Organic Carbon in the Sediment of Cockle Culture Area at Bandon Bay, Thailand

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Abstract**—**Soil organic carbon is the carbon contained within soil organic matter that influences soil characteristics and nutrient accumulation. The study was aimed to determine organic carbon of sediment in cockle culture area at Bandon Bay, Thailand. Sample collection was performed at 6 stations cover the east and the west coast of the Bay during rainy season (June and August, 2013) and summer (March, 2014) and the samples were cut into seven layers, each 1 cm depth, before analyzed. It was found that organic carbon accumulated in sediment varied by season and depth. The crumbly clay sediments in the east coast showed the high amount of organic carbon than the sandy soil in the west coast. Organic carbon contents were in the range of 0.19±0.11 to 0.91±0.12, 0.06±0.00 to 0.69±0.03 and 0.08±0.04 to 0.63±0.04% in June, August, and March, respectively. The high amount of organic carbon was found in rainy season (0.06±0.04 to 0.91±0.12%) compared to summer (0.08±0.04 to 0.63±0.04%) and the content was shown in the deep soil layer (3-6 cm) more than the top layer. The pH value of the soil during rainy season expressed a mild acid to neutral, while neutral pH to light alkaline was found in summer. The results indicated that accumulation of organic carbon related to the high utilization in the east area resulted in the release of organic substances in the water and the nature of the clay sediments so favorable to the accumulation of organic carbon.

Keywords**—**sediment, organic carbon, Bandon Bay

I. Introduction

The abundance of Bandon Bay, an important coastal area in the south of Thailand, comes from the flowing of rivers into the bay, mainly Tapi River, the largest and longest river in the south. The rivers had accumulated the amount of various fossils, organic matter and trace minerals during flow through several districts before released into the Bay. The mixing of river flow with seawater caused the settling of perfect condition of sediment in the floor where presented the suitable area for aquaculture, especially blood cockle, one of the most economic aquatic animals in Thailand. As the nature of cockle habitats in mud or clay, they use foot movement to find food, avoid enemies and find the appropriate environment. Cockles come up to the water surface to find food then embed on the sediment to prevent the loss of water outside the shells.

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Fertility and thickness of clay should be considered for the nutrients deposit. It is truth that how grown of shellfish relies on many factors, especially the right of the area and the abundance of sediment is critical to the growth and survival. Salinity, water temperature and conditions of sediment such as nutrients, pH and dissolved gases are reported to effect cockle's living. pH plays the important role in biochemical reactions, maintains homeostasis, involves enzymes working, influences nutrient uptake and also controls the presence or activity of many micro-organisms.

Sediment is necessary habitat for epifauna and infauna that are responsible for the transfer energy through the food chain and the cycle of nutrients in the sea [1]. The nutrients in sediment liberated from runoff from the land, sediment water and natural resources [2].Organic carbon is a key parameter of the soil. It is an index showing the amount of organic matter in the soil and plays important roles on the properties and fertility of soil as well. It was occurred through a degradation process in aerobic and anaerobic condition [3].In general, the average of 0.5-5% organic matter found in soils [4]. Therefore, the study of organic carbon in aquaculture area mainly cockle farm aimed to know the nature and quality of the sediment is very important aspect. It has contributed to explain the characters of the environment area and led to know the relationship of cockle production occurred in the western and eastern side of the bay and the condition of the place. It's used as primary information in deciding the place which is suitable for aquaculture in the future.

II. Meterials And Method

The study of organic carbon content of the sediment in cockle farm during rainy season (June 2013 and August 2013) and summer (March 2014) was investigated. Sampling sites were assigned into 6 stations; station 1, 2 and 3 represented for the east coast (Kanchanadit district) and station 4, 5 and 6 for the west (Chaiya district) of Bandon Bay (Figure 1). Sediment samples collected by hand corer were dissected into 7 layers (1 cm each) by depth, kept in plastic bag and frozen at -20 °c until analysis. Total organic carbon was determined according to [5]. The weight of 0.3 gram soil sample was added with 5 ml potassium dichromate ($K_2Cr_2O_7$) and 10 ml conc. sulfuric acid (H_2SO_4) before mixing well and left for 1-2 min. The solution was diluted with distilled water into 100 ml and filled with 5 ml orthophosphoric acid (H_3PO_4) and 0.1 gram of sodium fluoride. The solution was then titrated with 0.5N ferrous sulfate ($FeSO_4.7H_2O$) using diphynylamine as an indicator. The volume of titration was recorded and calculated as the formula;

$$\text{Organic carbon}(\%) = \frac{(b-s)\times 0.5N\times 0.3}{w\times 77}\times 100$$

where, b = blank titre,

s = sample titre,

0.5N = normality of ferrous sulphate solution and,

w = weight of soil sample

Sample collection and analysis

Statistical analysis of data

Data were analyzed by comparing average and analysis of organic carbon in the sediment of each area and time of sample collection by Analysis of Variance (ANOVA) at 95% confidence level ($p<0.05$).

Fig1. Sampling site around Bandon Bay, Surat Thani Province, Thailand

III. Result And Discussion

A. Sediment in Bandon Bay

The nature of sediment in the east and west coast of Bandon Bay seemed quite different. In the east coast, the sediment was shown as loamy soil, sandy loam soil and loamy sand, while at west coast consisted of sandy soil and sandy loam crumbly (Fig. 1). The difference of soil texture is rather important because the physical properties have influenced the other properties such as water holding, capacity of ion exchange, and also particle size of the organic constituents in the soil. Clay soil is fine, highly flexible, good water holding capacity, easily to exchange nutrients and accumulates a lot of nutrients. Sandy soil is large particle size, less water holding, good circulation but low capacity to accumulate nutrients.

