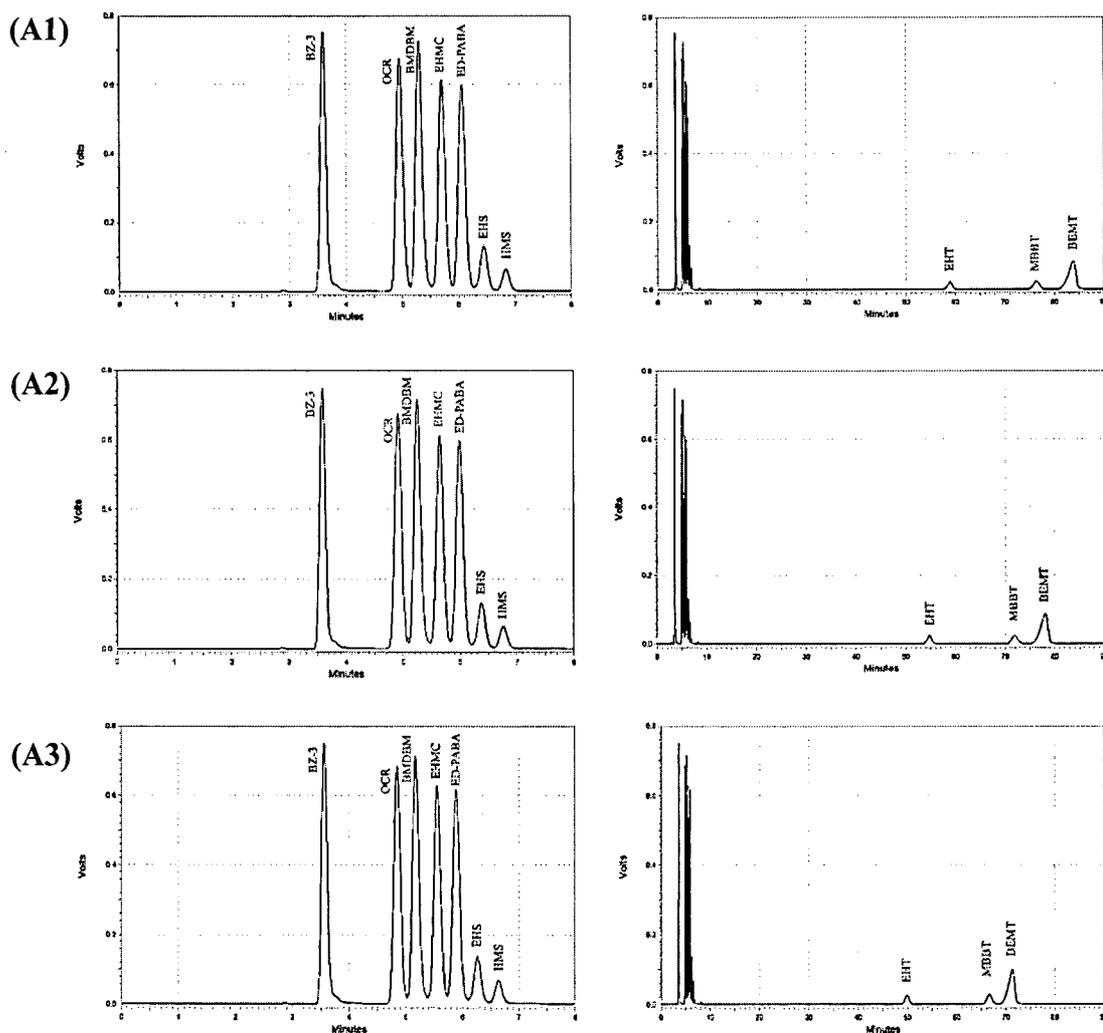


## **APPENDIXES**

## APPENDIX A EFFECTS OF COLUMN TEMPERATURE



**Figure A Chromatogram of effects of column temperature observed at (A1): 25, (A2): 30 and (A3): 35 °C. The ten UV filters detected at 325 nm. Chromatography was performed using the reverse phase column C18 (250 x 4.6 mm, 5 $\mu$ m) under isocratic mode of acetonitrile: ethyl acetate (95:5:2, v/v/v), at a flow rate 1.0 mL/min and injection volume 20  $\mu$ L.**



## APPENDIX C ANOVA *F*-TEST OF THE REGRESSION MODELS

**Table A1** The results of statistical tests of the regression models of all UV filters performed using ANOVA *F*-test at 95% confidence level.

