

COLOR SPECTRUM PROPERTIES OF PURE AND NON-PURE LATEX IN DISCRIMINATING RUBBER CLONE SERIES

(Ciri-Ciri Warna Spektrum dalam Membezakan Siri Klon Getah untuk Susu Getah Tulen Dan Bukan Tulen)

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Abstract

A study of color spectrum properties for pure and non-pure latex in discriminating rubber clone series has been presented in this paper. There were five types of clones from the same series being used as samples in this study named RRIM2002, RRIM2007, RRIM2008, RRIM2014, and RRIM3001. The main objective is to identify the significant color spectrum (RGB) from pure and non-pure latex that can discriminate rubber clone series. The significant information of color spectrum properties for pure and non-pure latex is determined by using spectrometer and Statistical Package for the Social Science (SPSS). Visible light spectrum (VIS) is used as a radiation light of the spectrometer to emit light to the surface of the latex sample. By using SPSS software, the further numerical analysis of color spectrum properties is being conducted. As the conclusion, blue color spectrum for non-pure is able to discriminate for all rubber clone series whereas only certain color spectrum can differentiate several clone series for pure latex.

Keywords: rubber clone series, RGB color, spectrometer, statistical analysis

Abstrak

Satu kajian mengenai ciri-ciri warna spektrum dalam membezakan siri klon getah untuk susu getah tulen dan bukan tulen telah dibincangkan di dalam kertas kerja ini. Terdapat 5 jenis klon daripada siri yang sama telah digunakan sebagai sampel iaitu RRIM 2002, RRIM 2007, RRIM2008, RRIM2014, RRIM3001. Tujuan utama kajian ini adalah untuk mengenal pasti warna asas spektrum (Merah, Hijau, Biru) daripada susu getah tulen dan tidak tulen yang boleh membezakan siri klon getah. Informasi penting daripada ciri-ciri warna spektrum ini ditentukan menerusi spektrometer dan analisa statistik. Spektrum cahaya yang boleh dilihat ini akan digunakan sebagai cahaya radiasi kepada spektrometer untuk memancarkan cahaya kepada permukaan sampel susu getah. Dengan menggunakan perisian SPSS ini, analisa numerikal selanjutnya akan dijalankan pada ciri-ciri warna spektrum. Secara kesimpulannya, warna spektrum biru bagi sampel tidak tulen boleh membezakan keseluruhan siri klon getah. Manakala, hanya warna spektrum tertentu boleh membezakan jenis klon untuk susu getah tulen.

Kata kunci: siri klon getah, warna MHB, spektrometer, analisis statistik

Introduction

Rubber is one of the largest economic income in Malaysia. Commonly products from the natural rubber are tires, gloves, latex suits, etc. Basically, latex is obtained by tapping rubber from the rubber trees [1]. In Malaysia, there are many types of rubber clone series that have been produced for almost nine decades ago where it consists of more than 185 clones breed [2]. As a result of that, farmers and agriculture officers may face difficulties in discriminating the best clone for cultivation [3]. Practically, the identification of rubber clone series is based on

pattern recognition from seeds and leaves by skilled workers while a beginner needs to do a comparison from library images [4]. Pure latex is classified as fresh latex which consists of 50-80% water, 25-45% hydrocarbon rubber, and 2-5% non-rubber constituents [1] while, non-pure latex or also known as preservative latex, the composition consists of water, sodium carbonate, sodium tetraborate, and formaldehyde [5]. The basic RGB color spectrums were chosen as the main parameter to analyze rubber clone series using spectrometer Carl Zeiss MCS 600. The light emitted by spectrometer will interact with the surface of the objects and will cause adjusting in the color spectrum of the light [6]. A number of researchers have been involved in natural rubber research where most of them investigated on the composition content [7] and the performance [8] of the rubber clone series. Researches also have been conducted to identify the rubber clone reflectance index and image processing of seeds [9,10] and leaves [11] respectively. Osman in [10] presented a study for five types of rubber seed clones (PB360, RRIM2009, RRIM2011, RRIM2016, and RRIM2025) classification via reflectance measurement. The research work investigated on maximum reflectance from the surface of the seed using spectrometer. He concluded that the reflectance index of lateral surface of seed can be used to identify the RRIM2009 clone. The other techniques have been applied in [9] for rubber seed clone identification was by an intelligent classification model via shape features through imaging technique. This work employs Artificial Neural Network (ANN) using Levenberg-Marquardt algorithm to train the inputs. The outcome of this work shows that the best accuracy is at 84% with more than 70% achievement for sensitivity and specificity [9]. Other work done by [11] is regarding to rubber tree leaf disease detection based on RGB color image. Findings have shown that developed intelligent models produced more than 70% of accuracy and sensitivity.

