

The Efficacy And Benefits of Extract *Solanum betaceum* as A Herbal Medicine: A Literature Review

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Abstract

Dutch eggplant (*Solanum betaceum Cav.*) contains anthocyanins, beta-carotene, isoflavones, carotenoids, fiber, and vitamins such as vitamin E, vitamin A, vitamin C, and vitamin B6. It is widely used empirically for high blood pressure, atherosclerosis, anemia, antidiabetic properties, aiding metabolism, boosting immunity, and serving as an antioxidant. The purpose of this research is to explore the potential of earthworm extract in treating various diseases. The research design is a literature review. The data collection process involved sourcing articles from three databases, namely Web of Science, PubMed, and Google Scholar. The search utilized the keywords "extract," "medication," and "*Solanum betaceum*." Inclusion criteria for the articles encompassed those published between 2010 and 2023. Based on the identification of the five analyzed articles, there are several benefits and herbal therapies that can be obtained from *Solanum betaceum* extract. The potential benefits of *Solanum betaceum* include the treatment of antidiabetes, anemia, dyslipidemia, and its use as a hand sanitizer. Additionally, there are potential applications in various other diseases that still need further research.

Keywords: *Solanum betaceum*; Extract; Medication

1. Introduction

Dutch eggplant (*Solanum betaceum Cav.*) is a perennial plant belonging to the Solanaceae family. Dutch eggplant is known by the name Tamarillo, adopted from New Zealand, which has become the standard name used in the trading industry. Tamarillo (*Chyromandra betaceae Sent.*) or Dutch eggplant is classified as a highland fruit plant. In Indonesia, this plant was first brought by the Dutch and planted in Bogor in 1941, so the plant is commonly known as Dutch eggplant. The plant was later developed in Bali, West Java, North Sumatra, specifically in the Karo region, and South Sulawesi in the North Toraja and Tana Toraja districts. In

its development, this plant is found to grow with various diversities and nutritional content due to free crossbreeding and influenced by different soil and climate factors.

The fruit of the Dutch eggplant is elongated and round, with a taste resembling a mix of tomato and guava. The Dutch eggplant or Tamarillo is relatively less known to the public, and its name is still unfamiliar among horticultural consumers. The utility of the Tamarillo commodity is quite extensive; besides being consumed as fresh fruit, Tamarillo fruit is also used as processed products such as jam, juice, and syrup.

From a functional aspect, Tamarillo fruit contains very high nutrition comparable to other fruits. Additionally, Tamarillo fruit is rich in water, contains provitamins that are beneficial for eye health, contains vitamin C to treat canker sores, and boosts immunity. Important minerals found in Tamarillo fruit are potassium, phosphorus, and magnesium, which are beneficial for overall health (Kumalaningsih and Suprayogi, 2006). Dutch eggplant, besides being rich in water, also contains provitamin A and vitamin C, as well as important minerals such as potassium, phosphorus, and magnesium that contribute to maintaining body health. Dutch eggplant also contains compounds such as beta-carotene, anthocyanins, and fiber. Among its antioxidant compounds, beta-carotene plays a crucial role as it is highly resistant to free radical attacks. Beta-carotene is one of the carotenoids widely present in fruits.

Due to the completeness of the nutritional content in Tamarillo, it is well-known in the United States as a fruit that is low in calories, a source of fiber, fat-free (reds variety) or low in fat (golden variety), cholesterol-free, and sodium-free, and a perfect source of vitamins C and E (Kumalaningsih, 2006).

2. Methods and Material

This study employs a literature review methodology. The process of data collection involved sourcing articles from three databases, namely Web of Science, PubMed, and Google Scholar. The search utilized the keywords "*Solanum betaceum*", "extract", and "medication", Inclusion criteria for the articles encompassed those published between 2010 and 2023, presented as original articles, complete in text and openly accessible, utilizing quantitative research approaches, and not confined to specific regions or countries. The gathered data will undergo analysis, leading to the formulation of conclusions based on the findings.