### BZ-3

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i> -value
Regression	1	6.34E+13	6.34E+13	1.89E+04	5.11E-26
Residual	16	5.37E+10	3.35E+09		
Total	17	6.35E+13			

### OCR

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i> -value
Regression	1	1.84E+13	1.84E+13	1.21E+04	1.81E-24
Residual	16	2.43E+10	1.52E+09		
Total	17	1.84E+13			

### BMDBM

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i> -value
Regression	1	8.96E+13	8.96E+13	1.91E+04	4.64E-26
Residual	16	7.49E+10	4.68E+09		
Total	17	8.97E+13			

### EHMC

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i> -value
Regression	1	6.28E+13	6.28E+13	1.50E+04	3.23E-25
Residual	16	6.69E+10	4.18E+09		
Total	17	6.29E+13			

### ED-PABA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i> -value
Regression	1	4.94E+13	4.94E+13	9.62E+03	1.14E-23
Residual	16	8.22E+10	5.14E+09		
Total	17	4.95E+13			

**Table A1 (Cont.)****EHS**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	1	1.27E+12	1.27E+12	1.83E+04	6.63E-26
Residual	16	1.11E+09	6.94E+07		
Total	17	1.27E+12			

**HMS**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	1	8.14E+11	8.14E+11	1.40E+04	5.69E-25
Residual	16	9.30E+08	5.81E+07		
Total	17	8.15E+11			

**EHT**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	1	2.47E+13	2.47E+13	7.64E+03	7.14E-23
Residual	16	5.16E+10	3.23E+09		
Total	17	2.47E+13			

**MBBT**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	1	2.42E+13	2.42E+13	1.47E+04	3.75E-25
Residual	16	2.63E+10	1.64E+09		
Total	17	2.42E+13			

**BEMT**

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	1	1.91E+14	1.91E+14	1.64E+04	1.59E-25
Residual	16	1.87E+11	1.17E+10		
Total	17	1.92E+14			

## APPENDIX D INFORMATION OF COMMERCIAL SUNSCREENS

**Table A2 The information of commercial sunscreens used in the study**

<b>Code</b>	<b>Products</b>	<b>Ingredient on labeling</b>	<b>Manufacturing date</b>
C1	Facial Sunscreen SPF 40 PA+++	Water, Cyclopentasiloxane, Zinc oxide, Dimethicone/Vinyl dimethicone cross-polymer, Ethylhexyl methoxycinnamate, Titanium dioxide, VP/Hexadecene copolymer, Diisopropyl dimer dilinoleate, Polyglyceryl-4-isostearate, Chitosan, Cetyl PEG/PPG-10/1 dimethicone, Hexyl laurate, Methylparaben, Iron oxide yellow, C9-15 Fluoroalcohol phosphates, Parfum, Propylparaben, Alumina, Iron oxide red, Iron oxide black	October, 2013
C2	Sunscreen SPF 40 PA+++	Water, Cyclomethicone, Butylene glycol, Octyl methoxycinnamate, Dimethicone, Polymethyl methacrylate, Dimethicone copolyol, Distear-dimonium hectorite, Trimethylsiloxy-silicate, Sodium glutamate, Tocopheryl acetate, Magnesium chloride, Calcium chloride, Dextrin palmitate, Isostearic acid, Aluminium distearate, Aluminium hydroxide, Silica, PEG-150, Trisodium EDTA, BHT, Phenoxyethanol, Methylparaben, Fragrance, Zinc oxide, Titanium oxide	July 2013

