ENZYME EXPRESSION PROFILES OF HETEROTROPHIC BACTERIA & NUTRIENT LEVELS IN SEA WATER, GÖKÇEADA ISLAND, AEGEAN SEA, TURKEY

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Abstract
The relationships between heterotrophic bacterial enzymes profiles and nutrient levels were investigated in the sea water samples taken from coastal and off-shore areas of the Gökçeada Island in the period between March 2012 and November 2013. Our results showed that the level of nitrate ($N–NO_3^-$), nitrite ($N–NO_2^-$), ammonia ($N–NH_4^+$), and phosphate ($P–PO_4^{3-}$) and chlorophyll-*a* have an influence on bacterial communities.

Keywords: Bacteria, Biodiversity, Nutrients, Aegean Sea

Introduction
Heterotrophic bacteria play a key role in marine biogeochemical cycling and food webs because of the wide diversity of their metabolic properties. The nutrient inputs offer dynamic media to bacteria that shape bacterial activity both in eutrophic and oligotrophic environment. In addition, the microbial community structure changes in terms of primer envrionmental variable parameters. The basic bio-geochemical processes in the water column is associated with the activity of heterotrophic bacteria (1).
In this study, enzyme expression profiles of the heterotrophic bacteria and nutrient levels in sea water around Gökçeada Island, Aegean Sea, Turkey were investigated regarding variations of bacterial ecto-enzymes and the trophic levels of the region with respect to nutrient levels.

Materials and Methods
The sea water samples were collected from 19 stations chosen from the coastal and off-shore areas of Gökçeada Island (Fig. 1). The samples were collected as seasonally for the autumn, winter and spring as monthly for the summer in 12 times in total between March 2012 and November 2013.

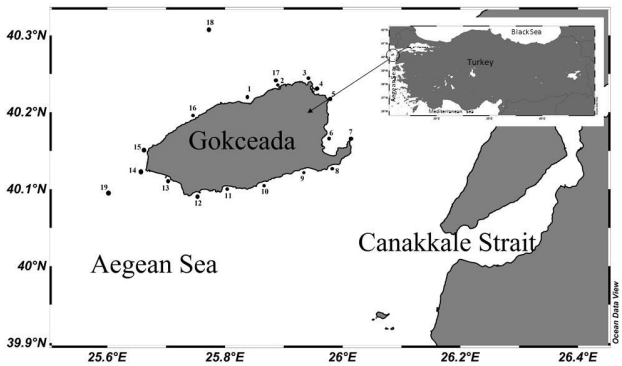

Fig. 1. Map of studying area (Schlitzer, 2014)

The bacterial isolates and enzymatic properties were identified with the automated micro identification system VITEK 2 Compact 30 (bioMerieux, France) (2). The nutrients and chlorophyll-*a* analyses were carried out by spectrophotometric method (3).

Results and Discussion
126 bacterial isolates belonging to fermenting and non-fermenting Gram negative bacilli (GN - 53.17%), Gram positive spore forming bacilli (BCL - 37.30%), Gram positive cocci and non-spore forming bacilli (GP-9.53%) identified during the study period. The bacterial isolates found in this study include species that are able to secrete large quantities of ectoenzymes. The Gram-negative (GN) isolates have been identified to be involved in destruction of Tyrosine (76% Tyrosine ARYLAMIDASE positive), glucose (64% D-Glucose positive), phosphate (52% phosphatase positive), mannose (51% D-Mannose positive) and the chemical bond of aryl-amide (51% L- Proline Arilamidase positive). The results showed that the GN isolates have lypolitic and proteolytic enzymes acitvities. It was found that the identified GP isolates can degrade the natural disaccharide (83% D-trehalose, D-Maltose positive). The 67% of GP isolates was recorded to be hydrolise the arginine and break down the aryl-amide chemical bond of the L-Pyrrolidonly. 50% of GP isolates was found as the glucose, mannose and saccarose positive. The defined Bacillus (BCL) isolates' biochemical characteristics react positively in the range between 50% - 98% showed sufficient enzyme activity for possible dissolved carbohydrates inputs of these areas. The isolates that have lipolytic and proteolytic enzym activities were detected to be the most abundant bacteria in the sea water. The enzymatic reactions of bacterial isolates offer us "warning signs" for understanding marine ecosistem functionings. For instance, the knowledge obtained showed that oligotrophic structure of the study area (for oligotrophic parts of the study areas) support natural enzyme activity of bacterial communities. Since nutrients and chlorophyll-*a* values were recorded between class I and IV (according to "Water Pollution and Control Regulation, 2004), our results imply that certain bacteria species isolated have potential importance in organic matter turnover in especially coastal part of studied areas. It was also recorded that percentage of the heterotrophic enzyme activity was higher in the coastal areas in summer seasons due to the fact that recreational activities. The percentage of bacterial enzymatic activity is associated with the positive correlation between heterotrophic bacteria and nutrients levels. This situation implied that the possible increases of pollution/nutrient inputs induce bacterial enzymatic activity. The data obtained related to bacterial enzyme profiles of the several parts of the study region showed that the region close to a fragile line and current state of the study region must be protected in the long term.

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