

EVALUATION OF NONI (*MORINDA CITRIFOLIA* L.) EXTRACT AND ITS APPLICATIONS IN COSMETIC AND MEDICINAL PRODUCTS

Ohnmar Kyi¹, Cho Cho Oo², Khin Thet Ni³

Abstract

The first portion of this research work was to prepare fermented Noni fruit extract and leaf extract from indigenous Noni which was cultivated as organic farming in Taungoo Township, Bago Region. The Noni fruit extract was prepared by Drip extraction method and was also determined the optimum fermentation period. The optimum fermentation period was found to be three months. The moisture, ash, protein, crude fiber, crude fat, carbohydrate contents and energy value of Noni fruit extract were examined. The vitamin content of Noni fruit extract was determined and the elemental analysis by EDXRF were also conducted. The Noni leaf extract was prepared as leaf juice and water extract. The amino acid content of leaf juice was determined and elemental analysis of water extract by EDXRF was conducted. The second portion was making the Noni cream as a cosmetic product prepared with resultant fruit extract and the Noni pain relieving cream as medicinal product prepared by using both the Noni leaf juice and Noni leaf water extract. It was found that the most suitable conditions were obtained by using Noni cream (a) and pain relieving cream PR I and PR II (a) according to the characteristics of the creams.

Keywords: Noni, Noni fruit extract, Noni leaf extract, Noni cream, Noni pain relieving cream

Introduction

The genus *Morinda* (Rubiaceae) consists of about 80 species. The most well-known species of this genus is *Morinda citrifolia* L., commonly known as Noni. Ye'yo is the Myanmar name of plant *Morinda citrifolia* L. and grows very well in Myanmar. In traditional Myanmar medicine Ye'yo has been used for many health conditions. People in Myanmar cooked unripe fruits in curries, and ate the ripened fruits with salt or jaggery. Noni leaves were used to wrap fresh fish for cooking. Noni juice is a rich source of carbohydrates and proteins. It is also rich in vitamins like vitamin A and

¹ Dr. Associate Professor, Industrial Chemistry Department, Dagon University

² Dr. Professor and Head, Industrial Chemistry Department, University of Yangon

³ Dr. Professor and Head (Retired), Industrial Chemistry Department, University of Yangon

vitamin C, along with adequate amounts of iron and niacin. The fruit juice is in high demand as an alternative medicine for various illnesses such as arthritis, diabetes, high blood pressure, muscle pains, menstrual difficulties, headaches, heart disease and drug addiction. It was reported that the fruits of Noni suppress the growth of tumors by stimulating the immune system. Because of containing the nutrient anthraquinone in Noni juice, it was shown to be potentially useful as an anti-wrinkle agent when use externally or internally. It is valued for its many unique health promoting components that are well known treatment for skin conditions of all kinds. Noni increases the production of collagen and is good to use for the skin. Noni acts an anti-inflammatory agent. It is effective with muscular and joints conditions such as arthritis. Juice from the leaves is used for arthritis in Philippines.

Materials and Methods

Raw Materials

Noni fruits and Noni leaves, stearic acid, cetyl alcohol, lanolin, olive oil, petroleum jelly, beeswax, glyceryl monostearate, KOH, triethanolamine, methyl paraben, propyl paraben, essence, ethylene glycol distearate, light liquid paraffin, cajeput oil, menthol, eucalyptus oil, camphor and propylene glycol and polymer (Visc Optima SE).

Methods

Preparation of Fermented Noni Juice

Firstly, Noni fruits, mainly whitish in colour with tinges of green were washed, air-dried and then the ripe, soft and translucent fruits were obtained. The soft fruits were placed into 3 separate stainless steel fermentation vessels and stood for 1 month, 3 months and 6 months respectively. The contact between the juice and fresh air was minimized throughout the process. During aging, the Noni juice was fermented gradually. The golden colour fermented juice was gradually darkened on aging. At the end of each fermentation period, the juice was drained from spigots at the base of containers. Then the fermented Noni fruit extract was decanted, filtered and kept in sterilized bottles.

Preparation of Noni Leaf Water Extract

The ground Noni leaves were extracted with cold water (solvent to ground leaves ratio of 1:10) at room temperature for 1 hr. Then the mixture was filtered with cheesecloth bag and Noni leaf water extract was obtained.