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C3	Sunscreen SPF 60 PA++++	Aqua, Octocrylene, Cetyl alcohol, Glyceryl stearate, PEG-75 stearate, Ceteth-20, Steareth-20, Titanium dioxide, Hydrogenated polydecene, C12-15 alkyl benzoate, Isododecene, Butylene glycol cocoate, Butylmethoxy dibenzoylmethane, Dimethicone silica, Xanthan gum, Pectin, Hydrolyzed vegetable protein, Serine, Arginine, Proline, Disodium EDTA, Phenoxyethanol, Niacinamide, Glycerin, Peucedanum ostruthium leaf extract, Buddleja davidii leaf extract, Artemisia umbrelliformis extract, Fragrance, Dipotassium clycyrrhizinate, Tetrasodium EDTA, Methylparaben, Sodium hyaluronate, Butylparaben, Ethylparaben, Propylparaben, Isobutylparaben, Imidazolidinyl urea	October 10, 2013

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C4	Sunscreen SPF 30 PA+++	Water, Ethylhexyl methoxycinnamate, Methylene Bis-benzotriazolyl tetramethylbutylphenol, Propylene glycol, Biosaccharide gum-1, Dibutyl adipate, Ethoxydiglycol, VP/Hexadecane copolymer, Biosaccharide gum-2, Tocopheryl acetate, Carbomer, Acrylates/C10-30 alkyl acrylate cross-polymer, Sodium hydroxide, Disodium EDTA, Imidazolidinyl urea, Methyl paraben	December 10, 2013

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C5	SPORT Sunscreen Lotion SPF 110 PA+++	Aqua, Octocrylene, Hydrogenated polyisobutene, Lauryl PEG-8 Dimethicone, Benzophenone-3, Butyloctyl salicylate, Ethylhexyl palmitate, Butyl methoxydibenzoyl- methane, Hydrated silica, Cyclopentasiloxane, Cyclohexa- siloxane, Acrylates/C12-22 alkyl methacrylate copolymer, Sodium chloride, Benzyl alcohol, Cera alba, Cera microcristallia, Polyethelene, Caprylyl glycol, Disodium EDTA, Stearoxy dimethicone, PEG-8 dimethicone, Aloe barbadensis leaf juice, Octyldodecanol, Retinyl palmitate, Silica, Tocopheryl acetate, Ascorbic acid, Sodium propoxy- hydroxypropyl thiosulfate silica, Methylparaben, Propylparaben	December 10, 2013

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C6	Sunscreen SPF 50 PA+++	Aqua, Ethylhexyl methoxycinnamate, Glyceryl stearate/Ceteareth-11/Cetyl palmitate/ Ceteareth-25, Ethylhexyl salicylate, Cetyl alcohol, Oxybenzone, Polyglyceryl-3, methylglucose distearate, Ceteareth-12, Polymethyl silsesquioxane, Cyclopentasiloxane, Nicotinamide, Propylene glycol, Magnesium stearate, Tocopheryl acetate, Methylisothiazolinone/ chlorphenesin, Methyl paraben, Propyl paraben, Disodium EDTA, Perfume	January 31, 2014
C7	Sunscreen for Kids SPF 50+ UVB & UVA protection	Aqua, Octocrylene, Glycerin, Alcohol denat., Butylene glycol dicaprylate/ dicaprinate, Titanium dioxide (nano), Butylmethoxy dibenzoylmethane, Isopropyl palmitate, Bis-ethylhexyloxy phenol methoxyphenyltriazine, Glyceryl stearate, Cetearyl alcohol, Hydrogenated Coco-glycerides, Glycyrrhiza inflata root extract, Glycyrrhetic acid, Xanthan gum, VP/Hexadecene copolymer, Trimethoxy caprylylsilane, Trisodium EDTA, Sodium citrate, Citric acid, Acrylates/C10-30 alkyl acrylate crosspolymer, Ethylhexyl glycerin, Phenoxyethanol	February 22, 2012

