

Colour Vision Properties For Peel of Mango's Fruit: An Approach to Objective of Total Pigments Assessment: RGB, CMY And Total Pigments Relations Mathematical Guide

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Abstract:- This study experimented the peel of fourteen cultivars were healthy ripe of Mango fruits (*Mangifera indica* L.) selected after picking from Mango Spp. namely Taimour [Ta], Dabsha [Da], Aromanis [Ar], Zebda [Ze], Fajri Kalan [Fa], Alfonso [Al], Bulluck's heart [Bu], Hindi-Sinnara [Hi], Compania [Co], Langra [La], Mestikawi [Me], Ewais [Ew], Montakhab El Kanater [Mo] and Mabrouka [Ma] under two color space tests (RGB: Red, Green and Blue) and (CMY: Cyan, Magenta and Yellow) utilizing digital color photographs as tool for obtainment the natural color information for each cultivar as a non-destructive analyses then the result linked with total pigment estimation as a destructive analyses. Our study was suggested the concentration (%) of structure pigments as well as some Pigment Index formula opposite some Color Space Index. To study and determine precisely the mathematical relations between concentration (%) of structure pigments and the digital visual color for purpose the interpretations and illustrations of the structure pigments induction on the color space elements. The result indicated to strong numeric correlation between total pigment data and color space data which the color space tests approach to evaluation the total pigment.

Key-words:- Mango fruits, *Mangifera indica* L., Color space tests, RGB, CMY, Digital color photographs, Natural color information, Non-destructive analyses, Color Space Index, Mathematical guide.

1 Introduction

The Mango is (*Mangifera indica* L.) Family *Anacardiaceae* (cashew family). Several physical and biochemical studies on the growth, development and maturation of Mango fruit openly cultivated in tropical areas have been reported (Krishnamurthy and Subramanyam, 1970; Lakshminarayana *et. al.*, 1970; Kalra and Tandon, 1983).

Physiological maturity shows changes in the pulp colour, breaking to yellow; hence it can be tested by slicing a fruit before harvesting. An ancient advice for Mango harvesting says that, when first fruits begin to drop, the crop is ready for picking (Tasneem, 2004). Changes in surface and flesh colours during maturation seem useful as a good index of fruit maturity and determination factors of optimal harvesting time as reported by

(Malevski *et. al.*, 1977). Mango fruits ripen unevenly on the tree and fruits are picked by hand at an average maturity. Tree ripe fruits show bright skin colour with uniformly softened flesh and developed flavor, but those fruits have a very short shelf life. For distant markets or for export, half ripe or unripe Mangoes are used depending on the market distance, but ripe fruits are preferred for local marketing. To extend the shelf life of the product, certain treatments are used to delay the ripening process of the Mangoes (Tasneem, 2004).

Physical theory, In 1931 CIE or Commission Internationale de l'Eclairage (International Commission on Illumination) standardized the colour order systems which provides a qualitative as well as quantitative

description of the colour. It is based on the theory that the colour is a combination of three primary colours, including red, green and blue. To locate a colour in a colour space the CIE colour system utilizes three co-ordinates. The colour spaces are CIE XYZ, CIE L* a* b* and CIE L* C* h°. Minolta chromameter can be used for determination of colour attributes expressed in CIE L* a* b* co-ordinates where L* defines lightness, a* represent red/green value and b* denotes the blue/yellow colour value (McGuire 1992). a* axis and +a direction shift towards red while along the b* axis +b movement shift toward yellow. The center L* axis the degree of lightness (L = 0 for black to 100 for white) on a vertical axis (McGuire 1992).

