

## Cookies Rich in Antioxidant from Mango (*Mangifera indica*) with Binahong (*Anredera cordifolia*) as a Potential for Postoperative Wound Healing

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### ABSTRACT

Poor wound healing is a significant problem in surgical practice because of impaired healing, excessive scarring, infections, or dehiscence in post-surgical intervention. Mango (*Mangifera indica*) contains high levels of nutrients, fiber, macronutrients, micronutrients, and minerals as well as abundant bioactive compounds such as vitamin C, beta-carotene, polyphenol types of quercetin, and kaempferol. Flavonoid and saponin in binahong (*Anredera cordifolia*) play a role in wound healing since flavonoid contains an anti-inflammation effect, while saponin can inhibit the growth of microorganism in the wound as an antiseptic to avoid infection, increase the number of fibroblast cells, and stimulate the formation of collagen. This research aims to process and determine the functional cookies formula from fermented mango and binahong with the highest vitamin C and antioxidant activity. There were 3 variations of the formulation based on mango, binahong, and CO<sub>2</sub>-free water. The variations were as follow: S1 = 1: 0.5: 0.5; S2 = 2: 1: 1; and S3 = 3: 2: 2. All samples were inoculated with *Lactobacillus paracasei* 5% b/v for 14 days under anaerobic conditions. The amount of Vitamin C (mg/100g) analysis from 3 samples of cookies using the Titration Iodometric Method, while the antioxidant activity was determined with 2,2-diphenyl-1-picrylhydrazyl (DPPH). The results of vitamin C and antioxidant activity in each sample of cookies were as follow: S1 with 130.40mg/100g and 35.31% antioxidant activity, S2 with 121.33mg/100g and 30.74% of antioxidant activity, and S3 with 137.56mg/100g and 39.42% antioxidant activity. The formulation of cookie samples containing the highest vitamin C was S3. There was a significant difference ( $P < 0.05$ ) which determined the vitamin C level between the sample formulations.

### Keywords:

Wound Healing, Mango, Binahong, Vitamin C, Antioxidant

### 1.Introduction

Wound healing is a complex event that is divided into 4 steps: hemostasis/coagulation, inflammation, migration/proliferation, and remodeling (Barchitta et al., 2019). Poor wound healing is a significant problem in surgical practice because of impaired healing, excessive scarring, infections, or dehiscence in the post-surgical intervention (Geers et al., 2018). Thus, the prevention of poor wound healing may ensure good and low-cost patient care.

Mango (*Mangifera indica*) is a tropical fruit plant that contains high levels of nutrients, fiber, macronutrients, micronutrients, and minerals as well as abundant bioactive compounds (Maldonado-Celis et al., 2019). The well-known high content in mangoes includes vitamin C, beta-carotene, polyphenol types of quercetin, and kaempferol (Mantik et al., 2021; Nurkolis et al., 2020). Tocopherols, phytosterols, and triterpenes in mango butter (Dhara et al., 2010) have significant restoring and protecting properties on human skin which also replenishes skin moisture (Kočevár Glavač et al., 2018; Mandawgade & Patravale, 2008).

Madeire vine (*Anredera cordifolia*) is known as binahong in Indonesia as a traditional medicinal plant (Bari et al., 2019). Many research has founded that binahong exerts antioxidant (Djamil, 2012), antihyperlipidemic (Lestari et al., 2015), antihyperuricemic (Widyarini et al., 2015),

wound healing, and analgesics properties (Astuti et al., 2011). The main bioactive compounds in binahong leaves consist of flavonoid, saponin, and tannin. Flavonoid and saponin play a role in wound healing since flavonoid contains anti-inflammation effects, while saponin can inhibit the growth of microorganisms in the wound as an antiseptic to avoid infection, increase the number of fibroblast cells, and stimulate the formation of collagen (Sasidharan et al., 2010).

Based on mango and binahong potential, a functional cookie high in vitamin C and antioxidant activity which may improve wound healing could be formulated. This research aims to process and determine the functional cookies formula from fermented mango and binahong with the highest vitamin C and antioxidant activity.

