NUTRITIONAL VALUE OF RED ALGAE *GRACILARIA* FROM SOUTHERN RAKHINE STATE

Tin Tin Maw[1], Ah Nge Htwe[2], Thida Oo[3], Zin Moe Moe[4], Ohn Maung[5]

Abstract

Morphological characters, nutritional value and elements composition of *Gracilaria* were studied. The red algae *Gracilaria* wre collected from Ngapali and Kyauk Phyu in the Southern Rakhine State during 2019. Algae are used as food in different parts of the world. In Rakhine State, a few kinds of marine algae have been harvested for food and algal salad is one of the traditional diet for local people. There is no scientific documents concerning with the edible algae. Edible red algae *Gracilaria* species were generally found in winter season and summer months. In the present research, morphological characters of *Gracilaria* were studied and elements composition and nutritional value were determined. Several constituents of nutritional value are present in red algae *Gracilaria* such as protein 16.57 %, carbohydrate 47.26 %, fiber 5.99 %, fat 0.23 %, ash 14.83 %, moisture 15.12 % and energy value 258 Kcal. Elements composition are Ca 19.24 %, K 23.20 %, S 27.70 %, Si 19.87 % and Fe 7.75 % respectively.

Keywords: *Gracilaria*, nutritional value, marine algae

Introduction

Seaweeds are generally classified into four main groups, largely on the basis of their structure and pigmentation: red algae (division Rhodophyta), brown algae (division Phaeophyta), green algae (division Chlorphyta) and blue green algae (division Cyanophyta). Red seaweeds show a variety of colours, from pink to purple and black. Red and brown algae are usually associated with marine environment, often rocky shores. Many species occur in temperate to tropical water, among which are several of considerable commercial interest. (Reine and Trono 2002)

Since ancient times, seaweeds are a dried food source for humans. In China and Japan, more than 70 species of marine algae are consumed. There is an almost infinite variety of health-care products available commercially lotions, shampoos and soaps, for skin production; against myocardial infarction, diabetes, rheumatism and as a source of vitamins and minerals (Wolfram Braune 2011).

In Myanmar, a total of 307 species of the tropical marine algae dominate along the costal regions i.e the Rakhine costal region, Ayeyarwaddy and the gulf of Mottama costal region and the Tanintharyi costal region (Kyaw Soe and Kyi Kyi Win 1977). Among the benthic marine algae, the Rhodophyta, with more than 42 orders, contains the greatest number of species. Currently, more than 6500 species of red algae are known, but actually may be more than 12000 species. (Norris 2014). Red algae *Gracilaria* is one of the genus in the family Gracilariaceae with more than 100 species worldwide, inhabiting temperate and tropical sea water, covering from intertidal to subtidal areas. *Gracilaria* is used as a food in Japan, Hawaii.

In Myanmar, the genus *Gracilaria* known as Kyauk-kyaw in local name, grown commonly along the Rakhine and Tanintharyi costal region and 15 species of *Gracilaria* were reported (Min Thein and Aung Myint 1977). In the present research, morphological characters, uses, elements composition and nutritional value of edible red algae *Gracilaria* were studied. The aim and

[1] Dr, Associate Professor, Department of Botany, Taunggoke University
[2] Dr, Associate Professor, Department of Botany, Kalay University
[3] Dr, Associate Professor, Department of Botany, Kalay University
[4] Dr, Associate Professor, Department of Botany, Taunggoke University
[5] Dr, Processor, Department of Botany, Taunggoke University

objective in this research are to know uses and morphological characters of *Gracilaria* and to analyze elements composition and to analyze nutritional value of *Gracilaria.*

Materials and Methods

Edible red algae *Gracilaria* were studied for nutritional value, elements composition and morphological characters. *Gracilaria* were collected from Ngapali (Lat. 18°37' N, Long. 94° 33' E) and Kyauk Phyu (Lat. 19° 15' N, Long. 93° 61' E) in Southern Rakhine State of Myanmar from 2018 to 2019. Ngapali and Kyauk Phyu costal region consists of larges beach and some rocky area.

