΔE vs a*.The positive a* value for Kithul flour samples showed its propensity towards pinkish colour as positive a* values represent the redness of samples (CIE,2004)

According to cluster analysis (Figure 4) (which is based on data in Table 1) it is clear that flour samples from Kegalle and Rathnapura represent the first cluster with highest similarity (Cluster 1.Similarity 64.37).As better observation this cluster was formed by the flour treatments from Sabaragamuwa province (Cluster 2 in Figure 3) as they belong to the same cluster among samples from other three districts.Similar observation has reported from UCL colour comparison in3.1 (Colour Variation of Kithul Flour by using UCL Color Chart) as flour samples from Sabaragamuwa province (Kegalle and Rathnapura) has not presented Yellowish white colour (UCL 92) (Figure 1). However second cluster was formed byKurunegala and Kandy area with 62.54 similarity level.

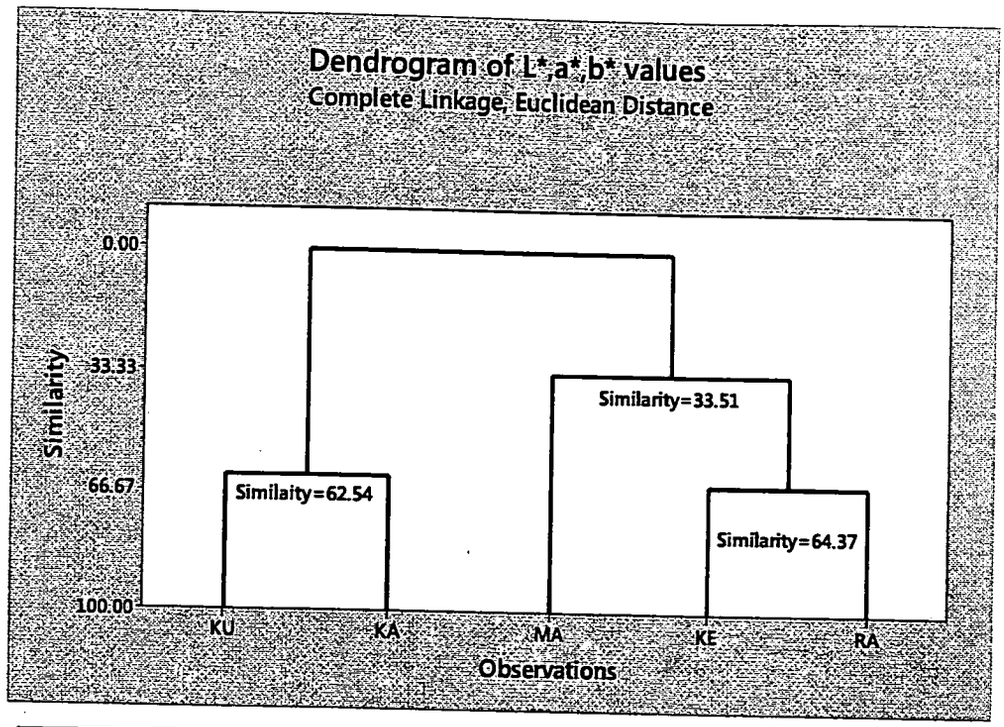

Figure 4.Cluster analysis of Colour variance of Kithul flour samples collected from five different districts by using L*a*b* values (Graphed by Using MINITAB 17 Software).

4.CONCLUSION AND FURTHER WORK: Kithul flour colour presented mainly three variations according to the UCL (Universal Colour Language) colour chart. Pale yellow (UCL 89) was the most common colour among all studied areas while pale orangish yellow colour (UCL 73) was the second common Kithul flour colour. Yellowish white colour (UCL 92) was not presented in Kithul flour samples from Sabaragamuwa province (Rathnapura and Kegalle). According to the instrumental measurements, there were significant differences($p< 0.05$) among flour samples from five different growing areas for all three colour attributes L* (lightness) value,a* (redness)and b* (yellowness)value. But the positive point is there were two strong similarity (> 50%) among five district's samples according to cluster analysis. It will be a good point for using flour samples from different growing areas to produce composite flours in food productions.

