STUDIES ON THE EXTRACTION OF ALGINIC ACID FROM SOME SPECIES OF PHILIPPINE SARGASSUM

By Jose I. Sulit and Regina C. San Juan
Of the Bureau of Fisheries, Manila

THREE PLATES

INTRODUCTION

The determination of alginic acid from brown algae was reported by Davis (1950) and by Steriner and McNeely (1951). The latter authors enhanced the utility of alginic acid as emulsifier by converting it to propylene glycol alginate. Such form of alginic acid derivative exhibits high viscosity property even at low concentration. Another form of alginic acid salt is algin, popularly known as sodium alginate.

Alginic acid in both forms of inorganic and organic esters has found commercial acceptance as a thickening and emulsifying agent. Calcium alginate, an insoluble inorganic salt of alginic acid, is popularly used as surgical thread. It is highly recommended in sewing internal wounds because the thread gradually dissolves, especially in alkaline medium (Cady, 1948).

Woodward (1951) reported that Great Britain made no less than 500,000 pound sterling annually in the production of alginate chemicals from seaweeds.

Sargassum, a brown alga seaweed is a universal marine plant. Stretching from Alaska to Mexico is a wide span of sargassum seaweeds often encountered by seamen in certain parts of the year. Off the shores of the Atlantic Ocean extending to the Bahamas and the surrounding waters of Scotland and Ireland, the sargassum abounds in great quantities.

In the marine waters surrounding many islands of the Philippine Archipelago, legendary reports of sailors and seamen described the endless span of floating sargassum seaweed that oftentimes obstructed the progress of navigation.

It is for this abundance of raw materials that a preliminary study was conducted to evaluate this potential important source of alginic acid and probable utilization of the waste material in the manufacture of commercial inorganic fertilizer.

MATERIALS AND METHODS

Nine species of sargassum (Table 1) were harvested from various parts of Philippine marine waters in different seasons of the year.

In this study the sargassum seaweeds harvested off the coast of Lingayen Gulf and Hundred Islands, Pangasinan Province, were used.

Harvesting the seaweeds.—The floating seaweeds were gathered off the coast of Lingayen Gulf and the Hundred Islands, Pangasinan Province. They were washed with fresh water and dried immediately in the shade with circulating air to avoid bacterial fermentation as much as possible.

After segregation and proper identification [1] the seaweeds were mounted and photographed (Plates 1–3).

TABLE 1.—*Sources of Philippine sargassum and date of harvest.*

Scientific name	Date of harvest	Places where found
Sargassum duplicatum J. Ag.	1951	Zamboanga City.
Sargassum enerve C. Ag.	May, 1953	Hundred Islands, Lingayen Gulf.
Sargassum hemiphyllum C. Ag.	May, 1953	Hundred Islands and vicinity
Sargassum gigantifolium Yamada	September 1, 1952	Coron Bay, Palawan
Sargassum kjellmanianum Yendo	September, 1952	Coron Bay, Palawan.
Sargassum nigrifolium Yendo	May, 1953	Hundred Islands and vicinity
Sargassum patens Ag. var. *schisophylla* Yendo	May, 1953	Pangasinan Province.
Sargassum serratifolium C. Ag.	January, 1953	Hundred Islands and vicinity
Sargassum siliquosum C. Ag.	1951	Lingayen Gulf. Hundred Islands, Lingayen Gulf. Zamboanga City.

TABLE 2.—*The proximate chemical composition and mineral content of some species of Philippine sargassum.*

Scientific name	Moisture	Ash	Fats	Protein (Nx6.25)	Computation based on the ash	
					Calcium	Potassium
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Sargassum enerve C. Ag.	9.98	21.07	0.76	10.27	1.41	2.64
Sargassum hemiphyllum C. Ag.	8.78	12.21	1.17	11.48	2.56	1.10
Sargassum nigrifolium Yendo	15.18	17.72	1.19	7.06	2.50	1.56
Sargassum serratifolium C. Ag.	10.05	13.43	1.38	7.68	2.05	0.79
Sargassum siliquosum C. Ag.	7.04	20.77	2.09	7.67	3.21	1.66

Extraction of alginic acid.—The principles involved in the extraction of alginic acid were based on the conversion of

[1] The identification of various species of sargassum was made by Jose S. Domantay, Ichthyologist, Bureau of Fisheries.

alginic acid with sodium carbonate and regeneration of the free alginic acid with acid. The method of extracting the alginic acid is described as follows:

1. *Leaching.*—Two hundred fifty grams of five species of the air-dried seaweeds was leached with a dilute solution of hydrochloric acid (0.33 per cent) for at least three hours. The leached seaweeds were washed thoroughly with fresh water, dried and then cut into fine pieces.