Our goal in the present study is Classification and analyzation of digital

2 Methodology

Plant materials

The peel for fourteen cultivars of healthy ripe Mango fruits selected after picking; corresponding fourteen cultivars from Mango Spp. namely Taimour [Ta], Dabsha [Da], Aromanis [Ar], Zebda [Ze], Fajri

Destructive method

Chlorophyll contents of mango organ are determined according to (Wettstein 1957) as follows : five grams of the organ was mixed with 30ml of 85% acetone in a dark bottle and then left to stand for 15 hours at room temperature. The samples were then filtered on glass wool into a 100ml. volumetric flask, and made up to volume by 85% acetone solution. The optical density of the samples was then measured in Carl Zeiss spectrophotometer at 644 and 662 nm. Acetone (85%) was used as a blank at each

Non-destructive method

The actually investigation emphasized classification and analyzation study of natural colour tone signal characteristics utilizing picture of portions samples (skin) for each fourteen Spp. of healthy ripe Mango fruits after picking; snapshot using scanner model (Scan Prisa 640P ACER); this method was done then confirmed it (Murakami *et. al.*, 2005). The natural colour

specific colour\Colour notation for healthy Mango fruit Spp. As a digital colour space index and electronic Munsell\computerized Munsell for assessing post-harvest changes in Mango fruits correlation with pigment concentrations as well as the visual colour and the pigment concentrations are the major issues to appear the colour tone on the digital picture; using some colour measurements software. Finally, to designed (color space-total pigments structures concentrations) calculator after the measuring for the plant organs from the digital picture. These goals are importance for determine the initial quality of the Mango fruits, quality assessment, quality of Mangoes after storage and quality evaluation after ripening for skin colour correlation with other chemical ways.

Kalan [Fa], Alfonso [Al], Bulluck's heart [Bu], Hindi-Sinnara [Hi], Compania [Co], Langra [La], Mestikawi [Me], Ewais [Ew], Montakhab El Kanater [Mo] and Mabrouka [Ma]

measurement. the contents of total chlorophyll were calculated using the following equations:

$$\text{Chlorophyll a} = (9.78 \times E_{662}) - (0.99 \times E_{644}) = \text{mg/Liter}$$

$$\text{Chlorophyll b} = (21.426 \times E_{644}) - (4.65 \times E_{662}) = \text{mg/Liter}$$

$$\text{Caroten} = 4.695(\text{read } 440) - .268(\text{chl a-chl b}) \text{mgm/liter}$$

Where E = sample optical density at the indicated wave length.

tone signal of varieties fruits (skin) were analyzed via measurements the replicates of 4 pixels from each 14 various samples carried with image. Whereas that were taken with collection by putting to use parcelling of colourimeter software to measure Red, Green and Blue\ (basic\additive colors) component RGB (0-255), Cyan, Magenta and Yellow (subtractive colors) component

(CMY) in colour range (0-255) and Hexadecimal (#HTML), Adobe Photoshop software was used after that to finding out electronic natural colour pixel (greenish-yellowish scale)\Color Pixel Grade consistently with 14 various samples natural colour tone degrees. Colour calculator software was used to checkup of colouring data accuracy. In clouding that, Originality Technique for Colour Measurements was designed by (Hammad 2007).. In this respect, the colour tests RGB, CMY, HTML, and electronic natural colour (greenish-yellowish scale)\Color Pixel Grade were selected in the recently study

3 Results and Discussion

3.1 The link between Destructive analyses data and Non-destructive analyses data for cultivars of Mango's peel:

The concentrations of pigments structures in any plant material as well as the pulp and flesh/skin of fruit is a major factor to appearance the coloring for sensing by hymen ayes. Mango fruits selected after picking. In the present study the skin for fourteen Mango fruit cultivars (Symbol: Ta, Da, Ar, Ze, Fa, Al, La, Hi, Co, Bu, Me, Ew, Specific color measurements were correlated with the pigments structure concentrations analysis these data were listing in (Table 1). The color data were a handsome and easy to categorization the digital color elements. In this attachment, our location study in the

3.2 Properties of pointers RGB and CMY senses: Concerning this, in (Table1) **RGB (basic colors) component:** RGB is common color space. As the general, the higher data Classified in two main parameters R & G; while B for lower data. Noted that in the R & G the trend of the data was divided between them which found that in (Ta, Da, Ar, Ze, Fa, Al, La and Hi) the data in G were a higher than the data in R and vice-

from 16 colour vision tests which Designed by (Hammad 2007).. The analysis performed to investigate the visual natural colour tone characteristic of 14 healthy ripe Mango fruits after picking (skin) and natural colour (greenish-yellowish scale\ grades) creating with the photo. Our investigated was suggested the concentration (%) of structure pigments as well as some Pigment Index formula such as $(Chl_a - Chl_b, Cl_a + Chl_b,$ and $Chl_a - Ca)$ opposite for color Space Index such as (R-G, R+G+B, R+G, C+M+Y and C+M).