Preparation of Noni Leaf Juice

Ground Noni leaves were put into the cheesecloth bag and squeezed. Then the resultant leaf juice was centrifuged to obtain a clear Noni leaf juice.

Preparation of Noni Cream

Formula of Noni Cream (a)

As an oil phase, 15 g of stearic acid, 8 g of cetyl alcohol, 2 g of lanolin, 3 g olive oil, 0.5 g petroleum jelly, 0.2 g beeswax and 5 g glyceryl monostearate were heated to 70 °C for 10 min with constant stirring until all the contents dissolved into a clear solution. As a water phase, 54.6 g of fermented Noni fruit extract, 0.9 g KOH, 7.0 g distilled water and 0.35 g triethanolamine were stirred at 70 °C. 0.1 g of methyl paraben, 0.05 g of propyl paraben and 3.0 g water were heated to 70 °C until a clear preservative solution was obtained. The water phase and preservative solution were gradually added to the oil phase. The oil phase and water phase were thoroughly stirred 1000 rpm for 10 minutes at 70 °C. After cooling to 40 °C, 0.3 g of lavender essence was added and stirred. The cream obtained was cooled to room temperature and poured into sterilized glass bottles.

Formula of Noni Cream (b)

Noni cream was prepared by the procedure as described in formula of Noni cream (a). The amount of fermented Noni fruit extract 44.6 g and amount of water 20 g were used. The amounts of other ingredients were the same.

Formula of Noni Cream (c)

The procedure was the same as described in formula of Noni cream (a) with same ingredients but fermented Noni fruit extract was 34.6 g and water was 30 g.

Preparation of Pain Relieving Cream**Formula of Pain Relieving Cream PR I**

As a primary oil phase, 1 g of stearic acid, 1 g of ethylene glycol distearate, 3 g of light liquid paraffin, 0.3 g methyl hydroxyl benzoate and 0.2 g of propyl hydroxyl benzoate were heated to 70 °C with constant stirring. 1.2 g of cajeput oil, 12 g of menthol, 1g of eucalyptus oil, 8 g of camphor and 0.5 g of propylene glycol were warmed gently to 40 °C and stirred slowly. It was noted as secondary oil phase. Primary oil phase and secondary oil phase were mixed thoroughly and it was noted as Part A. After that, 2 g of polymer was added to the mixture of 54.2 g of water and 15 g Noni leaf extract and then stirred until a thick paste was obtained. Then 0.3 g of triethanolamine was added to this mixture with continued stirring and it was noted as part B. Part A and part B were mixed with constant stirring at 1000 rpm for 4 minutes. Then the prepared cream was poured into sterilized bottles.

Formula of Pain Relieving Cream PR II (a), II (b) and II (c)

Pain relieving cream was prepared by the same procedure as described in formula PR I. In PR II (a) 12 g of Noni leaf water extract and 47.2 g of water, in PR II (b) 22 g of Noni leaf water extract and 37.2 g of water, and in PR II (c) 32 g of Noni leaf water extract and 27.2 g of water were used. But the amounts of other ingredients were the same for these three formulae.

Results and Discussion

The fermented juices were obtained by drip extraction method with different fermentation periods (1 month, 3 months and 6 months). The three months fermentation product was satisfactory because its colour, odour and taste were better than that of the other fermented Noni juices. There was no significant difference in the percent (w/w) yields of fermented juices with

periods as shown in Table (1). The shelf life of all fermented juices without preservative was one year. The compositions and nutritional facts of the 3 months fermented juice and 6 months fermented juice are shown in Table (2). The results were consistent with the literature values. Because of the lower yield of Noni leaf juice, water extract was prepared by using water and ground leaves ratio of 1: 10. The results are shown in Table (3). The vitamin C content of fruit extract and amino acid content of leaf extract are shown in Tables (4) and (5) respectively. Noni fruit extract contains 567.18($\mu\text{g}/\text{mL}$) vitamin C and that value had led to the preparation of skin cream because vitamin C creates a brighter complexion and evens out skin tones, and also diminishes the appearance of fine lines and wrinkles.