3. Result and Discussion

Based from the gathered and analyzed articles, the findings are presented as follows

Table 1. List of articles

No	Authors	Title	Method	Result
1.	(Sandhiutami, <i>et al.</i> , 2021)	The Effect of Tammarillo (<i>Solanum betaceum</i> Cav.) Juice on Lipid Profile of Dislipidemia Mice	True Eksprimental	In the study, it was found that the Dutch eggplant fruit, at the dose of 28 g/kgBW/day, the Dutch eggplant fruit extract appears to be capable of lowering both total cholesterol and triglyceride levels while increasing HDL (high-density lipoprotein) levels. These effects are reported to be comparable to the positive control group using Atorvastatin at a dose of 2.6 mg/kg body weight and the normal control group.
2.	(Sirumapea, <i>et al.</i> , 2020)	Utilization of Dutch Eggplant Peel Extract (<i>Solanum betaceum</i>) as an Antidiabetic Agent in Male Wistar Rats Induced with Alloxan	True Eksprimental	In the study, it was found that the Dutch eggplant fruit, at doses of 0.25 g/kgBW, 0.75 g/kgBW, and 1.25 g/ kgBW can lead to a more significant decrease in blood sugar levels compared to those not receiving Dutch eggplant peel extract over a 14-day period. However, none of the doses of Dutch eggplant peel extract demonstrated effectiveness comparable to metformin when administered for 14 days.
3.	(Tanjung, <i>et al.</i> , 2023)	Hand Sanitizer Gel Formulation with Dutch Eggplant Fruit Extract (<i>Solanum Betaceum Cav</i>) as an Antiseptic	True Eksprimental	The gel of Dutch eggplant fruit extract (<i>Solanum Betaceum Cav</i>) demonstrates the most effective antibacterial activity at a concentration of 15%, measuring 4.51 mm, categorized as moderate. This is in comparison to the moderate category of the reference hand sanitizer
4.	(Sianturi, <i>et al.</i> , 2013)	The Effect of Dutch Eggplant (<i>Solanum betaceum</i> Cav.) Fruit on the Number of Red Blood Cells and Hemoglobin Levels in Male Mice (<i>Mus musculus</i> L.) with DDW Strain	True Eksprimental	In the study, it was found that juice of Dutch eggplant (<i>Solanum betaceum Cav.</i>) yields fluctuating results on the number of red blood cells in male mice with anemia. The concentration of 40% provides the most significant increase ($p>0.05$). And dutch eggplant juice

	Anemia through Sodium Nitrite (NaNO ₂)	enhances the percentage of hemoglobin levels in male mice with anemia, with the optimal concentration being 60% (p<0.05).
5.	(Farhati, <i>et al.</i> , 2021) Addressing Anemia with a True Mixed Date and Dutch Eggplant Juice	Based on the Wilcoxon test results, the study indicates that there is no significant difference in the average hemoglobin levels before and after treatment in both the control group and the treatment group (p>0.05). However, the significance test for the difference in the increase in hemoglobin levels, using the Mann-Whitney test, shows that there is no significant difference in the increase in hemoglobin levels between the treatment and control groups with a value of (p>0.05).

Based on the table above, from the five research articles on earthworms, several benefits and related aspects of *Solanum betaceum* can be identified.

3.1. The Use of *Solanum betaceum* as A Treatment for Lipid Profile of Dislipidemia Mice

Dyslipidemia is a condition characterized by changes in lipid profiles such as increased levels of total cholesterol, low-density lipoprotein (LDL), triglycerides, and a decrease in high-density lipoprotein (HDL) levels or a combination of these (Wells et al, 2015). Elevated levels of cholesterol and triglycerides in the blood are the main causes of atherosclerosis, a process involving thickening and loss of elasticity in the walls of arterial blood vessels characterized by the presence of atheroma in the intima of the artery. As a result of this process, blood vessels, especially coronary arteries, become narrow, obstructing blood flow, and leading to coronary heart disease (Suyatna, 2007; Dalimarta & Dalimarta, 2014).

In 2018, the prevalence of heart disease increased from 0.5% in 2013 to 1.5% based on doctor diagnoses (Riskesdas, 2018). Most cardiovascular diseases can be prevented by addressing behavioral risk factors such as smoking habits, unhealthy diet and obesity, lack of physical activity, and alcohol consumption (WHO, 2021). Besides prevention, treatment for hyperlipidemia is also necessary to normalize lipid levels in the blood. Alternative treatments to lower cholesterol levels in the blood include consuming grapes, watermelon, bananas, broccoli, pomegranate, blueberries, kiwi, garlic, and Dutch eggplant (Andi, 2014).

