APPENDIX 1

Ethical approval

UNIVERSITY OF MALAYA
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يونيۏرسيتى ملاي

Ruj: UM.D/PD211/09

21 December 2009

Dr. Humam Laith Mahmoud

Through:

Supervisor:

Prof. Madya Dr. Zakiah Binti Mohd. Esa
Department of Prosthetic Dentistry
Faculty of Dentistry

Dear Sir,

ETHICS APPROVAL

It is a pleasure to inform you that your application for the ethical clearance by Faculty of Dentistry Medical Ethics committee for your research project titled 'Comparison of Spectrophotometer, Digital Camera, and Visual Perception Methods in the Analysis of Skin Colour and Texture' has been approved. Your ethics approval number is **DF PD0902/0019(P)**.

Thank You.

Yours Sincerely,

PROF. DR. ROSNAH MD. ZAIN
Chairperson
Faculty of Dentistry Medical Ethics Committee

s.k.   Dean, Faculty of Dentistry
        Head of Prosthetic Dentistry Department

MS ISO 9001:2000 REG. NO. AR 2760

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APPENDIX 2

INFORMATION FOR RESEARCH PARTICIPANTS

Please read the following information carefully. Do not hesitate to discuss any questions that you may have with your doctor.

Research Title: Comparison of spectrophotometer, digital camera, scanner, and visual perception methods in the analysis of skin colour.

The principle investigator is Dr. Humam Laith Mahmoud.

Introduction

You are invited to take part voluntarily in a study which is described below. The purpose of this information sheet is to explain to you clearly and in detail about the study. Before agreeing to participate in this research study, it is important that you read and understand this form. It describes the purpose, procedures, benefits and discomforts of participating in the study.

Purpose of the Study

   a) This research intends to record the facial skin colour and texture using the following recording device; spectrophotometer, digital camera, and scanner.
   b) The skin colour of Malaysian people will be classified and the data used to produce a shade guide for the skin.
   c) This will simplify the colour and texture skin matching for the specialist who treat patients with defects like missing nose, ear or any facial structure to be replaced by maxillofacial prosthesis.

Requirements for participation

The doctor in charge of this study will discuss with you the requirements for participation in this study.

Some of the requirements to be in this study are:
i.   You must be a Malaysian citizen.
ii.   You must be between 20 and 40 years old.
iii.   You belong to one of the three main ethnic groups in Malaysia, i.e. Malay, Chinese or Indian.
iv.   You do not have a defect in the face or mouth as a result of trauma or a surgical procedure to remove a growth or tumour.

Study Procedures

If you agree to participate in this study, you will be asked to provide information about your medical and dental history, your past and present therapies, any medical conditions that you have, and any medicines that you are taking.

A spectrophotometer, digital camera and a small scanner (passport scanner) will be used to obtain the skin tone around your forehead. You will sit comfortably in a chair in a well lit room while the procedures are being done. The spectrophometer probe will be placed on your forehead for 10 seconds, and you will be seated comfortably in a standardized position with your head at a certain position and distance from a digital camera and scanner while they are being used. The whole process of obtaining your skin tone should be completed in less than 30 minutes.

Participation in the Study

Your taking part in this study is entirely voluntary. You may refuse to take part in the study.

Possible Benefits

(a) For you as the participant

You will be given an honorarium of RM10 for your participation in the study.

(b) For the investigators

This study is to fulfil the research requirement for a Masters degree for the main researcher Dr. Humam Laith Mahmoud. The results of the study will enable a database of the skin tone of the Malaysian population to enable a shade guide to be produced to simplify the shade matching procedures for patients requiring maxillofacial prosthesis.

Risks/Inconveniences that may arise

You may experience inconvenience in getting time-off from your daily schedule to come to the Faculty of Dentistry. We will however, try as much as possible to accommodate your requests for appointments at times that may be convenient for you.