Table 1: Percent Yield and Physical Characteristics of Fermented Noni Fruit Extract

Property	Fermentation Period of Fermented Juice		
	1 month	3*months	6 months
Yield, % (w/w)	60.83	66.25	66.44
pH	3.17	3.17	3.16
Specific gravity	1.01	1.03	1.03
Colour	brown	brown	dark brown
Odour	strong smell	pungent	less pungent
Taste	slightly sour	sour	more sour with a bitter taste

* refer to the most favorable fermentation period

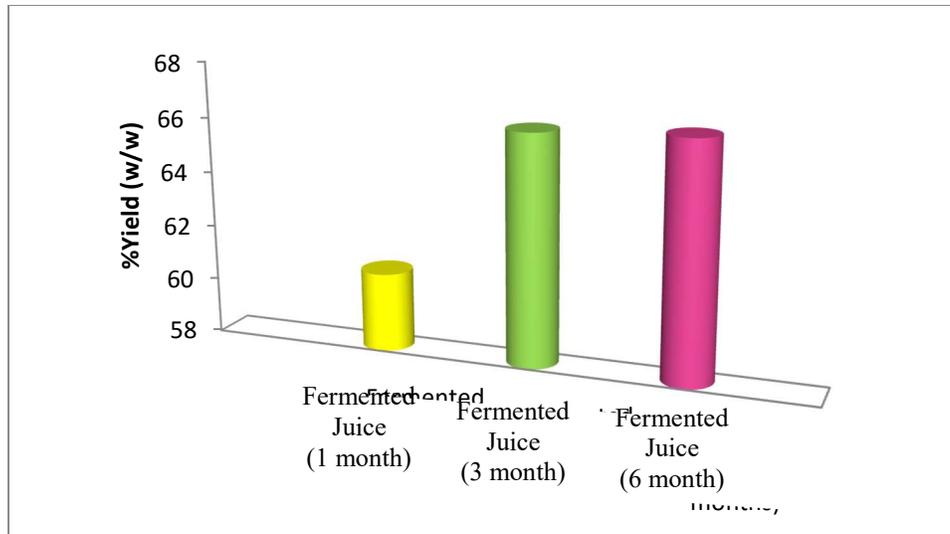


Figure 1: Percent Yields of Noni Juice with Different Fermentation Periods

Table 2: Composition of Noni Fruit Extracts (Juices)

Sr. No.	Constituent/ Nutritional Fact	Fermented Juice % (w/w)		
		(3 months)	(6 months)	*Literature Value
1	Moisture	94.71	95.5	91.6
2	Ash	0.56	0.52	0.46
3	Protein	0.65	0.55	0.39
4	Crude fiber	0	0	0.72
5	Crude fat (ether extract)	0	0	0.14
6	Carbohydrate	4.08	4.08	3.84
7	Energy value (kcal/100g)	20	19	15.4

* refer to (<https://www.University of Hawaii/ctahr/noni/nut...>)

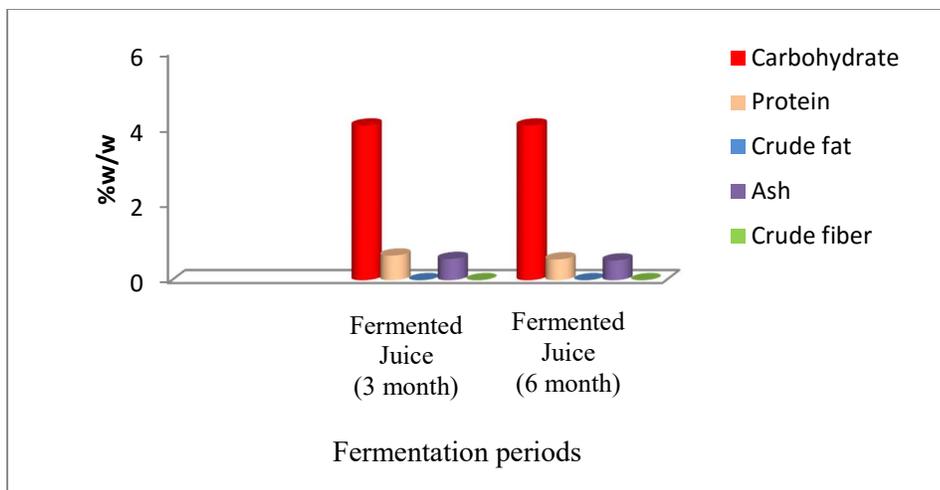


Figure 2: Percent Composition of Noni Juices

Table 3: Percent Yields of Noni Leaf Juice and Water Extract

Sr. No.	Type of Noni Leaf Extract	Yield % (w/w)
1	Leaf juice	18.99
2	Water extract	40.12

