



## ELEMENTAL ANALYSIS AND VOLATILE ORGANIC COMPOUNDS FROM LIQUID FOUNDATION MAKEUP

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### ABSTRACT

In this research work, a survey of liquid foundation makeup was carried out to choose research samples. During the survey, brands, price and volume of liquid foundation makeup were recorded. pH of the liquid foundation makeup samples were measured by using pH meter. Elemental analysis of liquid foundation makeup samples were performed by EDXRF (Energy Dispersive X-ray Fluorescence) Spectrophotometer. Moreover elements that contain in liquid foundation makeup samples were determined by XGT (X-ray Guide Tube) Analytical Microscope. Furthermore volatile organic compounds were investigated by GCMS (Gas Chromatography Mass Spectrometry) analysis.

**Keywords :** Liquid foundation makeup, Volatile organic compounds, Elemental analysis, pH, GCMS, EDXRF, XGT

### 1 INTRODUCTION

COSMETICS, have been used since mankind's earliest days. There has long been a desire by individuals to improve their appearance and artificially enhance their sexual attraction and the cosmetics trade and industry have a long history. Make-up has been used to enhance facial colour since before 4000BC. The Ancient Egyptians led the way in cosmetic production, developing innovative formulations for their beauty needs. They decorated their eyes with green, white and black make-up. The use of black eye liners, known as kohl, was very popular, and was used to emphasise the eyes. (Kulikov.E.)

The chemical constituent of cosmetics sometimes cause concerns, some chemicals are widely seen as beneficial. Titanium dioxide, found in sunscreens, and zinc oxide have anti-inflammatory properties, mineral makeup with those ingredients can have a calming effects on the skin, which is particularly important for those who suffer from inflammatory problems such as rosacea. Zinc oxide is anti-microbial, so mineral makeup can be beneficial people with acne.

Makeup can be classified into three categories: everyday, medical and theatrical. The most common group includes everyday products won to enhance natural appearance. Some items also fall into the medical category and are used for things like covering scars or reducing the visibility of rashes. The last group is theatrical, television and film makeup, which actors and actresses use so their features look better in bright or harsh stage lights. (wisegeek.com)

The types and main properties of natural cosmetics and beauty products are antibacterial, anti-inflammatory, antioxidant, moisturizing, anti-acne, regenerating and relaxing. Fragrances and preservatives are the main ingredients in cosmetics. Fragrances are the most common cause of skin problems. Products marked "fragrance free" or "without perfume" means that no fragrances have been added to make the product smell good. Preservatives in cosmetics are the second most common cause of skin problems. They prevent bacteria and fungus from growing in the product and protect products from damage caused by air or light. But preservatives can also cause the skin to become irritated and infected.

Foundation is used to smooth out the face by covering spots, acne, blemishes, or uneven skin tone. These are sold in a liquid, cream, or powder, or more recently in a mousse. Foundation provides sheer, matte, dewy or full coverage. Foundation primer is applied before foundation to fill out pores, create a dewy look or create a smoother finish. They usually come in cream formulas to be applied before foundation as a base. (Web site: Cosmetics and Your Health – FAQs)

In this research, liquid foundation makeup was selected for chemical analysis. Three brands of sample were chosen and the pH values of sample were determined. Moreover, elemental analysis of liquid foundation makeup samples were performed by EDXRF and XGT Technique. Furthermore, volatile organic compounds of three samples were determined by GC-MS method.

## 2 EXPERIMENTAL

### 2.1 Product Survey on the Supermarket

In December 2018, a survey of liquid foundation makeup was carried out to choose research samples. During the survey, brands, price and volume of liquid foundation makeup were recorded and these results were shown in Table (1).

### 2.2 Sample Collection

Based on the survey, liquid foundation makeup samples were selected for analysis and three brands were chosen for this research. Three brands of liquid foundation makeup were purchased from U Bo Aye Cosmetics Store, Zay Cho Market, Mandalay, Myanmar.

