like breathlessness in immune-compromised patient [105]. Recent developments in the field of nanotechnology have improved the biocompatibility and biodegradability of polymeric nanoparticle making it less toxic. Moreover, these modifications have largely improved the recognition ability and activity during targeted drug delivery [57, 106, 107].

Even though inhaling steroids is the first choice of therapeutic agents to treat asthmatic patient. But, inhaling therapeutic agent decreases the bioavailability of therapeutic agent at the targeted site. Hence, to improve the efficacy and to reduce the side effects of the drug, betamethasone phosphate containing polymeric nanoparticles have been developed. Additionally, its effects are assessed in asthmatic murine model [108]. Moreover, RNA interference, that is, RNAi-based treatment approach is believed to be an endogenous approach for regulating the gene expression. Furthermore, microRNAs (miRNAs) can be used as traceable targets for COPD, for which miR146a was conjugated along with poly(glycerol adipate-*co*-ω-pentadecalactone) and PGA-*co*-PDL polymeric nanoparticles to suppress the gene expression of target IRAK1. The result obtained from this study revealed that poly(glycerol adipate-*co*-ω-pentadecalactone) and PGA-*co*-PDL polymeric nanoparticles is a suitable candidate for targeted drug delivery system for treating COPD [109]. Recently, alveolar macrophage targeting pyrazinamide containing polymeric nanoparticles have been developed to regulate the dosing frequency and profile of pyrazinamide and treat pulmonary TB [110, 111]. Another study reported by the development of Crizotinib-encapsulated polylactide tocopheryl polyethylene glycol 1000 succinate polymeric nanoparticle which regulated the release of the therapeutic agent at target site and caused noteworthy toxicity in NCIH3122 cells of lung cancer. Additionally, another group of researchers developed polycaprolactone/poly(ethylene glycol)/polycaprolactone (PCEC) polymeric nanoparticle loaded with paclitaxel and is used in combination with chrono-modulated chemotherapy procedure in lung cancer [112].

5.5. Solid Lipid Nanoparticles

Solid lipid nanoparticles (SLNs) are the improved alternative of conventional delivery system. Electron microscopic techniques like scanning electron microscopy (SEM) and transmission electron microscopy (TEM) have aided in determining the range between 50 and 1000 nm and spherical shape of these nanoparticles [113]. The biocompatibility and safety profile of these nanoparticles in pulmonary system has made it recommended drug delivery system. These SLNs comprises solid lipid in the 0.2%–30% (*w*/w) range, which allows it to get dissolved in the aqueous solution. Furthermore, to improve the stability of these nanoparticles, 0.5%–5% surfactants are used [6, 114]. These SLNs come in the category of nanoparticles comprising lipids which maintain their solid structure even at room temperature. Moreover, they have additional advantages like they are easily amendable, biocompatible with lipophilic drug, less toxic, efficient to deliver therapeutic agents at targeted site in contrast to other carriers. The large surface of these nanoparticles allows the loading of high amount of therapeutic agent and protect it from environmental factors, as a resultant bioavailability of drug increases [115]. The main reason for this nanoparticle to be ideal targeted drug delivery system is that its traits are the amalgam of emulsion, liposomes and polymeric nanoparticles. Bee wax, cholesterol butyrate, Dynasan, and emulsifying wax are the common lipids material used for developing these nanoparticles [35].

The previously published literature has highlighted the therapeutic potential of curcumin. Therefore the group of researchers have developed curcumin-loaded SLNs to improve the efficacy of curcumin in rat model of asthma, which showed this approach will be promising in treating asthma [116]. The long-acting β agonist is an effective treatment approach for COPD patients. Hence, Salmeterol Xinafoate containing SLNs have been developed, characterized and assessed on bronchial epithelial cells in the model organism and found to be effective in treating COPD [117]. Additionally, inhalable formulation in powder form has been developed of Ethambutol-containing SLNs for treating TB [118]. Lately, paclitaxel-containing SLNs and coated with chitosan as well as folate-poly(ethylene glycol) has been formulated and reported about the reduction in IC_{50} value in M109HiFR cell line of lung cancer [119].

5.6. Dendrimers

Dendrimers are the branched synthetic polymers that are of size ranging from 10 to 100 nm. These nanocarriers have well-defined size and structure which makes them unique among the other nanocarriers. Chiefly, they consist of globular structure with core, dendrons and a surface-active molecule which makes it the perfect candidate for the controlled drug delivery system [120]. Dendrimers are composed of from a core element (with two identical functional groups), dendrons (monomers linked to the core, forms a layer around it) that are further attached to the bifunctional surface molecule. The presence of bifunctional group on the surface of nanocarrier makes biocompatible and is responsible for physiochemical properties of the dendrimers [121]. These