This study reveals that the colour attributes of Kithul flour influenced by the growing area ,although it could be the enzymatic browning though the flour processing steps. This can be a positive point for food applications in future as composite flours with similar colours can be produced using Kithul flour obtained from same growing areas. Flour colour often affects the colour of the finished product and therefore it will be one of a key flour specification which could be required keen attention of food technologists to empower the Kithul flour industry.

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6. REFERENCE :

1) Anilakumai B.,And Rajyalakshmi P.(2000); Qualitative aspects, product suitability and in vitro starch digestibility of caryota palm sago-An uncommon food tribals. *J.FoodSci.Technol.*, vol,37No.1,76,75-78 .
2) Azalea Society of America,.RHS, UCL and RGB Colors, gamma,2007; (http://azaleas.org/index.pl/rhsmacfan1.html).Cited on 2014/07/15.
3) CIE 15:2004. The Executive Director Office Of The Federal Register, Washington,.*CIE 15: Technical Report: Colorimetry*, 2004,3rd edition.17, 16-27.
4) Hutchings J. R., Luo W., (2002); Color in Food, Improving quality, Chapter 14: Calibrated color imaging analysis of food: B.D. MacDougall, Woodhead Publishing in Food Science and Technology, Cambridge, England, 2002,pp. 352–366. ISBN 0-8493-1542-5.
5) ISCC (Inter-Society Color Council) and NBS (the United States Department of Commerce's National Bureau of Standards) .2013.Universal Color Language, Level 3 Color Names. http://www.december.com/html/spec/colorucl.html).Cited on 2014/07/15.
6) Konica Minolta Chroma Meter CR-400/410 instruction manual.2002-2013.9222-1878-20. http://www.konicaminolta.com/instruments/download/instruction_manual/color/pdf/cr-400-410_instruction_eng.pdf
7) Macdougall D. B.,(2002), Colours in food, Improving quality, Chapter 3: Colour measurement of food, Principles and practice,*B.D.MacDougall, Woodhead Publishing in Food Science and Technology, Cambridge, England.* 2002,44, 33-60. ISBN 0-8493-1542-5.
8) Ministry of Traditional Industries and Small Enterprise Development(2009); Statistics On Kithul Palms In Sri Lanka. *National programme for Kithul Development*, pp. 3-7 .
9) Morrison, W.R and Laignelet, B. 1983. An improved colorimetric procedure for determining apparent and total amylose in cereal and other starches. Journal of Cereal Science 1: 9-20.d, 2002,pp. 352–366. ISBN 0-8493-1542-5.
10) Oliver J.R., Bkakeney A.B., Allen H.M.,(1992); Measurement of flour in colour space parameters. *cereal chem.*,69(5).546-551
11) OnsaG.H ., Nazamid S.,Sharifah K., Zaiton H. And Jinap,S.(1998); Purification, characterization and molecular properties of polyphenoloxidase from sago (*Metroxylonsagu*) pith. 1998.
12) Orwa C.,Mutua A.,Kindt R.,Jamnadass R., Simons A. (2009) ; Arecaceae L; *Caryotaurens*.Agroforestree Database: a tree reference and selection guide version 4.0. (2009). (http://www.worldagroforestry.org/af/treedb/) visited on 2013.10.02.
13) Rajyalakshmi P .,*Caryota* palm sago O A potential get underutilized natural resource for modern starch industry. Natural product radiance , (May-June 2004) ,vol 3(3) , pp144 -149.
14) RajyalakshmiP .,(2005); Processing Of Unconventional Foods.*Report On Training Programme Of "Emerging Trends In Food Processing Technology – Prospects & Opportunities"14-09-2005 to 4-10-2005*, pp-24-29.