Liquid foundation makeup samples were vigorously mixed for a minimum of ten seconds to ensure homogeneity and placed into glass plate prior to air dried preparation. Air dried samples were used for analysis throughout the experiment.



Figure: (2.1) Three Selected Samples

### 2.3 Determination of pH value of Makeup Samples

Electrodes were rinsed with distilled water and dried by gently cleaning with a soft tissue. The instrument was standardized with electrodes immersed in a buffer solution of pH 7.

Liquid foundation makeup (1g) was placed in beaker and then 100ml of distilled water was added. And then the beaker was heated on the hot plate until the solution was boiled. After cooling, the solution was filtered and pH of the filtrate was measured by using pH meter. The results were shown in the Table (2).

### 2.4 Elemental Analysis of Makeup Samples by EDXRF Technique



Figure: (2.2) Spectro XEPOS EDXRF Spectrometer, Germany

The elements that contain in liquid foundation makeup samples were analyzed by using Energy Dispersive X-ray Fluorescence (EDXRF) spectrometer at Department of Physics, University of Mandalay. The resulting datas were shown in Table (4).

### 2.5 Elemental Analysis of Liquid Foundation Makeup Samples by XGT Technique

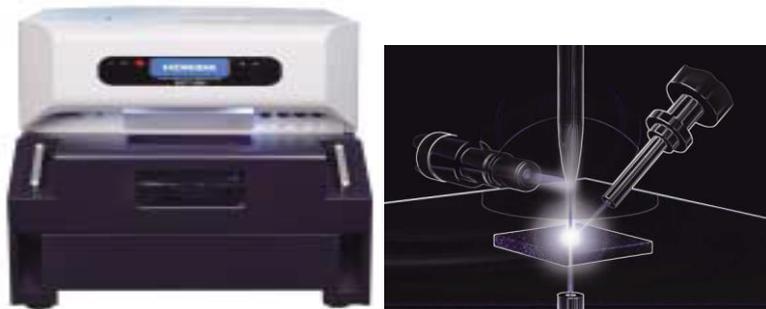


Figure: (2.3) XGT(X-ray Tube) -7000V

The elements that contain in liquid foundation makeup were analyzed by using X-ray Guide Tube (XGT) Analytical Microscope at Department of Geology, University of Mandalay. The resulting datas were shown in Table (5).

## 2.6 Organic Volatile Compound Analysis of Liquid Foundation Makeup Samples by GCMS Technique

Gas chromatography coupled to mass spectrometry is a versatile tool to separate, quantify and identify unknown (volatile) organic compounds and permanent gases. By combining sensitivity and a high resolving power, complex mixtures can be analyzed. The information obtained can be used for detection of impurities, contamination control and improvement of, for example, semiconductor manufacturing processes.

The volatile organic compounds that contain in liquid foundation makeup were analyzed by using High resolution Gas Chromatography Mass Spectrometer (GCMS) at Department of Defence Service Science and Technology Research Centre (DSSTRC), Pyin Oo Lwin.

Liquid foundation makeup sample (1 g) was placed in a measuring flask (50ml) half filled with methanol. The measuring flask is filled up to the marking methanol. The sample was dissolved during a period of approx. 2 hours. After dissolution, part of the methanol phase was transferred to conical flask, whereupon it was ready for analysis. The methanol used for the analyses was also used to dilute the sample. Also analyses of blind samples of the methanol used for the analyses are carried out. The extract is analysed on GC-MS. The following method parameters were used: Oven: Starting temperature 40° C to be kept for 3 minutes, then a slope of 30°C/minute until 300°C had been reached. The final temperature was kept for 2 minutes. The resulting datas were shown in Table (6).

