Controlled release dosage forms are gradually emerging as popular products owing to better therapeutic efficacy. Various techniques employed for extended or controlled release dosage forms have been briefly reviewed in this chapter.

**Rahman et al (2011)** formulated matrix systems for oral sustained release drug delivery systems using diverse grades of hydroxypropyl methylcellulose in order to investigate the effect of various grades of these polymers on release mechanism from matrix tablets of Diclofenac Sodium. Lactose was used as diluent and tablets were prepared by direct compression process. At a fixed polymer level, drug release from the higher viscosity grades (K100M) was slower as compared to the lower viscosity grades (K100LV). The best-fit release kinetics was achieved with the zero order plot, followed by the Higuchi and Korsmeyer equations. The release of the model drug from these HPMC matrix tablets was prolonged; as a result, an oral release dosage form to avoid the gastrointestinal adverse effects was achieved.

**Narayana Raju P et al (2011)** formulated Zidovudine matrix tablets by using Eudragit L 100, Poly ethylene oxide and Carbopol 971 P. The granules of Zidovudine using above polymers were prepared by direct mixing, wet granulation with water and wet granulation with IPA. The granules were characterized for the morphological study, bulk density, tapped density and particle size distribution. Different shapes of the granules were formed with the wet granulation process with different polymers. In vitro dissolution studies showed the prolonged release of the Zidovudine with these polymers. The drug release depended up on the type of polymer and granulation process.

**Sundaramoorthy K et al (2011)** formulated monolithic extended release matrix tablets of metformin hydrochloride by employing ethyl cellulose polymer and the extended release characterization of the formulated tablets was investigated. Extended release matrix tablets containing 500 mg metformin hydrochloride were developed by changing concentration of drug: polymer (EC) in the ratio of 5:1, 5:2, 5:3 and 5:4 by direct compression. The result of in-vitro was extended release of metformin hydrochloride 99-100.5% release at the end of 10 h. A decrease in release of the drug was observed on increasing polymer ratio at certain level.

**Zafar Iqbal et al (2010)** studied the impact of hydroxypropylmethyl cellulose (HPMC K 100M) alone and in combination with the guar gum, xanthan gum and gum
tragacanth on the release of the diclofenac sodium matrix tablets were evaluated. The granules were prepared using wet granulation method and compressed into tablets using different ratio of drug and gum ratio. It was resulted that the formulations containing HPMC K 100M drug ratio 1:1.3 and 1:1.6 and formulations containing HPMC, gum and drug with different ratio also sustained the release of diclofenac sodium for 12 hours. It was concluded that HPMC K100M alone and in combination with natural gums as the retarding material retarded the release up to 12 hours.

Manivannan Rangasamy et al (2010) worked to develop a stable solid dosage form of extended release tablets of Divalproex sodium for the treatment of epilepsy bipolar disorder, and migraine headache. In this study extended release of Divalproex sodium tablet was prepared by using direct compression technique. Different formulations were made by using two rate controlling polymer like HPMCK 100M and HPMC K4M combined with directly compressible grade diluents like Microcrystalline cellulose pH102, Starch, Lactose DCL21 and finally tablet was made film coated. All the formulations were evaluated for physical characteristics, in vitro dissolution and stability.

Saravana kumar Met al (2010) formulated once daily sustained release matrix tablets of Stavudine using putative hydrophilic matrix materials such as hydroxyl propyl methyl cellulose (HPMC) K4M and Carbopol 974P. The prepared extended release tablets were then evaluated for various physical tests like diameter, thickness, weight variation, hardness, friability, and drug content uniformity. The results of all these tests were found to be satisfactory. Formulation extended the drug release till the end of 24 hours and showed higher r values for zero order plots, indicating that drug release followed zero order kinetics.