## 2. Material and Methods

There were 3 variations of the formulation based on mango, binahong, and CO<sub>2</sub>-free water. The variations were as follow: S1 = 1: 0.5: 0.5; S2 = 2: 1: 1; and S3 = 3: 2: 2. All samples were inoculated with *Lactobacillus paracasei* 5% b/v for 14 days under anaerobic conditions. The part of mangoes and binahong used were pure ripe flesh. The fermented products were made into flour using the freeze dryer. The powder was mixed and stirred with the addition of 5% water using a mixer with a power of 102-189 rpm for 30 minutes and then put in the oven for 15 minutes with a temperature of 70 – 90°C so that it became cookies. Sample variation was done to determine the average significance of the antioxidant content in it. The next step was determining the amount of Vitamin C (mg/100g) analysis from 3 samples of cookies using the Titration Iodometric Method, while the antioxidant activity was determined with 2,2-diphenyl-1-picrylhydrazyl (DPPH).

$$\text{Vitamin C} \left( \frac{\text{mg}}{100\text{g}} \right) = \frac{V I 2 \times 0,88 \times Fp \times 100}{Ws \text{ gram}}$$

The determination of water content used was the AOAC drying method (thermogravimetry). The water content was calculated using the following formula:

$$\text{Water Content (\%)} = \frac{W1 - W2}{W1 - W0} \times 100$$

The procedure for determining the ash content was carried out using the AOAC 2005 method. Calculation of the ash content was carried out using the following formula:

$$\text{Ash Content (\%)} = \frac{\text{Weight of Bowl after Heated} - \text{Constant Weight of Empty Bowl}}{\text{Sample Weight}} \times 100$$

## 3. Results and Discussion

Sample	Vitamin Content (mg/100g)	Anti-oxidant activity towards DPPH (%)	Ash Content (%)	Water Content (%)
S1	130.40	35.31	1.99	1.79
S2	121.33	30.74	1.96	1.89
S3	137.56	39.42	2.12	1.94
Mean	129.76 ± 8.13	35.15 ± 4.34	2.02 ± 0.08	1.87 ± 0.07

The results of vitamin C and antioxidant activity in each sample of cookies were as follow: S1 with 130.40mg/100g and 35.31% antioxidant activity, S2 with 121.33mg/100g and 30.74% of antioxidant activity, and S3 with 137.56mg/100g and 39.42% antioxidant activity. The formulation of cookie samples containing the highest vitamin C was S3. There was a significant difference ( $P < 0.05$ ) which determined the vitamin C level between the sample formulations. The higher the antioxidant activity, the higher the antioxidant levels, and the less food needed to reduce free radicals (Lisdawati, 2006). This shows that the formulation of a blend of fermented mango and binahong which was made into cookies contains high vitamin C and antioxidant activity. The average vitamin C level in the three cookie samples was 129.76mg/100g. S3 showed the best activity, namely antioxidant activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH) of 39.42%. This makes the formulated cookies a potential healthy snack that is high in vitamin C and antioxidants which can accelerate the healing process since the vitamin C content is essential for enhancing neutrophil migration and lymphocyte transformation (Palmieri et al., 2019), collagen and ceramides synthesis, early resolution of inflammation, and angiogenesis, while antioxidant activity may restore the balance between pro and antioxidant (Barchitta et al., 2019; Mohammed et al., 2016).

The average ash content of the three samples was 2.02% and water content was 1.87% which corresponds to the Indonesian National Standard (SNI) 01-2973-1992. Higher ash content in cookies indicates the higher mineral contents in cookies such as calcium, potassium, and iron (Andarwulan et al., 2014). It is clinically known that mineral intake can improve the respiratory system, especially in tuberculosis sufferers (Taslim et al., 2020).

Fermented mango and binahong have a great potential to be developed into healthy snack cookies. The vitamin C and antioxidants content in cookies from the fermentation of mango and binahong leaves may be a great substitute for snacks for the postoperative patient since antioxidants and vitamin C may accelerate the wound healing process. These cookies are also a good anti-inflammatory source, since anti-inflammatory agents may minimize tissue damage in the inflammation process and provide greater comfort to the patient (Nunes et al., 2020). It needs clinical trials in humans to find out more about its effects on human health and the authors are very open to joint research collaborations.

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### **Conflict of Interest**

The authors declare that there are no conflicts of interest

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