CHAPTER 3
HEMPEDU BUMI HYDROGEL FOR WOUND HEALING

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3.1 INTRODUCTION

The United States recorded that 3% of the elder communities above 65 years old faced open wounds with slow recovery. This is due to the high cost to undergo wound care with healthcare institutions and pharmacies. This has been uplifted by the World Health Organization (WHO) with the recognition from the Association for the Advancement of Wound Care (AAWC) Global Volunteers. The global wound healing market is expected to grow by 2026 at an annual rate of 7.6% to 27.8% billion U.S. dollars, up from 19.3% billion U.S. dollars in 2021. The use of regenerative medicine in wound treatment and technological advancements can drive up the market expansion. The strong development potential of emerging nations, as well as the increasing number of acquisitions by important competitors, have created a plethora of chances for the wound healing industry to expand.

The injury begins with a series of complex cellular and biochemical events that lead to wound healing. The wound healing can be divided into four overlapping stages: (1) Haemostasis and inflammation, (2) proliferation, (3) Maturation and remodelling, and (4) Wound contraction which will lead to scar formation. The injuries mainly caused by external forces come from various sources such as burns,

minor scrapes from sharp objects or excessive friction towards the skin. Skin has high adaptability to the environment to preserve the human against chemical, physical, and ultraviolet (UV) radiation. Hence, the skin is well equipped with advanced repair systems which will effectively speed up the healing process.

Apart from following the medicine prescriptions from doctors, herbal medicine is also recommended to cure the wound naturally without interruptions due to harmful substances. For instance, the usage of *Kaempferia galangal* L. or aromatic ginger is applied by Malay women for their postpartum care. By boiling the herbs and make it as a drink, *Kaempferia galangal* L. is believed to cure bloating stomach post pregnancy. The consumption of traditional plants is increasingly sought worldwide because of their good efficacy, few side effects and relatively low-cost. Many drugs in the pharmacopoeia are sourced for pharmaceuticals, but they have been refined and evaluated so that the precise and safe doses may be achieved. Thus, recent biomedical research has increasingly focused on developing herbs and their bioactive compounds as therapeutic agents for wound healing.

Andrographis paniculata, locally known as hempedu bumi is chosen along with hydrogel because of its bitterness flavour and ability to cure fever, common cold and cough across the Southeast Asian countries, India and China. Besides, the hempedu bumi extracts are widely used for treating diabetes, inflammatory and mental disorders (Islam, 2017). Therefore, the focus is now directed to utilizing plant-derived medicines or herbal plants as promising therapeutic for wound healing. Hempedu bumi or andrographolide (AG) is highly abundant, making it a promising and cost-competitive option for wound healing.

3.2 HEMPEDU BUMI INCORPORATION INTO HYDROGEL

Andrographis paniculata (Burm. F.) Nees (family, Acanthaceae) or known as hempedu bumi (Figure 3.1) is synonym to the people in Sri Lanka, Thailand and India as the king of bitters among existing herbal plants

due to its strong bitter taste when directly ingested. Hempedu bumi is proven safe, natural, and non-toxic, and has been formulated in various Chinese traditional medicines; patented and clinically available to the public (Jiang et al., 2021).

Figure 3.1 Hempedu bumi

Andrographolide (AG) is composed of diterpenoids, flavonoids and polyphenols. The sources include stems, thorns and leaf of *A. paniculata*. The solution is colourless aside from the extremely bitter flavour when ingested directly. The chemical formula for AG is $C_{20}H_{30}O_5$ (Reshi & Chi Young, 2020). It has compact molecules, dominating across the plants and can be directly extracted into colourless crystalline solid (Reshi & Chi Young, 2020). Few works in the literature reveal the health benefits of AG to cure influenza, cough and fatigue. Besides, AG is reported to supply extra energy and nutrients as food supplements.

Andrographolide (AG) is a natural polymer that has shown to boost the metabolic rates of human body owing to its anti-inflammation and antiviral properties, aid in minimizing the effects of cold and cough. Consequently, it has been identified as a therapeutic substitute for the treatment of metabolic syndrome (Islam, 2017). Also, AG serves as