Questions

If you have any question about this study or your rights, please contact;

Dr. Humam Laith Mahmoud　　　　　Dr. Zakiah bt. Mohd Isa
Department of Prosthetic Dentistry　　Department of Prosthetic Dentistry
Faculty of Dentistry　　　　　　　　Faculty of Dentistry
University of Malaya　　　　　　　　University of Malaya
50603 Kuala Lumpur　　　　　　　　50603 Kuala Lumpur
Tel: 017 2041640　　　　　　　　　Tel: 03-7967 4566 or 03-7967 4881

By signing this consent form, you authorise the information storage and data transfer for purposes of publication of research findings, teaching and learning, without revealing your identity as an individual.

Signature

To be entered into the study, you must sign and date this page.

Patient Information and Consent Form
(Signature Page)

Research Title: Comparison of spectrophotometer, digital camera, scanner, and visual perception methods in the analysis of skin colour and texture.

Researcher's Name: Dr. Humam Laith Mahmoud

By signing this page, I am confirming the following:

- I have read all of the information in this Patient Information and Consent Form
- All of my questions have been answered to my satisfaction.
- I voluntarily agree to be part of this research study
- I may freely choose to stop being a part of this study at anytime.

_____

Participant Name (Print or type)

_____   _____

I.C No. (New)   I.C No. (Old)

_____   _____

Participant signature   Date (dd/MM/yy)

APPENDIX 3

THE INFORMATION SHEET

The information sheet that was used in the research.

Case Sheet

No:

Date:

Personal information:

Name:

Age:

Sex:

Ethnic group:

Work:

Address:

Telephone:

Tests:

1-SpectroPhotometer: 2-Digital Camera: 3-Scanner:

APPENDIX 4

RESULTS OF THE STUDY

Table 1 The result showed that the females composing percentage was twice the males.

	Frequency	Percent
F	67	74.4
M	23	25.6
Total	90	100

Table 2 The ethnic groups equal because of the taken sample are equal.

Ethnics	Frequency	Percent
Malay	30	33.3
Indian	30	33.3
Chinese	30	33.3
Total	90	100

Table 3 L*a*b* values of the forehead spot colour captured by the three devices.

		N	Min	Max	Mean	SD	Skewness	SE
Spectrophotometer	L*	90	44	79	61.61	7.56	.033	.25
	a*	90	5	13	8.29	1.55	.099	.25
	b*	90	5	15	10.19	2.36	-.02	.25
Digital camera	L*	90	34	62	49.40	6.27	-.37	.25
	a*	90	4	12	7.23	1.79	.23	.25
	b*	90	8	22	15.82	3.43	-.34	.25
Scanner	L*	90	34	62	51.86	6.77	-.68	.25
	a*	90	9	14	11.64	1.16	.12	.25
	b*	90	12	22	16.93	2.16	-.10	.25

Table 4 Pair t test for L*a*b* values of the 3 devices.

		Mean	SD	SD Error Mean	95% CI		T	DF	Sig.
Sp – DC		12.21	6.52	.69	10.85	13.58	17.78	89	.01*
Sp – Sc	L	9.76	6.18	.65	8.46	11.05	14.97	89	.01*
Sc – DC		2.46	4.45	.47	1.52	3.39	5.24	89	.01*
Sp – DC		1.06	1.73	.18	.69	1.42	5.81	89	.01*
Sp – Sc	A	-3.36	1.40	.15	-3.65	-3.06	-22.73	89	.01*
Sc – DC		4.41	1.63	.17	4.07	4.75	25.71	89	.01*
Sp – DC		-5.63	3.10	.33	-6.28	-4.99	-17.26	89	.01*
Sp – Sc	B	-6.74	2.30	.24	-7.23	-6.26	-27.87	89	.01*
Sc – DC		1.11	2.45	.26	.60	1.63	4.30	89	.01*

Sp; Spectrophotometer, **DC**; Digital camera, **Sc**; Scanner

The means of the L*a*b* values for all three devices are significantly correlated (p< 0.01). *Significant value   (p<0.05).

Table 5 The descriptive statistics for L*a*b* values of the three devices according to each ethnic group.

