Transparent Wound Dressing Patch

Ready-to-use PVA-PVP based patch for wound dressing and tissue engineering applications. (Patent# 345685; Granted on 31.08.2020).

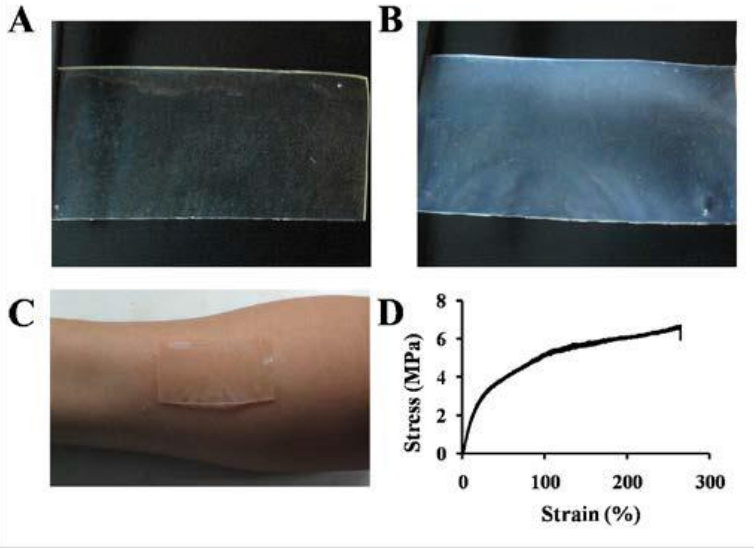

Figure 1: The patch (A) forms a hydrogel in PBS (B) that may be used as a patch (C) and have the desired mechanical property (D) for stretching. ((Indian Patent# 345685; Pusph et al., 2021, Biotechnology and Bioengineering, 118: 2312-2325)

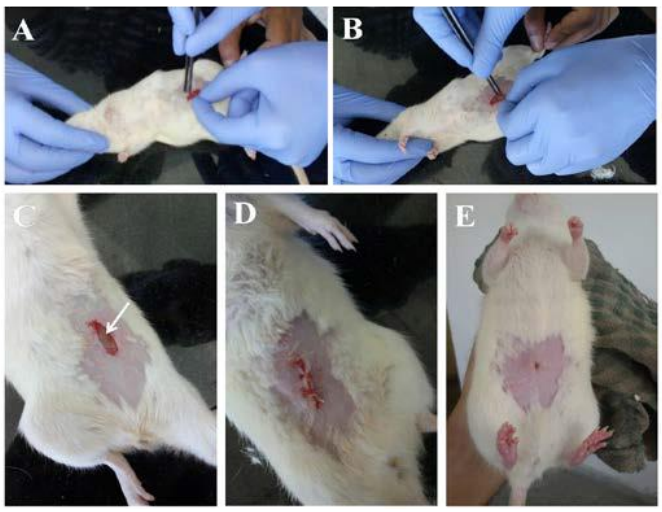

Figure 2: Subcutaneous implantation of patches in rats. An incision was made on the skin at the ventral midline (A), and a subcutaneous pouch was created (B). A PVA-PVP patch (arrow) was implanted in the subcutaneous pouch (C) and sutured by Catgut (D). The implantation site did not show any signs of wound infection or tissue reaction (E). (Pusph et al., 2021, Biotechnology and Bioengineering, 118: 2312-2325).

