

AMINO ACID POLYMERS

For Therapeutic and Biomedical Applications

Imagine a synthetic absorbable polymer derived from natural amino acids with excellent engineering properties, tunable hydrolysis profiles and which upon absorption releases safe and biocompatible molecules and amino acid at the site of action as such in a controlled manner. At Bezwada Biomedical, we not only imagined it, we have made it into a reality.

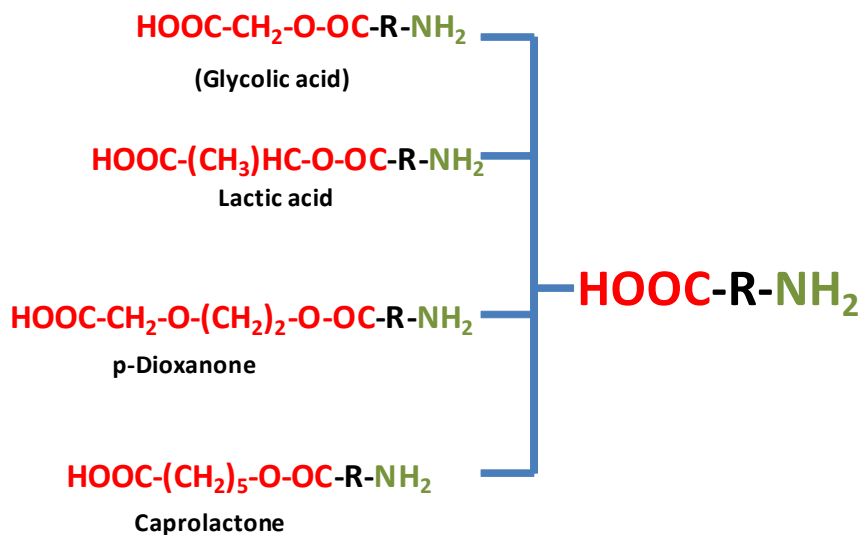
We are pleased to offer a portfolio of amino acids functionalized with safe and biocompatible molecules such as lactic and glycolic acid for technical evaluation and product development. These functionalized amino acids can be used to prepare absorbable polymers with the potential to answer unmet customer needs.

Key features and benefits of these amino acid polymers include:

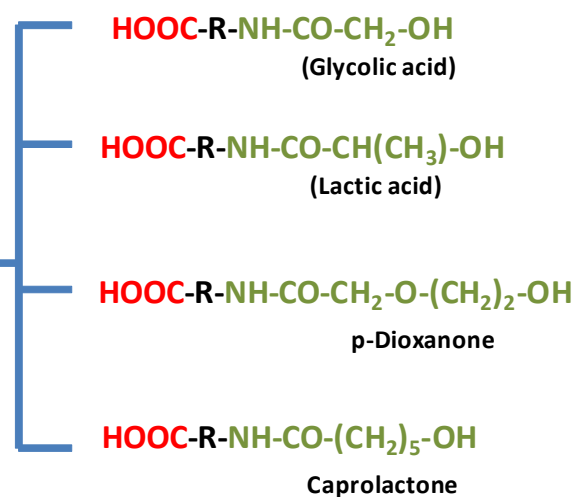
- *Amino acid such as tyrosine and lysine are a part of polymer backbone*
- *Completely hydrolysable into safe and biocompatible products and amino acids*
- *Tunable hydrolysis profile*
- *Therapeutic value of amino acid delivered at the site of action in a controlled manner*
- *Excellent engineering properties*

Key Technology : Functionalization of Amino acid via Esterification or Amidation

Functionalization via Esterification



Functionalization via Amidation



Where R represents residual Aliphatic or Aromatic amino acid

This results in amino acid based monomers containing a carboxylic acid and hydroxyl functionality prepared via functionalization of amino acid on both carboxylic acid and amino terminal end group

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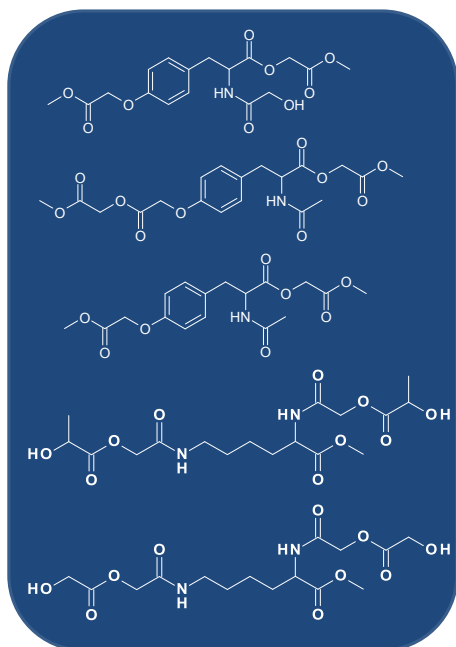
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Amino acid based monomers containing a carboxylic acid and hydroxyl functionality prepared via functionalization of amino acid on both carboxylic acid and amino terminal end group