Ethnic		Spectrophotometer			Digital camera			Scanner		
		L*	a*	b*	L*	a*	b*	L*	a*	b*
Chinese	Mean	66.63	7.37	9.00	54.20	5.90	14.10	57.97	11.47	15.23
	N	30	30	30	30	30	30	30	30	30
	SD	6.32	1.47	2.02	4.18	1.54	3.22	2.66	1.22	1.72
	Min	54	5	5	40	4	8	51	9	12
	Max	79	10	13	62	10	21	62	14	18
Indian	Mean	57.17	8.37	10.50	43.87	7.87	17.03	44.50	11.43	17.90
	N	30	30	30	30	30	30	30	30	30
	SD	6.47	1.13	2.43	5.04	1.38	3.48	5.36	.77	1.95
	Min	44	6	6	34	5	9	34	9	14
	Max	71	10	15	53	12	22	53	13	21
Malay	Mean	61.03	9.13	11.07	50.13	7.93	16.33	53.10	12.03	17.67
	N	30	30	30	30	30	30	30	30	30
	SD	6.84	1.50	2.18	4.65	1.66	2.95	2.94	1.35	1.75
	Min	49	7	6	42	5	9	48	9	15
	Max	72	13	15	59	11	21	60	14	22
Total	Mean	61.61	8.29	10.19	49.40	7.23	15.82	51.86	11.64	16.93
	N	90	90	90	90	90	90	90	90	90
	SD	7.56	1.55	2.36	6.27	1.79	3.43	6.77	1.16	2.16
	Min	44	5	5	34	4	8	34	9	12
	Max	79	13	15	62	12	22	62	14	22

Table 6 The descriptive information for L*a*b* values of the three devices according to gender.

Gender		Spectrophotometer			Digital camera			Scanner		
		L*	a*	b*	L*	a*	b*	L*	a*	b*
F	Mean	62.61	8.04	10.13	50.12	7.10	15.93	52.70	11.36	16.78
	N	67	67	67	67	67	67	67	67	67
	SD	7.53	1.42	2.38	6.28	1.79	3.51	6.42	1.03	2.07
	Min	49	5	5	34	4	8	37	9	12
	Max	79	11	15	62	12	22	62	14	21
M	Mean	58.70	9.00	10.35	47.30	7.61	15.52	49.39	12.48	17.39
	N	23	23	23	23	23	23	23	23	23
	SD	7.00	1.71	2.35	5.87	1.78	3.22	7.30	1.16	2.41
	Min	44	6	6	34	4	9	34	11	14
	Max	73	13	15	58	11	21	60	14	22
Total	Mean	61.61	8.29	10.19	49.40	7.23	15.82	51.86	11.64	16.93
	N	90	90	90	90	90	90	90	90	90
	SD	7.56	1.55	2.36	6.27	1.79	3.43	6.77	1.16	2.16
	Min	44	5	5	34	4	8	34	9	12
	Max	79	13	15	62	12	22	62	14	22

Table 7 The L*a*b* values of the spectrophotometer, digital camera and scanner according to the gender.

Device		Sex	N	Mean	SD	SD Error Mean
Spectrophotometer	L*	M	23	58.70	7.00	1.46
		F	67	62.61	7.53	.92
	a*	M	23	9.00	1.71	.36
		F	67	8.04	1.42	.17
	b*	M	23	10.35	2.35	.49
		F	67	10.13	2.38	.29
Digital camera	L*	M	23	47.30	5.87	1.22
		F	67	50.12	6.28	.77
	a*	M	23	7.61	1.78	.37
		F	67	7.10	1.79	.22
	b*	M	23	15.52	3.22	.67
		F	67	15.93	3.51	.43
Scanner	L*	M	23	49.39	7.30	1.52
		F	67	52.70	6.42	.78
	a*	M	23	12.48	1.16	.24
		F	67	11.36	1.03	.13
	b*	M	23	17.39	2.41	.50
		F	67	16.78	2.07	.25

Table 8 Independent t test between Male and Female.

Devices		F	Sig.	T	DF	Sig. (2-t)	M Dif	SE Dif	95% CI	
Spectro-photometer	L*	.89	.35	-2.19	88	.03*	-3.92	1.79	-7.47	-.36
	a*	.48	.49	2.64	88	.01*	.96	.36	.24	1.67
	b*	.02	.89	.37	88	.71	.21	.57	-.93	1.35
Digital camera	L*	.26	.62	-1.89	88	.06	-2.82	1.49	-5.78	.15
	a*	.00	.98	1.17	88	.24	.50	.43	-.35	1.36
	b*	.67	.41	-.49	88	.63	-.40	.83	-2.06	1.25
Scanner	L*	.53	.47	-2.06	88	.04*	-3.31	1.61	-6.50	-.12
	a*	2.05	.16	4.37	88	.01*	1.12	.26	.61	1.63
	b*	1.46	.23	1.18	88	.24	.62	.52	-.42	1.65

*Significant value (p<0.05).

