Determination of LMW Organic Acids in East China Sea Aerosols by HPLC

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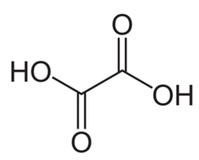
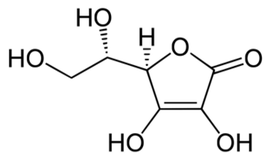
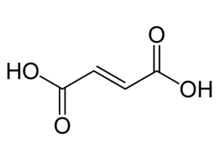
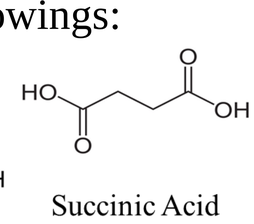
Introduction

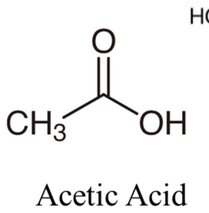
Aerosol organic acids may enhance aerosol metal solubility during transport process in the atmosphere. Dissolvable aerosol metals is considered to be bioavailable to marine phytoplankton. Besides, organic acids also can act as a nutrient source for marine heterotrophic bacteria. In this study, I have attempted to establish an HPLC method to measure aerosol organic acids by using HPLC and to quantify their concentrations in size-fractionated aerosols collected from Matsu island during winter and summer monsoon seasons. The organic acids we have measured included the followings:

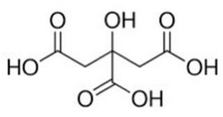

Oxalic Acid

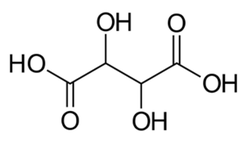

Ascorbic Acid

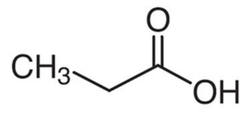

Fumaric Acid

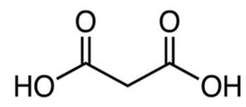

Succinic Acid

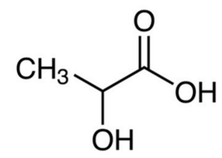

Acetic Acid


Citric Acid


Tartaric Acid


Propionic Acid


Malonic Acid


Lactic Acid

Method

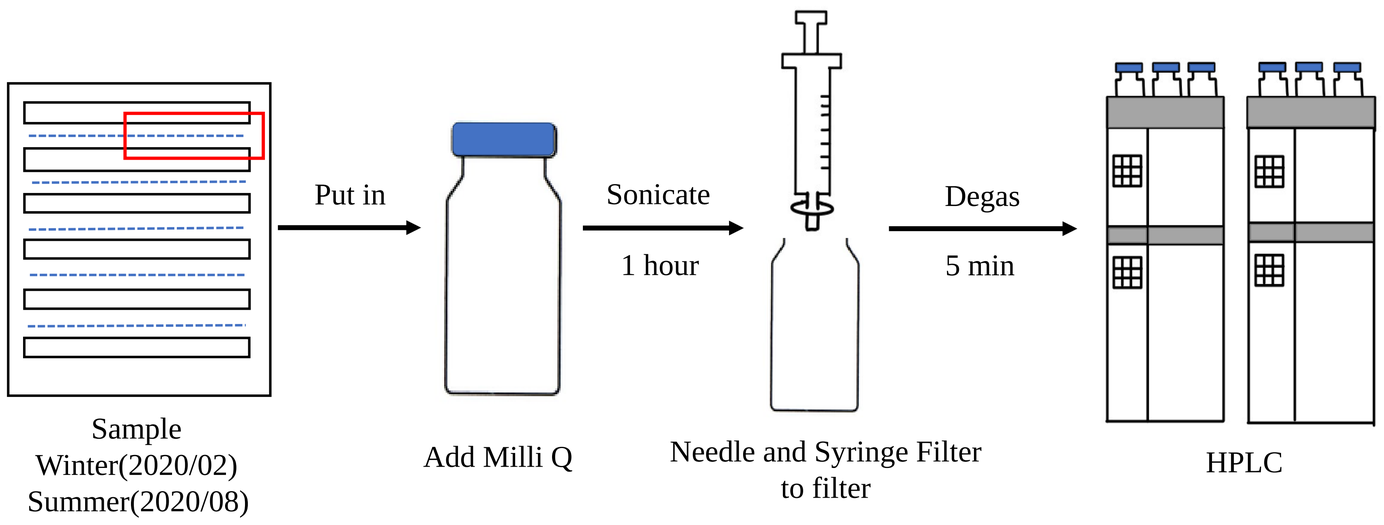


Figure 1. The pretreatment procedures of this experiment.