## 3. RESULTS AND DISCUSSION

### 3.1 Result Of Survey On The Supermarket

During the survey, brands, price and volume of liquid foundation makeup were recorded and these result datas were shown in Table (1)

**Table (1) Result of survey on the supermarket**

No.	Brand	Amount	Price(Kyat)	Country
1.	Maybelline	30mL	12500	U.S.A
2.	Nyc	30 mL	8800	NEW YORK
3.	Tai lai mel	65 mL	6500	CHINA
4.	Camella	37 mL	5600	JAPAN
5.	Cute press	30 mL	4500	JAPAN
6.	Grey girl	35 mL	4100	U.S.A
7.	Mild snow	30 mL	2800	KOREA
8.	Sheene	30 mL	2000	THAILAND
9.	Rena	40 mL	1000	-

### 3.2 pH Values of Three Liquid Foundation Makeup Samples

pH values of three different brands of Makeup (liquid foundation) samples were measured by digital pH meter. The results were shown in Table (2).

**Table (2) Results of pH values of Three Samples.**

No.	Makeup (liquid foundation) Sample	pH value
1.	Sample I	7.49
2.	Sample II	7.84
3.	SampleIII	7.03

According to this table, the pH values of three Makeup samples were 7.03-7.49. These indicated that three Makeup samples are slightly alkaline. pH cosmetics offers alkaline based products to promote healthy, radiant skin, supply skin and overall well-being.

### 3.3 Determination of Weight Percents of Makeup Samples

Three Liquid Foundation Makeup samples were dried in air. The air dried samples were weighed and the weight percents were calculated.

**Table (3) Results of Weight Percents of Dried Samples,**

Makeup Samples	Volume of Makeup (mL)	Weight of Makeup (g)	Weight of Dried Sample (g)	Dried weight percent (%)
Sample I	37	35.05	5.08	14.49
Sample II	30	29.08	11.07	38.07
Sample III	30	28.90	6.10	21.11

The dried weight percent of liquid foundation sample I, sample II and sample III were found to be 14.49% to 38.07%.

### 3.4 Elemental Contents of Three Makeup Samples by EDXRF

Minerals contents of three dried Makeup samples were determined by EDXRF method at Department of Physics, University of Mandalay. The results are shown in Table (4).

**Table (4) Results of Mineral Contents of Three Dried Samples**

No.	Minerals	Content (%)		
		Sample I	Sample II	Sample III
1.	Titanium	14.8400	21.8400	8.9090
2.	Silicon	3.0620	7.0540	2.2650
3.	Iron	2.5650	5.5180	2.3520
4.	Potassium	0.2019	0.0000	0.0398
5.	Aluminum	0.1739	0.0422	0.0270
6.	Calcium	0.1251	0.1085	0.1780
7.	Phosphorus	0.1204	0.0054	0.0099
8.	Vanadium	0.0968	0.1473	0.0559
9.	Chlorine	0.0683	0.1085	0.1780
10.	Sulfur	0.0295	0.0082	0.0099
11.	Strontium	0.0071	0.0005	0.0046
12.	Manganese	0.0059	0.0055	0.0047
13.	Zirconium	0.0042	0.0098	0.0047
14.	Niobium	0.0029	0.0253	0.0178
15.	Zinc	0.0026	4.1580	0.0064

According to EDXRF analysis, Liquid foundation makeup sample I contains high amount of titanium (two digits) and moderate amount of silicon and iron (one digits). Sample II contains high amount of titanium (two digits) and moderate amount of silicon and iron (one digits). Sample III contains moderate amount of titanium, silicon and iron (one digits).

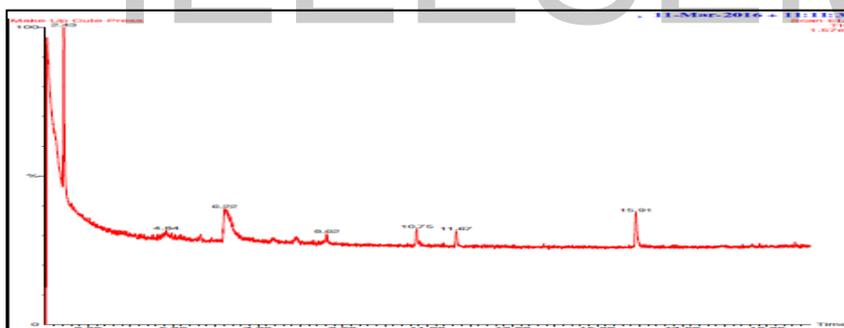
### 3.5 Elemental Contents of Three Makeup Samples by XGT method

Mineral contents of three dried Makeup samples were determined by XGT method at Department of Geology, University of Mandalay. The results are shown in Table (5).

