INTRODUCTION
Insulin is a 51-amino acid polypeptide. It has 2 chains-A and B. A-chain consists of 21 amino acids while B-chain consists of 30 amino acids. Both chains are linked by disulphide bonds. In mammals, insulin is synthesized in the pancreas within the β-cells\(^{1-3}\) of the islets of Langerhans.\(^{4-9}\) One million to three million islets of Langerhans (pancreatic islets) form the endocrine part of the pancreas, which is primarily an exocrine gland. The endocrine portion accounts for only 2% of the total mass of the pancreas. Within the islets of Langerhans, beta cells constitute 65–80% of all the cells. It is however first synthesized as a single polypeptide called preproinsulin\(^{10}\) in pancreatic β-cells. Preproinsulin contains a 24-residue signal peptide\(^{11}\) which directs the nascent polypeptide chain to the rough endoplasmic reticulum (RER).\(^{12-15}\) The signal peptide is cleaved as the polypeptide is translocated into lumen of the RER, forming proinsulin. In the RER the proinsulin folds into the correct conformation and 3 disulfide bonds are formed. About 5–10 min after its assembly in the endoplasmic reticulum, proinsulin is transported to the trans-Golgi network (TGN) where immature granules are formed. Transport to the TGN may take about 30 min. Proinsulin\(^{16}\) undergoes maturation into active insulin through the action of cellular endopeptidases known as prohormone convertases (PC1 and PC2), as well as the exoprotease carboxypeptidase E. The endopeptidases cleave at 2 positions, releasing a fragment called the C-peptide,\(^{17-20}\) and leaving 2 peptide chains, the B- and A- chains, linked by 2 disulfide bonds. The cleavage sites are each located after a pair of basic residues (lysine-64 and arginine-65, and arginine-31 and -32). After cleavage of the C-peptide, these 2 pairs of basic residues are removed by the carboxypeptidase. The C-peptide is the central portion of proinsulin, and the primary sequence of proinsulin goes in the order "B-C-A" (the B and A chains were identified on the basis of mass and the C-peptide was discovered later). The resulting mature insulin is packaged inside mature granules waiting for metabolic signals (such as leucine, arginine, glucose and mannose).
and vagal nerve stimulation to be exocytosed from the cell into the circulation. The endogenous production of insulin is regulated in several steps along the synthesis pathway:

- At transcription from the insulin gene
- In mRNA stability
- At the mRNA translation
- In the posttranslational modifications.

Insulin and its related proteins have been shown to be produced inside the brain, and reduced levels of these proteins are linked to Alzheimer's disease. Insulin is stored in pancreas as its biological precursor proinsulin, which is a single chain polypeptide that is cleaved by proteolysis on demand to form insulin, with C-peptide as one of the byproduct. Insulin is stored in granules in β cells of islets of langerhans and consists of two atoms of Zn and six molecules of insulin.

The amino acid sequence of human proinsulin is shown in Fig. 3. By proteolytic cleavage, four basic amino acids (residues 31, 32, 64, 65) and the connecting peptide are removed, converting proinsulin to insulin. The sites of action of the end peptidases PC2 and PC3 are shown.

Insulin is usually administered to diabetic patients through subcutaneous injection. However, problems encountered with subcutaneous insulin injections are pain, allergic reactions, hyperinsulinemia and insulin lipodystrophy around the injection site.

The oral route is the most convenient and comfortable means of administering protein drugs and eliminates pain caused by an injection, stress associated with multiple daily injections such as needle anxiety and possible infections. Indeed, insulin absorbed by the intestinal epithelium reaches the liver through the portal vein and can directly inhibit hepatic glucose output; subcutaneous insulin treatment however does not replicate the normal dynamics of endogenous insulin release, resulting in a failure to achieve a lasting glycemic control in patients. However, peptides and proteins such as insulin cannot be administered via the oral route. This is due to degradation by gastrointestinal enzymes and poor permeability across intestinal mucosa.