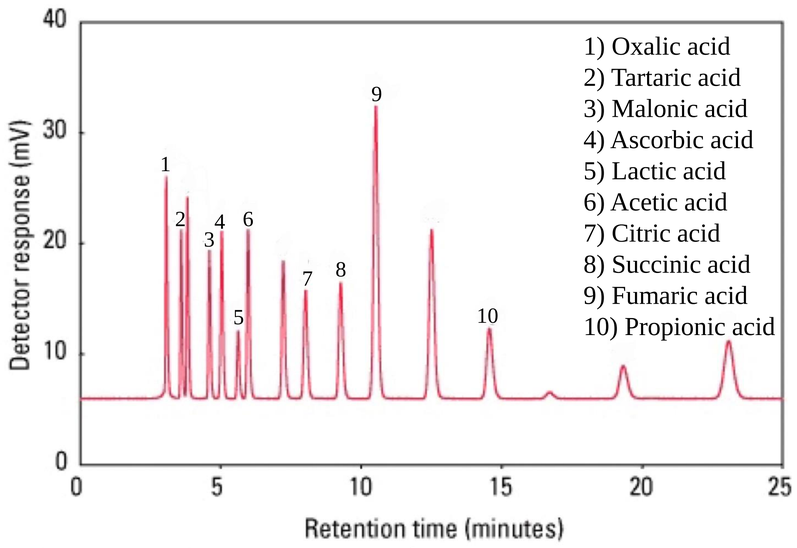
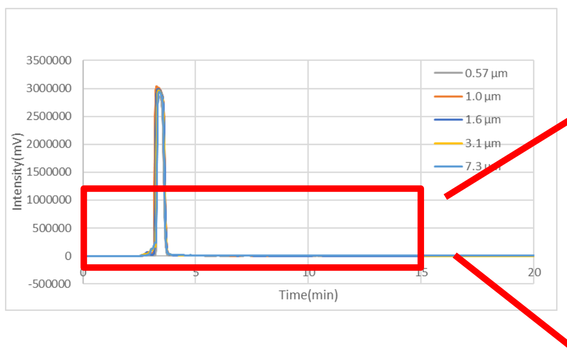
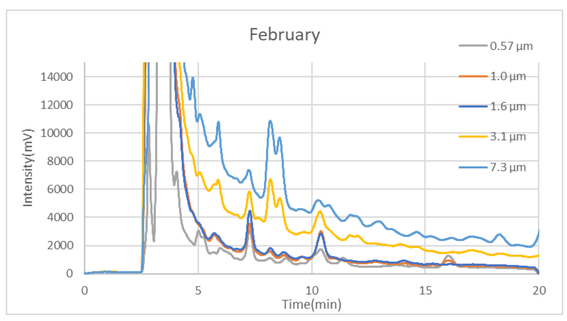


Figure 2. The HPLC chromatogram of the ten organic acid standards separated by TSK gel ODS-100V column, which is used in this experiment. (TOSOH Bioscience)

Result and Discussion

We found that the organic acid concentrations potentially exhibit significant seasonal and aerosol size variations. In terms of seasonality, the concentrations in winter monsoon season (February) show much higher concentrations than the sample collected in summer (August). The acids with highest concentrations are oxalic acid, succinic acid, and citric acid.





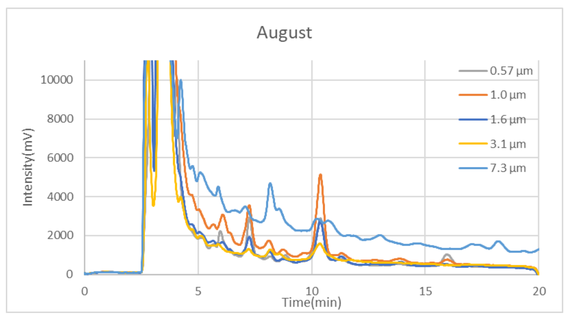


Figure 3. Chromatogram spectrum of sample from Matsu in different season.

Table 1. The concentrations of organic acids (ng m^{-3}) of size-fractionated aerosol samples collected in winter (February) and summer (August) seasons. (*b.d.l. stands for below detection limit.)

Size-fractionated Aerosol Sample (Feb. 2020)					
Organic acid (ng m^{-3})	0.57 μm	1.0 μm	1.6 μm	3.1 μm	7.3 μm
Oxalic	3,100	13,000	10,000	7,700	6,600
Succinic	16.8	16.3	6.93	16.2	8.99
Malonic	8.05	b.d.l.	b.d.l.	3.15	13.6
Citric	b.d.l.*	b.d.l.	b.d.l.	68.3	149
Ascorbic	b.d.l.	b.d.l.	b.d.l.	b.d.l.	4.61

Aerosol Sample (Aug. 2020)					
Organic acid(ng m^{-3})	0.57 μm	1.0 μm	1.6 μm	3.1 μm	7.3 μm
Oxalic	4,000	8,200	4,900	1,800	260
Succinic	13.4	9.27	4.58	b.d.l.	b.d.l.
Malonic	b.d.l.	b.d.l.	b.d.l.	b.d.l.	15.1
Citric	b.d.l.	b.d.l.	b.d.l.	b.d.l.	34.3
Ascorbic	b.d.l.	b.d.l.	0.20	b.d.l.	0.61
Tartaric	1.73	b.d.l.	b.d.l.	b.d.l.	b.d.l.

Summary

Oxalic acid has the highest concentration in both samples. For future study, we may focus on the connection between oxalic acid abundance in aerosols and aerosol metal solubility. If possible, I would like to improve the method so that I may quantify more organic acids in aerosol samples accurately.

Acknowledgment

I am thrilled to join Dr. Ho's lab as a intern. Thanks to Dr. Ho who always keeps an eye on our experiment and give me inspiring advice. Also thanks to Oliver, Emily, and Mei-Chen who have helped me greatly in this project. Every time I have any problems they give me a hand. My time here has been incredibly enriching, and I am grateful for the experience.

Reference

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