**(5) Results of Mineral Contents of Three Dried Samples**

No.	Minerals	Content (%)		
		Sample I	Sampe II	Sample III
1.	Titanium	66.02	50.37	45.07
2.	Iron	17.18	15.63	18.44
3.	Silicon	11.01	13.59	25.68
4.	Magnesium	1.93	5.16	7.90
5.	Aluminum	1.37	0.30	1.38
6.	Phosphorus	0.67	0.00	0.07
7.	Sulfur	0.54	0.07	0.13
8.	Vanadium	0.52	0.67	0.55
9.	Potassium	0.48	0.03	0.13
10.	Calcium	0.21	0.13	0.37
11.	Manganese	0.03	0.00	0.03
12.	Silver	0.03	0.03	0.04
13.	Niobium	0.01	0.08	0.16
14.	Chlorine	0.00	0.00	0.01
15.	Zinc	0.00	13.93	0.03

According to XGT Analytical Microscope Method, Makeup samples I contains high amount of Titanium, Iron, Silicon (two digits) and moderate amount of Magnesium and Aluminum (one digits). Sample II contains high amount of Titanium, Iron, Silicon (two digits) and moderate amount of Magnesium. Sample III contains high amount of Titanium, Silicon, Aluminum (two digits) and moderate amount of Magnesium and Aluminum (one digits).

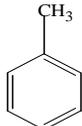
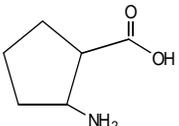
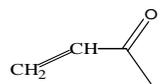
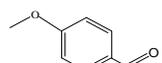
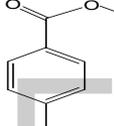


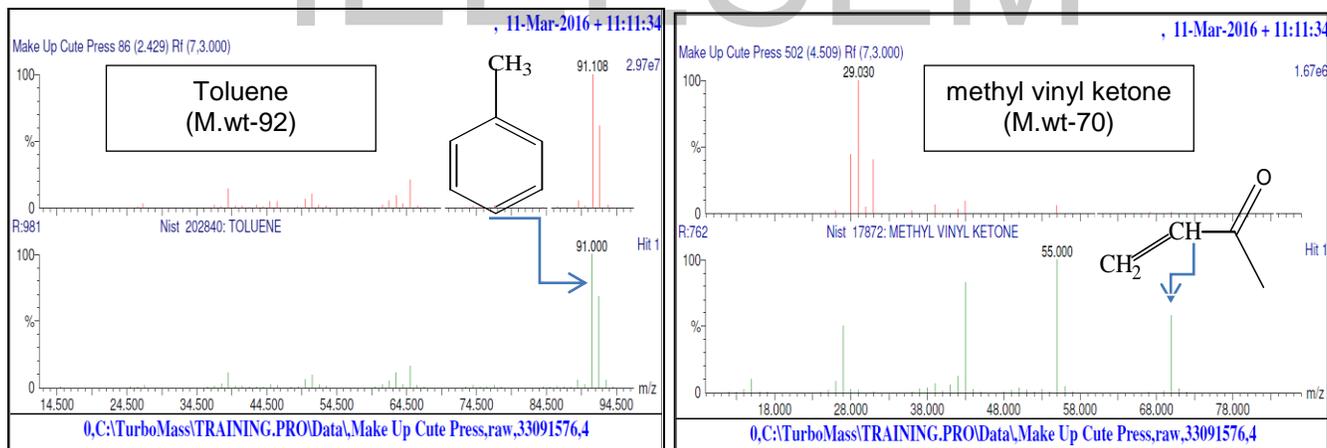
**Figure(3.1)Chromatogram of Liquid Foundation Makeup by GCMS**