Colon Anatomy

The GI tract is divided into stomach, small intestine and large intestine. The large intestine extending from the ileocecal junction to the anus is divided into three main parts. These are the colon, the rectum and anal canal. The entire colon is about 5 feet (150 cm) long, and is divided into five major segments. Peritoneal folds called as mesentery which is supported by ascending and descending colon. The right colon consists of the cecum, ascending colon, hepatic flexure and the right half of the transverse colon. The left colon contains the left half of the transverse colon, descending colon, splenic flexure and sigmoid. The rectum is the last anatomic segment before the anus.

The major function of the colon is the creation of a suitable environment for the growth of colonic microorganisms, storage reservoir of fecal contents, expulsion of the contents of the colon at an appropriate time and absorption of potassium and water from the lumen. The absorptive capacity is very high, each about 2000ml of fluid enters the colon through the ileocecal valve from which more than 90% of the fluid is absorbed. On average, it has been estimated that colon contains only about 220 gm of wet material equivalent to just 35 gm of dry matter. The majority of this dry matter is surfactants irritate the protective mucous membrane leads to passage of unwanted toxins and pathogens.
bacteria. The colon tissue containing the villi, lymph, muscle, nerves, and vessels.

**Chemical structure**

![Structure of Eudragit L 100](image)

**EUDRAGIT® L 100**

It is an anionic polymer synthesized from methacrylic acid and methylmethacrylate and have a pH-dependent solubility. Eudragit L 100 would release the drug in the region of G.I.T. of pH 6-6.5 i.e. ileum or large intestine. It is available as an organic solution (Isopropanol), solid or aqueous dispersion.

**Physical properties**

It is a solid substance in form of a white powder with a faint characteristic odour.

**Fig. 3: Human Proinsulin and its conversion to insulin**

**Fig. 4: Structure of Eudragit® L 100**

**Product Form**

Powder

**Targeted Drug Release Area**

Jejunum

**Dissolution**

Dissolution between pH 6.0 and 7.0.

**Characteristics**

- Effective and stable enteric coatings with a fast dissolution in the upper Bowel
- Granulation of drug substances in powder form for controlled release
- Site specific drug delivery in intestine by combination with EUDRAGIT® S grades
- Variable release profiles.

**Chemical/IUPAC name**

Poly (methacylic acid-co-methyl methacrylate) 1:1

**INCI name**

Acrylates Copolymer

**Monographs**

Ph. Eur

Methacrylic Acid - Methyl Methacrylate Copolymer (1:1)

USP/NF

Methacrylic Acid Copolymer, Type A - NF

JPE

Methacrylic Acid Copolymer L

**Weight average molar mass**

approx. 125,000 g/mol

**Acid Value**

315 mg KOH/ g polymer

**Glass Transition Temperature (Tg)**

>130°C (+/- 5°C)

**Viscosity / Apparent viscosity**

60 - 120 mPa. s

**Refractive index**

1.390 - 1.395

**Relative density**

0.831-0.852
The suitability of Eudragit L 100 microspheres as oral carrier for peptide drugs like insulin was evaluated. Insulin loaded EudragitL100 microspheres were prepared using water-in-oil-in water (w/o/w) emulsion-solvent evaporation with polysorbate 20 as dispersing agent in internal aqueous phase and PVP/PVA as stabilizer in the external aqueous phase. In PBS pH 7.4, microspheres showed an initial burst release of 21% in 1 hr. and additional 35% release in next 5 hr. Thus, EudragitL100 microspheres have the potential to serve as an oral carrier for peptide drugs like insulin.

EUDRAGIT® S 100
It is an anionic copolymer based on methacrylic acid and methyl methacrylate. It is available only as an organic solution (Isopropanol) and solid.

Physical properties
It is a solid substance in form of a white powder with a faint characteristic odour.

