Formulation and Antioxidant Activity of Purple Sweet Potato (*Ipomoea batatas* L.) Extract in Jelly Candy

Mentari, Neni Sri Gunarti (✉), Eko Sri Wahyuningsih, Ainun Mar'atus Putri Warsito, Dyah Kharisma Ariyanti, Dinda Dinanti, and Dhavid Twua Mangunsong

Faculty of Pharmacy, Universitas Buana Perjuangan Karawang, West Java, Indonesia
neni.gunarti@ubpkarawang.ac.id

Abstract. Purple sweet potato is a plant that having a purple pigment which is an anthocyanin pigment that functions as antioxidant. Antioxidants themselves are compounds that can inhibit free radicals. With the inhibiting oxidation reactions in easily oxidizable materials and resisting substrate oxidation due to free radical's potential, the potential can be exploited as a functional ingredient. The purpose of this research did formulation of jelly candy using purple sweet potato extract which has antioxidant activity. The method is purple sweet potato extract used maceration method. Then, put extract in candy jelly, then did tested using UV-Vis spectrophotometer for antioxidants activity. The main finding, firstly the phytochemical screening of purple sweet potato extract with results that extract are positive alkaloid, flavonoid, saponin and tannin. Then, mix jelly candy's formula with that extract. After the jelly candy is formed, tested the jelly candy by UV-vis spectrophotometer with result that sample contained antioxidants of 51.17% inhibition. The implication of this research, with the antioxidant activity in jelly candy can be used as a functional food because it is in great demand by public because it can be consumed easily.

Keywords: Purple Sweet Potato, Jelly Candy, Antioxidant.

1 Introduction

Ipomoea batatas L., commonly referred to as sweet potato, is a plant belonging to the Convolvulaceae family, with various parts including leaves, roots, stems, tubers, tuber skin, and flowers. This plant plays a vital role as an energy source and is rich in active compounds [1].

One popular type of sweet potato plant for processed food use is the purple sweet potato, known for containing active compounds such as tannins, anthocyanins, and flavonoids [2]. The eminent characteristic of purple sweet potatoes lies in the dense purple pigment present, making it particularly intriguing. According to [3], this purple pigment is attributed to the anthocyanin pigment found in the sweet potato's skin, which serves as an antioxidant [4]. Antioxidants, known for inhibiting oxidation reactions in easily oxidizable materials and resisting substrate oxidation due to free radicals, are crucial compounds [5]. Free radicals are reactive molecules with unpaired electrons in their outer orbitals, leading to reactions with body cell molecules, ultimately binding to the

Z. B. Pambuko et al. (eds.), *Proceedings of 5th Borobudur International Symposium on Humanities and Social Science (BISHSS 2023)*, Advances in Social Science, Education and Humanities Research 856,
https://doi.org/10.2991/978-2-38476-273-6_124

cell molecule's electrons. The presence of free radicals in the body can cause cellular abnormalities or what is known as malondialdehyde (MDA) levels. In research with high doses of glucose, there can be an increase in MDA levels, which is a sign of oxidative stress. By combining ethanol extract of purple sweet potato tubers with high doses of glucose in mice, it can reduce MDA [6].

Apart from its potential as an antioxidant, with anthocyanin content, purple sweet potato has other benefits because anthocyanin is a type of flavonoid which is a water-soluble glycoside from polyhydroxy and polymethyl derivatives of 2-phenylbenzopyrylium or flavylium salt. which has anti-inflammatory, antiproliferative, antimutagenic, anti-microbial, anticarcinogenic effects, protection from heart damage and allergies, improvement of microcirculation, prevention of peripheral capillary fragility and prevention of diabetes [7]. In cases of hyperglycemia, anthocyanins will protect endothelial cells against oxidative stress by inhibiting cell apoptosis through protection of mitochondrial membranes and down regulation of caspase-3 activation. If caspase-3 increases, neurons and Schwann cells will die due to oxidative stress [8]. Oxidative stress is a condition where there is an imbalance in the amount of oxidants (free radicals) with the amount of antioxidants in the body, causing successive damage starting from cells to higher levels [9].