Table 9 Comparison of L*a*b* values of the spectrophotometer, digital camera and scanner according to the Ethnic groups (Malays and Chinese).

Device		Ethnic	N	Mean	SD	SD Error Mean
Spectrophotometer	L*	Malay	30	61.03	6.84	1.25
		Chinese	30	66.63	6.32	1.15
	a*	Malay	30	9.13	1.50	.27
		Chinese	30	7.37	1.47	.27
	b*	Malay	30	11.07	2.18	.40
		Chinese	30	9.00	2.02	.37
Digital camera	L*	Malay	30	50.13	4.65	.85
		Chinese	30	54.20	4.18	.76
	a*	Malay	30	7.93	1.66	.30
		Chinese	30	5.90	1.54	.28
	b*	Malay	30	16.33	2.95	.54
		Chinese	30	14.10	3.22	.59
Scanner	L*	Malay	30	53.10	2.94	.54
		Chinese	30	57.97	2.66	.49
	a*	Malay	30	12.03	1.35	.25
		Chinese	30	11.47	1.22	.22
	b*	Malay	30	17.67	1.75	.32
		Chinese	30	15.23	1.72	.31

Table 10 Independent t test between Malay and Chinese.

Devices		F	Sig.	T	Df	Sig. (2-t)	M Dif	SE Dif	95% CI	
Spectro-photometer	L*	.23	.64	-3.29	58	.01*	-5.60	1.70	-9.00	-2.20
	a*	.01	.98	4.60	58	.01*	1.77	.38	1.00	2.54
	b*	.05	.82	3.81	58	.01*	2.07	.54	.98	3.20
Digital camera	L*	1.94	.17	-3.56	58	.01*	-4.07	1.14	-6.35	-1.78
	a*	.83	.37	4.92	58	.01*	2.03	.41	1.21	2.86
	b*	.24	.63	2.80	58	.01*	2.23	.80	.64	3.83
Scanner	L*	.26	.61	-6.73	58	.01*	-4.87	.72	-6.32	-3.42
	a*	.34	.56	1.70	58	.09	.57	.33	-.10	1.23
	b*	.01	.97	5.44	58	.01*	2.43	.45	1.54	3.33

*Significant value (p<0.05).

Table 11   Comparison of L*a*b* values of the spectrophotometer, digital camera and scanner according to the Ethnic groups(Malays and Indians).

Devices		Ethnic	N	Mean	SD	SD Error Mean
Spectrophotometer	L*	Malay	30	61.03	6.84	1.25
		Indian	30	57.17	6.47	1.18
	a*	Malay	30	9.13	1.50	.27
		Indian	30	8.37	1.13	.21
	b*	Malay	30	11.07	2.18	.40
		Indian	30	10.50	2.43	.44
Digital camera	L*	Malay	30	50.13	4.65	.85
		Indian	30	43.87	5.04	.92
	a*	Malay	30	7.93	1.66	.30
		Indian	30	7.87	1.38	.25
	b*	Malay	30	16.33	2.95	.54
		Indian	30	17.03	3.48	.64
Scanner	L*	Malay	30	53.10	2.94	.54
		Indian	30	44.50	5.36	.98
	a*	Malay	30	12.03	1.35	.25
		Indian	30	11.43	.77	.14
	b*	Malay	30	17.67	1.75	.32
		Indian	30	17.90	1.95	.36

Table 12   Independent t test between Malay and Indians.