Chemical structure

![Structure of Eudragit S 100](image)

**Form of Product**
Powder

**Targeted Drug Release Area**
Colon delivery

**Dissolution**
Above pH 7.0

**Characteristics**
- Granulation of drug substances in powder form for controlled release
- Effective and stable enteric coatings with a fast dissolution in the upper Bowel
- Site specific drug delivery in intestine by combination with EUDRAGIT® S grades
- Variable release profiles

**Chemical/IUPAC name**
Poly(methacrylic acid-co-methyl methacrylate) 1:2

**INCI name**
Acrylates Copolymer

**Monographs**

**Ph. Eur.**
Methacrylic Acid - Methyl Methacrylate Copolymer (1:2)

**USP/NF**
Methacrylic Acid Copolymer, Type B - NF

**JPE**
Methacrylic Acid Copolymer S

**Weight average molar mass**
approx. 125,000 g/mol

**Acid Value**
190 mg KOH/ g polymer

**Glass Transition Temperature (Tg)**
>130°C (+/- 5°C)

**Viscosity / Apparent viscosity**
50 - 200 mPa. S

**Refractive index**
1.390 - 1.395

**Relative density**
0.831-0.852

EudragitS100 microspheres have the potential to serve as an oral carrier for peptide drugs like insulin. Insulin loaded PVA stabilized EudragitS100 microspheres showed maximum drug encapsulation released 2.5% insulin at pH 1.0 in 2 hr. Oral administration of PVA stabilized microspheres in normal albino rabbits (equivalent to 6.6 IU insulin/kg of animal weight) demonstrated a 24% reduction in blood glucose level, with maximum plasma glucose reduction of 76 ± 3.0% in 2 hours and effect continued upto 6 hr.

The hypoglycemic effect of Eudragit S100 enteric-coated capsules containing sodium salicylate as an absorption promoter formulated with insulin in various ways: as physical mixture, by wet granulation or in suppository bases (polyethylene glycol 4000 or Witepsol W35) was studied in hyperglycemic beagle dogs. 25-30% reduction in plasma glucose levels and relative hypoglycemia (RH) of about 12.5% relative to subcutaneous injection of regular soluble insulin can be achieved by formulating insulin in Witepsol W35 (1 g) with sodium salicylate (50 mg) as an absorption promoter, reducing the resulting mass into particle size 180-315 microm, packing into hard gelatin capsules and coating with Eudragit S100.

EUDRAGIT® S 12,5
It is an anionic copolymer based on methacrylic acid and methyl methacrylate.

Physical properties
It is a colourless and clear to slightly cloudy liquid with the characteristic odour of isopropyl alcohol.
Chemical structure

**Fig. 6: Structure of Eudragit® S 12.5**

**Product Form**
Organic Solution 12.5%

**Targeted Drug Release Area**
Colon Delivery

**Dissolution**
Above pH 7.0

**Characteristics**
- Granulation of drug substances in powder form for controlled release
- Effective and stable enteric coatings with a fast dissolution in the upper bowel
- Site specific drug delivery in intestine by combination with EUDRAGIT® S grades
- Variable release profiles

**Chemical/IUPAC name**
Poly(methacrylic acid-co-methyl methacrylate) 1:2

**INCI name**
Acrylates Copolymer

**Monographs**
Ph. Eur
Methacrylic Acid - Methyl Methacrylate Copolymer (1:2)

USP/NF
Methacrylic Acid Copolymer, Type B – NF

JPE
n/a

**Weight average molar mass**
approx. 125,000 g/mol

**Acid Value**
190 mg KOH/g polymer

**Glass Transition Temperature (Tg)**
>130°C (+/- 5°C)

**EUDRAGIT® FS 30 D**
It is an aqueous dispersion with 30 % dry substance. EUDRAGIT® FS 30 D is the aqueous dispersion of an anionic copolymer based on methyl acrylate, methyl methacrylate and methacrylic acid. It is insoluble in acidic media, but dissolves by salt formation above pH 7.0. Apart from its enteric properties, its dissolution at a higher pH value allows targeted colon delivery.

