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RESEARCH **Open Access**

Characteristics and Antioxidant Activity of Sweet Potato Syrup (*Ipomea Batatas* (L) with Propylene Glycol Variation

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Abstract

Sweet Potato Leaf (*Ipomea Batatas* (L) contains flavonoids and polyphenols which play a role in antioxidant activity. Sweet Potato leaf extract is formulated into syrup because it is faster to be absorption compared to solid preparations and more easily to swallow. Sweet potato extract is formulated with variations in the amount of propylene glycol which is 11% (F1), 12% (F2), 13% (F3) and 0% (control). The characteristics of syrup include organoleptic tests, viscosity tests and time of flow were determine and syrup antioxidant activity testing using method 2 , 2-diphenyl-1-picrylhydrazyl (DPPH). Test results showed that all formulas have the same organoleptic properties, which are brown, sweet and slightly bitter. Weak antioxidant activity showed by IC_{50} and AAI values. IC_{50} and AAI syrup were 134 ± 19.28, 128 ± 4.04, 115 ± 13.07, and 142 ± 1.5 µg / mL and the AAI values were 0.074, 0.078, 0.087 and 0.070, respectively for F1, F2, F3 and control. Statistical analysis with the Kruskal-Wallis test ($p > 0.05$) showed no significant IC_{50} differences for the three formulas and control. The increase in propylene glycol affects the viscosity and ease of pouring but not the organoleptic properties while the antioxidant activity is not significantly different from the increase in propylene glycol. It is recommended to do a hedonic test for all three formulas in further research.

Keywords: Ipomea Batatas, Syrup, Propylenglycol, Antioxidant Activity.

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1. INTRODUCTION

Chronic and degenerative diseases are caused due to DNA damage and lipid and protein oxidation in the body (Liguori et al., 2018). The damage is triggered by oxidation reactions involving reactive oxygen species (ROS), Reactive Nitrogen Species (RNS) including superoxide radicals, hydroxyl, and nitric oxide (Peng et al., 2014). Normally, the body is able to reduce these radicals, but exposure to cigarettes, alcohol, and radiation can induce excessive ROS and RNS production, which disrupts the balance between oxidation and anti-oxidation (Pizzino et al., 2017). Exogenous antioxidants from plants and food can inhibit the initiation or propagation of oxidation reactions (Guerra-Araiza et al., 2013).

One of the plants known to have antioxidant activity is Sweet Potatoes (Ipomea Batatas (L.) (Fidrianny et al., 2012); (Ghasemzadeh et al., 2012); (Zhang et al., 2020). It is caused by the polyphenol content in sweet potatoes which ranges from 23.3 to 43.8 mg CAE/g (Fu et al., 2016). Besides having antioxidant activity, sweet potatoes can also increase platelet counts in experimental animals (Khaerani et al., 2014); (Hutabarat & Widyawati, 2018); (Damayanti, 2013).

Processing of sweet potato leaves for consumption both as vegetables and for treatment is still done conventionally by boiling. Boiling method that involves heating can reduce levels of polyphenols in sweet potato leaves. Research conducted by (Sun et al., 2014) shows a decrease in polyphenol levels by 30.51% and a decrease in antioxidant activity by 81.40%. To minimize the damage of polyphenols and the practicality of use, it is necessary to develop products, one of which is syrup preparation.

Syrup is a liquid dosage form that can be used by almost all ages, is easy to use, is homogeneous and is quickly absorbed so that the onset of action is faster. Syrups contain sweeteners and scents so they have a sweet and fragrant taste and attractive colors that are liked by the public. One of the requirements for syrup preparation is homogeneity so that its solubility must be considered (Mahato & Narang, 2011).

Propyl glycol is a component that affects the solubility of active substances in syrup. It can increase the solubility of the active ingredient in a solution preparation (Prasetyo & M, 2017); (Jiménez & Martínez, 2006); (Nayak & Panigrahi, 2012); (Khusna et al., 2015). The objective of this study is to formulate sweet potato leaf extract into syrup preparations with variations in the concentration of propylene glycol to determine the effect of propylene glycol on the characteristics and antioxidant activity.

