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Antioxidant Capacity of Snack Cookies Made from Mango and Aloe Vera Fermentation

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ABSTRACT

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. Aloe vera also has many pharmacological effects such as antioxidant, digestive diseases protection, antidiabetic, cardioprotective, skin protection, bone protection, anticancer, antimicrobial, prebiotic, and skin protection. This research aims to process and determine the functional cookies formula from fermented mango and aloe vera with the highest vitamin C and antioxidant activity. There were 3 variations of the formulation, based on mango, aloe vera, and CO2-free water. The variations were as follow: S1 = 1: 0.5: 0.5; S2 = 2: 1: 1; and S3 = 3: 2: 2. Then, 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 110.20mg/100g and 25.31% antioxidant activity, S2 with 101.65mg/100g and 20.63% of antioxidant activity, and S3 with 117.69mg/100g and 34.71% 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:
Mango, aloe vera, antioxidant, cookies, fermentation

1.Introduction

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).

Aloe vera is a green herb originating in the hot and dry region such as the Middle East of Asia that has been traditionally utilized to treat skin injuries and digestive problems. A recent review has stated that aloe vera has many pharmacological effects such as antioxidant, digestive diseases protection, antidiabetic, cardioprotective, skin protection, bone protection, anticancer, antimicrobial, prebiotic, and skin protection (Sánchez et al., 2020). These effects are exerted from the bioactive compounds in aloe vera, including flavonoids, terpenoids, tannins, sterols, amino acids, proteins, anthraquinones, vitamins, and minerals (Marzanna & Dziedzic, 2019). Other reported effects of aloe vera are blood glucose and cholesterol modulation (Pothuraju et al., 2016) and hepatoprotective activity (Cui et al., 2014).

Recent research has shown that increasing the intake of foods high in antioxidants and polyphenols such as Vitamin C, beta-carotene, quercetin and kaempferol can increase the body immunity against viral infection (Levy et al., 2020; Pitsillou et al., 2020; Suhail et al., 2020).

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Therefore, the consumption of food sources of antioxidants can be one of the efforts to minimize inflammation, one of which is inflammation caused by functional digestive diseases and non-communicable diseases (Omodanisi et al., 2017). Based on mango and aloe vera potential, a functional cookie high in vitamin C and antioxidant activity could be formulated. This research aims to process and determine the functional cookies formula from fermented mango and aloe vera with the highest vitamin C and antioxidant activity.

2. Material and Methods

There were 3 variations of the formulation, based on mango, aloe vera, and CO_2-free water. The variations were as follow: S1 = 1: 0.5: 0.5; S2 = 2: 1: 1; and S3 = 3: 2: 2. Then, all samples were inoculated with *Lactobacillus paracasei* 5% b/v for 14 days under anaerobic conditions. The part of mangoes and aloe veras 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).

$$Vitamin\ C\ \left(\frac{mg}{100g}\right) = \frac{V\ I2\ x\ 0{,}88\ x\ Fp\ x\ 100}{Ws\ gram}$$

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

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

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:

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

3. Results and Discussion

Sample	Vitamin C Content (mg/100g)	Anti-oxidantactivitytowards DPPH (%)	Ash Content (%)	Water Content (%)
S1	110.20	25.31	1.97	1.85
S2	101.65	20.63	1.99	1.65
S3	117.69	34.71	2.01	1.82
Mean	109.84 ± 8.02	26.88 ± 7.17	1.99 ± 0.02	1.77 ± 0.10

The results of vitamin C and antioxidant activity in each sample of cookies were as follow: S1 with 110.20mg/100g and 25.31% antioxidant activity, S2 with 101.65mg/100g and 20.63% of antioxidant activity, and S3 with 117.69mg/100g and 34.71% 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 aloe vera which was made into cookies contains high vitamin C and antioxidant activity. Foods that are high in antioxidants and vitamin C can act as immunomodulators and even help the process of T-cell maturation (Manning et al., 2013). This makes formulated cookies a potential healthy snack that is high in vitamin C and antioxidants during the COVID-19 pandemic. The average vitamin C level in the three cookie samples was 109.84mg/100g. S3 showed the best activity, namely antioxidant activity against 2.2-diphenyl-1-picrylhydrazyl (DPPH) of 34.71%.

The average ash content of the three samples was 1.99% and water content was 1.77% 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 aloe vera 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 aloe vera may be a great substitute for snacks during the pandemic since antioxidants and vitamin C can improve immunity and anti-inflammatory response. These cookies are also good prebiotics for the gut microbiome which plays a good role in the immune system. 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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