Compounds in Dutch eggplant suspected to have anti-hyperlipidemia activity include fat-soluble compounds (vitamin A, vitamin E, carotenoids) and water-soluble compounds (vitamin C, flavonoids/anthocyanins, fiber).

In this study, Dutch eggplant is used because, from a functional aspect, it has many beneficial properties for the body, with one of its main benefits being a natural antioxidant source that helps neutralize free radicals (atoms or molecules containing one or more unpaired electrons). LDL is prone to oxidation, and oxidative

stress from increased oxygen free radicals can lead to the peroxidation of polyunsaturated fatty acids in LDL membranes, transforming LDL into oxidized LDL (Fairudz, 2015). The antioxidant mechanism as a hypolipidemic effect of Atorvastatin aligns with the mechanism of Dutch eggplant, which contains flavonoids (anthocyanins) that work by inhibiting the activity of HMGCoA reductase enzyme, thereby inhibiting cholesterol synthesis (Depkes, 2011).

Based on the statistical analysis using the BNT test, only the high-dose group (28 g/kgBW/day) demonstrated comparable effectiveness with Atorvastatin in lowering total cholesterol to near-normal levels. In terms of triglyceride levels in the blood of mice, both the moderate-dose group (21 g/kgBW/day) and high-dose group (28 g/kgBW/day) of Dutch eggplant fruit extract exhibited similar efficacy to Atorvastatin in lowering blood triglyceride levels to near-normal. Meanwhile, the moderate-dose group (21 g/kgBW/day) and high-dose group (28 g/kgBW/day) of Dutch eggplant fruit extract demonstrated the ability to lower LDL levels to near-normal but not equivalent to Atorvastatin.

3.2. The Use of *Solanum betaceum* as A Treatment for Antidiabetic

Diabetes mellitus has become a global health issue due to its increasing prevalence each year. Therefore, there is a need for effective and affordable medications or therapeutic agents to address diabetes mellitus. Dutch eggplant peel extract contains anthocyanins and beta-carotene, which have the ability to lower blood sugar levels, making it a potentially effective and inexpensive traditional remedy (Sabuluntika & Ayustaningwarno, 2014).

Anthocyanin compounds have benefits as antidiabetic agents, including the ability to lower blood sugar, enhance insulin secretion, inhibit the production of free radicals, and prevent insulin resistance (Jawi, Suprpta, & Subawa, 2008). Beta-carotene is one of the secondary antioxidants that functions as a hypoglycemic agent by inhibiting free radicals and suppressing lipid peroxidation in tissues, thereby reducing complications in diabetes mellitus (Hanachi, Moghadam, & Latiffah, 2009).

The decrease in blood sugar levels in alloxan-induced Wistar rats is attributed to the administration of Dutch eggplant peel extract. The administration of Dutch eggplant peel extract, at doses of 0.25 g/kg BW, 0.75 g/kg BW, and 1.25 g/kg BW, resulted in a more significant reduction in blood sugar levels compared to those not receiving Dutch eggplant peel extract for 14 days.

3.3. The Use of *Solanum betaceum* as A Hand Sanitizer

Health is a crucial aspect that can influence the quality of life for every individual. One effective way to maintain bodily health is by practicing hygiene, including hand hygiene (Meishanti et al., 2021). Hands serve as a medium for the transmission of various diseases, as viruses, bacteria, and fungi can adhere to them during various activities. One of the simplest, most straightforward, effective, and commonly practiced methods by the community is handwashing with running water and soap (Sinaga et al., 2020). *Staphylococcus aureus* is one of the bacteria most frequently found on the skin of hands, and its spread often occurs from hand to hand (Galuh, 2021).

According to research conducted by Dew et al. (2021), Dutch eggplant is a natural substance containing tannins, alkaloids, saponins, and flavonoids that function as antibacterial agents. The study shows inhibitory effects of Dutch eggplant fruit extract on the growth of *Staphylococcus aureus* bacteria after incubation at 37°C in an incubator for 24 hours (Jayadi, 2022).

