The films were nontoxic and promoted cell proliferation [78]. Chitrattha and Phaechamud prepared poly(lactic acid) porous film by solvent casting method. Gentamicin sulfate or metronidazole was incorporated into the films. The film exhibited a porosity of 55.31% porosity with 20-μm pore size which enhanced the oxygen transmission rate, water vapor transmission rate, degradation rate, and percentage of drug release from the films. The gentamicin-loaded films inhibited *S. aureus, P. aeruginosa*, and *Proteus mirabilis* growth while metronidazole-loaded film inhibited *Bacteroides fragilis* for 7 days [79].

Tvl et al. developed chitosan-gelatin films loaded with ciprofloxacin. The drug-loaded films showed good water absorption capacity, folding endurance and antibacterial activity. The percentage of wound contraction was enhanced for the wounds treated with ciprofloxacin-loaded film. The ciprofloxacin drug-loaded films capacity for fast healing and rapid epithelialization of skin is attributed to its antibacterial action which prevents infections of the wound ([80]). Donnadio et al. prepared sodium carboxymethylcellulose films loaded with chlorhexidine into the layered zirconium phosphate nanoparticles with potential antibiofilm activity. Chlorhexidine was intercalated between the layers of zirconium phosphate nanoparticles for prolonged release. The films showed potent antimicrobial and antibiofilm activity. In vitro cytotoxicity evaluation on human keratinocytes and fibroblasts revealed a low cytotoxic effect [81]. Volova et al. prepared cellulose composites films loaded with silver nanoparticles and antibiotics. The films were loaded with amikacin and ceftriaxone. The films displayed good antibacterial activity against *E. coli, P. aeruginosa, Klebsiella pneumoniae, and S. aureus* [82].

Alavi et al. developed film dressings made of pluronic F127 and pectin or pluronic F127 and gelatin using glycerol (2.5%) as a plasticizer. Erythromycin (0.1%) was loaded in the films. The optimized film (1:4; pluronic F127/Pectin and pluronic F127/gelatin) displayed a smooth, translucent, and good flexibility. The drug-loaded film exhibited smoother surface morphology. The films mechanical properties were superior with extended drug release suggesting good patient compliance by reducing dressing changes. The films were nontoxic with good antibacterial activity [83]. Lee et al. developed a thin soft Janus polydimethylsiloxane (PDMS) film with good porosity, stretchability, and water-wettability [84]. The film can be stretched to 150% of its original length and the nonporous face of the film contributes to its waterproof barrier. The porous face of the films is suitable for the preloading of bioactive agents and quick drug release with enhanced water vapor permeability. Blood absorbed by the film's network is distributed thereby preventing the formation of a large clot and hardened scab that can cause a secondary injury to the wound bed upon removal [61,84]. Nunes et al. evaluated collagen-based films loaded with usnic acid as a wound dressing for burn wounds. In vivo studies on second-degree burn wounds in 45 Wistar rats showed that the use of usnic acid improved the formation of collagen with rapid epithelization indicating that they are suitable for burn wound healing. The presence of usnic acid in the liposomes prevented over deposition of collagen fibers [85]. Ambrogi et al. reported chitosan/montmorillonite composite films containing chlorhexidine with prolonged drug release. The drug was intercalated between the layers of montmorillonite and the films and they displayed good antimicrobial and antibiofilm activities with no cytotoxic effects. The results revealed their potential use as a wound dressing material for the prevention of microbial colonization in wounds [86]. Niamlang et al. prepared poly(vinyl alcohol) films loaded with tetracycline hydrochloride encapsulated in quaternized chitosan nanoparticles. The success of the encapsulation was confirmed by Fourier transform infrared (FT-IR) spectroscopy. The encapsulation efficiencies of the drug-loaded chitosan nanoparticles were in the range of 72%–95%. In vitro release studies showed a slow drug release with good antibacterial activity against *E. coli, S. aureus*, and *Enterococcus faecium* [87]. Sebri and Amin developed chitosan films loaded with norfloxacin to combat bacterial infection around the wound area. The loading of norfloxacin into the films enhanced the flexibility of the film. In vitro studies show that the present of norfloxacin in the film reduced the number of human dermal fibroblast cell after 72 h incubation. The antibacterial activity of the films was significant against *E. coli, Bacillus cereus, S. aureus*, and *K. pneumoniae* strains of bacteria [88]. Kouchak et al. prepared blend films using chitosan and poly(vinyl alcohol) loaded with nitrofurazone by casting evaporating technique [89]. Loading nitrofurazone into the films reduced the tensile strength, swelling ability, oxygen permeability of the films. However, the water vapor transmission rate was increased. The films exhibited high antibacterial activity against *P. aeruginosa* [89].

3.5. Dermal Patches

A transdermal patch is composed of a multilayered structure with an impermeable film loaded with drugs and excipients which is suitable for good skin adhesion and a protective release liner. The liner must be removed