The different in soil texture of the area resulted to affect growth and productivity of benthic habitat, especially cockles that embedded and encountered the condition of the soil.

B. Organic carbon in the sediment of cockle farm

Organic carbon accumulated in sediment of cockle culture area in rainy season at station 1,2,3,4,5 and 6 (Fig. 1) was shown in the range of 0.28±0.03 to 0.91±0.12 , 0.22±0.15to 0.65±0.07 , 0.19 ± 0.06 to 0.67±0.03 , 0.15±0.03 to 0.37±0.21 ,0.08±0.04 to 0.67±0.08 and 0.11±0.04 to 0.56±0.08%

while the content in summer was0.22±0.04 to 0.58±0.06 , 0.32±0.06 to 0.58±0.00 , 0.24±0.10 to 0.63±0.04, 0.35±0.07 to 0.63±0.04, 0.19±0.00 to 0.43±0.04 and 0.08±0.04 to 0.24±0.04%, respectively (Fig. 2).

The amount of organic carbon accumulated in each layer of the depth (depth 1-7 cm) was not significantly different in summer and rainy season. Sediment organic carbon in the east coast (crumbly clay) where the cockles has been cultured for a long time, showed difference statistically significant ($p<0.05$) amount comparing to the west coast (sandy soil) during rainy season. The accumulation of organic carbon in sediment found varies with season and depth. The high amount has accumulated in the deep layer than the surface area. During rainy season (June and August 2013), the organic carbon content became the highest in the east coast at the depth of 5-6 cm, and the west at 4-5 and 5-6 cm. In summer (March, 2014) both east and west coast accumulated the highest content at 3-4 cm depth.

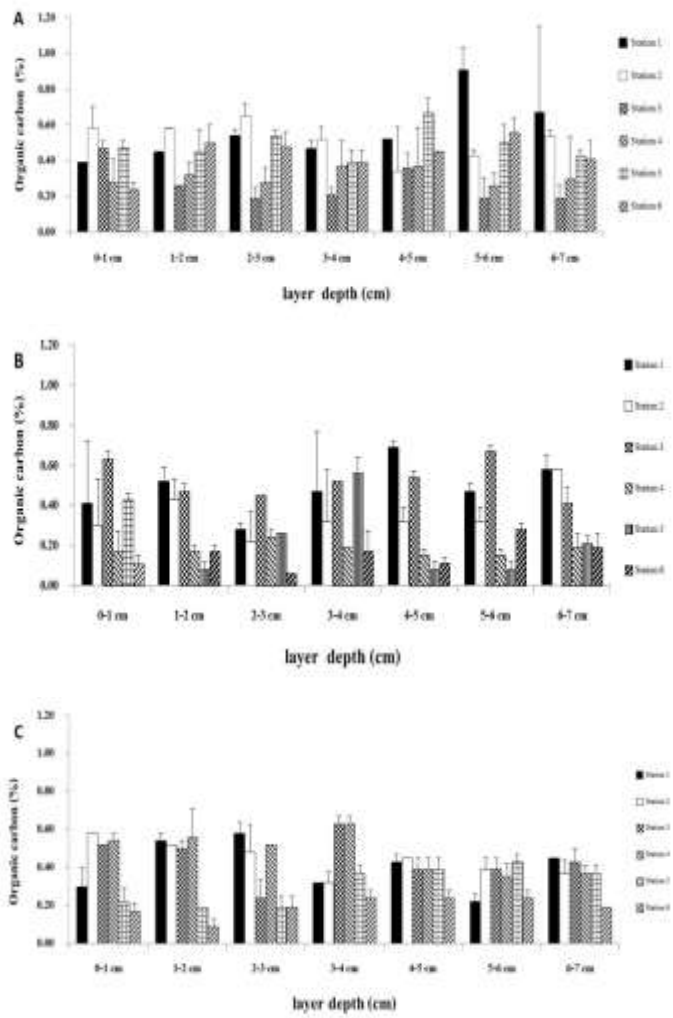

Fig 2 Organic carbon in sediment collected from cockle farm in stations of Bandon Bay in June 2013 (A), August 2013 (B) and March 2014 (C)

It was clearly found that the accumulation was mainly occurred in rainy season comparing to the summer. This is due to the utilization in the area resulted to the release of organic substances into the water. Beach lane or mud is called resources of life caused of storage of much organic

substances. It is generally found that a variety of organisms embedded in the mudflat were less than those in the sand, but higher biomass. Organisms in mudflat synthesized sheath beneath the lane or they can survive in the condition of muddy sediment [6] and the nature of clay silt had high ability of adhesion to organic substances compared to sandy soil that bind organic matter poorly [7]. In general, the amount of organic matter in the sediment is high near the shore, mainly mangrove area, and the value decreases as the distance to the far side away or deep-sea [8]. Most organic substances are decomposed by microbial processes in mud, the sources of food for suspension feeders and filter feeders, in a short time after settling. The organic matter in the ocean is very important because it influenced the chemical reaction after precipitation. Distribution of organic content in the sediments is variable to environment mainly changing of tides and tidal [9]–[10]. Sediment pH of the cockle farm in June2013 showed pale acid to neutral in east coast (6.91 ± 0.13 to 7.26±0.01) and west coast (6.51±0.02 to 6.97±0.05).

In August 2013, pH of the sediment in both areas showed neutral properties (6.90 ± 0.03 to 7.56 ± 0.02). And for summer (March 2014), the pH was quite neutral to slight alkaline (7.68±0.08 to 8.37±0.04). The depth of the soil may be affected pH changing which could be observed by the different of sediment color. The sediment reduction in pH with depth possibly produced by bacteria and may depend on the type of sediment particles.

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