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SHORT COMMUNICATIONS

AMINO ACID CHANGES DURING IN VITRO DECOMPOSITION OF MARSH PLANT DETRITUS[1]

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ABSTRACT Dead plant material was collected from a tidal marsh, ground to a uniform size (250 μm) and decomposed in vitro at 30°C in darkness for 36 days. Crude protein, total amino acids, and essential amino acids increased from 19.0 to 31.0 mg/g, 11.1 to 17.6 mg/g and 5.8 to 8.1 mg/g respectively from day 0 to day 36. The amino acid and crude protein values observed in the detritus are generally low but the increment during decomposition is considered significant in terms of the marine consumers that depend on highly decomposed detritus for food.

INTRODUCTION

Tidal wetlands (e.g., salt marshes, mangrove swamps, eel grass and seaweed beds) have been reputed to be high producers of plant biomass (Keefe 1972; de la Cruz 1973) which is the major source of oceanic detritus. Studies by a number of investigators (Petersen 1918; Hickling 1961; Darnell 1964; de la Cruz 1965; Heald 1969; Odum 1970) have pointed to the value of plant detritus as food for estuarine and nearshore marine heterotrophs. A recent study by de la Cruz and Gabriel (1974) indicated a nutritive enrichment of marsh plant tissues during decomposition to particulate detritus. In a previous study (de la Cruz and Poe 1975), we have shown that amino acid concentrations increased during in situ decomposition of dead marsh plant materials to particulate detritus (2.5 mm). In this study, we considered the changes in amino acid levels during advanced stage of decomposition of detritus beyond the 2.5 mm particle size under laboratory conditions.

MATERIALS AND METHODS

Detritus was artificially prepared by collecting dead and partially decomposing plant material from a tidal marsh dominated by the giant cordgrass, *Spartina cynosuroides*, grinding it to a uniform size (250 μm) in a Wiley Mill. A 5-gram sample of the ground material was resuspended in each of five 1000-ml sterile flasks containing 600 ml of autoclaved estuarine water. Each flask was inoculated with 5 ml natural water from the marsh estuary and incubated in the dark at ambient summer temperature (≅30°C). The flasks were aerated and the gentle bubbling caused slow agitation of the suspension.

At 0, 5, 13, 25, and 36 days, one flask was harvested, vacuum evaporated and dried at 103°C. One half gram sample was hydrolyzed in 6 N HCl for 24 hours according to the procedure of Smith et al. (1965). Amino acid analysis was performed according to the procedure we previously described (de la Cruz and Poe 1975) utilizing a Beckman Model 120C Amino Acid Analyzer.

Protein was estimated from total nitrogen (x 6.25) determined by a modification of the Kjeldahl method (Assoc. Chem. 1965).

RESULTS AND DISCUSSION

The concentrations of the 17 amino acids analyzed, with the exception of histidine, increased during the vitro decomposition from day 0 to day 36 (Table 1). Aspartic acid, glutamic acid, proline, glycine, isoleucine, leucine and phenylalanine increased by as much as 62–100%. Since the plant material we used in the present study was collected from a *Spartina cynosuroides* marsh and presumably consisted mostly of dead *Spartina* plants, it is expected that the amino acid level of the artificially prepared detritus at day 0 is essentially the same as the amino acid values we previously obtained for dead *Spartina* tissue (de la Cruz and Poe 1975).

Total amino acid (AA) and crude protein (CP) increased by 27% and 13% respectively from day 0 to day 5; the levels remained virtually the same through the 25th day, and increased again by 25% and 45% respectively at day 36. The decline in AA/CP ratio in spite of increases in amino acid and crude protein indicates the occurrence of nitrogen sources (presumably ammonia and other nitrogenous metabolic products) in the suspension. Our previous study (de la Cruz and Poe 1975) on the in situ decomposition of marsh plant detritus also revealed a decline in AA/CP ratio despite increases in amino acids and protein. However, the increment in crude protein in the in situ studies is generally

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TABLE 1.

Amino Acid Analysis (mg/g) of Marsh Plant Detritus (250 μm) After In Vitro Decomposition at 30°C in the Dark

Protein	Number of Days				
	0	5	13	25	36
Amino Acid					
Acidic					
Aspartic acid	1.2	1.7	1.7	1.8	2.1
Glutamic acid	1.1	1.7	1.8	1.8	2.1
Basic					
Lysine	0.7	0.7	0.7	0.6	0.8
Histidine	0.3	0.3	0.2	0.2	0.3
Arginine	0.6	0.7	0.8	0.8	0.8
Neutral					
Threonine	0.7	0.9	1.0	0.9	1.1
Serine	0.8	0.9	0.9	0.9	1.1
Proline	0.7	1.0	0.6	1.1	1.3
Glycine	0.8	1.0	1.0	1.1	1.3
Alanine	0.8	0.6	1.1	0.7	1.0
Valine	0.8	0.9	0.9	0.9	1.2
Isoleucine	0.5	0.7	0.8	0.8	1.0
Leucine	0.9	1.3	1.3	1.3	1.6
Sulfur					
Half cystine	0.0	0.0	0.0	trace	trace
Methionine	0.3	0.4	0.4	0.3	0.4
Aromatic					
Tyrosine	0.4	0.5	0.5	0.4	0.6
Phenylalanine	0.5	0.8	0.9	0.7	0.9
Total Amino Acids	11.1	14.1	14.6	14.3	17.6
Crude protein	19.0	21.4	22.7	23.4	31.0
AA/CP ratio (%)	58.42	65.89	64.32	61.11	56.77
Essential amino acids	5.8	6.7	7.0	6.7	8.1
EAA/CP ratio (%)	30.53	31.31	30.84	28.63	26.13

higher than in the in vitro experiments suggesting additional sources of nitrogen in the natural environment (e.g., adsorbed and/or absorbed soluble nutrients). The essential amino acids, which comprise about 52% of the total amino acids and about 30% of crude protein, also increased from 5.8 mg/g at day 0 to 8.1 mg/g at day 36.

The increases in amino acids and crude protein during in vitro decomposition of fine detrital particles (250 μm) did not parallel in degree the increases we previously observed during in situ decomposition of dead marsh plants to course (2.5 mm) particulate detritus. Obviously, the limited conditions inside the incubation flask lack the complex physico-chemical processes occurring on the marsh. For example, fresh-water drainage from land and the regular inundation by saline water during the tidal cycles enrich the marsh substrate and enhance the microbial colonization of decaying organic biomass on the marsh.

Our present observations of amino acids and those of others (Odum and de la Cruz 1967; Heald 1969; de la Cruz and Gabriel 1974) on the nutritive values of decomposing detritus indicate collectively the nutritional enrichment accompanying decomposition. It is believed that this process is brought about by the adsorption and/or absorption of nutrients to the detritus particles, and the growth in the populations of attendant microbiota (e.g., bacteria, fungi, and protozoa). The significance of amino acid-protein enrichment, whether due to microbial colonization or some other physico-chemical agents, lies in the role of detritus as a source of food for estuarine and near-shore marine heterotrophs.

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