The location were measured by GPS (Global Positioning System). In collection field, temperature and p^H of collected water were measured by thermometer and p^H meter. The fresh specimens of *Gracilaria* were collected during low tide and wash with water to remove the adhering materials such as sand particles, rocks, shell, mud and other debris. Morphological characters of fresh specimens were identified and record with the photograph by digital camera. Identification of specimens were made by mainly base on the following taxonomic references; Kyaw Soe (1977), Soe Htun (1984), Kyi Win (1972), Norris (2014). Photogeography and potential uses of these algae were acknowledged from the worldwide literature records.

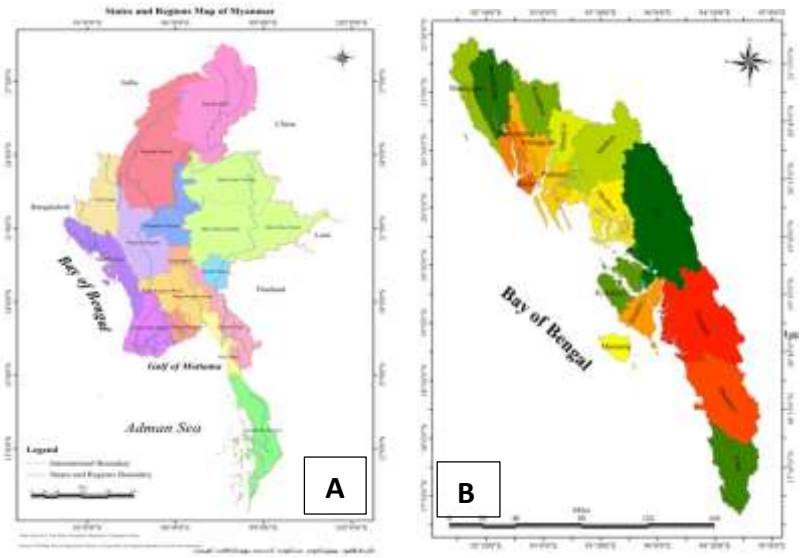


Figure 1 Map showing the collection sites of sample and study areas
A. Location map of Rakhine State in Myanmar
B. Location map of Township in Rakhine State

Determination of nutritional value and elements composition

The fresh *Gracilaria* were collected and dried in room temperature. Dried *Gracilaria* were ground into powder for determination of elements composition and nutritional value. The analysis of element composition were carried out at Department of Chemistry, Monywa University. All the determination of nutritional value were carried according to laboratory procedures at Myanmar Food Processors and Exporters Association (MFPEA), Yangon Region.

Protein content of *Gracilaria* were determined by Kjeldahl method. Ash content was obtained by burning it and were calculated combustion, Muffle Furnace method. Moisture content were estimate by Moisture Analyzer. Determination of water soluble carbohydrate by Phenol-

Sulphuric Colorimetric method was made and determination of crude fat was done by Buchi Soxhlet Extraction method.

Results

Gracilaria are red algae (sea weed). It grow abundantly on rock, coral, mangrove root and on intertidal mud flats. *Gracilaria* species were collected from Ngapali and Kyauk Phyu in southern Rakhine State. In Ngapali beach, the water temperature was 25°C and pH was 7.8 and water temperature of Kyauk Phyu was 23°C, pH was 7.4 respectively.

In this result, 3 speices of *Gracilaria* were found in Ngapali and Kyauk Phyu, namely *G. crassa* Harvey; *G. edulis* (J. Ag) Silva and *G. follifera* (Forssk.) Borgesen, *Gracilaria* species were collected by costal communities for food used either as a salad after blanching with hot water or a source of homeprepared agar. *Gracilaria edulis* (J. Ag) Silva described morphological characters.

Morphological Characters of *Gracilaria edulis* (J. Ag) Silva.

Division - Rhodophyta

Class - Florideophyceae

Order - Gracilariales

Family - Gracilariaceae

Scientific Name - *Gracilaria edulis* (J. Ag) Silva

Myanmar Name - Kyauk-Kyaw

Thalli up to 20 cm tall, brownish red, each arising from a discoid hold fast, branching dense and fastigiated, divaricate, dichotomus to trichotomous, up to 7 orders and with long branch intervals; branches 1-1.5 mm in diameter, cartilaginous, flexuous, with or without a constriction at their base or with only a slight constriction, cylindrical, ending in pointed apies.

Figure 2 Habit of *Gracilaria edulis* (J. Ag) Silva.

Morphological Characters of *Gracilaria crassa* Harvey.