With various properties of purple sweet potato in previous research and a considered a local commodity with increasing productivity, it can be utilized as a source of functional ingredients, including the manufacturing of jelly candy. Jelly candy, popular among diverse consumer groups due to its ease of consumption, is a soft confectionery comprising water, flavor, sugar, and gel-forming ingredients [10]. Therefore, this study focuses on the formulation and testing of antioxidant activity of purple sweet potato (Ipomoea batatas L.) extract in the manufacturing of jelly candy.

2 Methods

2.1 Tools and materials

Tools: Glass beaker, measuring cup, stirring rod, Buchner funnel, blender, filter paper, mortar and pestle, glass funnel, test tube, hot plate, porcelain cup, watch glass, evaporator, spatula, analytical balance, alumunium foil, rubber stopper, black plastic, large jar, jerry can, vacum rotary evaporator.

Ingredients: Purple sweet potato, 96% ethanol, methanol, gelatin, sucrose, citric acid, purple sweet potato aroma, distilled water, DPPH (1.1 – Diphenyl – 2 - Picryl Hydrazyl), methanol.

2.2 Work procedures

Process of Making Purple Sweet Potato Simplicia

Two kilograms of purple sweet potatoes are peeled, wet-sorted, washed with running water, and then drained. Subsequently, the potatoes are shaped by cutting them into thin pieces. The subsequent treatment involves the drying process, where the sweet potato slices are dried in the sun and covered with a black cloth.

Fig. 1. Process of Purple Sweet Potato Simplicia

Following this, the dried simplicia is sorted again and stored in a container (see Fig. 1).

Phytochemical Screening

Phytochemical screening was conducted to identify the secondary metabolites present in purple sweet potato extract (Fig. 2).

Fig. 2. Phytochemical Screening

The following are the phytochemical tests that will be conducted:

1. Alkaloid Test

Align the filtrate using dilute ammonia (10%), then grind it in a mortar. Next, add chloroform while grinding.

Obtain a layer of chloroform, which is then pipetted, filtered, and added to 2N HCl. Shake the mixture vigorously until it forms two layers.

Pipette the layer; there are three parts (filtrates), treat these three parts differently:

- Adding Mayer's reagent to Filtrate 1 will form a cloudy area, indicating a positive alkaloid.
- Adding Dragendorff's reagent to Filtrate 2 will form an orange/yellow to brown precipitate, indicating a positive alkaloid.
- Filtrate 3 is used as a blank.

2. Flavonoid Test

Dissolve the filtrate in 0.5 mL of ethanol, then add NaOH little by little. The solution changes color to yellow, then add sulfuric acid until there is no color in the extract, indicating a positive flavonoid.

3. Saponin Test

Mix the filtrate with water in a test tube, then heat it in a water bath and filtrate.

After cooling, shake the filtrate vigorously for approximately 30 seconds. If there is foam at least 1 cm high and it does not disappear immediately after adding 1 drop of dilute HCl, it indicates a positive saponin.

4. Polyphenolate Test

Saturate the filtrate with sodium acetate, then add 1% FeCl3 reagent.

If there is a blue-black or black-greenish color change, it indicates a positive polyphenolate.

5. Tannin Test

Add 1% gelatin to the filtrate. If there is a white precipitate, it indicates a positive tannin.

6. Quinones Test

Add 5% NaOH to the filtrate. If a red color forms in the filtrate, it indicates a positive quinone.

7. Steroid Test

Filter ether from the filtrate, then evaporate until dry. If a residue forms, drop the residue with Liebermann Burchard's reagent. If a greenish-bluish color forms, it indicates a positive steroid.

8. Monoterpenoid Test

Filter the filtrate using ether, then evaporate the ether juice until dry.

If residue forms, drip it with Anisaldehyde reagent - sulfuric acid or vanillin sulfuric acid.

If color forms, it indicates positive monoterpenoid and sesquiterpenoid.

Making Purple Sweet Potato Extract

Making purple sweet potato extract involves a cold extraction method known as maceration (Fig. 3 and 4).

