

1.6.3 Periplasmic Transfer and Modification

Alginate is modified almost exclusively at the periplasm in bacteria, which suggests that ALG is synthesized as polymannuronate and modification occurs at the polymer level. A number of enzymes (AlgI/AlgJ/AlgF, the polymannuronan epimerase, AlgG, and AlgX) including the O-acetylation complex catalyze the modification of polymannuronic acid to the mature ALG polymer, in the periplasm [34, 35, 40, 41]. The function of AlgX is not clear, but it is likely to be associated with the multiprotein complex and polymer modification. Alkaline phosphatase fusion proteins were used to map membrane topology of AlgI, and it is found to contain seven transmembrane domains and two large cytoplasmic domains AlgF and AlgJ, which were both localized to the periplasm; AlgJ is anchored in the cytoplasmic membrane by an uncleaved signal peptide [42, 44].

The cellular location of AlgI/AlgJ/AlgF suggested a model for ALG O-acetylation, where AlgI transfers the acetyl group contained on a donor molecule (possibly an acyl carrier protein or Coenzyme A) across the membrane, and then the acetyl group is transferred to AlgJ or AlgF for O-acetylation of the mannuronate residues at the polymer level.

There are three classes of ALG modifying enzymes, which have been described as

1. Transacetylases
2. Mannuronan C 5-epimerases
3. Lyases

1.6.3.1 Transacetylases

Transacetylation occurs only at mannuronic acid residues at the O-2 and/or O-3 position. Acetylation of these residues prevents their epimerization to guluronic acid residues by AlgG. It also prevents the ALG chain degradation by AlgL. Therefore, the acetylation of ALG is indirectly responsible for controlling epimerization and length of the ALG polymer. The water binding capacity of ALG can be strongly enhanced by increasing the degree of acetylation, which may be particularly crucial for survival under dehydrating conditions [43]. Although the genes *algI*, *algJ*, and *algF* are required for the addition of O-acetyl groups to the ALG polymer, acetylation itself is not required for ALG biosynthesis [44].