Division - Rhodophyta

Class - Florideophyceae

Order - Gracilariales

Family - Gracilariaceae

Scientific Name - *Gracilaria crassa* Harvey.

Myanmar Name - Kyauk-Kyaw

Figure 2 Habit of *Gracilaria crassa* Harvey.

Thalli more than 30 cm tall, green red, coarse, cartilaginous, with disc-shaped holdfast; frond cylindrical; branching at short intervals, profusely or more scarcely irregular; branches 4-7 mm in diameter, thick, succulent, branch based of only the long branches constricted.

Morphological Characters of *Gracilaria follifera* (Forssk) Borgese.

Division - Rhodophyta
Class - Florideophyceae
Order - Gracilariales
Family - Gracilariaceae
Scientific Name - *Gracilaria follifera* (Forssk) Borgese.
Myanmar Name - Kyauk-Khat

Figure 2. Habit of *Gracilaria follifera* (Forssk) Borgese.

Thalli usually bushy, more than 5 cm tall, dark red or purple red, arising from a small discoid base, regularly dichotomously branched with entire margins; ranch 2-15 mm wide, divaricate, dictotomus to trichotomous, flattened, fleshy to cartilaginous.

Preparation of *Gracilaria* algal salad

Edible red algae *Gracilaria* (seaweed) are maintly harvested from natural habitats. Harvested plant of *G. edulis* should be cleaned and dried packed in bags and stored in dry place. Dried and fresh *Gracilaria* were sold in the local market. Dried and fresh form of *Gracilaria* were used as vegetable and home-made agar. That are eaten in the form of algal salad.

To prepare algal salad, *Gracilaria* were washed well with water and blanching with hot water. The juice from lemon were squeezed and poured into *Gracilaria* and then these *Gracilaria* with salt, pea nut oil, green onion, garlic and chilli are also mixed with it. After, that are eaten in the form of algal salad were shown in figure 3.