Mo and Ma) were created on the picture and the colour tone of the skin was experimented by nine color measurements such as RGB, CMY, HTML and Color Pixel Grade\Scale the output of these estimation were manifested in (Table 1). The data consider as an active average values\color number which these values are available for treatment in color space programs to extracting the HTML and Color Pixel Grade.

visual green, yellow and orange color degrees from the visible color of electromagnetic spectrum in wavelength between (~500 to 625) nm and frequency between (~ 600 to 480) THz.

versa the data for other cultivars (Bu, Me, Ew, Mo and Ma) were a higher R than G. these reasonability attribute in (Table 1) to increase the colors pigments in the latter cultivars. In Compania the R=G this especially statues indicated that to occurrence balance between green pigment and colour pigment concentration which the pigment structure in the (Table 1.) verify\confirm for this point

Table 1. The link between Destructive analyses data and Non-destructive analyses data for cultivars of Mango's peel

Symbol	Cultivars	Destructive analyses										Non-destructive analyses										# HTML	Color Pixel Grade					
		µg/g			%			Pigment index				Color Space test					Color Space index											
		Chl a	Chl b	Carotene	Chl a	Chl b	Carotene	Chl a-Chl b	Cl a-Cbl b	Chl a-Ca	Chl b-Ca	R	G	B	C	M	Y	R-G	R-G	R-G	C-M			C-M-Y	C-M	SCSTI*		
Ta	Taimour	235.75	244.75	200.05	35	36	29	100	1	71	6	7	66	73	28	189	182	227	765	-7	167	139	7	598	371	1275	2040	# 42491C
Ar	Aromaris	216.60	238.73	178.85	34	38	28	100	4	72	6	10	77	84	31	178	171	234	765	-7	192	161	7	573	349	1275	2040	# 4D541F
Fa	Fagn Kelan	271.13	320.15	227.48	33	39	28	100	6	72	5	11	64	76	26	191	179	229	765	-12	166	140	12	599	370	1275	2040	# 404C1A
Al	Alphonse	265.58	295.65	228.05	34	37	29	100	3	71	5	8	106	109	26	149	146	229	765	-3	241	215	3	524	295	1275	2040	# 6A6D1A
La	Langra	255.95	282.85	203.93	34	39	27	100	5	73	7	12	82	96	32	173	159	235	765	-14	210	178	14	555	332	1275	2040	# 526020
Ew	Ewais	240.68	264.10	191.55	35	37	28	100	2	72	7	9	130	113	29	125	142	226	765	17	272	243	-17	493	267	1275	2040	# 82711D
Me	Mestikawi	248.85	276.33	254.98	32	35	33	100	3	67	-1	2	102	94	28	153	161	221	765	8	224	196	-8	541	314	1275	2040	# 66SE1C
Mo	Montakhab El Kanater	158.05	206.30	187.48	29	37	34	100	8	66	-5	3	150	117	47	105	138	208	765	33	314	267	-33	451	243	1275	2040	# 96752F
Ma	Mabroka	181.48	216.58	195.48	31	36	33	100	5	67	-2	3	138	108	24	97	147	231	765	50	290	266	-50	475	244	1275	2040	# 9E6C18
Da	Dabsha	375.60	393.13	443.85	31	33	36	100	2	64	-5	-3	88	90	26	167	165	229	765	-2	204	178	2	561	332	1275	2040	# 585A1A
Hi	Hindi-Sirnara	136.03	145.53	195.35	29	31	40	100	2	60	-11	-9	75	87	33	180	168	220	765	-12	195	162	12	570	348	1275	2040	# 4B5721
Ze	Zebda	258.50	243.28	281.53	33	31	36	100	-2	64	-3	-5	74	77	26	181	178	229	765	-3	177	151	3	588	359	1275	2040	# 4A4D1A
Bu	Bulbek heart	311.48	285.88	330.73	34	31	35	100	-3	65	-1	-4	77	76	30	178	179	225	765	1	183	153	-1	582	357	1275	2040	# 4D4C1E
Co	Compania	395.98	373.45	389.83	34	32	34	100	-2	66	0	-2	71	71	23	184	184	333	765	0	165	142	0	600	368	1275	2040	# 474717
	Average	254	271	251	33	35	32		2	68	1	3	28	91	29	161	164	226	699	4	214	185	-4	551	325			