Fig. 3. Maceration Method

Fig. 4. Vacuum Rotary

The process is outlined as follows:

1. Mash 250 grams of purple sweet potato simplicia using a blender.
2. Conduct extraction using 2.5 liters of 96% ethanol solvent.
3. Close the extract, stirring occasionally.
4. Filter and collect the liquid extract into a jerry can.
5. Conduct re-maceration two times and collect the filtrate.
6. Once the results have been obtained, proceed with thickening using a vacuum rotary evaporator instrument at a temperature of 40°C to obtain purple sweet potato extract.

Jelly Candy Preparation Formulation

1. Dissolve gelatin and sucrose (to taste) separately using hot water (temperature +80°C).
2. Stir the solutions on a hot plate at 100°C for 5-10 minutes until a jelly mass forms.
3. Add citric acid at a temperature of 75°C.
4. Add purple sweet potato extract to the mixture, stirring until thickened at a temperature of 40-50°C for 10–15 minutes.
5. Pour the formed mass into the candy mold.
6. Allow it to set for 20-30 minutes at room temperature, then refrigerate at 6°C.
7. Remove the formed jelly candy from the mold and place it in a container, sealing it tightly.

Evaluation of Jelly Candy

1. Organoleptic Test

This test is conducted by testing the smell, taste, texture and shape of the preparation.

2. Antioxidant Test

Fig. 5. Preparing of Blank & DPPH indicator

Conducted by adding DPPH. This test enables the determination of the weak and strong antioxidant activity of the preparation (Fig. 5).

3 Results And Discussion

This research utilizes purple sweet potatoes. The primary process involves the production of simplicia, initiated by peeling purple sweet potatoes and subsequently cutting them into thin pieces to expedite the drying process. Drying is conducted outdoors under the shade of a black cloth to shield the simplicia from direct sunlight, preventing potential damage. Direct exposure to sunlight during drying could result in the deterioration of the chemical content of the material. Elevated temperatures and prolonged drying durations are pivotal factors contributing to the reduction in antioxidant activity [11].

Subsequently, a straight forward phytochemical test is conducted to identify the secondary metabolites present in purple sweet potatoes:

Table 1. Phytochemical Test

Active Compunds	Result
Alkaloids	+
Flavonoids	+
Saponins	+
Polyphenols	-
Tannins	+
Quinones	-
Steroids	-
Monoterpenoids	-

The test results presented in Table 1 differ from those of the study conducted by [12], which found that purple sweet potatoes contain active compounds such as alkaloids, tannins, flavonoids, saponins, steroids, and triterpenoids. Despite the advantages of the maceration extraction method, such as the preservation of secondary metabolites in the extract, there are other factors to consider in the extraction process, notably the duration of the soaking process. The longer the simplicia is soaked, the greater the contact between the solvent and the material, leading to an increased number of cell ruptures and the dissolution of active ingredients [13].

The extraction process begins with grinding the simplicia, followed by the use of a cold extraction method known as maceration. Maceration involves immersing the material to be extracted to attract the desired compounds into a solution. Simplicia, having undergone a softening process, is soaked in a solvent for an ideal duration of 3x24 hours. This method offers the advantage of isolating natural compounds, as the soaking process causes cell ruptures due to pressure differences, allowing secondary metabolites in the cytoplasm to become soluble in the organic solvent. The solvent entering the cell during the rupture causes the protoplasm to expand, resulting in the dissolution of cell contents based on their solubility. Choosing the appropriate solvent in the extraction process ensures high effectiveness by considering the solubility of natural compounds in the solvent [14].

