

NUTRITIONAL ANALYSIS OF SWEET ORANGE PEEL EXTRACT FOR DEVELOPMENT OF OBESITY TREATMENT

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ABSTRACT

Obesity is a complex chronic disease that becomes the main factor of cardiometabolic diseases such as heart diseases, stroke and diabetes mellitus. Oxidative stress is involved in the obesity pathogenesis. Diet and physical exercise are recommended for obesity treatment but many obese people have low compliance to these treatments. Sweet orange (*Citrus sinensis* L.) is an Indonesian fruit with high production per year. This fruit pulp contains high vitamin C level, which is widely used as a strong anti oxidant to inhibit oxidative stress. However, sweet orange peel is just thrown in the soil and becomes rubbish. Therefore, the aim of this study was to analyze nutritional contents of sweet orange peel extract (OPE). Fresh orange peels were obtained from a local market at the Surakarta city and the dried orange peels were extracted using ethanol solvent. Carbohydrate, protein, and fat levels were determined using the existing method at the Food Technology Laboratory while vitamin C and Magnesium (Mg) levels were determined using the spectrophotometric and SSA-flame methods respectively. 100g OPE contained 68.88% carbohydrate, 3.23% protein, 3.41% fat, 1556.6 mg vitamin C and 239.74 mg Mg. In conclusion, the OPE is a good source of vitamin C and Mg, which can be developed as a nutraceutical for obesity treatment. Further investigation is required to determine active compounds in the OPE, which enhances the beneficial effects of vitamin C and Mg.

Keywords: magnesium; obesity; oxidative stress; sweet orange peel; vitamin c

INTRODUCTION

Obesity is an epidemic disease that continues to increase every year. The World Health Organization (WHO) states that by 2020, 32% of the world's adult population (≥ 20 years) will be obese and by 2030 this number is expected to continue to increase to 43%. (The World Obesity Federation, 2022). Indonesia, one of the most populous countries in the world, is currently experiencing several nutritional problems, not only malnutrition, but also excess nutrition (Kemenkes, 2020). The population that continues to grow is directly proportional to the number of people who are obese. In Indonesia, the adult population (≥ 18 years), 42.2% are overweight and obese (Kemenkes, 2018).

Obesity is a condition caused by an imbalance between energy intake and energy used, resulting in continuous excessive accumulation of fat and leading to weight gain (Apovian, 2016). This fat accumulation has a negative effect on health because it triggers the emergence of various degenerative diseases, including; coronary artery disease and its complications and diabetes mellitus (Klein *et al.*, 2022). Obesity can be determined by calculating Body Mass Index (BMI) and percent body fat. A person can be declared obese if the BMI calculation results are ≥ 25 kg/m² and body fat percentage is $> 25\%$ for men and $> 35\%$ for women (Chen *et al.*, 2021). Obesity not only negatively impacts physical and mental health, but also reduces productivity and increases

health care costs (Wharton *et al.*, 2020). Thus, obesity has a negative impact on the global economy with losses estimated at 2 trillion USD per year (Kemenkes, 2018).

Obesity management therapy can be done in two ways, namely by non-pharmacological therapy and pharmacological therapy (Lin and Li, 2021). Non-pharmacological therapy is carried out by combining diet with physical exercise. Non-pharmacological therapy often fails because patients are inconsistent in carrying out therapy (Rosalinda and Nugroho, 2022). Likewise, pharmacological therapy also often fails because it usually requires higher costs and a long treatment time. Utilization of phytochemical substances from natural ingredients is an additional alternative that needs to be considered in the treatment of obesity (Wijaya, 2018).

Sweet orange (*Citrus sinensis* L.) is a type of fruit that is commonly consumed because it is easy to find and the price is relatively affordable. Sweet orange fruit contains various kinds of nutrients that are good for health. In general, only the pulp of the sweet orange fruit is consumed. The sweet orange peel is rarely used and ends up as waste. Previous research has shown that sweet orange peel extract contains phytochemicals that are good for Type 2 Diabetes (Gosslau *et al.*, 2018, Deasy, 2019). However, this study only focused on the phytochemical content of sweet orange peel extract. Therefore, in this study, we aim to determine the macro and micro nutrient content of sweet orange peel extract which can be developed in the treatment of obesity.