From this overview, it is known that there is lack of work that has been done on rubber clone classification from natural latex especially through color spectrum. As regards to these, a new technology is needed in order to make the work to be efficient and accurate. Therefore, this work proposes a technique of analyzing rubber clone series using RGB color spectrum for five selected clones. Latex samples from each clone are then processed to acquire information of color spectrum based on the reflectance measurement obtained from spectrometer. The data will be analyzed with the statistical method in order to find any significant to discriminate the rubber clone series for both pure and non-pure latex.

Materials and Methods

The rubber clone samples used in this study were taken from Rubber Research Institute of Malaysia (RRIM), Permatang Station, Kota Tinggi, Johor, Malaysia. The tapping process started early at 6.00 am and the latex were collected after 3 hours tapping which is starting from 9.00 am until 11.30 am. This tapping procedure was used half spiral (1/2S) method [12] and S2, D3 method which is cut for every three days. However, this tapping process depends on the season and it was conducted on low yielding period at the end of February 2014. The samples were placed in ice box with clone labels and brought to Room Image Capturing Studio (ICS), Advanced Signal Processing (ASP) laboratory, level 10 in UiTM Shah Alam, Malaysia. There were two randomly trees selected for each clone used in this work. The latex samples have been divided into two categories which are pure and non-pure latex.

Reflectance Measurement

In this study, the reflection spectra of VIS were used as the optical properties and the wavelength spectrum for VIS were between 400 nm and 800 nm as shown in Figure 1. The light features with different wavelengths started from ultraviolet (UV) up to infrared (IR) [13]. For this work, the selected primary colors were Red (620-750nm), Green (495-570nm), and Blue (450-475nm).

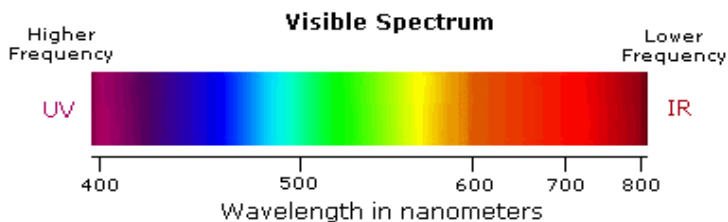


Figure 1. Optical properties [13]



Figure 2. Component of MCS 600 spectrometer



Figure 3. Sample of measurement from bottom side

The MCS 600 as shown in Figure 2 is a component of spectrometer from Carl Zeiss that cover spectral range from 190 nm to 2200nm [14]. The OFK 30 is a measuring head that has been added to the MCS 600 as its accessory program. The maximum diameter that can be measures is 30 mm [15]. In this work, the reflectance measurements of the latex samples were obtained from the bottom side of the specimen cup as shown in Figure 3.

Data Acquisition and Data Conversion

An Aspect Plus software is used to extract and display the reflectance measurement from spectrometer MCS 600 from Carl Zeiss. The data were then being transferred to a graph of reflectance (%) versus wavelength which is ranging from 450-950nm [15]. The reflectance data from the Aspect Plus software was automatically saved in ASCII code format (DAT.) and converted the obtained data into Microsoft Excel for ease of analysis [9].

Numerical Analysis

Results were analysed for normality test, error bar test and one way ANOVA. Normality Test need to be conducted prior to other test for checking the normality of a population. If the population found to be normal then the parametric test can be carried out [16]. Error bar test is one of the parametric test which can be used for comparing between groups of variables. Meanwhile, the one-way ANOVA is suitable for comparison means from one or more group [9].