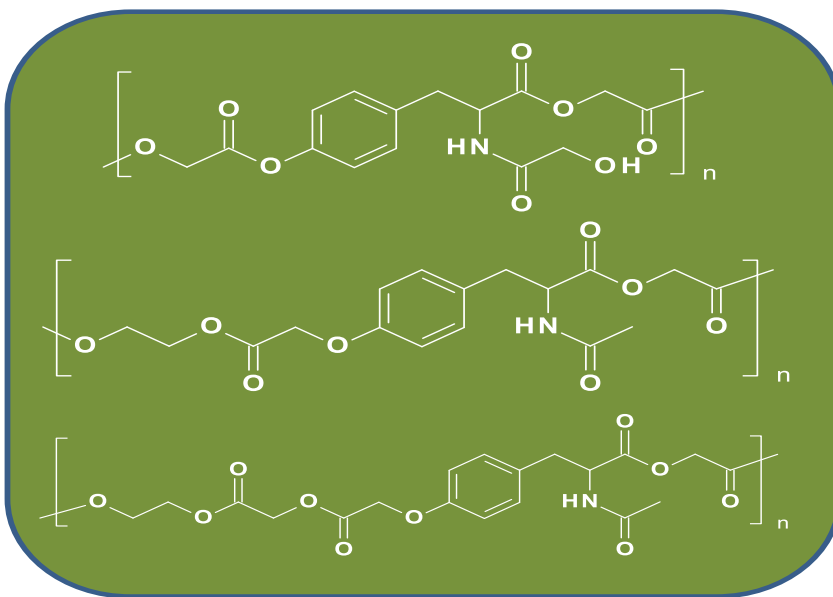
1	Glycolation	$\text{HOOC-CH}_2\text{-O-OC-R-NH-CO-CH}_2\text{-OH}$ (Glycolic acid) (Glycolic acid)
2	Lactolation	$\text{HOOC-(CH}_3\text{)HC-O-OC-R-NH-CO-CH(CH}_3\text{)-OH}$ (Lactic acid) (Lactic acid)
3	Dioxonation	$\text{HOOC-CH}_2\text{-O-(CH}_2\text{)}_2\text{-O-OC-R-NH-CO-CH}_2\text{-O-(CH}_2\text{)}_2\text{-OH}$ p-Dioxanone p-Dioxanone
4	Caprolation	$\text{HOOC-(CH}_2\text{)}_5\text{-O-OC-R-NH-CO-(CH}_2\text{)}_5\text{-OH}$ Caprolactone Caprolactone