Phytochemical screening of Dutch eggplant fruit (*Solanum Betaceum Cav*) revealed positive results for flavonoids, tannins, and saponins. Testing for alkaloids, steroids, quinones, and triterpenoids yielded negative results. The gel extracted from Dutch eggplant fruit (*Solanum Betaceum Cav*) exhibited the best antibacterial activity at a concentration of 15%, with a zone of inhibition measuring 4.51 mm, categorized as moderate. When compared to the reference hand sanitizer Antis using the Disc diffusion method (Kirby Bauer Method), it can be concluded that the higher the concentration used in the test, the larger the inhibition zone obtained.

3.4. The Use of *Solanum betaceum* as A Treatment for Anemia

Indonesia has a relatively high prevalence of iron-deficiency anemia in infants and children (Soegijanto, 2004). Anemia is a condition caused by a lack of blood in the body, including insufficient production of red blood cells by the bone marrow. This is related to a deficiency of iron in the diet or rapid destruction of red blood cells. The concentration of hemoglobin in the blood decreases due to disrupted formation of red blood cells resulting from a reduced iron level. Increasing severity of iron deficiency leads to more severe anemia (Wirakusumah, 1998). Efforts to address nutritional anemia include providing iron supplements for short- and medium-term interventions, improving the consumption of iron-rich foods, using fortified foods, and addressing hookworm parasite infestations and infectious diseases (Wirakusumah, 1998).

According to Kumalaningsih (2006), Dutch eggplant is a plant with a complete nutritional profile, especially rich in iron. This is a crucial component that enhances hemoglobin levels because hemoglobin is a blood component that binds with iron (Fe). In addition to its high iron content for hemoglobin formation, Dutch eggplant is also rich in vitamin A. Therefore, it is noted that Dutch eggplant juice (*Solanum betaceum Cav.*) produces fluctuating results on the number of red blood cells in male mice with anemia, with a concentration of 40% providing the most significant increase ($p>0.05$). Dutch eggplant juice also increases the percentage of hemoglobin levels in male mice with anemia, with an optimal concentration of 60% ($p<0.05$).

4. Conclusion

Based on the identification of the five analyzed articles, there are several benefits and herbal therapies that can be obtained from *Solanum betaceum* extract. The potential benefits of *Solanum betaceum* include the treatment of antidiabetes anemia, dislipidemia, and hand sanitizer, as well as potential applications in various other diseases that still need further research.

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References

Andi Imam Arundhana. Sayur dan Buah Pencegah Aterosclerosis. 2014. Diambil dari: <http://kesehatan.kompasiana.com/makanan/2012/12/22/sayur-dan-buah-pencegah-aterosklerosis-518780.html>.