Following the extraction, a concentrated extract is obtained with the following results (Table 2):

Table 2. Yield of Purple Sweet Potato Extract

Extraction Method	Sample Weight	Extract Weight	Yield % w/w
Maceration	250 grams	11.34 grams	5.06%

The yield of purple sweet potato extract is 5.06%. The requirement for the yield of thick extract should not be less than 10%. Therefore, the yield in this study does not meet the specified requirements. Subsequently, the formulation of purple sweet potato extract jelly candy is conducted using the following formula (Table 3):

Table 3. Formulation of Purple Sweet Potato Extract Jelly Candy

Material	Formulas
Purple Sweet Potato Extract	5 grams
Sucrose	25 grams
Citric Acid	1 gram
Gelatin	50 grams
Aquadest	300 mL
Sweet Potato Aroma	q.s

The primary ingredients in the manufacturing of jelly candy include gelatin, water, and sweetener. Additionally, an auxiliary ingredient, citric acid, is used as a flavor enhancer. Certain factors play a crucial role in the jelly candy-manufacturing process, specifically the concentration of gelatin. Insufficient gelatin concentration prevents gel formation in the preparation, while excessive gelatin concentration beyond the limit results in a stiff texture (Fig. 6) [15].

Fig. 6. Purple Sweet Potato's Extract Jelly Candy

Subsequently, qualitative tests are conducted, including organoleptic and antioxidant tests. The following presents the results of the organoleptic tests (Table 4):

Table 4. Organoleptic Test

Taste	A Little Sweet
Smell	Sweet potato
Shape	Chewy
Texture	Soft

After that, an antioxidant test is conducted with the following results:

$$\%\text{Inhibition:}\frac{blank\ absorbent - sample\ absorbent}{blank\ absorbent} \text{x } 100\% \quad (1)$$

$$\%\text{Inhibition: } \frac{0.893-0.436}{0.893} \text{ x } 100\% \quad (2)$$

$$\%\text{Inhibition: } \frac{0.457}{0.893} \text{x } 100\% = 51.17\% \quad (3)$$

The calculated percent inhibition for purple sweet potato extract jelly candy is 51.17%. A compound is categorized as a very strong antioxidant for IC50 values <50, strong antioxidant for IC50 values between 50 - 100, moderate antioxidant for IC50 values between 100 - 150, and weak antioxidant for IC50 values between 151 - 200. A smaller IC50 value indicates higher antioxidant activity [16].

4 Conclusion

Based on the research results concerning the formulation and testing of antioxidant activity of purple sweet potato (Ipomoea batatas L.) extract in the manufacturing of jelly candy, it can be concluded that the preparation exhibits an antioxidant activity of 51.17%.

Acknowledgements. The researchers wish to extend their gratitude to the Directorate of Learning and Student Affairs (BELMAWA) for funding of the 2023 Student Creativity Program (PKM). Additionally, appreciation is conveyed to Buana Perjuangan Karawang University which has provided support in the form of facilities, funding, and consultants for the execution of this study.

Author Contributions. In this study, the first author played a pivotal role in directing aspects related to the research. Subsequently, authors two through seven actively participated in the research process.

References

1. Mohanraj, R.; Sivasankar, S. Sweet Potato (Ipomoea Batatas [L.] Lam) - A Valuable Medicinal Food: A Review. *J. Med. Food* **2014**, *17*, 733–741,