Devices		F	Sig.	T	Df	Sig. (2-t)	M Dif.	SE Dif.	95% CI	
Spectro-photometer	L*	.30	.59	2.25	58	.03*	3.87	1.72	.43	7.31
	a*	1.94	.17	2.23	58	.03*	.77	.34	.08	1.46
	b*	.87	.36	.95	58	.35	.57	.60	-.63	1.76
Digital camera	L*	.16	.65	5.00	58	.01*	6.27	1.25	3.76	8.77
	a*	2.27	.14	.17	58	.87	.067	.39	-.72	.86
	b*	.98	.33	-.84	58	.40	-.70	.83	-2.37	.97
Scanner	L*	19.06	.01	7.71	58	.01*	8.60	1.12	6.37	10.83
	a*	9.09	.01	2.11	58	.04*	.60	.28	.03	1.17
	b*	.00	.96	-.49	58	.63	-.23	.48	-1.19	.73

*Significant value   ($p < 0.05$).

Table 13 Comparison of L*a*b* values of the spectrophotometer, digital camera and scanner according to the Ethnic groups(Chinese and Indians).

Devices		Ethnic	N	Mean	SD	Std. Error Mean
Spectrophotometer	L*	Chinese	30	66.63	6.32	1.15
		Indian	30	57.17	6.47	1.18
	a*	Chinese	30	7.37	1.47	.27
		Indian	30	8.37	1.13	.21
	b*	Chinese	30	9.00	2.02	.37
		Indian	30	10.50	2.43	.44
Digital camera	L*	Chinese	30	54.20	4.18	.76
		Indian	30	43.87	5.04	.92
	a*	Chinese	30	5.90	1.54	.28
		Indian	30	7.87	1.38	.25
	b*	Chinese	30	14.10	3.22	.59
		Indian	30	17.03	3.48	.64
Scanner	L*	Chinese	30	57.97	2.66	.49
		Indian	30	44.50	5.36	.98
	a*	Chinese	30	11.47	1.22	.22
		Indian	30	11.43	.77	.14
	b*	Chinese	30	15.23	1.72	.31
		Indian	30	17.90	1.95	.36

Table 14 Independent t test between Chinese and Indians.

Devices		F	Sig.	T	Df	Sig. (2-t)	M Dif	SE Dif	95% CI	
Spectro-photometer	L*	.01	.92	5.73	58	.01*	9.47	1.65	6.16	12.77
	a*	2.24	.14	-2.95	58	.01*	-1.00	.34	-1.68	-.32
	b*	1.50	.23	-2.60	58	.01*	-1.50	.58	-2.66	-.35
Digital camera	L*	2.82	.10	8.64	58	.01*	10.33	1.20	7.94	12.73
	a*	.27	.60	-5.21	58	.01*	-1.97	.38	-2.72	-1.21
	b*	.25	.62	-3.39	58	.01*	-2.93	.87	-4.67	-1.20
Scanner	L*	24.30	.00	12.34	58	.01*	13.47	1.09	11.28	15.65
	a*	6.18	.02	.13	58	.90	.03	.26	-.50	.56
	b*	.01	.98	-5.62	58	.01*	-2.67	.48	-3.62	-1.72

*Significant value   (p<0.05).

Table 15 The evaluation of the observers for all samples.

Devices	Grade	Obs.1 %	Obs.2 %	Obs.3 %	Obs.4 %
Spectrophotometer	Poor	84.4	94.4	94.4	84.4
	Fair	15.6	3.3	3.3	15.6
	Good	0.0	2.2	2.2	0.0
Digital camera	Poor	10.0	3.3	3.3	10.0
	Fair	18.9	24.4	22.2	16.7
	Good	71.1	72.2	74.4	73.3
Scanner	Poor	6.5	2.2	2.2	6.5
	Fair	66.7	72.2	74.4	68.9
	Good	27.8	25.6	23.3	25.6

Table 16 The evaluation of the observers for each ethnic groups.