Lee BJ et al (2008) formulated a dual melatonin-loaded hydroxypropylmethylcellulose (HPMC) matrix tablet simultaneously containing drug in inner tablet core and outer coated layer using drug-containing aqueous-based polymeric Eudragit RS30D dispersions. The biphasic release profiles of dual drug-loaded HPMC matrix tablet were highly modified, depending on the amount and type of five plasticizers. The current dual drug-loaded HPMC matrix tablet, showing biphasic release profiles.
Talukder MM et al (2008) prepared a swelling matrix core containing pectin, hydroxypropyl methylcellulose (HPMC), microcrystalline cellulose and 5-aminosalicylic acid was developed. In-vitro dissolution studies were carried out in USP apparatus-I using sequential pH media. The first 2 h of dissolution studies were done in HCl buffer at pH 1.5, the next 2 h in pH 5.5 and, finally, in phosphate buffer at pH 6.8 with and without pectinolytic enzyme present. Less than 2% drug was released in the first 6 h and about 90% released in the following 12 h in a controlled manner. Results indicate that this delivery system has potential for site-specific delivery of drugs to the colon.

Lakade and Bhalekar et al (2008) developed hydrophilic polymer (HPMC) and hydrophobic polymer (Ethyl cellulose) based Nicorandil matrix sustained release tablet which can release the drug up to time of 24 hrs in predetermined rate. The formulation of Nicorandil matrix tablet was prepared by the polymer combination in order to get required theoretical release profile. The influence of hydrophilic and hydrophobic polymer and granulation technique on Nicorandil was studied.

Bailey CJ et al (2008) Combined of two or more oral agents with different mechanisms of action are often used for the management of hyperglycaemia in type 2 diabetes. Presently available antidiabetic fixed-dose combinations include metformin combined with a sulphonylurea, thiazolidinedione, dipeptidylpeptidase-4 inhibitor or meglitinide as well as thiazolidinedione-sulphonylurea combinations, each at a range of dosage strengths to facilitate titration. Anticipated future expansion of multiple drug regimens for diabetes management is likely to increase the use of fixed-dose single tablet combinations.

Ochoa L et al (2008) prepare theophylline sustained release matrix tablets based on the combination of hydroxypropyl methylcellulose (HPMC K4M and K100M) and different meltable binders by melt granulation in a high-shear mixer. In particular, the dissolution rate was delayed when lipophilic binders were used and only formulations containing Gelucire 50/13 or PEG 6000 with HPMC K4M had a profile similar to the commercial formulation. The release mechanism of theophylline from the formulations was described by Peppas's equation showing a non-Fickian release mechanism. These results suggest that melt granulation could be an easy and fast method to formulate sustained release tablets.
Khan GM et al (2007) investigated the preparation of ibuprofen-containing controlled release tablets formulated from either the established granular product, Ethocel Standard Premium, or the novel finely-milled product, Ethocel Standard FP Premium. The tablets were prepared by either direct compression or wet granulation. It was found that Incorporation of Ethocel FP polymers and application of the wet granulation technique facilitated greater efficiency in controlling ibuprofen release behaviour from the matrices.

Vueba ML et al (2006) studied different ketoprofen:excipient formulations, in order to determine the effect of the polymer substitution and type of diluent on the drug-release mechanism. Substituted cellulose-methylcellulose, hydroxypropylcellulose and hydroxypropylmethylcellulose were used as polymers, while lactose monohydrate and beta-cyclodextrin were tested as diluents. Polymers MC25 and HPC were found not to be appropriate for the preparation of modified release ketoprofen hydrophilic matrix tablets, while HPMC K15M and K100M showed to be advantageous. The mean dissolution time (MDT) was determined, the highest MDT value being obtained for HPMC formulations.

Datta Biddut Kanti et al (2005) studied that as the efficiency of a matrix forming polymer in sustaining drug release is a multiple function of physico-chemical nature of the active ingredient and pH of the surrounding environment. Matrix tablets of diclofenac sodium, theophylline and diltiazemHCl were prepared using ethylcellulose as the matrix forming agent. The drug dissolution behaviour of the matrix tablets were studied over 10 hours in buffer media of pH 1.2, 4.5 and 6.8. Elevation of pH of the dissolution medium increased the rate and extent of diclofenac release.