Another addition, the higher value of R was Mabroka and lower value in R was Taimour which (Ma) more coloration than (Ta) see the Color Pixel Grade in the (Table 1.). The Compania was lower values in G and B while the Montakhab El Kanater was higher values in G and B. Taimour was also lower value in G. On the other hand, some congener value such as value 77 with (Ar) and (Bu) in R, value 76 with (Fa) and (Bu) in G and value 28 with Ta and Me also (Ze, Fa and Al) equal 26 in B. This congener value is weaken the capability of the Classification for plant samples in single parameter such as R or G or B while the Classification via component such as RGB is completely identified and the values are as the same color signature for the samples see **CMY (subtractive colors) component:** In the first, physically theory according to (Mannising 2003) CMY is vice-a-Our CMY data in (Table 1.) were typical for this theory. See also columns (R-G) and (C-M) absolutely as the theory. Consequently, the values in the all C and M columns were interchanging the higher and lower values for cultivar by comparison of the values in the R and G columns. Nevertheless, the values in C, M and Y were very higher than R, G and B values. Unless C=M for Compania as the same in R and G but the difference was C and M values very higher than R and G values (184 opposite to 71). On the other hand, found character colours as reason to affecting the structures of pigment concentrations and the other said, the physical properties for the colour self-explanatory in (Flowchart 1) which the first, in the item C was (Ma) lower value while in R zone was higher value; on the other hand,

also HTML in (Table 1.) in spite of hard difficult the differentiation within the color in the Color Pixel Grade (Table 1.) by human eyes. The main average for all skin of fruit cultivars was R>G>B format this mean the coloring pigment is most prevailing. As the general, the interpenetration and the degree of Chla, Chlb and Carotene concentrations importance factors for the repartition color data in the RGB component. In this respect, the R, G and B not work solitary but work at the all; as the same entire color space component. Summation R, G, and B: not found congener values consequently, dependable for pure Classification; notice higher value was with (Mo) and lower value in (Co).
versa\reverse RGB which it is active view and CMY is passive view
the higher point in C was (Fa 191) opponent to lower value in R was (Fa 64). Second instruction, in M was Compania higher values and Montakhab El Kanater was lower values and completely exchange the turn as vice versa in G parameter for those cultivars; as the same position for this cultivars in zone Yellow with Blue. According to that the symbol data of C as ascending order for data in R, the symbol data of M as ascending order for data in G and symbol data of Y as ascending order for data in Blue. Meanwhile, found symmetric value in the C as the same symbol in the R, symmetric value in the M as the same symbol in the G and symmetric value in the Y as the same symbol in the B see (Diagram 1).