**3.6 Identified Compounds in Methanol Extract from Makeup by GCMS Method**

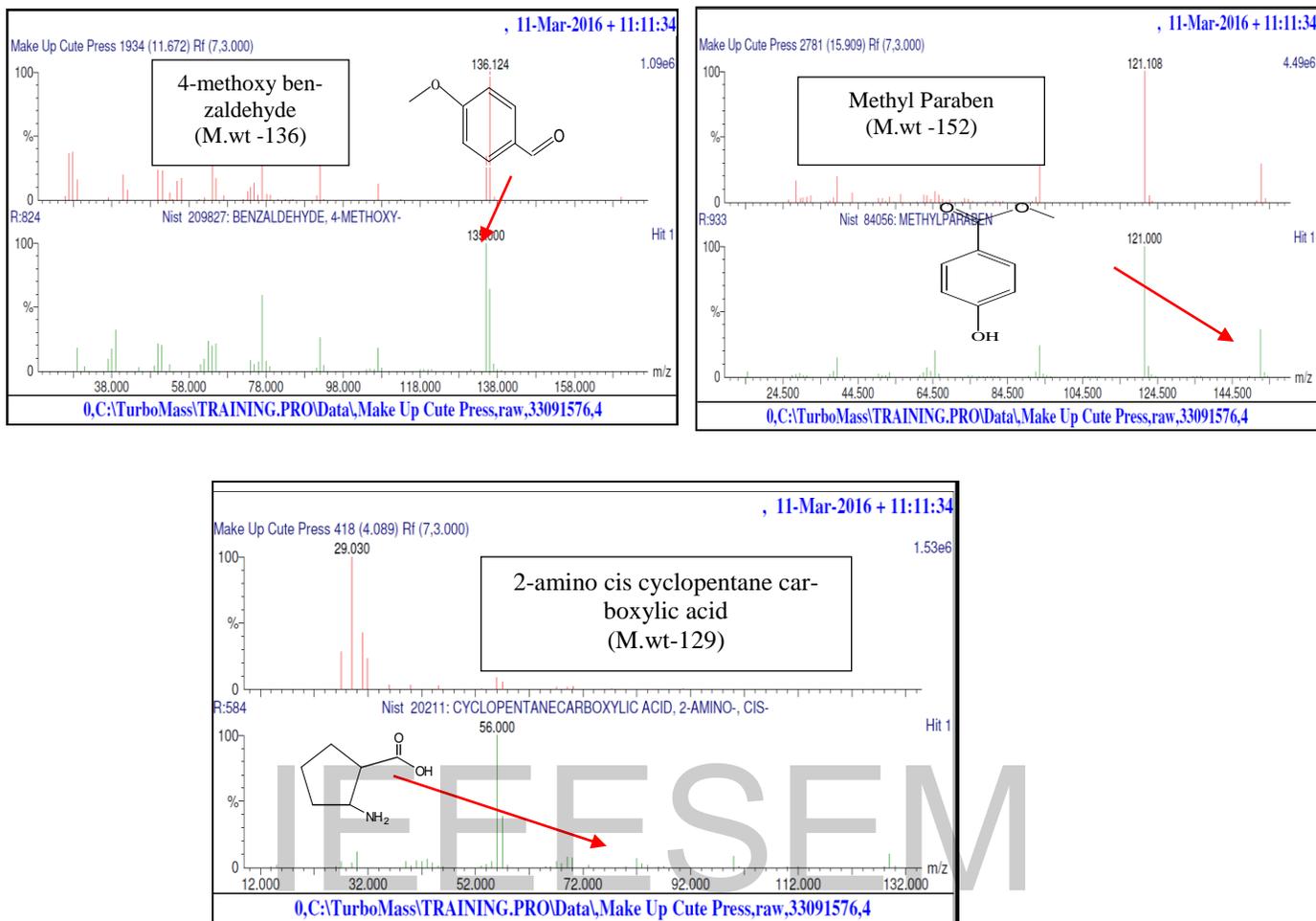
The volatile organic compounds that contain in liquid foundation makeup were analyzed by using High resolution Gas Chromatography Mass Spectrometer (GCMS) at Department of Defence Service Science and Technology Research Centre (DSSTRC), Pyin Oo Lwin, Myanmar.