**Chemical structure**

**Fig. 7: Structure of Eudragit® FS 30 D**

**Chemical/IUPAC name**
Poly(methyl acrylate-co-methyl methacrylate-co-methacrylic acid) 7:3:1

**INCI name:** Acrylates Copolymer

**Acid Value**
70 mg KOH/g polymer

**Minimum Film Forming Temperature (MFT)**
~14°C

**Glass Transition Temperature (Tg)**
43°C (+/- 5°C)

The ratio of the free carboxyl groups to the ester groups is approx. 1:10. It is milky-white liquid of low viscosity with a faint characteristic odour. The monomers are randomly distributed along the copolymer chain. The weight average molar mass (Mw) of EUDRAGIT® FS 30 D is approx. 280,000 g/mol.

The dispersion is miscible with water in any proportion, the milky-white appearance being retained. A clear or slightly cloudy, viscous solution is obtained by mixing 1 part EUDRAGIT® FS 30 D with 5 parts acetone. The same results are obtained by mixing with ethanol or isopropyl alcohol; initially, the polymer is precipitated, but then dissolves again in the excess organic solvent.

A clear or slightly cloudy liquid is obtained by mixing 1 part EUDRAGIT® FS 30 D with 2 parts 1 N sodium hydroxide.

**Dissolution**
Above pH 7.0

**Viscosity / Apparent viscosity**
Max. 20 mPa.s

**pH:** 2.0 - 3.5

**Relative density**
1.058 - 1.068

**Monomers**
Max. 100 ppm

**Sample solution**
Dissolve approximately 11.0 g of EUDRAGIT® FS 30 D accurately weighed in acetone p.a. and
dilute to 50.0 ml. Add 5.0 ml of the solution drop wise to 20 ml of a 70 % solution of methanol for chromatography in phosphoric acid pH 2 (adjust an appropriate volume of water with phosphoric acid 85 % to pH 2). Centrifuge until the supernatant is clear and use the supernatant solution as the sample solution.

Storage and handling
Store between 5 °C and 10 °C. Protect from freezing. Keep in well closed containers. Avoid contamination during sampling. Containers that have been opened for use should be closed again immediately and the content used up within the next few weeks. Matrix systems with EUDRAGIT® FS 30 D will release 100% of the drug. Polymer amounts of 10 to 20 % are sufficient to get a pH-independent matrix.

EUDRAGIT® L 12.5
It is solution of EUDRAGIT® L 100 with 12.5% (w/w) dry substance in aqueous Isopropyl Alcohol Ph. Eur. / USP. The solution contains 3% (w/w) deionised water. The product contains 0.3 % Sodium Lauryl sulfate Ph. Eur. / NF on solid substance. EUDRAGIT® L 100 is described as Copolymer (1:1), Type A or Copolymer L in the monographs.
It is colourless, clear to slightly cloudy liquids with the characteristic odour of isopropyl alcohol.

Table 1: Dissolution properties of enteric Eudragit polymers

<table>
<thead>
<tr>
<th>EUDRAGIT® polymer</th>
<th>Product form</th>
<th>Dissolution properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eudragit L 100</td>
<td>Powder</td>
<td>Dissolution above pH 6.0</td>
</tr>
<tr>
<td>Eudragit S 100</td>
<td>Powder</td>
<td>Dissolution above pH 7.0</td>
</tr>
<tr>
<td>Eudragit S 12.5</td>
<td>12.5 % organic solution</td>
<td>Dissolution above pH 7.0</td>
</tr>
<tr>
<td>Eudragit FS 30 D</td>
<td>30 % aqueous dispersion</td>
<td>Dissolution above pH 7.0</td>
</tr>
<tr>
<td>Eudragit L 12.5</td>
<td>12.5 % organic solution</td>
<td>Dissolution above pH 6.0</td>
</tr>
</tbody>
</table>