(a) Dry *Gracilaria*

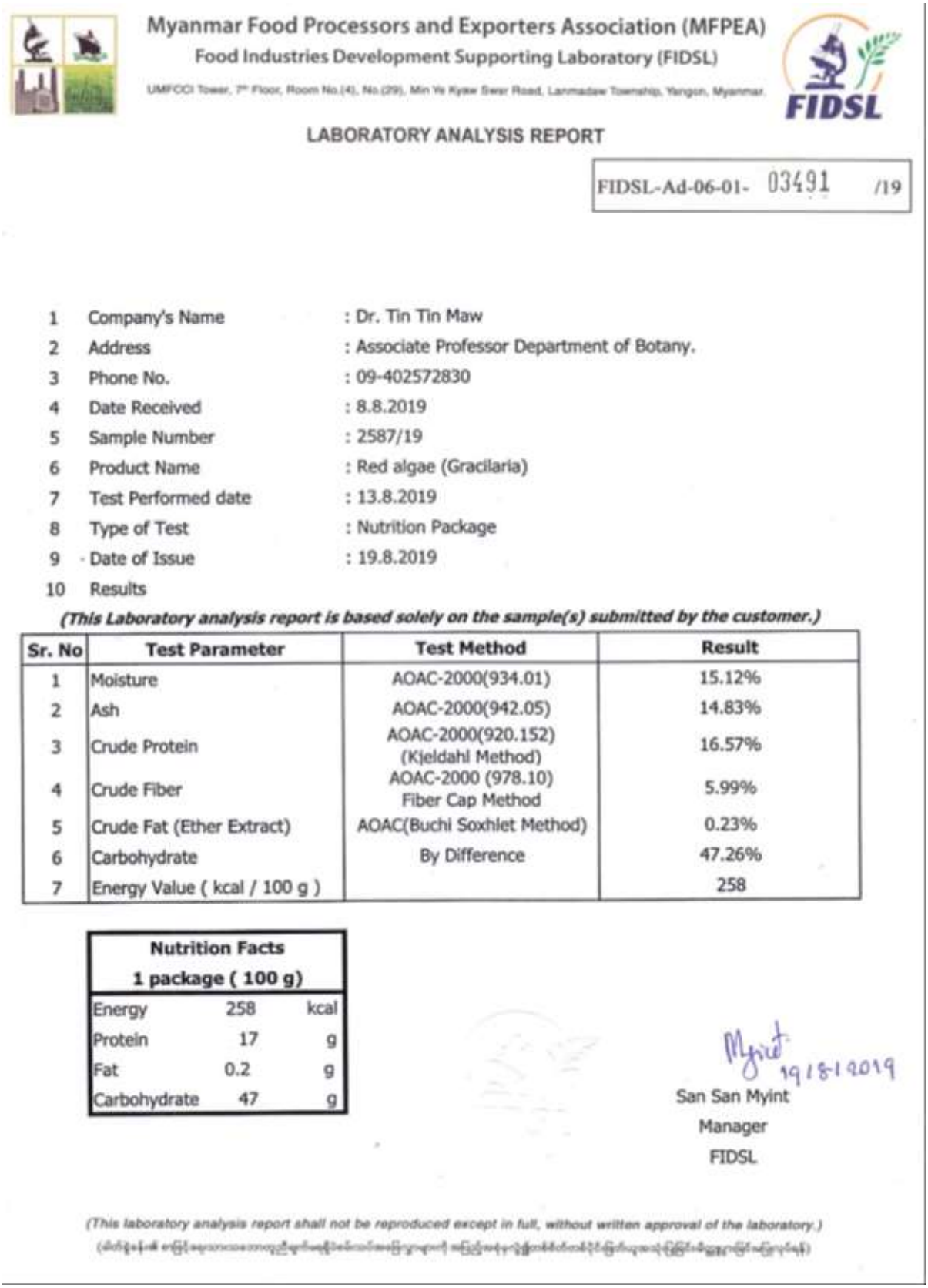
(b) Fresh *Gracilaria*

(c) *Gracilaria* algal salad

Figure 3 Preparation of *Gracilaria* algal salad

Nutritional value and elements composition of *Gracilaria*

Nutritional value analysis of *Gracilaria* include percentage of protein, carbohydrate, lipid, ash, moisture, fiber and energy value were shown in figure 4.



Myanmar Food Processors and Exporters Association (MFPEA)
Food Industries Development Supporting Laboratory (FIDSL)
UMFCCI Tower, 7th Floor, Room No.(4), No.(29), Min Ye Kyaw Swar Road, Lanmadaw Township, Yangon, Myanmar.
FIDSL

LABORATORY ANALYSIS REPORT

FIDSL-Ad-06-01- 03491 /19

1	Company's Name	: Dr. Tin Tin Maw
2	Address	: Associate Professor Department of Botany.
3	Phone No.	: 09-402572830
4	Date Received	: 8.8.2019
5	Sample Number	: 2587/19
6	Product Name	: Red algae (Gracilaria)
7	Test Performed date	: 13.8.2019
8	Type of Test	: Nutrition Package
9	Date of Issue	: 19.8.2019
10	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	15.12%
2	Ash	AOAC-2000(942.05)	14.83%
3	Crude Protein	AOAC-2000(920.152) (Kjeldahl Method)	16.57%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	5.99%
5	Crude Fat (Ether Extract)	AOAC(Buchi Soxhlet Method)	0.23%
6	Carbohydrate	By Difference	47.26%
7	Energy Value (kcal / 100 g)		258