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C8	Facial Sunscreen SPF 40 UVA & UVB Protection	Stearic acid, Ethylhexyl methoxycinnamate, Propylene glycol, Ethylhexyl salicylate, Benzophenone-3, Glyceryl stearate, Triethanolamine, Silica, Dimethicone, C12-15 alkyl benzoate, Titanium dioxide, Isopropyl palmitate, Magnesium aluminium silicate, Talc, Fragrance, Xanthan gum, Propylparaben, Methylparaben, Simmondsia chinensis (Jojoba) seed oil, Polyhydroxystearic acid, Disodium EDTA, Cetyl palmitate, Butylparaben, Bisabolol, Mineral oil, Alumina, Aluminium tristearate, Maltodextrin, Aloe barbadensis leaf juice, Methylisothiazolinone, Ethylhexyl glycerin, Alcohol, Lecithin, Arbutin, Tocopheryl acetate, Ascorbyl palmitate, CI 77492, CI 77491, CI 77499	December 12, 2013

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C9	Sunscreen SPF 50 PA+++	Water, Octyl methoxycinnamate, Homosalate, Isododecane, HDI/Trimethylol hexyllactone cross-polymer, Butylmethoxy dibenzoyl methane, Cyclomethicone, Hydrogenated polydecene, Cyclopentasiloxane, Methylpropanediol, Octocrylene, Titanium dioxide, Butylene glycol cocoate, Isononyl isonanoate, Phenethyl benzoate, Cetyl alcohol, Biosaccharide gum-1, Glyceryl monostearate, Stearyl alcohol, Dimethicone/Vinyl dimethicone crosspolymer, Glyceryl stearate, PEG-75 stearate, Niacinamide (Vitamin B3), Tocopheryl (Vitamin E) acetate, Ceteth-20, Stearate-20, Disodium EDTA, Xanthan gum, Glycerin, Butyrospermum parkii (Shea Butter) fruit, Silica, Mannitol, Propylene glycol, Alcohol denat, Aloe barbadensis (Aloe vera) leaf powder, Lecithin, Cyclodextrin, Carnitine, Methylisothiazolinone, Polyamino-propyl biguanide, Polysorbate 20, Yeast extract, Glycyrrhiza glabra (Licorice) root extract, Sucrose dilaurate, Phenoxy-	December 17, 2012

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
		ethanol, Disodium succinate, Butylparaben, Ethylparaben, Isobutylparaben, Methylparaben, Propylparaben, Sodium hydroxide, Ubiquinone, Pisum sativum (Pea) seed extract, Sorbic acid	
C10	Sunscreen SPF 50 PA+++	Aqua (Water), Isopropyl palmitate, Beeswax, Cocoglycerides, Butyl methoxy dibenzoylmethane, Octocrylene, Cetyl dimethicone, Butylene glycol, Methylene Bis-benzotriazolyl tetramethylbutylphenol, Ethylhexyl methoxycinnamate, PEG-15 cocamide, Phenoxyethanol, PEG-40 Stearate, Tocopheryl acetate, Acrylates/C10-30 alkyl acrylate crosspolymer, Triethanolamine, Disodium EDTA, BHT, Methyl paraben, Ethyl paraben, Propyl paraben	April, 2013

Table A2 (Cont.)