Glass transition temperature (Tg)
The glass transition temperature is an important factor for describing the physical properties of polymers. On a macroscopic level it describes the solidification of an anisotropic polymer melt. The glass transition temperature has far-reaching consequences, e.g. for film formation, melt processing and storage of finished pharmaceutical dosage forms. Plasticizers, solvents or residual solvents (including water) that act as plasticizers usually cause a reduction in glass transition temperature, which is specifically exploited in application formulations. Most common plasticizer for EUDRAGIT polymers is triethyl citrate (TEC).

Effect of Plasticizers Compatibility
Polymers with high glass transition temperatures need plasticizer to obtain coatings which are not brittle. For example: Eudragit® L 100 in organic solution needs 10% Triethyl citrate (TEC). Dispersions from Polymers with high glass transition temperatures needs plasticizer to decrease the minimum Film-Forming Temperature and to optimize the film formation. For example: Redispersed Eudragit® L 100 needs 50% Triethyl citrate (TEC).

Chemical structure

![Fig. 8: Structure of Eudragit® L 12.5](image)

Dissolution
Dissolution between pH 6.0 and 7.0

Storage
Protect from warm temperatures (USP, General Notices). Store in tightly closed containers.

Monomers
Max. 70 ppm

Viscosity / Apparent viscosity
60 – 120 mPa.s

Refractive index
1.390 - 1.395

Relative density
0.831 - 0.852

It provides effective and stable enteric coatings with a fast dissolution in the upper Bowel and site specific drug delivery in intestine by combination with EUDRAGIT® S grades.
Pathak et al.

(Eudragit L and S) polymer films were formulated with a range of plasticizers for measuring $T_g$ of polymer films in the wet state. This allows better prediction of polymer behavior in vivo conditions. A colon-specific drug delivery technology was designed to avoid the inherent problems associated with pH- or time-dependent systems. In this regard, Eudragit have served to be a much better enteric coated polymer. There have been several studies where formulations have been enteric coated with different grades of Eudragit exploiting either time, pH- dependent or microbial degradation mechanisms for targeting colonic release.

**MICROPARTICLES**

The microencapsulation process in which the removal of the hydrophobic polymer solvent, achieved by evaporation has been widely reported in recent years for the preparation of microspheres and microcapsules. The encapsulation of highly water soluble compounds including proteins and peptides presents formidable challenges to the researcher. The successful encapsulation of such entities requires high drug loading in the microspheres, prevention of protein degradation by the encapsulation method. To achieve these goals, solvent evaporation techniques and their innovative modifications have been attempted.

Different techniques of microencapsulation are

2. Multiple emulsion system.
3. Double emulsion solvent evaporation.

Fig. 9: SEM micrographs of optimized insulin loaded a) Eudragit S 100 b) Eudragit L 100

**ENCAPSULATION OF POORLY WATER SOLUBLE DRUGS**

**Basic Drugs**

Poorly water soluble basic drugs are very sensitive to pH changes and their dissolution in the acidic stomach environment tends to precipitate them upon gastric emptying, which leads to compromised or erratic oral bioavailability. The oral bioavailability of such drugs can be improved by encapsulation of drug within highly pH responsive Eudragit L microparticles using emulsion solvent evaporation method.

**Acidic Drugs**

Sometimes, acidic drug encapsulated by emulsion solvent evaporation, are present in its crystalline form, which can affect drug release and produce negative impact on other characteristics of the final product. Henceforth, investigations were carried out to find factors that are responsible for the formation and inhibition of drug crystals in modified-release microparticles using Eudragit S or Eudragit L. It was concluded that the drug crystallization can be inhibited by optimizing the ratio of drug to polymer in the microparticles thereby stabilizing this acidic drugs for drug delivery.