Ethnic	Device	Grade	Obs.1 %	Obs.2 %	Obs.3 %	Obs.4 %
Malay	Spectrophotometer	Poor	83.3	93.3	93.3	83.3
		Fair	16.7	6.7	6.7	16.7
		Good	0.0	0.0	0.0	0.0
	Digital Camera	Poor	13.3	3.3	3.3	13.3
		Fair	20.0	23.3	20.0	13.3
		Good	66.7	73.3	76.7	73.3
	Scanner	Poor	3.3	3.3	3.3	3.3
		Fair	66.7	70.0	73.3	73.3
		Good	30.0	26.7	23.3	23.3
Indians	Spectrophotometer	Poor	93.3	96.7	96.7	93.3
		Fair	6.7	3.3	3.3	6.7
		Good	0.0	0.0	0.0	0.0
	Digital camera	Poor	3.3	3.3	3.3	3.3
		Fair	13.3	20.0	16.7	13.3
		Good	83.3	76.6	80.0	83.3
	Scanner	Poor	3.3	0.0	0.0	3.3
		Fair	80.0	76.7	80.0	80.0
		Good	16.7	23.3	20.0	16.7
Chinese	Spectrophotometer	Poor	76.7	93.3	93.3	76.7
		Fair	23.3	0.0	0.0	23.3
		Good	0.0	6.7	6.7	0.0
	Digital camera	Poor	13.3	3.3	3.3	13.3
		Fair	23.3	30.0	30.0	23.3
		Good	63.3	66.7	66.7	63.3
	Scanner	Poor	10.0	3.3	3.3	10.0
		Fair	53.3	70.0	70.0	53.3
		Good	36.7	26.7	26.7	36.7

Table 17 The evaluation of the observers according to gender.

Gender	Device	Grade	Obs.1 %	Obs.2 %	Obs.3 %	Obs.4 %
F	Spectrophotometer	Poor	83.6	92.5	92.5	83.6
		Fair	16.4	4.5	4.5	16.4
		Good	0.0	3.0	3.0	0.0
	Digital Camera	Poor	10.4	4.5	4.5	10.4
		Fair	19.4	23.9	20.9	19.4
		Good	70.1	71.6	74.6	70.1
	Scanner	Poor	6.0	3.0	3.0	6.0
		Fair	65.7	71.6	74.6	65.7
		Good	28.4	25.4	22.4	28.4
M	Spectrophotometer	Poor	87.0	100.0	100.0	87.0
		Fair	13.0	0.0	0.0	13.0
		Good	0.0	0.0	0.0	0.0
	Digital camera	Poor	8.7	0.0	0.0	8.7
		Fair	17.4	26.1	26.1	8.7
		Good	73.9	73.9	73.9	82.6
	Scanner	Poor	4.3	0.0	0.0	4.3
		Fair	69.6	73.9	73.9	78.3
		Good	26.1	26.1	26.1	17.4

Table 18 The responses of Observer 1.

Observer 1											
Spectrophotometer				Digital camera				Scanner			
Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.
1	76	45	31	1	9	30	-21	1	5	30	-25
2	14	45	-31	2	17	30	-13	2	60	30	30
Total	90			3	65	30	34	3	25	30	-5
				Total	90			Total	90		

Table 19 For the first observer the three tested devices were different in their results in matching efficiency of the skin colour.

	Spectrophotometer	Digital camera	Scanner
Chi-Square	42.71	58.87	51.67
Df	1	2	2
Asymp. Sig.	.01*	.01*	.01*

*Significant value   (p<0.05).

Table 20   The responses of Observer 2.

Observer 2											
Spectrophotometer				Digital camera				Scanner			
Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.
1	85	30	55	1	3	30.0	-27	1	2	30	-28
2	3	30	-27	2	22	30.0	-8	2	65	30	35
3	2	30	-28	3	65	30.0	35	3	23	30	-7
Total	90			Total	90			Total	90		

Table 21   For the second observer the three tested devices were different in their results in matching efficiency of the skin colour.

	Spectrophotometer	Digital camera	Scanner
Chi-Square	151.267	67.267	68.600
Df	2	2	2
Asymp. Sig.	.01*	.01*	.01*

*Significant value   (p<0.05).

Table 22   The responses of Observer 3.

Observer 3											
Spectrophotometer				Digital camera				Scanner			
Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.
1	85	30	55	1	3	30	-27	1	2	30	-28
2	3	30	-27	2	20	30	-10	2	67	30	37
3	2	30	-28	3	67	30	37	3	21	30	-9
Total	90			Total	90			Total	90		

Table 23   For the third observer the three tested devices were different in their results in matching efficiency of the skin colour.