2. *Digestion with sodium carbonate solution.*—The chopped seaweeds were treated with five liters of 4 per cent sodium carbonate solution and set aside overnight. The pH was maintained between 9 and 10. The next day the digested material was homogenized. The resulting thick paste was treated with enough 6 N-hydrochloric acid until all the crude alginic acid was completely precipitated. After washing with enough 95 per cent alcohol the precipitate was filtered off and then dried under vacuum (Table 3). The dark-brown crude alginic acid was purified by washing it several times with 95 per cent alcohol, and drying it under vacuum until a light-brown amorphous alginic acid was obtained.

TABLE 3.—*Showing the acid contents of some species of sargassum and other brown algae found in Philippine marine waters.*

Scientific name	Moisture	Alginic acid	
		Fresh basis	Dry basis
	Per cent	*Per cent*	*Per cent*
Sargassum enerve C. Ag.	9.98	25.60	28.44
Sargassum hemiphyllum C. Ag.	8.78	26.00	28.50
Sargassum nigrifolium Yendo	15.18	26.00	28.31
sargrassum serratifolium C..Ag.	10.05	25.20	28.02
Sargassum siliquosum C. Ag.	7.04	26.32	30.65
Turbinaria sp.	9.45	19.00	20.09
Hydroclothrus sp.	10.54	16.70	18.62

The stabilizing property of alginic acid in the form of sodium alginate was tested with coconut syrup prepared as follows:

(*a*) *Preparation of syrup:*

Refined sugar	grams—	900
Water	ml—	450
Hydrochloric acid (10 per cent)	do—	1.5

The mixture was heated to 120° C. or until a clear invert sugar solution was obtained.

(*b*) *Preparation of coconut cream.*—To two parts of grated

the mixture squeezed to extract the milk. The mixture was pressed and the milk strained through sinamay cloth to remove the coconut pulp.

The milk was allowed to stand for one hour and the water portion was separated from the cream by syphoning.

Preparation of coconut syrup, commercial name (coco-honey):

Coconut cream	grams—	200
Invert sugar (syrup)	do—	100

The above mixture was heated to 106° C. using varying amounts of alginic acid dissolved in 4 per cent sodium carbonate solution as stabilizer, the percentages enumerated as follows: 0.1, 0.2, 0.3, 0.5, 0.7, 1.0, 1.2, 1.4, 1.7, and 2.0.

The products were transferred to 250 ml beakers, covered and set aside to be observed for separation studies.

RESULTS AND DISCUSSION

Percentage of alginic acid.—The alginic acid content of all the species of sargassum used in this study is quite high and may be used in the production of commercial alginate chemicals (Table 3).

Chemical analysis.—Table 2 shows the proximate chemical composition and calcium and potassium contents of several species of sargasum. Because of the high amount of mineral present in the ash in the forms of calcium and potassium, the seaweeds may be useful as a fertilizer.

Stabilizing property of alginic acid.—The stabilizing property of alginic acid in the form of sodium alginate was tested with coconut syrup, or "coco-honey". In the experiments using various percentages of alginic acid, such as 0.1, 0.2, and 0.3, there was separation of the product, signifying that the amounts were too small to avoid separation.

From 0.5 per cent and above, no separation in the finished product was noticed. It is quite evident, therefore, that the least amount of alginic acid to stabilize the coconut syrup was 0.5 per cent.

Coconut syrup is a local commercial product that found its way in the international market but the main defect of this product is the tendency to separate upon storage. The use, therefore, of alginic acid in the form of sodium alginate is highly recommended in the light of the aforementioned studies.