Results and Discussion

Normality Test

Table 1 and 2 tabulates the normality test for pure latex and non-pure latex for each clone series. According to both table, it is shows that only pure Red 2008 (Table 1) and non-pure Blue 2002 (Table 2) were not normally distributed

from the data set with $p < 0.05$. Thus, it is denote that pure Red 2008 and non-pure Blue 2002 are no longer can be used for next processing. The rule for normal distribution is when the significance value (p-value) is greater than 0.05, it means that the data set is in normal distribution otherwise, it is not normal distribution [17].

Table 1. Normality test for pure latex

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
red_2002	.163	26	.075	.931	26	.080
green_2002	.124	26	.200	.924	26	.056
blue_2002	.131	26	.200	.951	26	.240
red_2007	.154	26	.114	.936	26	.109
green_2007	.148	26	.146	.924	26	.056
blue_2007	.066	26	.200	.991	26	.997
red_2008	.186	26	.022	.913	26	.030
green_2008	.124	26	.200	.951	26	.243
blue_2008	.144	26	.174	.933	26	.089
red_2014	.167	26	.059	.928	26	.070
green_2014	.128	26	.200	.934	26	.096
blue_2014	.062	26	.200	.993	26	.999
red_3001	.147	26	.153	.949	26	.216
green_3001	.156	26	.102	.927	26	.064
blue_3001	.019	26	.200	.988	26	.988

Table 2. Normality test for non-pure latex

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
red_2002	.140	26	.200	.962	26	.423
green_2002	.152	26	.128	.893	26	.011
blue_2002	.189	26	.018	.873	26	.004
red_2007	.135	26	.200	.964	26	.476
green_2007	.122	26	.200	.912	26	.030
blue_2007	.081	26	.200	.992	26	.998
red_2008	.126	26	.200	.963	26	.452
green_2008	.112	26	.200	.929	26	.074
blue_2008	.111	26	.200	.973	26	.693
red_2014	.112	26	.200	.975	26	.760
green_2014	.082	26	.200	.962	26	.440
blue_2014	.092	26	.200	.979	26	.854
red_3001	.137	26	.200	.953	26	.275
green_3001	.127	26	.200	.915	26	.034
blue_3001	.072	26	.200	.990	26	.995

Error Plot

Figure 4 until 6 displays the Error Bar Plot for pure latex with respect to each clone based on RGB color spectrum. Based on plot in Figure 4, it is shows that Red 2002 are obviously significant different with each other. From Figure 5, it can be said that, Green 2002 can be discriminated between Green 2007, 2014, and 3001. While these three clones (2007, 2014, and 3001) are able to differentiate from 2002 and 2008. The following Figure 6 depicts the Error Bar for Blue color. It can be clearly observed that the Blue 2008 are extremely significant between other clones.

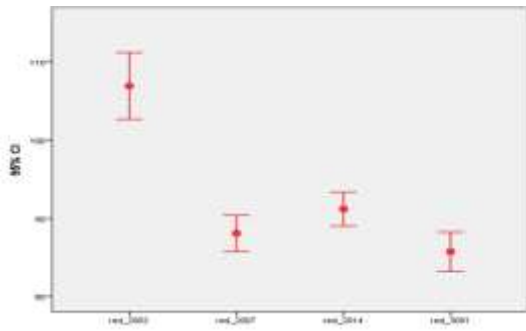


Figure 4. Error bar plot for all red rubber clones.