Contoar SL et al (2004) worked to investigate the effectiveness of an ethylcellulose (EC) bead matrix and different film-coating polymers in delaying drug release from compacted multiparticulate systems. Formulations containing theophylline or cimetidine granulated with Eudragit(R) RS 30D were developed and beads were produced by extrusion-spheronization. modified release profiles >8 h were achievable in tablets for both drugs using either coating polymer, Surelease(R)-coated theophylline beads released drug fastest overall.

Kapat et al (2004) focused on the effects of different hydroxypropylmethylcellulose (HPMC) types and HPMC:directtabletting agent ratio on Verapamil Hydrochloride
release from monolayered and three-layered matrix tablets. Investigated polymers were Methocel K100LV, K15M, K100M and DC-agent was Ludipress® LCE. Release data of three-layered matrix tablet (F12) and the reference product (Isoptin®-KKH) which were in agreement with USP XXVII criteria, were evaluated by mathematical models (zero order, first order, Higuchi, Hixson-Crowell, Korsmeyer-Peppas).

Neau Steven H et al (2003) evaluated the applicability of fine particle ethylcellulose (FPEC) to produce matrix tablets by a wet granulation technique was evaluated. The effect of various formulation and process variables, such as FPEC content, hardness of the tablet, and solubility of the drug, on the release of drug from these tablets was examined. Drug release studies were conducted in 37°C water with UV detection. As the FPEC content and the hardness of the tablets increased, the release rate of the drug decreased. The drug release rate increased with an increase in the solubility of the drug.

Makhija et al (2002) Combinations of non-swellable polymers with HPMC were also tried in order to get the desired sustained release profile over a period of 16 h. The effect of drug to polymer ratio on in vitro release was studied.

Sánchez Lafuente et al (2001) developed sustained release matrix tablets of didanosine containing methacrylic and ethylcellulose polymers which has been incorporated into directly compressed monolythic matrices whose excipients were mixtures at different ratios of a methacrylic resin (Eudragit RSPM) and an ethylcellulose (Ethocel 100), both water-insoluble and pH-independent polymers. The effect of varying the Eudragit–Ethocel ratio, as well as the drug–polymeric matrix ratio, was evaluated. The results showed the suitability of Eudragit–Ethocel mixtures as matrix-forming material for didanosine sustained release formulations.

Sajeev C et al (2001) formulated controlled release tablets of Diclofenac sodium using ethyl cellulose as retardant by matrix-embedding technique, the membrane barrier technique, and a combination of the two. In vitro release rate studies showed that increasing the proportion of ethyl cellulose extended the release of DFS. In the case of polymer-coated tablets, an increase in the thickness of the coat controlled and extended the release. However, for an ideal controlled release formulation of water-soluble drugs like DFS, a combination of both matrix-embedding and the membrane
barrier technique was found to be better proposition for extended release beyond 12 hours.

**Upadrashta Sathyanarayana *et al* (1995)** studied Pseudoephedrine hydrochloride as a model drug to prepare direct compression sustained release tablets with ethylcellulose (EC). Initially, different viscosity grades of EC were studied. An increase in viscosity grade resulted in a marginal to moderate increase in the release rate. However, lower viscosity grades produced harder tablets. The highly compressible 10 cp grade was used to study the effect of drug loading, particle size, compression force, and magnesium stearate concentration on release properties. The rate of drug release decreased with a decrease in the drug concentration in the matrix.

**Abidi.S.E. *et al* (1987)** evaluated ethylcellulose as a carrier for the prolonged release solid dispersions of relatively water soluble drugs, acetaminophen and theophylline. The concentration of polymer in the formulation was the determining factor in controlling release rate of the drug, as the results indicate prolongation in release of the drug with increase in amount of ethylcellulose. The higher the viscosity grades of ethylcellulose, slower the release of drug from the solid dispersions. The release of drug from the tablets was more prolonged to the granular solid dispersions. In vitro release of acetaminophen and theophylline was more or less similar in both dissolution media.