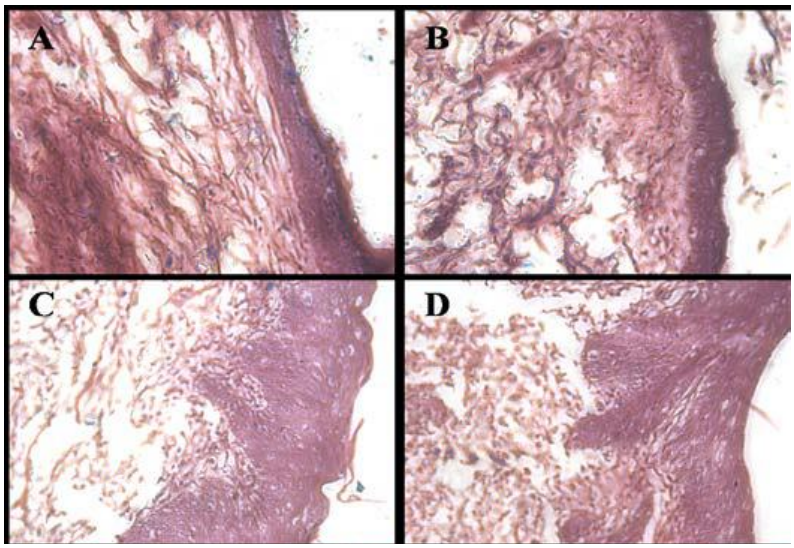

Figure 3: Histological sections of skin stained with Hematoxylin and Eosin stains. The PPG10 (A, C) and PP5Gy3 (B, D) were implanted in the subcutaneous pouch under the skin and samples were collected after 15 days and one day, respectively. A-B: 100X magnification of skin sections; C-D: 400X magnifications of skin sections. (Pusph et al., 2021).

Composition and Preparation:

Patches has been developed using synthetic Polyvinyl alcohol (PVA) and Polyvinyl pyrrolidone (PVP) as base polymers. The polymeric network has been further modified with organic additives such as glycerol (Gy) and propylene glycol (Py) that functionally serve as cross linker, and plasticizers. They can be prepared by a solution casting method, which is a highly inexpensive fabrication method and can be adopted even in circumstances that cannot afford large scale processing schemes.

Mechanism of Action:

The patch creates a moist environment that would enable the body to heal on its own through the endogenous enzymes. Further, it provides a physical barrier to the wound against the entry of environmental pathogens. It can also be loaded with antibiotics and growth factors for enhanced functionality.

Upon contact with the fluid of wound exudates, the patch swells, soften and achieves a hydrogel structure that stick to the entire surface and contour of the wound. The softened and moist environment of the resulting hydrogel assists in the wound healing on its own through the endogenous enzymes. Since the patch leech out the wound exudates towards the external surface, it also facilitates a localized antibacterial effect. Moreover, the protection barrier ensured through the leached constituents accelerates the cellular and tissue growth in the wound region.

The degradation time of the patch is 5-7 days, which is similar to characteristic time frame of wound healing although it varies with the nature of the wound.

Advantages:

- Fully synthetic polymers
- Biodegradable
- Non-cytotoxic to growth of cells and tissues
- Transparent and allows direct visualization of wound for monitoring the healing process without the need to remove the patch.
- Cheaper than similar materials made commercially.
- Less pain, natural healing and safer than cotton wool, lint and gauzes that are currently used in bandages for wounds.
- The mechanical strength and elongation characteristics facilitate the product to take any shape or curvature of the wound to allow their complete coverage. Moreover, it can stretch with skin stretching without affecting the wound healing process.

Comparison with commonly used dressing materials (Cotton wood, lint and gauzes)

The patch could change the way hospitals bandage wounds in a safer, more natural and eco-friendly way than using cotton wool, lint and gauzes.

Cotton wool, gauzes and lint are commonly used for management of exudates and speed up the healing process during wound healing process. However, they have several disadvantages:

i) They are opaque. Thus, the doctor/nurses have to regularly remove them from the sensitive wounds to visualize and monitor the wound healing process and the treatment required.
ii) Their removal for visualization or during subsequent dressing causes pain. This is particularly important for large-sized wounds.
iii) If not done properly, the removal process can damage a healed tissue.
iv) It is often difficult to get rid of complete dressing material, which can lead to maceration of the newly generated tissue.

In contrast, our patch not only allows natural healing by endogenous enzymes and prevents accumulation of wound exudates on the surface but also has several advantages:

i) They are transparent, which allows for wound observation without changing the dressing materials.
ii) The patch can be easily taken off without causing pain or damaging healed tissue because of the controlled moist environment facilitated by the material.
iii) The patch is biocompatible and do not require to get rid of.
iv) The patch is non- cytotoxic, non-irritant, non-corrosive, and does not hampers the growth of cells, tissues and natural healing processes.
v) It can stretch with skin stretching without affecting the wound healing process.

Cost comparison with other commercially available dressing materials

The estimated cost of producing the our patch at a laboratory scale is about Rs. 0.087/ cm^2. This is about 92.8% less expensive than commercial patch such as 3M Tegaderm IV Transparent Film (1633IN) that costs 0.9375/cm^2. Considering processing cost, scale up cost, marketing cost etc,

the anticipated cost of our patch is expected to be less than 50% of the commercially available products.

Current status:

i) In vitro studies on cells and in vivo studies on mouse are completed.
ii) Patent granted.
iii) Scale up analysis and in vivo studies in GML facilities are required for licensing.