- Dalimarta S, Dalimarta FA. 2014. *Tumbuhan Sakti Atasi Kolesterol*. Jakarta: Penebar Swadaya Grup. h. 3, 18, 19.
- Fairudz A dan Nisa K, 2015. Pengaruh Serat Pangan terhadap Kadar Kolesterol Penderita Overweight. *Majority*. 4(8). h.121-126
- Farhati F, Resmana R. Monograf: Mengatasi Anemia dengan *Mixed Juice* Kurma dan Terong Belanda
- Galuh, S. M. (2021). Formulasi Dan Evaluasi Sediaan Gel Hand Sanitizer Minyak Serai (*Cymbopogon citratus L.*) Dan Uji Aktivitas Terhadap Bakteri *Staphylococcus aureus*. Sekolah Tinggi Ilmu Kesehatan Nasional.
- Hanachi, P., Moghadam, R., and Latiffah, A.L., (2009). Investigation of lipid profiles and lipid peroxidation in patient with type-2 diabetes rats. *European J of Sci Res*. 28(1): 6-13
- Jawi, I.M., Suprpta, D.N., Subawa, A.A.N., (2008). Ubi jalar ungu menurunkan kadar MDA dalam darah dan hati mencit setelah aktivitas fisik maksimal. *Jurnal Veteriner*. 9(2): 65- 72.
- Jayadi, N. E. A. (2022). Uji Aktivitas Antibakteri Fraksi Daun Sirih Merah (*Piper crocatum Ruiz & Pav*) Terhadap Bakteri *Staphylococcus aureus* ATCC 25923 Secara In Vitro. Stikes Karya Putra Bangsa Tulungagung
- Kumalaningsih. 2006. Antioksidan Alami Terong Belanda (*Tamarillo*). Surabaya: Trubus Agrisarana. hlm. 4-11.
- Meishanti, O. P. Y., Robingah, B., Muhibuddin, A., & Kholid, A. (2021). Pelatihan pembuatan Hand Sanitizer (SANMAN) di Pondok Pesantren An Nashriyah Bahrul Ulum. *Jumat Pendidikan: Jurnal Pengabdian Masyarakat*, 2(1), 41–48.
- Riset Kesehatan Dasar (Riskesdas) (2018). Badan Penelitian dan Pengembangan Kesehatan Kementerian RI tahun 2018.
- Sabuluntika, N., & Ayustaningwarno, F., (2014). Pengaruh Variasi Pemberian Snack Bar Ubi Jalar Kedelai Hitam Terhadap Kadar *Superoksida Dismutase* (SOD) Darah. *Jurnal Gizi Indonesia*. 3(1): 20-25
- Sandhiutami NM, Khairani S, Moordiani M, Purpranoto IN. Efek Sari Buah Terong Belanda (*Solanum betaceum Cav.*) terhadap Perubahan Profil Lipid pada Mencit Dislipidemia. *PHARMACY: Jurnal Farmasi Indonesia (Pharmaceutical Journal of Indonesia)*. 2021 Dec 31;18(2):226-37.
- Sianturi S, Tanjung M, Sabri E. Pengaruh Buah Terong Belanda (*Solanum betaceum Cav.*) Terhadap Jumlah Eritrosit dan Kadar Hemoglobin Mencit Jantan (*Mus musculus L.*) Anemia Strain DDW Melalui Induksi Natrium Nitrit (NaNO₂). *Saintia biologi*. 2013;1(2):49-54.
- Sinaga, L. R. V., Munthe, S. A., & Bangun, H. A. (2020). Sosialisasi perilaku cuci tangan pakai sabun di desa sawo sebagai-bentuk kepedulian terhadap masyarakat ditengah mewabahnya virus covid-19. *Jurnal Abdimas Mutiara*, 1(2), 19–28.

- Sirumapea R, Suhartatik N, Wulandari YW. Pemanfaatan Ekstrak Kulit Terong Belanda (*Solanum Betaceum*) sebagai Antidiabetes pada Tikus Wistar Jantan yang Diinduksi Aloksan. JITIPARI (Jurnal Ilmiah Teknologi dan Industri Pangan UNISRI). 2020 Feb 20;5(1):111-8.
- Soegijanto, S. 2004. *Penyakit Tropis dan Infeksi di Indonesia*. Jilid 2. Surabaya: Airlangga University Press. hlm.1-3.
- Suyatna FD. Hipolipidemik. Dalam: Gunawan SG, Setiabudy R, Nafrialdi, Elysabeth (Ed.) 2007. *Farmakologi dan Terapi*. (Ed. Ke- 5). Jakarta: Departemen Farmakologi dan Terapeutik Fakultas Kedokteran Universitas Indonesia. h. 373-385.
- Tanjung VR, Rahmawati D, Yuwanda A. Formulasi Hand Sanitizer Gel dengan Ekstrak Buah Terong Belanda (*Solanum Betaceum Cav*) Sebagai Antiseptik. COMSERVA: Jurnal Penelitian dan Pengabdian Masyarakat. 2023 Apr 25;2(12):2904-11.
- Wells BG, Dipiro JT, Schwinghammer TL dan Dipiro CV. 2015. *Pharmacotherapy handbook*. Ed 9th. New York : The McGraw; Hill Medical. h. 65, 101, 103-107.
- Wirakusumah, E. S. 1998. *Perencanaan Menu Anemia Gizi Besi*. Jakarta: Trubus Agriwidya. hlm. 5-11.
- WHO (2021). Cardiovascular diseases (CVDs). World Health Organization. [https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))