**Water Soluble Drugs**

Generally, highly water-soluble and poorly bioavailable drugs are unstable at gastric pH. Hence, to resolve this problem mucoadhesive microparticles were formulated using Eudragit S100 and EC using w/o/o double emulsion solvent diffusion method. Microparticles made with drug: Eudragit S100 (ratio 1:3) exhibited maximum entrapment efficiency and followed fickian diffusion with delayed release. The efficacy of microencapsulation process is dependent on many factors, including organic solvent, rate of solvent removal, and amount of organic solvent or drug solubility, drug to polymer ratio, partition coefficient, polymer composition and molecular weight, and method of manufacture. These variables must be considered in order to develop a successful controlled release microsphere containing drugs. Properties such as relative contribution of microsphere size and drug’s molecular weight and acid solubility, on the extent of such undesired release in gastric pH have been highlighted. Microparticles were formulated using a novel polymer. The multiple regression of microparticles formulated using Eudragit S and Eudragit L by emulsion solvent evaporation process revealed that the drug's molecular weight was the most important factor that determined its extent of release in the acid.
medium, while its acid solubility and microsphere's size had minor influences.53

**ENHANCEMENT OF PROTEIN STABILITY**

Purpose of such an approach was to formulate a stable formulation for proteins and peptides which are susceptible to denaturation, degradation, and conformational changes which render them inactive. Amongst the pioneering works in this regard, an oral colonic targeted heparin dosage form was fabricated, allowing the release of Low molecular weight heparins (LMWH) directly in the inflamed tissue using pH-sensitive microspheres of Eudragit P 4135 F by double emulsion technique54,55.

**COMBINATION OF EUDRAGIT L 100 AND EUDRAGIT S 100**

Studies in human volunteers have confirmed that pH drops from 7.0 at terminal ileum to 6.0 at ascending colon, and Eudragit S based systems sometimes fail to release the drug. To overcome the shortcoming, combination of Eudragit S and Eudragit L which ensures drug release at pH < 7 has been advocated.56

---

**Table 2: Characterization of insulin loaded microparticles using Chitosan and different concentrations of Eudragit L 100, Eudragit S 100 and Eudragit L 100 : Eudragit S 100 (1:1)**