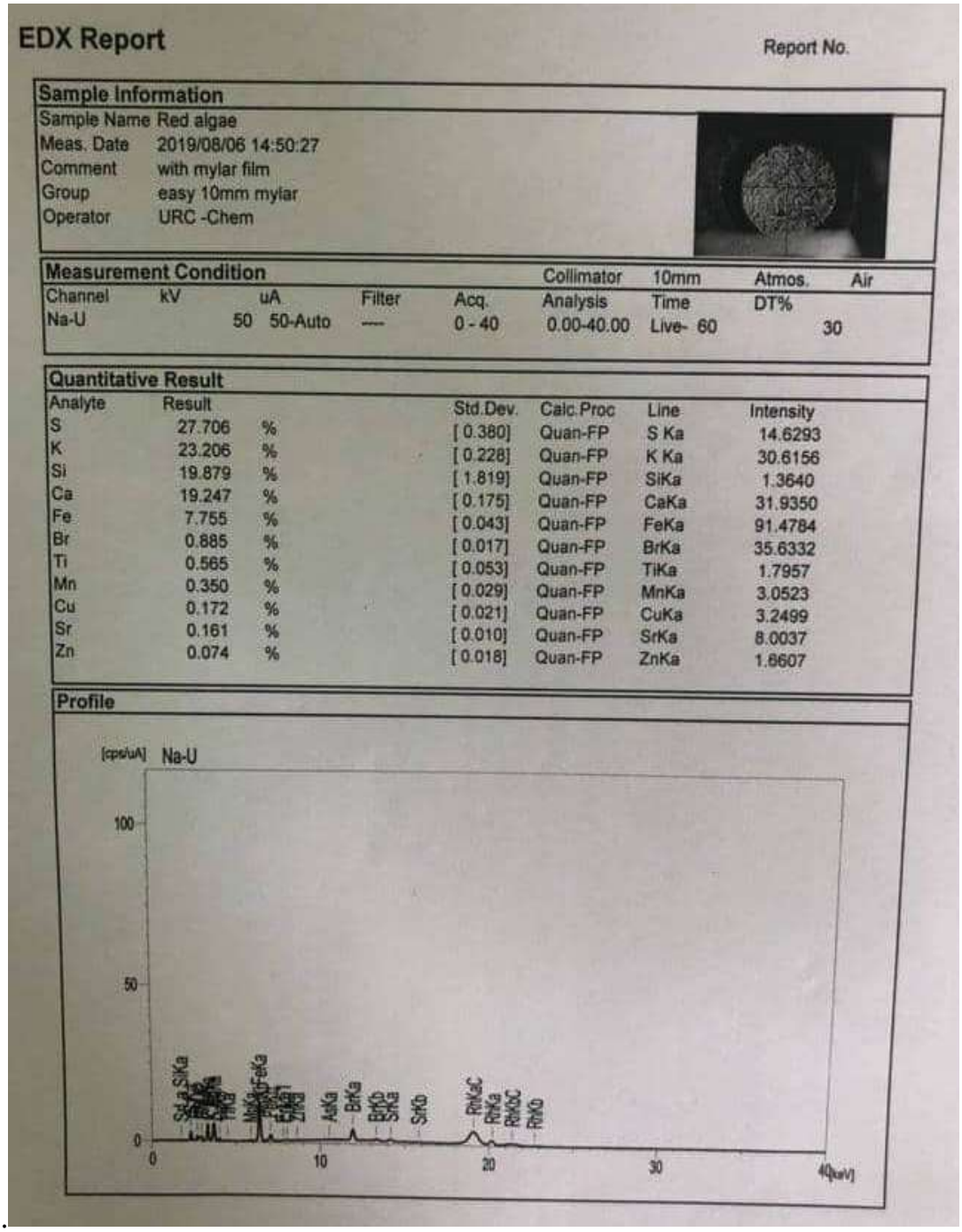
Nutrition Facts 1 package (100 g)		
Energy	258	kcal
Protein	17	g
Fat	0.2	g
Carbohydrate	47	g

19/8/2019
San San Myint
Manager
FIDSL

(This laboratory analysis report shall not be reproduced except in full, without written approval of the laboratory.)

Figure 4 Nutritional value analysis report of *Gracilaria*

Elements composition of *Gracilaria* were shown in Figure 4.



EDX Report

Report No.

Sample Information

Sample Name	Red algae
Meas. Date	2019/08/06 14:50:27
Comment	with mylar film
Group	easy 10mm mylar
Operator	URC -Chem

Measurement Condition

Channel	kV	uA	Filter	Acq.	Collimator	10mm	Atmos.	Air
Na-U	50	50-Auto	----	0 - 40	Analysis	Time	DT%	
					0.00-40.00	Live- 60	30	

Quantitative Result

Analyte	Result		Std.Dev.	Calc.Proc	Line	Intensity
S	27.706	%	[0.380]	Quan-FP	S Ka	14.6293
K	23.206	%	[0.228]	Quan-FP	K Ka	30.6156
Si	19.879	%	[1.819]	Quan-FP	SiKa	1.3640
Ca	19.247	%	[0.175]	Quan-FP	CaKa	31.9350
Fe	7.755	%	[0.043]	Quan-FP	FeKa	91.4784
Br	0.885	%	[0.017]	Quan-FP	BrKa	35.6332
Ti	0.565	%	[0.053]	Quan-FP	TiKa	1.7957
Mn	0.350	%	[0.029]	Quan-FP	MnKa	3.0523
Cu	0.172	%	[0.021]	Quan-FP	CuKa	3.2499
Sr	0.161	%	[0.010]	Quan-FP	SrKa	8.0037
Zn	0.074	%	[0.018]	Quan-FP	ZnKa	1.8607