	Spectrophotometer	Digital camera	Scanner
Chi-Square	151.27	73.27	74.47
Df	2	2	2
Asymp. Sig.	.01*	.01*	.01*

*Significant value   ($p < 0.05$).

Table 24 The responses of Observer 4.

	Spectrophotometer				Digital camera				Scanner			
	Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.	Resp.	Obs.	Exp.	Res.
	1	76	45	31	1	9	30	-21	1	5	30	-25
	2	14	45	-31	2	15	30	-15	2	62	30	32
	Total	90			3	67	30	36	3	23	30	-7
					Total	90			Total	90		

(header: Observer 4)

Table 25 For the forth observer the three tested devices were different in their results in matching efficiency of the skin colour.

	Spectrophotometer	Digital camera	Scanner
Chi-Square	42.71	65.40	56.60
Df	1	2	2
Asymp. Sig.	.01*	.01*	.01*

*Significant value (p<0.05).

Table 26 For the total observers and devices.

	Spectrophotometer				Digital camera				Scanner			
Observer	1	2	3	4	1	2	3	4	1	2	3	4
X^2	42.7	151.3	151.3	42.7	58.86	67.26	73.26	65.4	51.66	68.6	74.46	56.6
Df	1	2	2	1	2	2	2	2	2	2	2	2
Asymp. Sig.	.01*	.01*	.01*	.01*	.01*	.01*	.01*	.01*	.01*	.01*	.01*	.01*

*Significant value (p<0.05).

Table 27   1 way ANOVA for L*a*b* values of the 3 devices.

All Devices		Sum of Squares	Df	Mean Square	F	Sig.
L*	Between Groups all devices	7509.36	2	3754.68	79.19	.01*
	Within Groups	12660.11	267	47.42		
	Total	20169.47	269			
a*	Between Groups all devices	954.96	2	477.48	206.55	.01*
	Within Groups	617.21	267	2.31		
	Total	1572.17	269			
b*	Between Groups all devices	2353.70	2	1176.85	160.60	.01*
	Within Groups	1956.54	267	7.33		
	Total	4310.24	269			

*Significant value   (p<0.05).

Table 28 2 way ANOVA between Male and Female.

Devices			Sum of Squares	Df	Mean Square	F	Sig.
Spectro-photometer	L * Sex	Between Groups (Combined)	262.61	1	262.61	4.79	.03*
		Within Groups	4822.78	88	54.80		
		Total	5085.39	89			
	A * Sex	Between Groups (Combined)	15.62	1	15.62	6.98	.01*
		Within Groups	196.87	88	2.24		
		Total	212.49	89			
	B * Sex	Between Groups (Combined)	.78	1	.78	.14	.71
		Within Groups	495.01	88	5.63		
		Total	495.79	89			
Digital camera	L * Sex	Between Groups (Combined)	135.69	1	135.69	3.55	.06
		Within Groups	3361.91	88	38.20		
		Total	3497.60	89			
	A * Sex	Between Groups (Combined)	4.35	1	4.35	1.37	.25
		Within Groups	279.75	88	3.18		
		Total	284.10	89			
	B * Sex	Between Groups (Combined)	2.79	1	2.79	.24	.63
		Within Groups	1042.37	88	11.85		
		Total	1045.16	89			
Scanner	L * Sex	Between Groups (Combined)	187.61	1	187.61	4.25	.04*
		Within Groups	3889.51	88	44.20		
		Total	4077.12	89			
	A * Sex	Between Groups (Combined)	21.48	1	21.48	19.07	.01*
		Within Groups	99.14	88	1.13		
		Total	120.62	89			
	B * Sex	Between Groups (Combined)	6.48	1	6.48	1.40	.24
		Within Groups	409.12	88	4.65		
		Total	415.60	89			