Table 4: Vitamin Contents of Noni Fruit Extract

Test Item	Result (µg/mL)	Limit of Detection, (µg/mL)	Test Method
Vitamin A (Retinyl)	ND	1.03	Asian Manual of Food Analysis(2011)
Vitamine E (α-Tocopherol)	ND	1	
Vitamin B ₁	ND	0.05	EN 14122:2003
Vitamin B ₂	ND	0.05	EN 14152:2003
Vitamin C (L-ascorbic acid)	567.18	-	Method for Food Analysis (2003)

The parameters were determined at Food Research and Testing Laboratory, Faculty of Science, Chulalongkorn University, Bangkok, Thailand.

Table 5: Amino Acid Contents of Noni Leaf Juice

Sr.No.	Amino Acid	Result (g/100 g)	Limits of Detection (g/100g)	Test Method
1	Alanine	ND	0.05	Amino Acid Analysis of Protein Hydrolysates by LC-MS/MS
2	Arginine	ND	0.1	
3	Aspartic acid	0.86	-	
4	Cystine	ND	0.14	
5	Glutamic acid	0.25	-	
6	Glycine	ND	0.05	
7	Histidine	ND	0.09	
8	Hydroxylysine	ND	0.1	
9	Hydroxyproline	ND	0.08	
10	Isoleucine	ND	0.08	
11	Leucine	0.12	-	
12	Lysine	0.13	-	
13	Methionine	0.16	-	
14	Phenylalanine	0.13	-	
15	Proline	0.34	-	
16	Serine	0.08	-	
17	Threonine	0.15	-	
18	Tryptophan	ND	0.08	
19	Tyrosine	ND	0.11	
20	Valine	ND	0.07	

The parameters were determined at Food Research and Testing Laboratory, Faculty of Science, Chulalongkorn University, Bangkok, Thailand.

Table 6: Compositions of Noni Creams with Fermented Noni Fruit Extract

Reaction condition	= 70 °C (30min)	Stearic acid	= 15 g
Glyceryl mono stearate	= 5 g	Cetyl alcohol	= 8 g
Petroleum jelly	= 0.5 g	Total	= 100 g
Lanolin	= 2 g	TEA	= 0.35g
Fragrance	= 0.3 ml		

Sample	Olive Oil (g)	Bees Wax (g)	Paraben Mixture (g)		KOH (g)	TiO ₂ (g)	Fermented Noni Fruit Extract (g)	H ₂ O (g)
			Methyl Paraben	Propyl Paraben				
Noni Cream (a)*	3	0.2	0.1	0.05	0.9	0.4	54.6	10
Noni Cream (b)	3	0.2	0.1	0.05	0.9	0.4	44.6	20
Noni Cream (c)	3	0.2	0.1	0.05	0.9	0.4	34.6	30

*the most suitable formula

The larger amount of fermented Noni fruit extract was used in formula of Noni cream (a) and a cream with good texture and white colour was obtained as shown in Table (6). TiO₂ was used to increase the opaqueness and also reduce the transparency of product. Moreover, TiO₂ absorbs and reflects light which can cause products to deteriorate. Moreover in formulating of Noni cream (a) olive oil was used because olive oil contains three major antioxidants: vitamin E, polyphenols and phytosterols. Among the samples of Noni cream with fermented fruit extract, Noni cream (a) was taken as the most suitable formula because it was smooth, spreadable and contained relatively larger amount of fermented Noni fruit extract as shown in Table (9). Table (7) indicates percent composition of Noni pain relieving cream PR I in which Noni leaf extract was found to be 15 %. Table (8) shows the formulation of pain relieving cream samples.