Profile

Figure 5 The EDX report of *Gracilaria*

Discussion and Conclusion

In the present study, the three species of *Gracilaria* were found in study areas namely *G. crassa* Harvey., *G. edulis* (J. Ag.) Silva. and *G. follifera* (Forssk.) Borgesene. The species of *Gracilaria* were eaten in Southern Rakhine state. Morphological characters of *Gracilaria edulis* (J.Ag) Silva reported in this research that are thalli up to 20 cm tall, brownish red, each arising from a discoid hold fast, branching dense and fastigiate, divariacate, dichotomus to trichotomous, up to 7 orders and with long branch intervals. Reine and Trono (2002) reported that taxonomic description of red algae *Gracilaria.* Norris (2014) described that traxonomy and nomenclature of

red algae species. Braune (2011) stated that morphological character, distribution and uses of *Gracilaria.*

In this results, edible *Gracilaria* species were harvested by native people as food in southern Rakhine State. *Gracilaria* are eaten in the form of algal salad and home-made agar. Nutritional value and element composition of red algae *Gracilaria* were emphasized. The nutritional value contents of *Gracilaria* are protein 16.57 %, carbohydrate 47.26 %, fiber 5.99 %, ash 14.83 %, moisture 15.12%, fat 0.23 % and energy value 258 Kcal. Moreover Ca 19.2 %, S 27.70 %, Fe 7.75 % and other elements are also present.

Than Nyunt and Hla Hla Cho (1975) reported that the extraction of agar from some species *Gracilaria.* Kyaw Soe (1977) stated that *Gracilaria* species were used as food and agar extraction. Reine and Trono (2002) described that uses, nutritional value and chemical products of marine macroalgae. They reported that algae are used as vegetable, medicinal uses, animal feed and producers of phycocolloids.

Arasaki (1983) reported nutritional value and elements composition of sea vegetables. He stated that nutritional values of red seawed *Gracilaria* sp. were protein 7.9 %, fat 0.05 %, carbohydrate 58.4 %, fiber 3.0 % and ash 17.8 % respectively. Moreover, sea vegetables contain more minerals than other kind of food. An extremely wide range of minerals accounts for from 7 to 38 % required by human beings, including calcium, sodium, magnesium, potassium, phosphorus, iodine, iron, and zinc are present in sufficient amounts. The high amount of calcium in sea vegetables, if all nutritionally effective, would make them the richest food after milk. The iron content of sea vegetables in from two to more than ten times that of egg yolks and spinach. Brown algae are very high in iodine content. Iodine 0.1 to 0.2 mg required by a normal adult or 0.2 mg needed by children and pregnant women.

Marine algae have been used as food not only in Myanmar but also in other countries. In this result, local people especially Taunggoke, Ngapali, Thandwe, and Kyauk Phyu from Southern Rakhine State are used red algae *Gracilaria* as seasonal food to prepare algal salad and home made agar. *Gracilaria* species are considered to be an important source for diet and food additive because it high content of protein, carbohydrate and minerals. These experimental results may be useful for local people who are collecting and selling the dried *Gracilaria* in the local markets. Moreover, agar can be extracted from the *Gracilaria* spp. (Than Nyunt and Hla Hla Cho 1975). Due to a lack of technology for mass production of agar form *Gracilaria* sp; there is no agar industry in Myanmar. Natural beds of *Gracilaria* remain unexploited and the only seaweed pilot-form of *Gracilaria edulis* in Maung Shwe lay Gyaing, Thandwe, in the Rakhine state, stopped successful production, due to lack of demand for an agar industry by local users (Soe Htun 1998).

To fiulfill the domestic demands for agar, collaboration between scientists and potential investors are required to establish a viable agar industry in Myanmar. However, it is expected that the abundance of natural beds of *Gracilaria* will lend support to the development of modern alginate factories in our country. The study of this research will inform the nutritional value and elements composition of *Gracilaria* for researchers. Further investigation should be made other edible marine algae for the purpose of mass production and commercial scale.

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