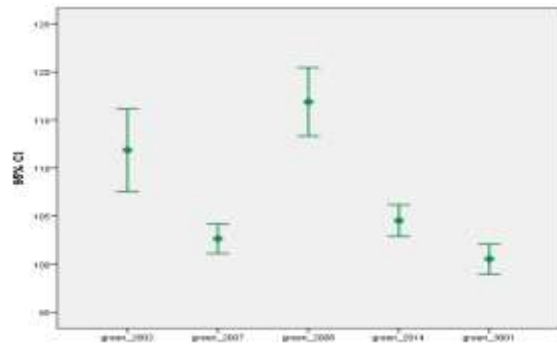


Figure 5. Error bar plot for all green rubber clone

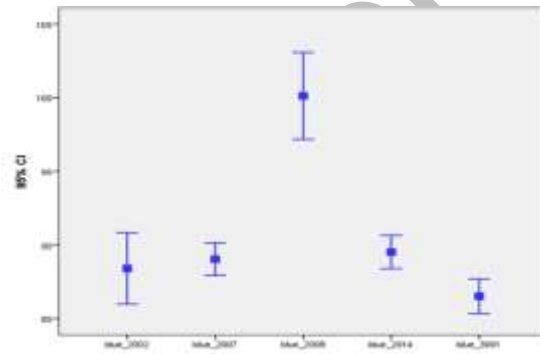


Figure 6. Error bar plot for all blue rubber clone

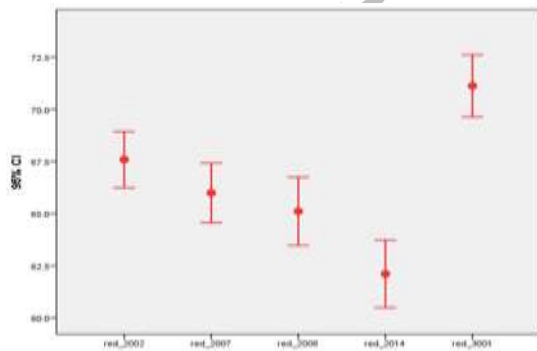


Figure 7. Error bar plot for all red rubber clone

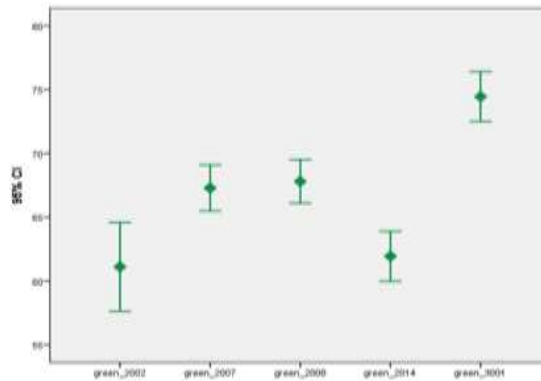


Figure 8. Error bar plot for all green rubber clone

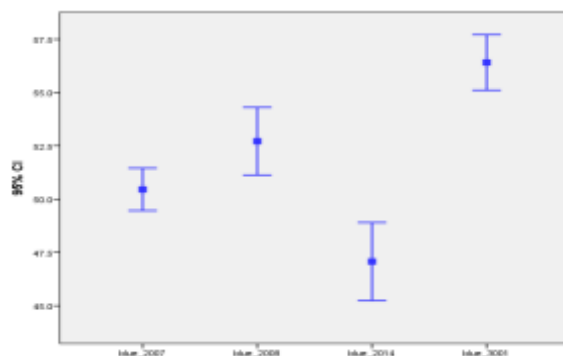


Figure 9. Error bar plot for all blue rubber clone

Figure 7- 9 shows that error bar plot for non-pure latex according to RGB spectrum color with respect to each rubber clone series. Referring to these figures, it can be conclude that the Red, Green, and Blue for RRIM3001 clone obviously having significant different between other clones due to high gap. Hence, it is suggested to do another analysis using ANOVA for obtaining more precise conclusion instead of graph observation.

ANOVA Test

Following are the hypothesis assumptions made using ANOVA test. H_0 = There are no different in RGB color spectrum between each clone. H_1 = There are at least one different in RGB color spectrum between each clone.

Pure Latex

Table 3-5 shows the comparisons for RGB color spectrum between all clones for pure latex. The results show that majority of the clones especially in Red and Green obtained $p < 0.05$, which proved that these clones are highly significant different. So, for this case, the null (H_0) hypothesis is rejected and the alternative (H_1) hypothesis is accepted since p -value < 0.05 . From that reason, a particular analysis cannot be done simultaneously for all clones.

