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Vitamin C Concentrate with Quercetin from Mango (Mangifera Indica) Potential as a Health Supplement

Maizer Said Nahdi[1], Fahrul Nurkolis[2], Isma Kurniatanty[3], Dian Aruni Kumalawati[4]
[1,2,3,4]Biological Sciences, Faculty of Sciences and Technology, The State Islamic University of Sunan Kalijaga, Yogyakarta, Indonesia.
[1]Corresponding email: maizer.nahdi@uin-suka.ac.id

ABSTRACT

This study aims to formulate a vitamin C concentrate product with quercetin from mango (Mangifera indica) as a health supplement that can be used as an anticancer, antidiabetic, antihypertensive, and immunomodulator. Samples consist of 3 formula variations based on the ratio between mango and CO2-free water (S1 = 1:0,5; S2 = 2:1; S3 = 3:2). The two main ingredients are mixed and stirred using a blender-type mixing machine for 15 minutes and then put in a freezer for 12 hours with a temperature of -20°C to -23°C. After that, it is dried using a freeze dryer in 0.100 mbar for 60 hours. The product becomes 100% dry which is then encapsulated. Vitamin C analysis was done using the Titration Iodometric Method to determine the amount of Vitamin C (mg/100g), while the quercetin was determined with HPLC. The formulation of a vitamin C concentrate supplement product with quercetin from mangoes is stable and has been based on tests using iodometric-titration techniques against 2,2-diphenyl-1-picrylhydrazyl (DPPH) and using high-performance liquid chromatography (HPLC). The obtained Vitamin C dan quercetin amount in each of the samples, S1 was 110.00 ±0.05 mg/100g and 41.93 µg/g, S2 was 130.00 ±0.20 mg/100g and 59.00 ±0.50 µg/g, and S3 was 165.00±0.01 mg/100g and 79.03± 0.08µg/g. S3 has the highest Vitamin C and quercetin content, which is potential to be produced commercially in the form of supplements.

Keywords:
Mango; Vitamin C; Quercetin; Supplement; Health

1.Backgrounds

Currently, there are many circulating health supplement products on the market in the form of tablets and capsules, but there aren't any health supplement products made from mango *(Mangifera indica)* which are useful as anticancer, antidiabetic, antihypertensive, and also immunomodulatory. In addition, products that utilize mango *(Mangifera indica)* as a source of vitamin C concentrate with quercetin have not been found on the market. Most supplements on the market are in the form of tablets and capsules consisting of medicinal plant extracts.

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, including vitamin C, beta-carotene, polyphenol types of quercetin, and kaempferol (Mantik et al., 2021; Nurkolis et al., 2020). 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). 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 research, mango fruit has vitamin C and quercetin content (Mantik et al., 2021; Nurkolis et al., 2020), which correspond to TKPI (Indonesian Food Composition Table) (Tim Update TKPI, 2018).

This research aims to utilize mango fruit *(Mangifera indica)* into vitamin C concentrate products with quercetin which can be used as a health supplement product source of vitamin C and

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quercetin that has potential benefits as an anticancer, antidiabetic, antihypertensive, and also immunomodulator.

2. Methods

Samples consist of 3 formula variations based on the ratio between mango and CO_2-free water (S1 = 1:0,5; S2 = 2:1; S3 = 3:2). The two main ingredients are mixed and stirred using a blender-type mixing machine for 15 minutes and then put in a freezer for 12 hours with a temperature of -20°C to -23°C. After that, it is dried using a freeze dryer in 0.100 mbar for 60 hours. The product becomes 100% dry which is then encapsulated. (1 Natural / Transparent Code 38).
Determination of Vitamin C Content:
Vitamin c level was determined using the iodometric titration method and using the formula below to calculate vitamin c level:

$$\boldsymbol{Vitamin\ c\ level\ (mg/100g) = \frac{V\ I2\ x\ 0,88\ x\ Fp\ x\ 100}{Ws\ gram}}$$

Determination of Quercetin Content :
Quercetin content was determined using HPLC and was conducted at the Pharmacy Laboratory of Sam Ratulangi University. Determination of absorption wavelength of quercetin was conducted at the maximum rate. A total of 10 mg of quercetin were put in a 50-mL shaped flask dissolve and dilute with chloroform to the mark. Then, a 2.5 mL pipette is put into a 10-mL flask, diluted with chloroform to the mark. Furthermore, the spectrum was made using a UV-Vis spectrophotometer at a wavelength of 450nm. Selection of mobile phase and flow rate A total of 10 mg of quercetin were put into a 50-mL flask, dissolve and dilute with chloroform to the mark. Then, a 2.5 mL pipette was put into a 10 mL flask, diluted with chloroform to the mark. Inject an amount of 20 µl into the HPLC device using the mobile phase methanol-chloroform (94: 6); methanol-tetrahydrofuran-water (67: 27: 6); chloroform-tetrahydrofuran-water (67: 27: 6); acetonitrile-chloroform (92: 8); and chloroform-tetrahydrofuran-methanol (70: 25: 5) with flow rates of 0.5 mL / minute and 1 mL / minute. The selected mobile phase and flow were those that provide the best separation with the least retention time.

3. Results and Discussions

Sample	Vitamin C (mg/100g)	Quercetin (µg/g)
S1	110.00±0.05	41.93 µg/g
S2	130.00±0.20	59.00± 0.50
S3	165.00±0.01	79.03 ± 0.08µg/g

The obtained vitamin C dan quercetin amount in each of the samples, S1 was 110.00±0.05 mg/100g and 41.93 µg/g, S2 was 130.00±0.20 mg/100g and 59.00±0.50 µg/g, and S3 was 165.00±0.01 mg/100g and 79.03± 0.08µg/g. There was a significant difference S3 has the highest vitamin C and quercetin content, which is potential to be produced commercially in the form of supplements. There was a significant difference ($P < 0.05$) which determined the vitamin C and quercetin level between the sample formulations.
Vitamin C intake may improve hyperuricemia, gout (Brzezińska et al., 2021), and osteoporosis (Brzezińska et al., 2020), delay the onset of cataracts (Lim et al., 2020), lower the risk of

developing metabolic syndrome (Wong et al., 2020b), and play a role in the pathogenesis of cardiovascular disease (Morelli et al., 2020).

Quercetin has been proved to exert beneficial effect on diabetes, obesity, and neurodegenerative disorders such as Alzheimer's disease (Alvarez-Arellano et al., 2020; Ebrahimpour et al., 2020; Sato & Mukai, 2020). Quercetin may also lower blood pressure and triglyceride level (Huang et al., 2020), modulate chronic inflammation (Sato & Mukai, 2020), act as an antiatherosclerosis agent in cardiovascular disease (Deng et al., 2020), protect against myocardial ischemia and injury (Zhang et al., 2020), and regulate bone homeostasis (Wong et al., 2020a).

Vitamin C and quercetin are known for their potential in cancer treatment since specific dose of vitamin C can stop cancer cell glycolysis (Fu et al., 2020) while quercetin can inhibit cancer cell growth, proliferation, and induce cell apoptosis (Davoodvandi et al., 2020; Rather & Bhagat, 2020).

These results highlight the potential of vitamin C and quercetin in mango to be developed into a health supplement that is useful in preventing non-communicable diseases, with a lot of health-related beneficial properties included. 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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