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Cookies Rich in Antioxidants from the Combination of Lactobacillus Paracasei with Avocado Juice as a Functional Food Anti-Diabetic

Christi Diana Mambo[1], Viktory Nicodemus Joufree Rotty[2], Fahrul Nurkolis[3], Nelly Mayulu[4]

[1]Department of Pharmacology, Faculty of Medicine, Sam Ratulangi University, Manado, Indonesia.
[2]Manado State University, Minahasa Regency, North Sulawesi, Indonesia.
[3]Department of Biological Sciences, Faculty of Sciences and Technology, State Islamic University of Sunan Kalijaga, Yogyakarta, Indonesia.
[4]Department of Nutrition, Faculty of Medicine, Sam Ratulangi University, Manado, Indonesia.
Corresponding author: Christi_diana@yahoo.com

ABSTRACT

Avocado (Persea americana) is a potential superfood originating from Mexico and Central America which contains an abundance of phytosterols and phytostanols, phenolics and polyphenolic compounds, carotenoids, minerals, vitamins, seven-carbon sugars, and fatty acids, tocopherols, and alkaloids. Lactobacillus paracasei (L. casei) has health beneficial effects ranging from atopic dermatitis, cancer, potentially allergic disease, obesity, to diarrhea. This research aims to process and determine the functional cookies formula from fermented avocado juice with the highest vitamin C and antioxidant activity. There were 3 variations of the formulation based on avocado and CO2-free water. The variations were as follow: S1 = 1:0.5; S2 = 2:1, and S3 = 3:2. 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 90.65mg/100g and 25.99% antioxidant activity, S2 with 91.49mg/100g and 26.64% of antioxidant activity, and S3 with 100.23mg/100g and 31.56% 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:
Avocado, Lactobacillus Paracasei, Antioxidants, Anti-Diabetic

1.Introduction

Avocado *(Persea americana)* is a potential superfood originating from Mexico and Central America which contains an abundance of phytosterols and phytostanols, phenolics and polyphenolic compounds, carotenoids, minerals, vitamins, seven-carbon sugars, and fatty acids, tocopherols, and alkaloids (Salazar-López et al., 2020; Tabeshpour et al., 2017). Avocado also exerts antioxidant, hypolipidemic, antimicrobial, antihypertensive, antidiabetic, anti-obesity, antithrombotic, antiatherosclerotic, hepatoprotective, and cardioprotective properties (Tabeshpour et al., 2017). A recent review stated that any parts of avocado (peel, seed, leaves, and flesh) can be used as a diet component in managing metabolic syndrome (Tabeshpour et al., 2017) which is associated with diabetes (James et al., 2020).

Probiotics are living microorganisms that, if administered in sufficient quantities, can provide health benefits to the host by regulating an unbalanced gastroenteric microbiota (Margiotta et al., 2021). Lactobacillus group is some of the most researched and applied probiotics. *Lactobacillus paracasei (L. casei)* has health beneficial effects ranging from atopic dermatitis, cancer, potentially allergic disease, obesity, to diarrhea (Hill et al., 2018). The probiotic strain of *L. paracasei* also can modulate biomarkers of immune function and responses (Guillemard et al., 2010; Merenstein et al., 2010), improve microbial activity (Cazorla et al., 2018), and limit gut

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injuries (Zakostelska et al., 2011). Yogurt created from *Lactobacillus* was also reported to reduce common infectious diseases (Poon et al., 2020).
Based on avocado potential, a functional cookie high in vitamin C and antioxidant activity which may have an antidiabetic property could be formulated. This research aims to process and determine the functional cookies formula from fermented avocado juice with the highest vitamin C and antioxidant activity.

2. Materials and Method

There were 3 variations of the formulation based on avocado and CO_2-free water. The variations were as follow: S1 = 1:0.5; S2 = 2:1, and S3 = 3:2. All samples were inoculated with *Lactobacillus paracasei* 5% b/v for 14 days under anaerobic conditions. The part of avocadoes used was 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

Table 1. Test on Vitamin C, Antioxidant Activity, Ash and Water Content

Sample	Vitamin C Content (mg/100g)	Anti-oxidantactivitytowards DPPH (%)	Ash Content (%)	Water Content (%)
S1	90.65	25.99	1.73	1.90
S2	91.49	26.64	1.93	2.01
S3	100.23	31.56	1.99	1.97
Mean	94.12 ± 5.30	28.06 ± 3.04	1.88 ± 0.13	1.96 ± 0.05

The results of vitamin C and antioxidant activity in each sample of cookies were as follow: S1 with 90.65mg/100g and 25.99% antioxidant activity, S2 with 91.49mg/100g and 26.64% of antioxidant activity, and S3 with 100.23mg/100g and 31.56% 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 fermented avocado juice with *L. paracasei* was made into cookies contains high vitamin C and antioxidant activity. The average vitamin C level in the three cookie samples was 94.12mg/100g. S3 showed the best activity, namely antioxidant activity against 2.2-diphenyl-1-picrylhydrazyl (DPPH) of 31.56%. This makes the formulated cookies a potential healthy snack that is high in vitamin C and antioxidants which can act as an antidiabetic agent. Avocado contains an abundant of indigestible carbohydrates that is able to prevent diabetes and regulate blood cholesterol (Pahua-Ramos et al., 2012). *L. paracasei* also potentially contribute to the prevention of insulin resistance development (Zhang et al., 2020) and type 2 diabetes ((Dang et al., 2018) by decreasing oxidative stress status and protecting beta-cell function (Zeng et al., 2019).

The average ash content of the three samples was 1.88% and water content was 1.96% 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 avocado has a great potential to be developed into healthy snack cookies. The bioactive content in cookies from fermented avocado juice may be a great substitute for snacks for the prevention and treatment of diabetes since antioxidants and vitamin C may reduce oxidative stress status while the probiotic effect of *L. paracasei* has a beneficial effect on the glucose metabolism-genes related expression (Dang et al., 2018). These cookies are also a good anti-inflammatory source, since anti-inflammatory agents may minimize tissue damage and protect beta-cell (Nunes et al., 2020; Zeng et al., 2019). 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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