6-sulfonic acid) (ABTS), hydroxyl, and superoxide radicals. They were also found to chelate very weakly with iron molecules. These make them useful as an effective antioxidant in food products for efficient preservation and protection from oxygen molecules and oxidative damage. Khan *et al*., [152] showed that alginate oligosaccharide produced by gamma irradiation of sodium alginate promoted plant growth and increased the content of morphine, codeine, and opium per plant. Apart from their various applications, the detection of alginate oligosaccharides was also studied and it has been found that they can be easily detected by LC-MS/MS equipped with anion exchange column and negative-ion electron tandem mass spectrometry [153, 154].

14.6.5 Drug Targeting

Site-targeted drug delivery has become an effective method for various diseases, where the drugs are carried by a vector to the targeted sites. Alginates are preferable natural polymers used in the field of medicine due to their biocompatibility, improved dispersability, and stability under physiological pH. Graphene oxide-based drug delivery system, modified by natural peptides protamine sulfate and sodium alginate, was found to establish higher drug-releasing property on the target Michigan Cancer Foundation-7 (MCF-7) cancer cell lines [155]. According to Tawfik *et al*., [156], anionic natural polymer acts as a functionalizing agent for up conversion nanoparticles (UCNPs) and shows higher stability and compatibility. UCNPs, when incorporated with doxorubicin (DOX), were found to inhibit the growth of Ubiquitous Keratin forming tumor cell line HeLa (KB)cancer cell line compared with free DOX.

The antiviral drug *Zidovudine* encapsulated inside amide-functionalized alginate nanoparticles (AZT-GAAD NPs) was found to be a promising candidate in antiviral drug delivery for HIV/AIDS therapy. *In vitro* cellular internalization studies indicate that the NPs were found to possess higher internalization efficiency in glioma cell lines [157]. Iron-linked alginate aerogel beads were found to release the loaded oral drug ibuprofen with higher acceleration in both phosphate-buffered saline (PBS) and hydrochloric acid (HCL) by incorporating the beads with ascorbic acid [158]. Nano lipid carriers (NLCs) loaded with alginates and the hydrophobic drug Amphotericin B were found to have a high swelling ratio, where the amount of drug delivery directly depends on the size of the alginate bead, which enables them to act as an effective oral drug delivery vector [159].