Table 7: Compositions of Noni Pain Relieving Cream, Formula PR I

Sr. No.	Ingredients	% (w/w)	Remarks
1	Noni leaf extract	15.00	A stable emulsion was observed up to 12 months
2	Methyl hydroxy benzoate	0.30	
3	Propyl hydroxy benzoate	0.20	
4	Light liquid paraffin	3.00	
5	Stearic acid	1.00	
6	Ethylene glycol distearate	1.00	
7	Propylene glycol	0.50	
8	Menthol	12.0	
9	Eucalyptus oil	1.00	
10	Cajeput oil	1.20	
11	Camphor	8.00	
12	fragrance	0.30	
13	Triethanolamine	0.30	
14	Water	54.2	
15	Visc Optima SE	2.00	
	Total	100.0	

The compositions of Noni leaf water extract in PR II (a), PR II (b) and PR II (c) were 12 % (w/w), 22 % (w/w) and 32 % (w/w) and respectively. Table (9) shows the characteristics such as pH, colour, viscosity and stability of Noni pain relieving cream samples PR I, PR II(a), PR II(b) and PR II(c). Among these 4 samples, PR I and PR II (a) gave the best results due to their viscosity, smoothness and absence of irritation and redness to skin.



Figure 3: Noni Cream



Figure 4: Noni Pain Relieving Cream

Table 8: Composition of Noni Pain Relieving Cream, Formula PR II (a), II (b) and II (c)

Sr. No.	Ingredients	PR II (a)	PR II (b)	PR II (c)
		% (w/w)	% (w/w)	% (w/w)
1	Noni leaf water extract	12.00	22.00	32.00
2	Methyl hydroxy benzoate	0.30	0.30	0.30
3	Propyl hydroxy benzoate	0.20	0.20	0.20
4	Light liquid paraffin	3.00	3.00	3.00
5	Stearic acid	1.00	1.00	1.00
6	Ethylene glycol distearate	1.00	1.00	1.00
7	Propylene glycol	0.50	0.50	0.50
8	Menthol	12.0	12.0	12.0
9	Eucalyptus oil	1.00	1.00	1.00
10	Cajeput oil	1.20	1.20	1.20
11	Camphor	8.00	8.00	8.00
12	fragrance	0.30	0.30	0.30
13	Triethanolamine	0.30	0.30	0.30
14	Water	57.2	47.2	37.2
15	ViscOptima SE	2.00	2.00	2.00
Total		100.0	100.0	100.0

Note: A stable emulsion was observed up to 12 months

Figures (3) and (4) show prepared Noni cream and pain relieving cream. Figures (5) and (6) present elemental analyses of Noni fruit extract and leaf extract. Figures (7) and (8) depict the elemental analysis of Noni pain relieving cream samples PR I and PR II (a) by EDXRF. It can be concluded that elements potassium and calcium were present in Noni leaf extract were also present in the samples of Noni pain relieving cream.

Table 9: Characteristics of Noni Cream and Pain Relieving Cream using Noni Extract

Sample	pH	Colour	Viscosity (cP)	Emulsion Stability (1 year)	Remarks		
					Smoothness	Spreadability	Absence of irritation, redness
Noni cream (a)*	5.2	white	9310	stable	4	4	5
Noni cream (b)	5.3	white	9440	stable	3	3	5
Noni cream (c)	5.3	white	9460	stable	3	3	5
PR I*	5.5	dark brown	1728	stable	4	4	5
PR II(a)*	6.1	light brown	1484	stable	4	4	5
PR II(b)	5.4	light brown	1384	stable	3	3	5
PR II(c)	5.4	brown	1267	stable	3	3	5

* The most suitable formula Note: 1 = very poor, 2 = poor, 3 = fair, 4 = good and 5 = excellent

Table 10: Elemental Analysis of Fermented Noni Fruit Extract, Noni Leaf Water Extract and Pain Relieving Creams by EDXRF

Sr. No.	Element/Compound	Noni Fruit Extract (mg/L)	Noni Leaf Water Extract, (mg/L)	Noni Pain Relieving Cream	
				PR I (ppm)	PR II(a) (ppm)
1	K	1443.023	5760.107	684.572	308.493
2	Cl	-	1592.749	-	-
3	Ca	-	1307.268	357.660	168.434
4	S	89.982	188.375	-	-
5	Rb	-	32.923	-	-
6	Zn	-	18.287	-	-
7	Fe	17.638	27.403	-	-
8	Cu	8.270	17.280	-	-
9	Mn	-	16.737	-	-
10	Sr	-	15.102	-	-
11	C ₆ H ₁₀ O ₅	12.500 mg/L	12.500 mg/cm ²	-	-
12	H ₂ O		-	99.896	99.952