<table>
<thead>
<tr>
<th>Formulation Code</th>
<th>Actual Loading (μg/mg)</th>
<th>Actual Loading (%)</th>
<th>%EE</th>
<th>Particle Size (d.nm)</th>
<th>Zeta Potential (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSB I</td>
<td>10.267</td>
<td>1.026</td>
<td>44.14</td>
<td>4732</td>
<td>-27.5</td>
</tr>
<tr>
<td>HSB II</td>
<td>8.836</td>
<td>0.883</td>
<td>48.59</td>
<td>5756</td>
<td>-18.1</td>
</tr>
<tr>
<td>HSB III</td>
<td>9.601</td>
<td>0.960</td>
<td>64.32</td>
<td>4351</td>
<td>-20.1</td>
</tr>
<tr>
<td>HSB IV</td>
<td>9.945</td>
<td>0.994</td>
<td>78.56</td>
<td>5991</td>
<td>-15.7</td>
</tr>
<tr>
<td>BSB I</td>
<td>11.404</td>
<td>1.140</td>
<td>49.04</td>
<td>2912</td>
<td>-34.3</td>
</tr>
<tr>
<td>BSB II</td>
<td>13.693</td>
<td>1.369</td>
<td>75.31</td>
<td>3748</td>
<td>-19.4</td>
</tr>
<tr>
<td>BSB III</td>
<td>11.653</td>
<td>1.165</td>
<td>78.07</td>
<td>8458</td>
<td>-25.4</td>
</tr>
<tr>
<td>BSB IV</td>
<td>10.493</td>
<td>1.049</td>
<td>82.90</td>
<td>6891</td>
<td>-21.2</td>
</tr>
<tr>
<td>HLA I</td>
<td>10.832</td>
<td>1.083</td>
<td>46.58</td>
<td>7353</td>
<td>-28.6</td>
</tr>
<tr>
<td>HLA II</td>
<td>12.308</td>
<td>1.238</td>
<td>68.13</td>
<td>6544</td>
<td>-13.3</td>
</tr>
<tr>
<td>HLA III</td>
<td>10.919</td>
<td>1.091</td>
<td>73.16</td>
<td>3439</td>
<td>-33.5</td>
</tr>
<tr>
<td>HLA IV</td>
<td>9.281</td>
<td>0.928</td>
<td>73.32</td>
<td>4147</td>
<td>-39.8</td>
</tr>
<tr>
<td>BLA I</td>
<td>16.875</td>
<td>1.687</td>
<td>72.64</td>
<td>4484</td>
<td>-23.7</td>
</tr>
<tr>
<td>BLA II</td>
<td>14.397</td>
<td>1.439</td>
<td>79.18</td>
<td>7747</td>
<td>-30.9</td>
</tr>
<tr>
<td>BLA III</td>
<td>12.029</td>
<td>1.203</td>
<td>80.59</td>
<td>8225</td>
<td>-27.8</td>
</tr>
<tr>
<td>BLA IV</td>
<td>11.124</td>
<td>1.112</td>
<td>87.88</td>
<td>5275</td>
<td>-22.4</td>
</tr>
<tr>
<td>HLSY I</td>
<td>9.307</td>
<td>0.930</td>
<td>40.02</td>
<td>1238</td>
<td>-31.7</td>
</tr>
<tr>
<td>HLSY II</td>
<td>8.230</td>
<td>0.823</td>
<td>45.26</td>
<td>3943</td>
<td>-42.3</td>
</tr>
<tr>
<td>HLSY III</td>
<td>10.382</td>
<td>1.038</td>
<td>69.55</td>
<td>6696</td>
<td>-36.1</td>
</tr>
<tr>
<td>HLSY IV</td>
<td>11.880</td>
<td>1.188</td>
<td>93.85</td>
<td>3363</td>
<td>-47.4</td>
</tr>
<tr>
<td>BLSY I</td>
<td>11.496</td>
<td>1.149</td>
<td>49.43</td>
<td>6771</td>
<td>-16.1</td>
</tr>
<tr>
<td>BLSY II</td>
<td>10.846</td>
<td>1.084</td>
<td>59.65</td>
<td>9045</td>
<td>-34.7</td>
</tr>
<tr>
<td>BLSY III</td>
<td>11.369</td>
<td>1.136</td>
<td>80.29</td>
<td>4651</td>
<td>-37.2</td>
</tr>
<tr>
<td>BLSY IV</td>
<td>10.881</td>
<td>1.088</td>
<td>85.96</td>
<td>9238</td>
<td>-26.8</td>
</tr>
</tbody>
</table>
After observing these formulations, it was found that size of particles was in the range of 1-10 μm, which is ideal for cellular uptake. Also, zeta potential values indicate the good stability of particles. As the concentration of polymer increases in the formulation, % Entrapment Efficiency (EE) increases. This could be due to more coating of the Eudragit polymer and hence less leakage of the drug occurs due to less number of pores left.

CONCLUSION
The large variety of applications as well as the steadily increasing number of research workers engaged in studies of Eudragit polymers due to their unique properties, have made significant contributions to many types of formulations and suggest that the potential of Eudragit as novel and versatile polymer will be even more significant in future. Purpose of such an approach was to formulate a stable formulation for proteins and peptides like insulin which are susceptible to denaturation, degradation, and conformational changes.

REFERENCES
5. Sleisenger, edited by Mark Feldman, Lawrence S. Friedman, Lawrence J. Brandt; consulting editor, Marvin H. Sleisenger & Fordtran’s gastrointestinal and liver disease pathophysiology, diagnosis, management. 2009 (9th ed.). St. Louis, Mo.: MD Consult.