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ILLUSTRATIONS

PLATE 1

FIG. 1. *Sargassum siliquosum* J. Ag., collected from Zamboanga City.
2. *Sargassum serratifolium* C. Ag., collected from Hundred Islands, Lingayen Gulf, Pangasinan Province.

PLATE 2

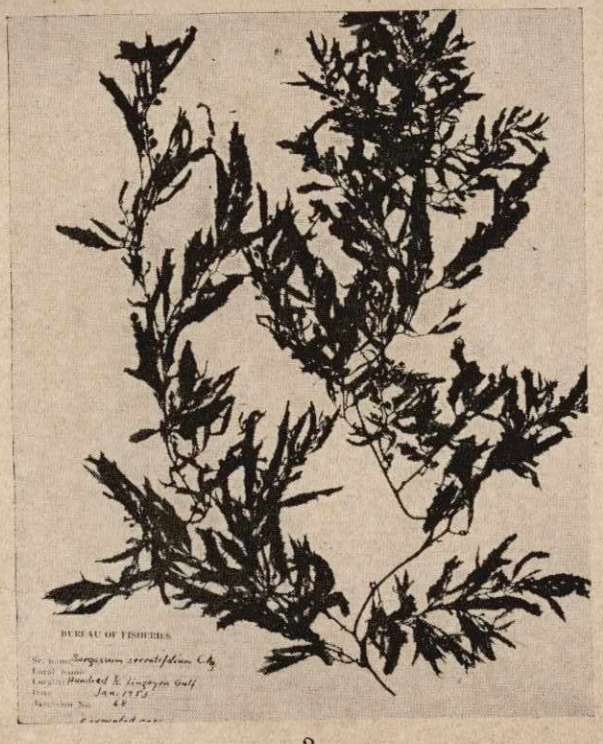
FIG. 1. *Sargassum enerve* C. Ag., lower frond; collected from Hundred Islands and vicinity, Pangasinan Province.
2. *Sargassum hemiphyllum* C. Ag., lower frond; collected from Hundred Islands and vicinity, Pangasinan Province.

PLATE 3

Sargassum nigrifolium Yendo, collected from Hundred Islands and vicinity, Pangasinan Province.


BUREAU OF FISHERIES
Sargassum siliquosum J. Ag.
Zamboanga, City
1931

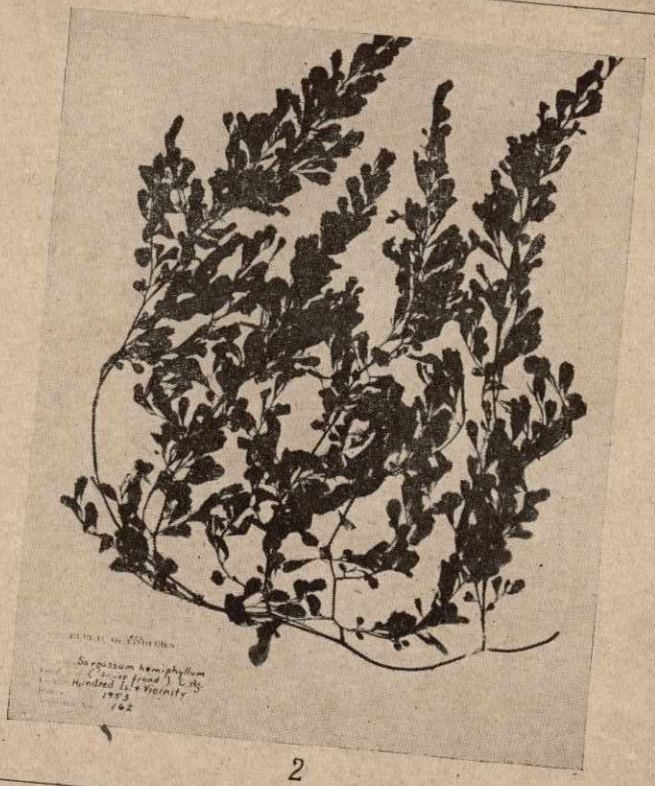
1


BUREAU OF FISHERIES
Sargassum serratifolium C. Ag.
Hundred Is. Lingayen Gulf
Jan. 1913

2

PLATE 1.

1



2

PLATE 2.

1