*Significant value ($p < 0.05$).
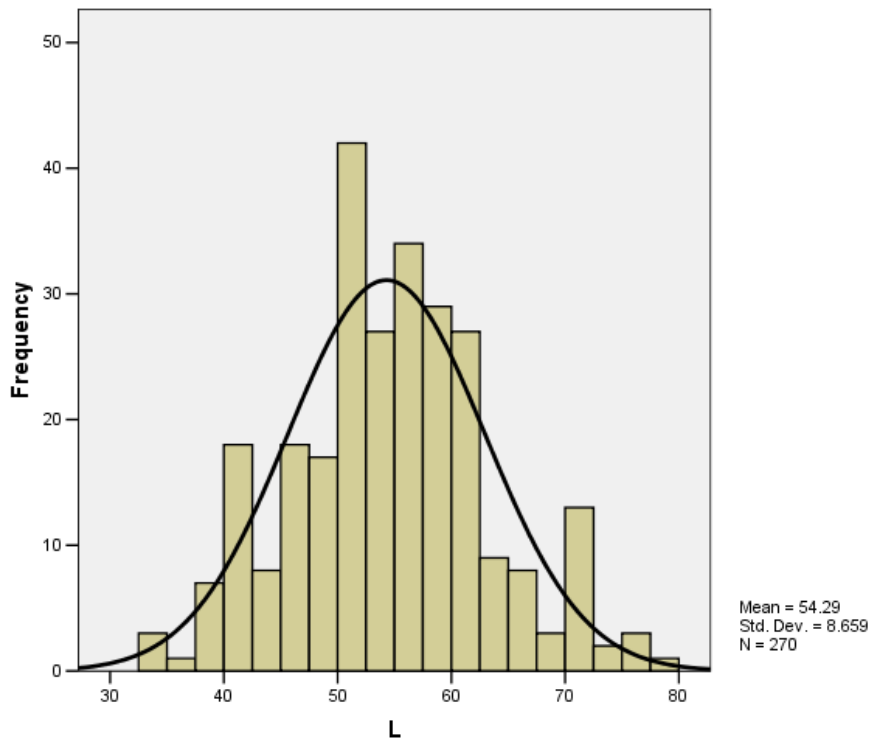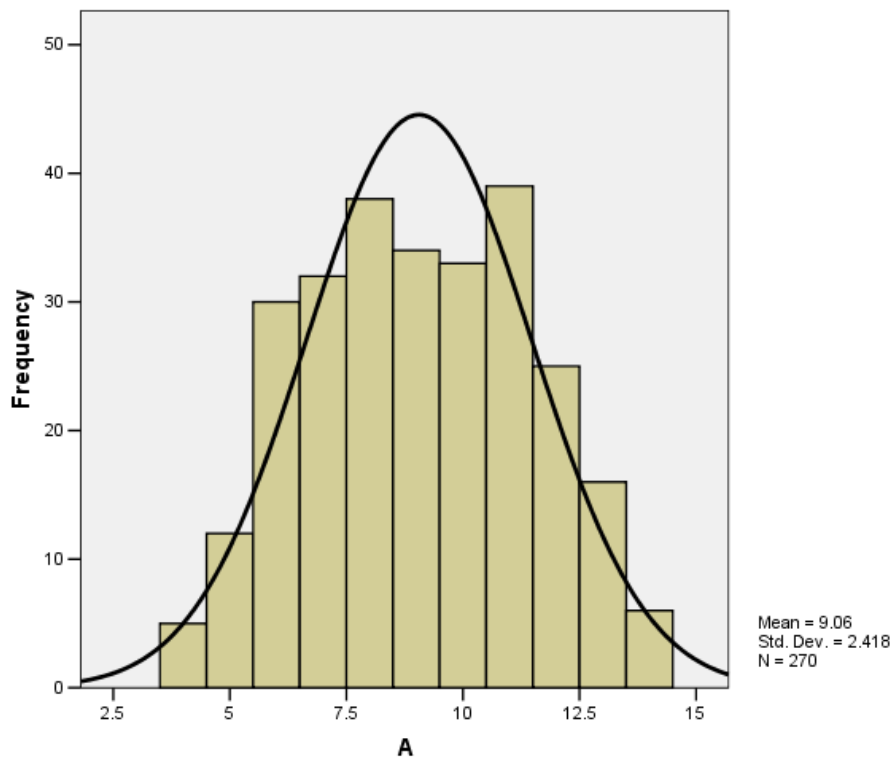
Figure 1   Histogram of L* data.

Figure 2   Histogram of a* data.

Figure 3   Histogram of the b* data.

Mean = 14.31
Std. Dev. = 4.003
N = 270