doi:10.1089/jmf.2013.2818.
2. Sulastri, S.; Erlidawati, E.; Syahrial, S.; Nazar, M.; Andayani, T. Aktivitas Antioksidan Ekstrak Etanol Daun Ubi Jalar Ungu (Ipomea Batatas L.) Hasil Budidaya Daerah Saree Aceh Besar. *J. Rekayasa Kim. Lingkung.* **2013**, *9*, 126, doi:10.23955/rkl.v9i3.781.
3. Khaldun, I.; Erlidawati; Munzir Kestabilan Zat Warna Alami Dari Umbi Ketela Ungu (Ipomoea Batatas). *Chim. Didact. Acta* **2013**, *1*, 35.
4. Ekoningtyas, E.A.; Wiyatini, T.; Nisa, F. Potensi Kandungan Kimiawi Dari Ubi Jalar Ungu (Ipomoea Batatas L) Sebagai Bahan Identifikasi Keberadaan Plak Pada Permukaan Gigi. *J. Kesehat. Gigi* **2016**, *3*, 1–6, doi:10.31983/jkg.v3i01.1117.
5. Agustin, Y.M.N.; Meylina, L.; Sastyarina, Y. Uji Aktivitas Antioksidan Kombinasi Ekstrak Umbi Bawang Tiwai (Eleutherine Bulbosa (Mill) Urb) Dan Rimpang Kunyit(Curcuma Domestica Val.). *Proceeding Mulawarman Pharm. Conf.* **2020**, *10*, 151–155, doi:10.25026/mpc.v10i1.382.
6. Yasa, W.; Mahendra, A.; Jawi, I. Ethanol Extract of Purple Sweet Potato Tubers (Ipomoea Batatas L) Decreases Blood Glucose and Increase Total Antioxidant Level in Rats with High Glucose Intake. *J. US-China Med. Sci.* **2013**, *10*, doi:10.17265/1548-6648/2013.01.007.
7. Anjani, E.P.; Oktarlina, R.Z.; Morfi, C.W. Zat Antosianin Pada Ubi Jalar Ungu Terhadap Diabetes Melitus. *Kedokteran* **2018**, *7*, 257–262.
8. Prakosa, A.G.; Ratnawati, R.; Prabawati, R.K. Pengaruh Antosianin Ubi Ungu (Ipomoea Batatas L.) Kultivar Gunung Kawi Terhadap Ekspresi Caspase-3 Pada Jaringan Otak Tikus Model DM Tipe 2. **2017**, *4*, 52–58.
9. Nurdyansyah, F. Stres Oksidatif Dan Status Antioksidan Pada Latihan Fisik. *Jendela Olahraga* **2017**, *2*, 105–108.
10. Nuh, M.; Barus, W.B.; Miranti; Yulanda, F.; Pane, M.R. Studi Pembuatan Permen Jelly Dari Sari Buah Nangka. *J. Penelit. dan Pengabdi. Masy.* **2020**, *9*, 193–198.
11. Dharma, M.A.; Nocianitri, K.A.; Yusasrini, N.L.A. Pengaruh Metode Pengeringan Simplisia Terhadap Kapasitas Antioksidan Wedang Uwuh. *J. Ilmu dan Teknol. Pangan* **2020**, *9*, 88, doi:10.24843/itepa.2020.v09.i01.p11.
12. Kusuma, I.M.; Aunillah, S.; Djuhariah, Y.S. Formulasi Krim Lulur Scrub Dari Ekstrak Etanol Ubi Jalar Ungu (Ipomoea Batatas (L.) Lam.) Dan Serbuk Beras Putih (Oryza Sativa L.). *J. Farm. Udayana* **2021**, *10*, 177, doi:10.24843/jfu.2021.v10.i02.p12.
13. Wahyuni, D.T.; Widjanarko, S.B. PENGARUH JENIS PELARUT DAN LAMA EKSTRAKSI TERHADAP EKSTRAK KAROTENOID LABU KUNING DENGAN METODE GELOMBANG ULTRASONIK The Effect of Different Solvent and Extraction Time of Carotenoids Extract From Pumpkin with Ultrasonic Method. *J. Pangan dan AgroindustrI* **2015**, *3*, 390–401.
14. Yulianingtyas, A.; Kusmartono, B. Optimasi Volume Pelarut Dan Waktu Maserasi Pengambilan Flavonoid Daun Belimbing Wuluh (Averrhoa Bilimbi L.). *J. Tek. Kim.* **2016**, *10*, 58–64, doi:http://dx.doi.org/10.1016/j.annemergmed.2013.08.024.

15. Sachlan, P.; Mandey, L.; Langi, T. SIFAT ORGANOLEPTIK PERMEN JELLY MANGGA KUINI (Mangifera Odorata Griff) DENGAN VARIASI KONSENTRASI SIRUP GLUKOSA DAN GELATIN. **2019**, 1–17.
16. Tristantini, D.; Ismawati, A.; Pradana, B.T.; Gabriel, J. Pengujian Aktivitas Antioksidan Menggunakan Metode DPPH Pada Daun Tanjung (Mimusops Elengi L). *Univ. Indones.* **2016**, 2.