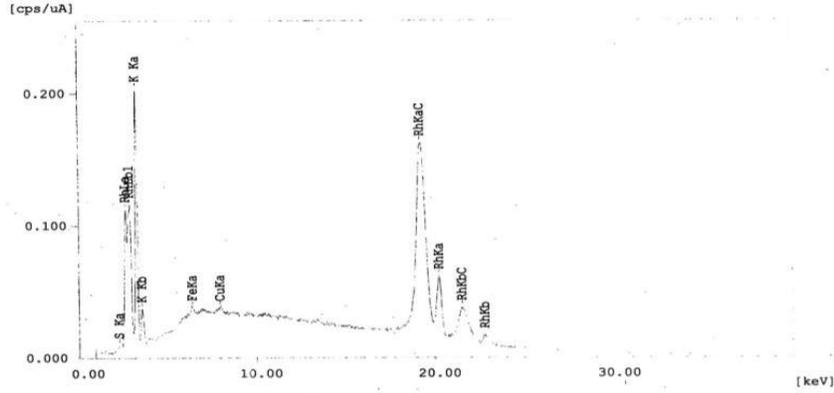
The elements were determined at Universities' Research Centre, Yangon Region.

Sample : Noni Juice
 Operator: OW+OMO
 Comment : filter
 Group : solution filter air
 Date : 2014-11-17 13:52:26



Measurement Condition

Instrument: EDX-720 Atmosphere: Air Collimator: 10(mm)
 TG kV uA FI Acq. (keV) Anal. (keV) Time(sec) DT(%)
 Na-U Rh 50 538-Auto --- 0 - 40 0.02-39.98 Real- 100 40



Quantitative Result

Analyte	Result	[3-sigma]	Proc.-Calc. Line	Int. (cps/uA)
	12.522 mg/cm2	[-----]	Total	
K	1443.023 mg/l	[19.805]	Quan-FP	K Ka 1.3278
S	89.982 mg/l	[19.356]	Quan-FP	S Ka 0.0266
Fe	17.638 mg/l	[2.253]	Quan-FP	FeKa 0.1081
Cu	8.270 mg/l	[2.179]	Quan-FP	CuKa 0.0558
C6H10O5	12.500 mg/cm2	[-----]	Fix	

Figure 5: EDXRF Spectrum of Noni Fruit Extract Sample

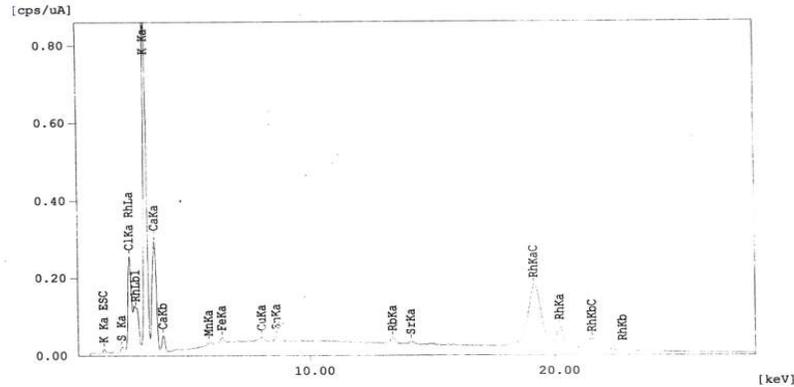
Sample : Daw Ohnmar Kyi Noni leaf
 Operator:
 Comment : for not dried paper
 Group : solution_filter_air
 Date : 2015-11-17 11:53:33



Measurement Condition

Instrument: EDX-720 , Atmosphere: Air Collimator: 10(mm)

Analyte	TG kV	uA	FI	Acq. (keV)	Anal. (keV)	Time (sec)	DT (%)
Si - U	Rh 50	378-Auto	----	0 - 40	0.48-28.20	Live-100	39