**Table (6) Identified Compounds in Methanol Extract from Makeup by GCMS Method**

No	Retention Time	Compound Name	Structure	Molecular weight
1.	2.429	Toluene		92
2.	4.089	2-amino cis cyclopentane carboxylic acid		129
3.	4.509	Methyl Vinyl Ketone		70
4.	11.673	4-methoxy Benzaldehyde		136
5.	15.909	Methyl Paraben		152



**Figure(3.2) Mass Spectra of Liquid Foundation Makeup from GCMS**



Figure(3.3) Mass Spectra of Liquid Foundation Makeup from GCMS

#### 4. CONCLUSION

In this research work, a survey of liquid foundation makeup was carried out to choose research samples. During the survey, brands, price and volume of liquid foundation makeup were recorded.

pH of the liquid foundation makeup samples were measured by using pH meter. The pH values of three Makeup (liquid foundation) samples are 7.03-7.49 and these indicated that three samples are slightly alkaline. pH cosmetics offers alkaline based products to promote healthy, radiant skin and supply skin and overall well-being. However, cosmetics with a high pH value that remain on the skin will cause stress to the skin.

Elemental analysis of liquid foundation makeup samples were performed by EDXRF Spectrophotometer. Liquid foundation makeup sample I contains high amount of Titanium (two digits) and moderate amount of Silicon and Iron (one digit). Sample II contains high amount of Titanium (two digits) and moderate amount of Silicon and Iron (one digit). Sample III contains moderate amount of Titanium, Silicon, and Iron (one digits).

Moreover elements that contain in liquid foundation makeup samples were determined by XGT (X-ray Guide Tube) Analytical Microscope method. Liquid foundation makeup samples I contains high amount of Titanium, Iron, Silicon (two digits) and moderate amount of Magnesium and Aluminum (one digit). Sample II contains high amount of Titanium, Iron, Silicon (two digits) and moderate amount of Magnesium (one digit). Sample III contains high amount of Titanium, Iron, Silicon (two digits) and moderate amount of Magnesium and Aluminum (one digit).

It was found that three liquid foundation makeup samples contain more amount titanium, silicon and iron other than the metals by EDXRF and XGT analysis. Titanium as titanium dioxide is listed as a safe pigment and is chemically processed to remove impurities. Silicon is known as a beautifying mineral. It is useful in taking care of nails, hair and skin. Iron as iron oxide is non-toxic, water repellent, medical uses and it is an ideal additive to cosmetics such as mascara, foundation, and eye shadow.

Furthermore volatile organic compounds were investigated by GCMS analysis. Volatile organic compounds such as toluene, methyl vinyl ketone, 2-amino cis cyclopentane carboxylic acid, benzaldehyde and methyl paraben were identified by GCMS analysis.

Toluene is toxic chemical and exposure to toluene can result in temporary effects such as headaches, dizziness and cracked skin. Methyl vinyl ketone is toxic and causes burn to skin, eyes and mucous membranes. Benzaldehyde is an aromatic aldehyde and is used in cos-

metics as a flavoring agent, and as a fragrance. Methyl paraben, is an ester of p-hydroxybenzoic acid and a fine crystalline powder and is used to prevent fungal growth and to preserve formula. 2-amino cis cyclopentane carboxylic acid is sensory properties to the formulation and good organic photoprotective filters. It was found that liquid foundation makeup samples have positive and negative effects of using daily.

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