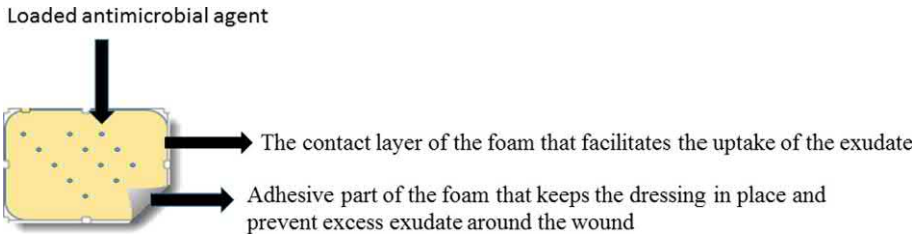

FIG 6 Diagram of foam for wound dressing.

protection; they are nontoxic; cost effective with a long shelf life. They are useful for the management of chronic and acute wounds (Table 2) [62,64].

Pyun et al. developed silver-hydroxyapatite-loaded polyurethane foams. In vivo wound healing was evaluated in Sprague-Dawley rat model. Silver-hydroxyapatite particles were uniformly dispersed in the foams. The in vitro release of silver from the foam was influenced by time and concentration. The foams displayed good antibacterial activity and were noncytotoxic on L-929 fibroblast cells in vitro. In vivo studies on the foam revealed a scar-free wound healing which was characterized by accelerated re-epithelialization and collagen deposition in the excision wound model [65].

Commercially available foams are Gentian violet and methylene blue (GV/MB) antibacterial dressings in poly(vinyl alcohol) (PVA) foam and polyurethane (PU) foam bonded with GV and MB with a thin film backing. The latter foam does not require hydration or a secondary dressing. They are affordable when compared with other wound dressings. They accelerate wound healing due to features such as easy to use, do not require frequent changes and promote autolytic debridement [66].

Kendall AMD antimicrobial foam dressings are incorporated with an antimicrobial agent, poly(hexamethylene biguanide) (PHMB). They are characterized by high absorption capacity and are designed for the management of acute or chronic wounds which produce moderate to high amount of exudates. They are made of polyurethane foam and provide moisture environment for the wound and inhibit the growth of bacteria. The presence of a polyurethane film prevents the leakage of exudate. The wound contact surface of the foam is nonadherent with an open-cell honeycomb structure that promotes high absorption of exudates into the core of the dressing. The inner core of the foam has a large honeycomb structure which also promotes the retention of exudates. Its good absorption capability prevents the maceration of the surrounding skin around the wound bed. Any bacteria in the exudates are exposed to the antimicrobial action of the loaded PHMB. PHMB mode of action on bacteria is via binding to bacteria cell's outer membrane and it disrupts the integrity of the cell membrane; inhibit bacteria cell metabolism and induce cell death [55].

Researchers reported the efficacy of Kendall™ AMD antimicrobial foam dressings in the management of chronic wounds. Sibbald et al. performed a clinical trial on patients with leg and foot ulcers over a period of 5 weeks. The PHMB foam dressing reduced wound superficial bacterial burden significantly at week 4 with ($P = .016$) when compared with the foam alone. It also reduced pain significantly at week 2 with ($P = .0006$) and at week 4 with ($P = .02$). A significant wound reduction by a 35% median by week 4 was also reported when compared with 28% in the control group [54]. Warriner and Spruce performed a clinical trial to investigate the potential application of PHMB foam for the management of overgranulation at gastrostomy sites. PHMB-impregnated foam dressing at 2 weeks resolved the overgranulation tissue in one-third of the patients, at week 4 for three patients and at week 6 for another three patients. Although overgranulation is not life threatening, it is responsible for factors such as odor, bleeding, and exudates which can affect patient quality of life, psychologically [56]. Evans reported the use of Kendall AMD Antimicrobial Foam Dressing with PHMB for the prevention and management of infection of exit sites [57].

PHMB-treated Kendall AMD antimicrobial foam dressing exhibit antimicrobial activity against MRSA suggesting its potential to reduce bacterial contamination of the wound by wound dressings (Internet source: MRSA FD. Efficacy of Kendall; [53]).

3.4. Films

Films have been designed as wound dressings (Table 3). Peles and Zilberman developed films from soy protein isolate followed by the loading of gentamicin for controlled release. The films exhibited high tensile strength with suitable Young's modulus. Factors such as the type