Where R represents residual Aliphatic and Aromatic Amino Acids

Functionalized Tyrosine and Lysine monomers



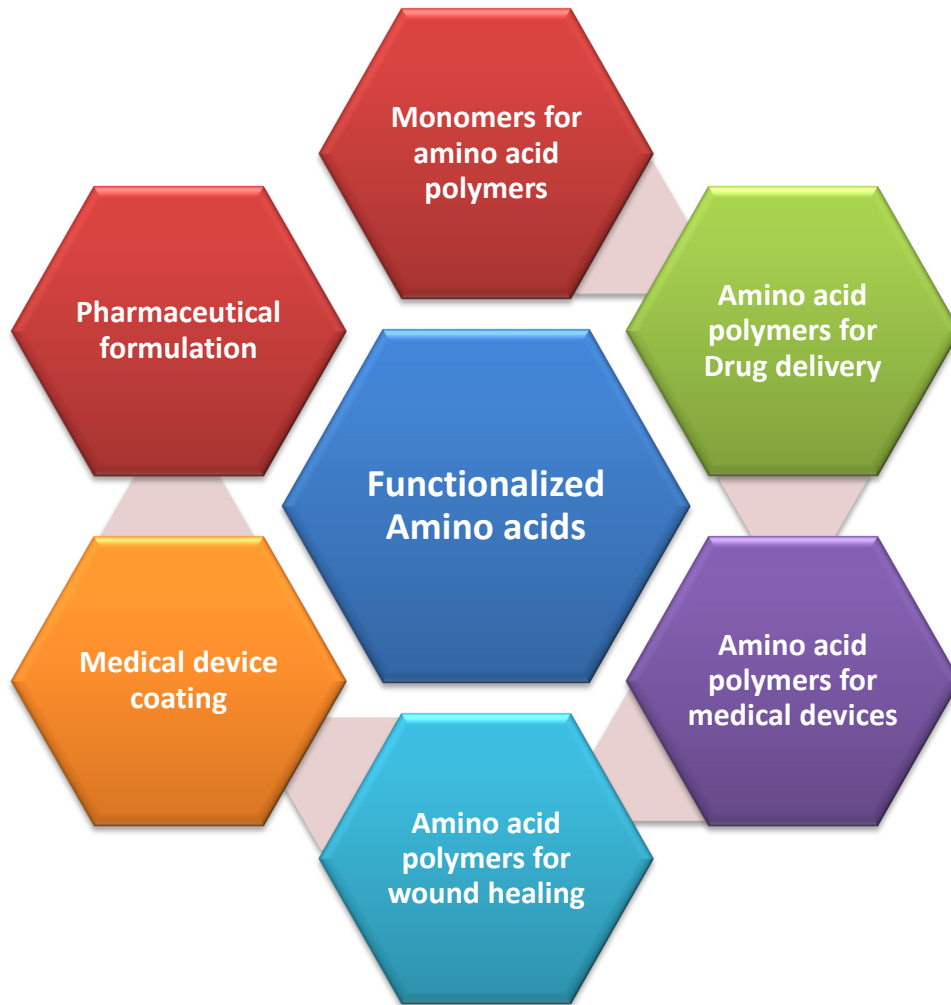
Absorbable polymers from functionalized Tyrosine with varying hydrolysis profiles



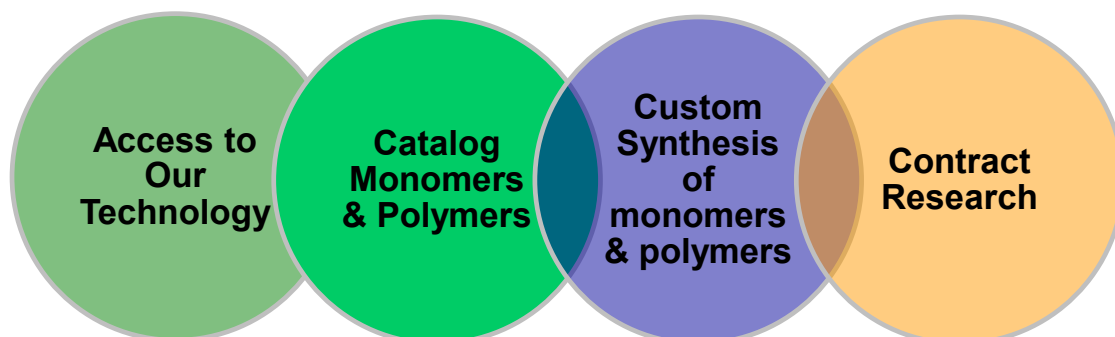
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Potential Applications



What can we offer



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Intellectual Property and Publications around Amino acid Technology Platform

1. **Rao S Bezwada** Functionalized Amino acids and Absorbable Polymers therefrom
US20130317118
2. **Rao S Bezwada** Amino acid derivatives and absorbable polymers therefrom
WO2012109535A3
3. **Rao S Bezwada** Amino acid derivatives and absorbable polymers therefrom
US20130245133
4. **Rao S Bezwada** Functionalized Amino acids and Absorbable Polymers therefrom
US8309754
5. **Rao S Bezwada** Functionalized Amino acids and Absorbable Polymers therefrom
US8519175
6. **Rao S Bezwada** Functionalized Amino acids and Absorbable Polymers therefrom
US8093420
7. **Rao S Bezwada** Functionalized Amino acids and Absorbable Polymers therefrom
US8664426
8. **Rao S Bezwada** Amino acid derivatives and absorbable polymers therefrom
US8461372
9. **Rao S Bezwada** and **Neeti Srivastava** Aromatic amino acid based polyurethanes presented at 245th National Meeting of American Chemical Society, New Orleans
10. **Rao S Bezwada** and **Neeti Srivastava** Absorbable Polyurethanes from functionalized Phenylalanine presented at Annual Meeting of Society for Biomaterials 2014