Table 3. Multiple comparison for red color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2002	2007	18.85105	2.09145	.000	14.7357	22.9664
	2014	15.74510	2.09145	.000	11.6298	19.8604
	3001	21.20118	2.09145	.000	17.0858	25.3165
2007	2002	-18.85105	2.09145	.000	-22.9664	-14.7357
	2014	-3.10595	2.09145	.139	-7.2213	1.0094
	3001	2.35013	2.09145	.262	-1.7652	6.4655
2014	2002	-15.74510	2.09145	.000	-19.8604	-11.6298
	2007	3.10595	2.09145	.139	-1.0094	7.2213
	3001	5.45608	2.09145	.010	1.3407	9.5714
3001	2002	-21.20118	2.09145	.000	-25.3165	-17.0858
	2007	-2.35013	2.09145	.262	-6.4655	1.7652
	2014	-5.45608	2.09145	.010	-9.5714	-1.3407

Bold is significant $p < 0.05$

Table 4. Multiple comparison for green color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2002	2007	9.20858	1.95196	.000	5.3621	13.0550
	2008	-5.02043	1.95196	.011	-8.8669	-1.1740
	2014	7.32097	1.95196	.000	3.4745	11.1674
	3001	11.32378	1.95196	.000	7.4773	15.1702
2007	2002	-9.20858	1.95196	.000	-13.0550	-5.3621
	2008	-14.22900	1.95196	.000	-18.0755	-10.3825
	2014	-1.88761	1.95196	.335	-5.7341	1.9589
	3001	2.11520	1.95196	.280	-1.7313	5.9617
2008	2002	5.02043	1.95196	.011	1.1740	8.8669
	2007	14.22900	1.95196	.000	10.3825	18.0755
	2014	12.34140	1.95196	.000	8.4949	16.1879
	3001	16.34421	1.95196	.000	12.4977	20.1907
2014	2002	-7.32097	1.95196	.000	-11.1674	-3.4745
	2008	1.88761	1.95196	.335	-1.9589	5.7341
	2007	-12.34140	1.95196	.000	-16.1879	-8.4949
	3001	4.00281	1.95196	.041	.1563	7.8493
3001	2002	-11.32378	1.95196	.000	-15.1702	-7.4773
	2008	-2.11520	1.95196	0.28	-5.9617	1.7313
	2007	-16.34421	1.95196	.000	-20.1907	-12.4977
	2014	-4.00281	1.95196	.041	-7.8493	.1563

Bold is significant p<0.05

Table 5. Multiple comparison for blue color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2002	2007	-63380	1.31986	.632	-3.2460	1.9784
	2008	-11.72825	1.31986	.000	-14.3404	-9.1161
	2014	-1.11884	1.31986	.398	-3.7310	1.4933
	3001	1.88656	1.31986	.155	-.7256	4.4987
2007	2002	63380	1.31986	.632	-1.9784	3.2460
	2008	-11.09445	1.31986	.000	-13.7066	-8.4823
	2014	-48504	1.31986	.714	-3.0972	2.1271
	3001	2.52036	1.31986	.058	-.0918	5.1325
2008	2002	11.72825	1.31986	.000	9.1161	14.3404
	2007	11.09445	1.31986	.000	8.4832	13.7066
	2014	10.60941	1.31986	.000	7.9972	13.2216
	3001	13.61480	1.31986	.000	11.0026	16.2270
2014	2002	1.11884	1.31986	.398	-1.4933	3.7310
	2008	48504	1.31986	.714	-2.1271	3.0972
	2007	-10.60941	1.31986	.000	-13.2216	-7.9972
	3001	3.00540	1.31986	.024	.3932	5.6176
3001	2002	-1.88656	1.31986	.155	-4.4987	.7256
	2008	-2.52036	1.31986	.058	-5.1325	.0918
	2007	-13.61480	1.31986	.000	-16.2270	-11.0026
	2014	-300540	1.31986	.024	-5.6176	-.3932

Bold is significant p<0.05

Non - Pure Latex

Table 6, 7 and 8 shows the comparisons for RGB color space between all clones for non-pure latex. It is clearly can be seen that in Table 8, all $p < 0.05$ which indicates that the clones are significant with each other at Blue color. However, in Table 6 and 7, which represent Red and Green color tabulates that at certain clones the $p < 0.05$. As a result, final conclusion can be made that the only Blue color can be used as the reference input for identification of all clones at non-pure latex while the other two color (Red and Green) still can be used at selected clones.