Quantitative Result

Analyte	Result	[3-sigma]	Proc.-Calc.	Line	Int. (cps/uA)
	12.627 mg/cm2	[-----]	Total		
K	5760.107 mg/l	[33.295]	Quan-FP	K Ka	6.9274
Cl	1592.749 mg/l	[16.526]	Quan-FP	ClKa	0.9374
Ca	1307.268 mg/l	[11.605]	Quan-FP	CaKa	2.5224
S	188.375 mg/l	[17.166]	Quan-FP	S Ka	0.0860
Rb	32.923 mg/l	[2.567]	Quan-FP	RbKa	0.1853
Fe	27.403 mg/l	[2.079]	Quan-FP	FeKa	0.1745
Zn	18.287 mg/l	[2.098]	Quan-FP	ZnKa	0.1273
Cu	17.280 mg/l	[2.110]	Quan-FP	CuKa	0.1189
Mn	16.737 mg/l	[2.080]	Quan-FP	MnKa	0.0946
Sr	15.102 mg/l	[2.395]	Quan-FP	SrKa	0.0835
C6 H10 O5	12.500 mg/cm2	[-----]	Fix		

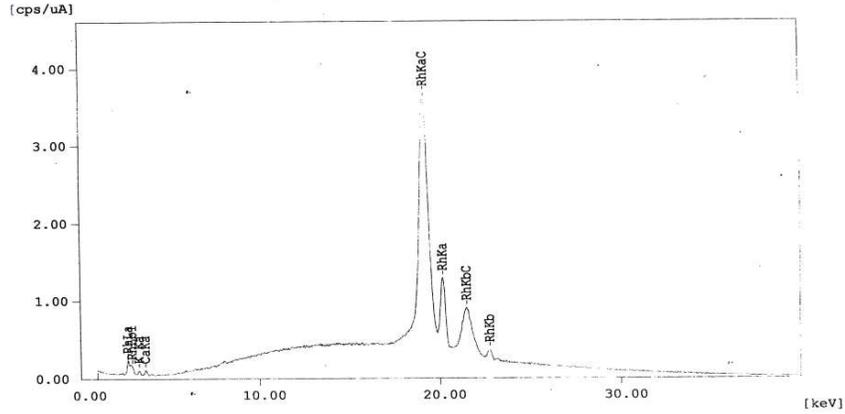
Figure 6: EDXRF Spectrum of Noni Leaf Extract Sample

Sample : Cream S1
 Operator: OW+NTDCS
 Comment : need adapter : 6um mylar
 Group : solution_liquid
 Date : 2015-09-07 13:35:48



Measurement Condition

Instrument: EDX-720 Atmosphere: Air Collimator: 10(mm) Sample Cup: Mylar
 Analyte TG KV uA FI Acq. (keV) Anal. (keV) Time (sec) DT(%)
 Si-U Rh 50 35-Auto ---- 0 - 40 0.02-39.98 Live- 100 40



Quantitative Result

Analyte	Result	[3-sigma]	Proc.-Calc.	Line	Int. (cps/uA)
====[No. 1 Layer]====< Layer1 >=====					
	6.000 um		[-----] Fix		
C10H8O4	100.000 %		[-----] Fix		
====[No. 2 Layer]====< Base >=====					
K	684.572 ppm	[95.170]	Quan-FP	K Ka	0.3775
Ca	357.660 ppm	[45.483]	Quan-FP	CaKa	0.4161
H2O	99.896 %		[-----] Balance		

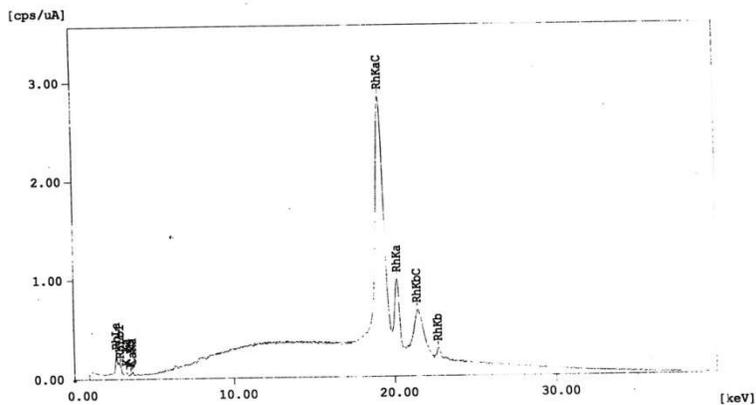
Figure 7: EDXRF Spectrum of Noni Pain Relieving Cream Sample PR I