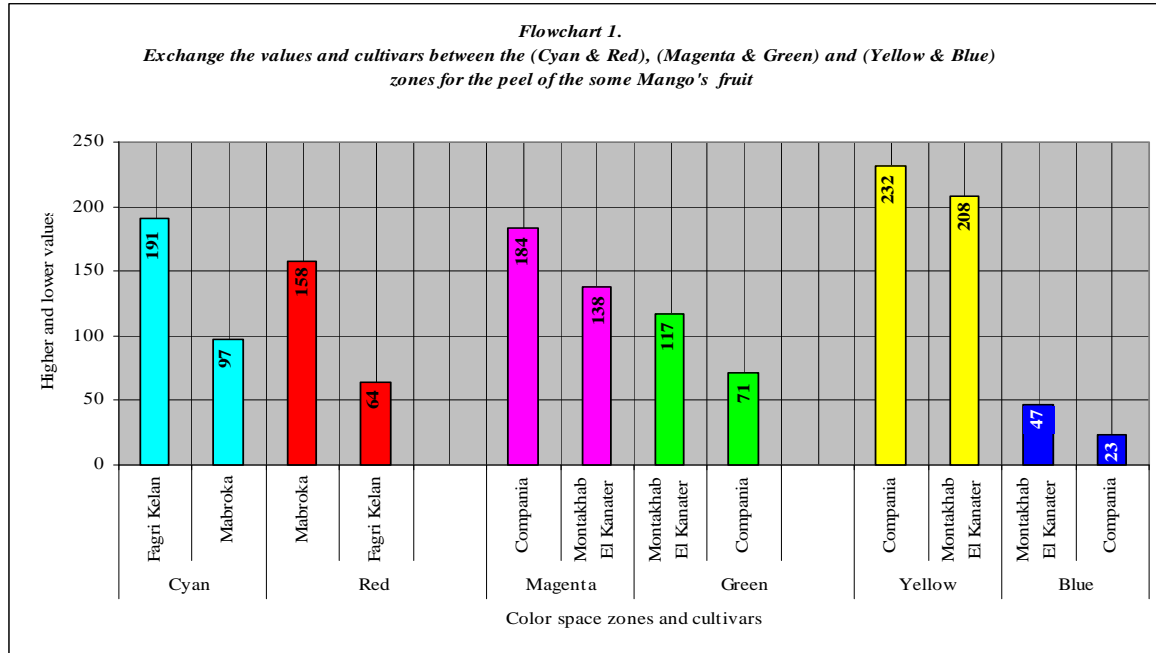


Diagram 1 The symbol data of C,M and Y as ascending order for R, G and B also symatic cell for C, M and Y as the same symbol in R,G and B

C	R	M	G	Y	B
Fa 191	Ma 158	Co 184	Mo 117	Co 232	Mo 47
Ta 189	Mo 150	Ta 182	Ew 113	Ma 231	Hi 33
Co 184	Ew 130	Fa 179	Al 109	Ze 229	La 32
Ze 181	Al 106	Bu 179	Ma 108	Da 229	Ar 31
Hi 180	Me 102	Ze 178	La 96	Al 229	Bu 30
Ar 178	Da 88	Ar 171	Me 94	Fa 227	Ew 29
Bu 178	La 82	Hi 168	Da 90	Me 227	Ta 28
La 173	Bu 77	Da 165	Hi 87	Ta 226	Me 26
Da 167	Ar 75	Me 161	Ar 84	Ew 225	Fa 26
Me 153	Hi 74	La 159	Ze 77	Bu 224	Al 26
Al 149	Ze 71	Ma 147	Bu 76	Ar 223	Da 24
Ew 125	Co 66	Al 146	Fa 73	La 222	Ze 24
Mo 105	Ta 64	Ew 142	Ta 71	Hi 208	Ma 23
Ma 97	Fa 64	Mo 138	Co 71	Mo 208	Co 23

Repeating cells were in C and M showing with as the same cultivars in the R and G and listed as the higher scale. Y tape in our (Presentation Table 1) was as registration remark for natural colour pixel of fruit which the character of all values was highest

3.3 Properties of pointers total pigments structure and concentrations senses:

In this context, in the (Table 1.) we showed such trends for the pigments structures Chl_a & Chl_b and Carotene (µg/g) which divided the cultivars to five formats: 1. Chl_b>Chl_a>Carotene for (Ta, Ar, Fa, Al, LA and Ew), 2. Chl_b>Carotene>Chl_a for (Me, Mo, and Ma)* notice that, it is for the most the coloring fruits, 3. Carotene>Chl_b>Chl_a for (Da & Hi), 4. Carotene>Chl_a>Chl_b for (Ze &

than C and M. furthermore, counteractive for B tape in RGB which including data more lowly than the all. Summation of CMY was as the same Sum. of RGB which was not including any number from congener cell.

