

for the healing of wounds. Adhesion, spread, and proliferation of the epidermal cells and fibroblast can also be influenced by the silk fibroin. But the mechanical strength of the silk fibroin at dry condition is very poor, which is its only drawback. To overcome this problem, naturally synthesized sodium alginate has been used in wound dressing. Sodium alginate not only increases the mechanical strength of the structure but also influences all advantageous properties in terms of wound-healing application. Finally, they observed that the angiogenesis and proliferation of the cells have been improved by using these blended films.

Panawes *et al.*, [25] studied the fruit hull of *Garcinia mangostana* (MT) extracts and alginate-based gauze as a wound dressing and evaluated its antibacterial characteristic. The concentration of the alginate in the gauze also affects wound characteristics in terms of swelling ratio, moist environment, and blood coagulation properties. Finally, they concluded that 0.5% AG and 50–55% MT are the suitable percentages to enhance the antibacterial properties of gauze-based wound dressing.

9.4.1.3 Zinc/Alginate- and Silver/Alginate-Based Wound Dressing

Zinc-incorporated alginate wound dressing has also been used tremendously in wound care application. As already mentioned in the above paragraph, the alginate itself has advantageous antimicrobial and proinflammatory reduction property. But incorporation of zinc in the alginate wound dressing significantly improves the antimicrobial and other activities. Zinc ions can also enhance the keratinocyte migration and endogenous growth factor in the wound dressing process [26].

Wiegand *et al.*, [27] investigated the functions of pure alginate and silver-based alginate in the cytotoxicity, antimicrobial activity, and binding capacity for pathophysiological factors in chronic wounds. They have developed three alginate-based wound dressings, namely, pure alginate, ionic silver-based alginate, and silver nanocrystals-based alginate. They finally observed that alginate binds a suitable amount of the elastase, reduces the proinflammatory cytokines, and also stops the free radical formation in the chronic wounds. Moreover, alginate also exposes the antimicrobial activity and biocompatibility. Addition of silver into the alginate improves the antibacterial activity and influences the antioxidant property of the alginate. Opananon *et al.*, [28] also studied the wound-healing capability of the Askina Calgitrol Ag[®] and the 1% silver sulfadiazine (1% AgSD)-based wound dressing. The Askina Calgitrol Ag[®] wound dressing has been made from polyurethane foam layer, which can absorb the wound exudate, and an ionic silver alginate part that was used to act as