Practice Problems for Biochemistry, Session 4: Proteins, Levels of Structure, Non-Covalent Forces

Question 1

You have discovered a new enzyme, enzyme E, which breaks down proteins by cleaving peptide bonds after tyrosine or phenylalanine.

a) Enzyme E is the product of gene G that encodes a protein with the molecular weight of 50 kilodaltons (50 kD). When you purify enzyme E, you obtain a single type of polypeptide of 50 kD. However, active enzyme E has a molecular weight of 250 kilodaltons (250 kD), not 50 kD.

i) Why might active purified enzyme E be larger than the product encoded by gene G?

ii) Define primary, secondary, tertiary, and quaternary structure.

iii) Is the primary structure of the 50 kD protein the same or different than the primary structure of the 250 kD protein? Explain briefly.

iv) Is the tertiary structure of the 50 kD protein the same or different than the tertiary structure of the 250 kD protein? Explain briefly.

v) Is the quaternary structure of the 50 kD protein the same or different than the quaternary structure of the 250 kD protein? Explain breifly.

b) You test enzyme E activity on a large protein substrate. This substrate is not cleaved by enzyme E. You then treat the substrate with DTT (a compound that disrupts disulfide bonds) and test the enzyme E activity again. This time the substrate is cleaved by enzyme E.
Why was enzyme E able to cleave the protein substrate only after the substrate was treated with DTT?

Question 2

For the first pair of amino acids listed below, draw the two amino acids with the side chains interacting and list the strongest type of interaction that can occur between the side chain groups. For the remaining pairs, simply list the strongest type of interaction that occurs between the side chain groups. Choose from covalent bonds, hydrogen bonds, ionic bonds, or van der Waals interactions.

i) tyrosine, asparagine

ii) cysteine, cysteine

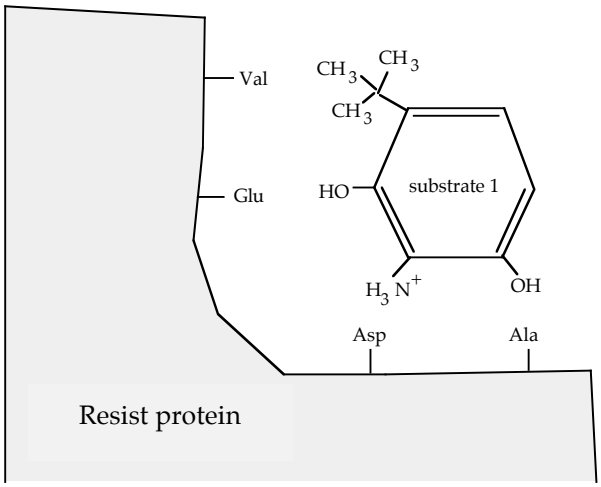
iii) isoleucine, valine

iv) glutamic acid, lysine

v) glycine, glutamine

Question 3

In analyzing differences between drug resistant fungi and drug sensitive fungi, you have discovered a protein that exists only in the drug resistant fungi. You named this the Resist protein and design substrates that you hope will bind to it.

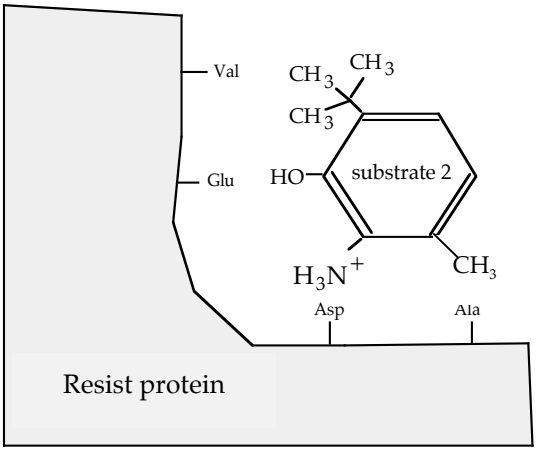


a) Give the name for the strongest intermolecular interaction between substrate 1 as shown and the side chains of following amino acids on the Resist protein. Choose from ionic bond, covalent bond, hydrogen bond, and van der Waals forces.

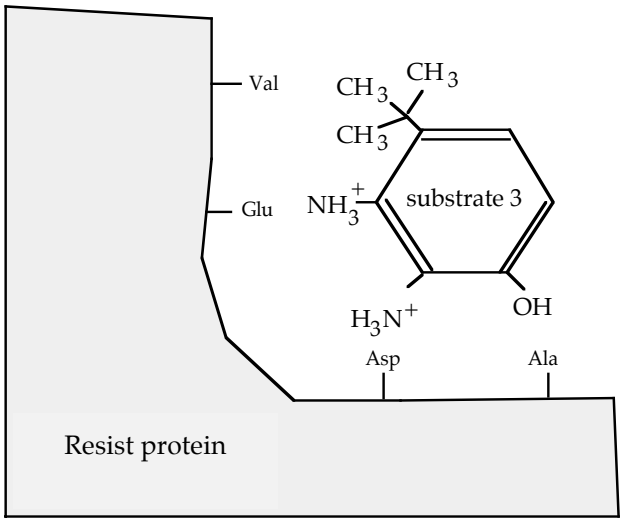
Amino Acid	Strongest interaction
Val	
Glu	
Asp	
Ala	

Question 3, continued

b) You make the following additional substrates .



What is the strongest interaction that now exists between the Ala of the Resist protein and substrate 2?



What is the strongest interaction that now exists between the Glu of the Resist protein and substrate 3?

c) Which substrate would you expect to bind the most tightly to the Resist protein?

substrate 1 substrate 2 substrate 3

Explain why you made this choice.

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