METHOD

This research is in the form of an experimental laboratoric study. The extract was made at the Setia Budi University Phytochemical Laboratory. The proximate test was carried out at the Food Technology Laboratory, Sebelas Maret University, and the magnesium content test was carried out by LPPT, Gadjah Mada University. Sweet orange peel extract is made using the maceration method. Fresh sweet orange peels were cut and dried at room temperature for 5 days. About 1500 g of sweet orange peel is ground and about 1360 g of crude simplicia is produced. The crude simplicia was then dissolved in 96% ethanol at a ratio of 1:10. Determination of carbohydrate content using the By Different method, protein using the Kjeldahl method, fat using the Soxhlet method, vitamin C using the Spectrophotometric method and magnesium using the SSA-flame method.

RESULTS AND DISCUSSION

Table 1.

Test the content of OPE

Kinds of Analysis	Analysis Method	Results Analysis
Carbohydrate	By Different	68,88%
Protein	Kjeldahl	3,23%,
Fat	Soxhlet	3,41%,
Vitamin C	Spektrofotometri	1556,6 mg/100 gr
Magnesium	SSA-nyala	2397,45 mg/kg

Table 1 describes the content of OPE, Fresh orange peels were obtained from a local market at the Surakarta city and the dried orange peels were extracted using ethanol solvent. Carbohydrate, protein, and fat levels were determined using the existing method at the Food Technology Laboratory while vitamin C and Magnesium (Mg) levels were determined using the spectrophotometric and SSA-flame methods respectively. Orange pell extract content test results

show that OPE has a high content of vitamin C and magnesium. In addition, OPE also contains moderate carbohydrates and low amounts of fat and protein. Vitamin C, also known as ascorbic acid, is a type of antioxidant that helps fight cellular damage caused by free radicals during metabolic processes and during strenuous exercise (Marks, 2021). Vitamin C is proven to be able to reduce Reactive Oxygen Species (ROS) by functioning as an electron donor to reduce molecular oxygen (Egini, et al., 2017) and can reduce problems related to inflammatory reactions, pain and depression faced by obese people. Among the possible positive effects of ascorbic acid on obesity-related mechanisms, it has been suggested that this vitamin has the following effects: (a) regulates lipolysis in adipocytes; (b) modulating glucocorticoid release from the adrenal glands; (c) inhibits glucose metabolism and leptin secretion on isolated adipocytes; (d) lead to amelioration of hyperglycemia and decreased glycosylation in obese diabetic models; (e) reduce the inflammatory response (Garcia-Diaz *et al.*, 2014).

Magnesium (Mg^{2+}) is an electrolyte whose intake needs are rarely met. This often occurs in obese people, especially obesity accompanied by diabetes and metabolic syndrome (de Baaij *et al.*, 2015). Previous studies have found that improving dietary patterns and meeting magnesium intake can improve metabolic syndrome by reducing blood pressure (Bateman, 2017), hyperglycemia (Kurstjens *et al.*, 2018) and hypertriglyceridemia (Morais *et al.*, 2017). This is done by modulating gene expression and proteomic profiles, and has a beneficial effect on the composition of the gut microbiota and the metabolism of vitamins B1 and D (Piuri *et al.*, 2021). Research related to magnesium intake has also been carried out in Mexico and the results show that magnesium intake in Mexicans is associated with lower BMI, lower WC and lower serum glucose levels (Castellanos-Gutiérrez *et al.*, 2018), and hypomagnesemia can be proved to be one of the important predictors of obesity. Magnesium suppresses hunger, reduces food intake, and helps you lose weight (Rafiee *et al.*, 2021). The most likely mechanism is based on stimulation of cholecystokinin by magnesium, which plays an important inhibitory role in controlling feeding behavior. (Kreft and Štrukelj, 2021).

CONCLUSION

In conclusion, the OPE is a good source of vitamin C and Mg, which can be developed as a nutraceutical for obesity treatment. Further investigation is required to determine active compounds in the OPE, which enhances the beneficial effects of vitamin C and Mg. However, further research is needed to find out the correct dosage regarding the use of OPE as an alternative therapy for treating obesity.

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