Hexadecimal measurements (#HTML) and Color Pixel Grade (CPG)/Scale Color: In (Table 1.) for credibility and adjustment of the colors degrees data the Hexadecimal and Color Pixel Grade-the benefit form in the computerized checkup and not using for a human eyes differentiation-were setting referring to each color degrees of electronic pictures for fruit's peel cultivars. The color spaces components such as RGB, CMY, (#HTML),...etc as the voice\telephone number to call the pixel tone personal.

Bu) and 5. Chl_a>Carotene>Chl_b for (Co). In the pigments concentrations Chl_a & Chl_b and Carotene (%) found as the same trends for the cultivars; remarkable exceptional was Compania which the Chl_a=Carotene>Chl_b. moreover, the congener cell not apparent in Chl_a & Chl_b and Carotene (µg/g) while in Chl_a & Chl_b and Carotene (%) found more cells were repeating.

Subsequently, the minimum and maximum values were more changing compare between pigments structures ($\mu\text{g/g}$) and its concentrations (%). The general average in the pigments structures ($\mu\text{g/g}$) & concentrations (%) pigments were $\text{Chl}_b > \text{Chl}_a > \text{Carotene}$. Major trend was Sum ($\text{Chl}_a + \text{Chl}_b$) which the cultivars manifested in two trends as for values (71, 72 and 73) were (Ta, Ar, Fa, Al, La and Ew) and values (60, 64, 65, 66, and 67) were (Me, Mo, Ma, Da, Hi, Ze, Bu and Co). In (Chl_a -ca) as the same directions for the same cultivars in the Sum ($\text{Chl}_a + \text{Chl}_b$) which the positive values for (Ta, Ar, Fa, Al, La and Ew) Chlassified as 6 for (Ta & A), 5 for (Fa & Al) and 7 for (La & Ew). And negative values for (Ta, Ar, Fa, Al, La and Ew) no symmetric values. The zero was for (Co) another remark.

4 Conclusion

RGB (basic colors) component is typical corresponding for total pigment structure and concentration. Concomitantly, physically CMY (subtractive colors) component is mirror/reflector for RGB. Ideal form (outspokenly) RGB is active voice and CMY is passive sound for total pigment movement/evolution. The properties of the pigments structures and concentrations of the plant are affecting in the digital inductions for color vision/specific color for appearance the tones degrees in the visible region. Opulent Intercommunions and digital/numeric relationships between pigments structures and concentrations% and (RGB & CMY) color spaces addition confirm that the Subtractive results between the rows of the destructive analyses and non-destructive analyses\ (chemicals estimation and physical measurements). The visual color basic colors component RGB\subtractive colors CMY components are highly to identifications and discernment for the digital of pixels degrees tones at the neutral picture then the elements of pigments in this respect. Basically, the visual color basic colors component RGB\subtractive colors CMY components and color space index are strongly sensitive to affect the total pigments structures and concentrations %. Basically, the visual color basic colors component RGB\subtractive colors CMY components and color space index consider as color signature for the pigments elements for each organic species\verities. The color spaces index as most importance assistant to appearances, explanations and confirmed the statues of interactions the pigments structures and concentrations % with the visual color space.

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(Chl_b -ca) approach was higher values for (Ta, Ar, Fa, Al, La and Ew), meddle values was 2 for Mestikawi and 3 for (Mo & Ma) and lower values were negative for (Da, Hi, Ze, Bu and Co) on the orderliness. In formula ($\text{Chl}_a - \text{Chl}_b$) the values were more scatter; nevertheless, the positive values were from Ta to Hi and negative values were from Ze to Co orderliness; symmetric between (Ze & Co). Symmetric points for (Ar & Fa) in model ($\text{Chl}_a + \text{Chl}_b$) were harmonized with Carotene %. (Me and Ma) in zone ($\text{Chl}_a + \text{Chl}_b$) were agreement in Carotene % as another Symmetric points. All these properties of the pigments structures and concentrations are essentials in the digital inductions for color vision\specific colour tones degrees.