Sample : Cream S2
 Operator: OW+NTDCS
 Comment : need adapter : 6um mylar
 Group : solution_liquid
 Date : 2015-09-07 13:39:44



Measurement Condition

Instrument: EDX-720 Atmosphere: Air Collimator: 10(mm) Sample Cup: Mylar
 Analyte * TG KV uA FI Acq. (keV) Anal. (keV) Time (sec) DT (%)
 Si-U Rh 50 44-Auto --- 0 - 40 0.00-40.00 Live- 100 39



Quantitative Result

Analyte	Result	[3-sigma]	Proc.-Calc. Line	Int. (cps/uA)
[No. 1 Layer]	Layer1	>		
	6.000 um	[-----] Fix		
	100.000 Å	[-----] Fix		
[No. 2 Layer]	Base	>		
Cl08B04				
K	308.493 ppm	[73.947] Quan-FP	K Ka	0.1702
Ca	168.434 ppm	[35.314] Quan-FP	CaKa	0.1968
H2O	99.952 %	[-----] Balance		

Figure 8: EDXRF Spectrum of Noni Pain Relieving Cream Sample PR II(a)

Conclusion

In this research, cosmetic and medicinal products of Noni were prepared with leaf extract and fermented fruit extract. Good quality fermented Noni fruit extract was obtained within 3 months yielding 66.44 %. The composition of Noni juice is consistent with literature value. Noni cream was prepared with fermented Noni fruit extract due to its vitamin C content of 567.18 µg/mL. In the preparation of Noni cream, amount of ratios of fruit extract and water were varied as 54.6:10, 44.6:20 and 34.6:30. The most

suitable formula is Noni cream (a) which was prepared with 54.6 g of fermented Noni fruit extract and 10 g of water. The creams obtained were smooth, spread easily, no redness and no irritation when applied onto the skin. The emulsion of cream samples was stable up to one year. Noni leaf extracts were prepared as leaf juice and water extract. The pain relieving cream PR I was prepared with 15 g of leaf juice and 54.2 g of water. Moreover, pain relieving cream Pr II (a), II (b) and II (c) were prepared by different ratios of Noni leaf water extract and water i.e 12.0:57.2, 22.0:47.2 and 32.0:37.2. The most suitable formula is PR II (a).

Acknowledgements

I would like to express my greatest appreciation to Dr Khin Hla Mon, Professor and Head, Department of Industrial Chemistry, Dagon University for her permission to submit this research paper. I wish to express my profound respect and deepest gratitude to my supervisor Dr Khin Thet Ni, Professor and Head (Retired), Department of Industrial Chemistry, University of Yangon, and co-supervisor Dr Cho Cho Oo, Professor and Head, Department of Industrial Chemistry, University of Yangon, for their constructive advice and valuable suggestions.

References

- Balsam, M.S and E. Sagarin, 1972. *Cosmetic Science and Technology*, Vol. I. 2nd Edition, John Wiley and Sons, Inc.
- Harry's *Cosmeticology*, 2011. 7th edition, Longman Scientific and Technical Inc.
- Hirazumi, A. and E. Fususawa. 1999. An immuno modulatory polysaccharide-rich substance from the fruit juice of *Morinda citrifolia* (noni) with anti-tumor activity. *Phytotherapy Research*, Vol 13: pp 380–7.
- Hirazumi, A., E. Furusawa, S. C., Chou, and Y. Hokama, 1996. Immunomodulation contributes to anti-cancer activity of *Morinda citrifolia* (noni) fruit juice. *Proceedings of the Western Pharmaceutical Society* Vol 39: pp 7–9.
- Nelson, S. C., & Elevitch, C. R., 2006. *Noni: The Complete Guide for Consumers and Growers*, Gardening – 104.
- <https://www.healingnoni.com>skin-care>
<https://www.UniversityofHawaii/ctahr/noni/nut...>