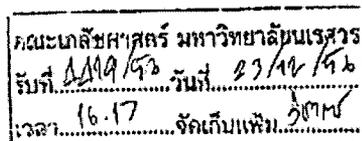
Code	Products	Ingredient on labeling	Manufacturing date
C11	Sun Spray SPF 30 PA+++	Water, Butylene glycol dicaprylate/dicaprate, Ethylhexyl methoxy cinnamate, Butyl methoxy dibenzoyl methane, Glycerin, Alcohol denat., Bis-ethylhexyloxyphenol methoxyphenyl triazine, Ethylhexyl triazone, C18-36 acid triglyceride, Cetereth-20, Phenoxy ethanol, Methyl paraben, Parfum, Taurine, Tocopheryl acetate, VP/hexadecane copolymer, Sodium acrylates/C10-30 alkyl acrylate crosspolymer, Trisodium EDTA, BHT, Propylparaben	August 14, 2013
C12	Sunscreen for Face SPF 50+ UVB & UVA protection	Aqua, Octocrylene, Glycerin, Alcohol denat., Titanium dioxide (nano), Butyl methoxydibenzoylmethane, Ethylhexyl salicylate, Homosalate, Bis-ethylhexyloxyphenol methoxyphenyl triazine, Ethylhexyl cocoate, Glyceryl stearate citrate, Hydrogenated cocoglycerides, Cetearyl alcohol, Glycyrrhetic acid, Glycyrrhiza inflata root extract, VP/Hexadecene copolymer, Xanthan gum, Acrylates/C10-30 alkyl acrylate crosspolymer, trimethoxy caprylylsilane, Trisodium EDTA, Silica dimethyl silylate, Dimethicone, Ethylhexyl glycerin, Phenoxyethanol	November 05, 2012

Table A2 (Cont.)

Code	Products	Ingredient on labeling	Manufacturing date
C13	Sun Spray Transparent SPF 50 UVB & UVA protection	Alcohol denat., C12-15 alkyl benzoate, Homosalate, Octocrylene, Butyl methoxydibenzoylmethane, Ethylhexyl salicylate, Butylene glycol dicaprylate/dicaprate, Dibutyl adipate, Glycerin, Bis-ethylhexyloxyphenol methoxyphenyl triazine, Tocopherol, Glycyrrhiza inflata root extract, Acrylates/Octylacrylamide copolymer, Aqua, Parfum	August 14, 2013

## APPENDIX E

The research entitles “Optimization and validation of HPLC method for determination UV filters in sunscreen products” has been approved by the Graduate school committee of Naresuan University



ประกาศบัณฑิตวิทยาลัย มหาวิทยาลัยนเรศวร  
เรื่อง อนุมัติให้นิสิตระดับปริญญาโทดำเนินการทำวิจัย  
ครั้งที่ ๒๒๒/๒๕๕๖

บัณฑิตวิทยาลัยอนุมัติให้ นางสาวนพมาศ อยู่ยิ่ง รหัสประจำตัว ๕๕๐๖๒๓๗๕ นิสิตระดับปริญญาโท  
หลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต สาขาวิชาวิทยาศาสตร์เครื่องสำอาง ดำเนินการทำวิจัย  
ตามโครงร่างวิทยานิพนธ์ที่เสนอ

เรื่อง ภาษาไทย “การหาสภาวะทดสอบที่เหมาะสมและการประเมินความใช้ได้ของวิธีวิเคราะห์สารกันแดด  
ในผลิตภัณฑ์เครื่องสำอางที่มีสารป้องกันแสงแดดโดยโครมาโทกราฟีของเหลว  
สมรรถนะสูง”  
ภาษาอังกฤษ “OPTIMIZATION AND VALIDATION OF HPLC METHOD FOR DETERMINATION  
UV FILTERS IN SUNSCREEN PRODUCTS”  
โดยมี รองศาสตราจารย์ ดร.ทัศนาศ พิทักษ์สุธีพงศ์ เป็นประธานที่ปรึกษาวิทยานิพนธ์

จึงประกาศมาให้ทราบโดยทั่วกัน

ประกาศ ณ วันที่ ๒๐ ธันวาคม พ.ศ.๒๕๕๖

(ศาสตราจารย์ ดร.รัตนะ บัวสนธ์)

คณบดีบัณฑิตวิทยาลัย มหาวิทยาลัยนเรศวร