Table 6. Multiple comparison for red color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2002	2007	1.59559	1.07166	.137	-.5115	3.7026
	2008	2.47794	1.07166	.021	.3709	4.5850
	2014	5.47835	1.07166	.000	3.3713	7.5854
	3001	-3.53274	1.07166	.001	-5.6398	-1.4257
2007	2002	-1.59559	1.07166	.137	-3.7026	.5115
	2008	.88235	1.07166	.411	-1.2247	2.9894
	2014	3.88276	1.07166	.000	1.7757	5.9898
	3001	-5.12833	1.07166	.000	-7.2354	-3.0213
2008	2002	-2.47794	1.07166	.021	-4.5850	-.3709
	2007	-.88235	1.07166	.411	-2.9894	1.2247
	2014	3.00041	1.07166	.005	.8934	5.1075
	3001	-6.01068	1.07166	.000	-8.1177	-3.9036
2014	2002	-5.47835	1.07166	.000	-7.5854	-3.3713
	2008	-3.88276	1.07166	.000	-5.9898	-1.7757
	2007	-3.00041	1.07166	.005	-5.1075	-.8934
	3001	-9.01110	1.07166	.000	-11.1181	-6.9041
3001	2002	3.53274	1.07166	.001	1.4257	5.6398
	2008	5.12833	1.07166	.000	3.0213	7.2354
	2007	6.01068	1.07166	.000	3.9036	8.1177
	2014	9.01110	1.07166	.000	6.9041	11.1181

Bold is significant $p < 0.05$

Table 7. Multiple comparison for green color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2002	2007	-6.17897	1.59890	.000	-9.3297	-3.0282
	2008	-6.69610	1.59890	.000	-9.8468	-3.5454
	2014	-.82862	1.59890	.605	-3.9794	2.3221
	3001	-13.33831	1.59890	.000	-16.4890	10.1876
2007	2002	6.17897	1.59890	.000	4.0282	9.3297
	2008	-.51712	1.59890	.747	-3.6679	2.6336
	2014	5.35035	1.59890	.001	2.1996	8.5011
	3001	-7.15934	1.59890	.000	-10.3101	4.0086
2008	2002	6.69610	1.59890	.000	3.5454	9.8468
	2007	51712	1.59890	.747	-2.6336	3.6679
	2014	5.86747	1.59890	.000	2.7167	9.0182
	3001	-6.64222	1.59890	.000	-9.7929	-3.4915
2014	2002	.82862	1.59890	.605	-2.3221	3.9794
	2008	-5.35035	1.59890	.001	-8.5011	-2.1996
	2007	-5.86747	1.59890	.000	-9.0182	-2.7167
	3001	-12.50969	1.59890	.000	-15.6604	-9.3590
3001	2002	13.33831	1.59890	.000	10.1876	16.4890
	2008	7.15934	1.59890	.000	4.0086	10.3101
	2007	6.64222	1.59890	.000	3.4915	9.7929
	2014	12.50969	1.59890	.000	9.3590	15.6604

Bold is significant p<0.05

Table 8 Multiple comparison for blue color spectrum

(I)Clone	(J)Clone	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval	
					Lower bound	Upper bound
2007	2008	-2.26036	1.00336	.026	-4.2510	-.2697
	2014	3.38144	1.00336	.001	1.3908	5.3721
	3001	-5.95759	1.00336	.000	-7.9482	-3.9670
2008	2007	2.26036	1.00336	.026	.2697	4.2510
	2014	5.64180	1.00336	.000	3.6512	7.6324
	3001	-3.69723	1.00336	.000	-5.6879	-1.7066
2014	2007	-3.38144	1.00336	.001	-5.3721	-1.3908
	2008	-5.64180	1.00336	.000	-7.6324	-3.6512
	3001	-9.33903	1.00336	.000	-11.3297	-7.3484
3001	2007	5.95759	1.00336	.000	3.9670	7.9482
	2008	3.69723	1.00336	.000	1.7066	5.6879
	2014	9.33903	1.00336	.000	7.3484	11.3297

Bold is significant p<0.05

Conclusion

The five types of rubber clones have been tested to observe the RGB color spectrum that can discriminate rubber clone series for pure and non-pure latex. As an overall conclusion through One-Way ANOVA test, it is shown that Blue color spectrum for non-pure latex can discriminate all rubber clone series simultaneously. This implies that the Blue color can be used as future reference in recognizing clone series.

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