2. RESEARCH METHOD

The study was descriptive in nature, to determine organoleptic and antioxidant activity of sweet potato leaf syrup extract with variations of propylene glycol. The study was conducted at the Laboratory of Pharmacetics and Instrumentation of Pharmacy Study Program Health Polytechnic Ministry of Health Kupang in June-October 2019.

The tools used in this study are: Glassware (pyrex), analytical scales, ovens, knives, blenders, mesh 200 sifter, rotary evaporator, container, whatman filter paper, Micropipet, Mortar and stamper, pH meter, stopwatch, stir bar, aluminum foil, UV-VIS spectrophotometer (Shimadzu). Ingredients used in this study include: Sweet potato leaves, 96% ethanol, propylenlycol, nipagin, citric acid, grape essences, sucrose, and aquades.

Sampling Sweet potato leaves were taken from Baumata village Kupang district. Extraction Making: Sweet potato leaves are made by maceration method, 100 g which

was sweet potato leaf powder is soaked with 1 L of ethanol 96% for 3 days with periodic stirring and remastered 2 times and filtered. All filtrates are combined and evaporated using a rotary evaporator and followed by evaporation using a water bath at 40°C to obtain a thick extract. Sweet potato leaf extract syrup was made in 3 formulations with modification on the amount of propylene glycol as shown in table 1.

Table 1. Sweet potato extracts syrup formula with variations in propylene glycol levels.

Ingredients	Control	Formula 1	Formula 2	Formula 3
Sweet potato leaf extract (g)	1,5	1,5	1,5	1,5
Propylene glycol (%)	-	11	12	13
Sucrose (%)	62	62	62	62
Essen wine (mL)	2,5	2,5	2,5	2,5
Citric Acid (%)	0,3	0,3	0,3	0,3
Aquades (mL)	ad 150	ad 150	ad 150	ad 150

Syrup evaluation includes a viscosity test, a pouring test and an organoleptic test. DPPH solution in ethanol (0.050 g/L) is made fresh. A 1 mL aliquot of this solution is mixed with 4 mL of syrup from five different concentrations of 100, 150, 200, 250 and 300 ppm. The solution was homogenized and then incubated in the dark for 30 minutes at room temperature, and the absorbance of the remaining DPPH was determined by colorimetry at 517 nm. Syrup damping activity is measured as a decrease in DPPH absorbance and expressed as a percent of DPPH radical inhibition calculated according to the following equation:

$$\%\text{Yeild} = \frac{\text{Absorbance Blank} - \text{Absorbance Sample}}{\text{Absorbance Blank}} x\ 100\%$$

AAI calculation is used to determine the antioxidant activity index with the formula:

$$\text{AAI} = \frac{\text{Final Concentration DPPH } \left(\frac{\mu g}{mL}\right)}{\text{IC50 Sample } \left(\frac{\mu g}{mL}\right)}$$

The antioxidant activity based on the AAI value is said to be weak if the AAI value <0.5; moderate antioxidant activity if 0.5 <AAI <1; Antioxidant activity is strong if 1 <AAI <2 and antioxidant activity is very strong if AAI> 2 (Scherer and Godoy, 2009).

Statistical analysis with the Kruskal-Wallis test with a 95% confidence stage was to see the effect of propylene glycol variations on the IC_{50} values of all three syrup and control formulas.

3. RESULTS AND DISCUSSION

Sweet potato leaf extract is made by maceration method because the maceration method does not involve heating during extraction so it is suitable for thermolable compounds such as flavonoids and polyphenols (Ćujić et al., 2016). The result of sweet potato leaf extraction using maceration method yields a yield of 18.49%.

The extract was formulated with variations of propylene glycol in order to find out whether there is an effect of propylene glycol concentration on the characteristics and antioxidant activity of syrup. Research conducted by (Padmawar, A., et al., 2018) shows Propylene glycol can increase the solubility of active natural ingredients.

Evaluation of the physical stability of syrup preparations was conducted which included organoleptic test, viscosity test and pouring test. Orgaleptic evaluation shows

that the three syrup formulas have the same taste, color and aroma, which are sweet and slightly bitter, dark brown in color and flavorful in wine.

Table 2. Syrup Viscosity Test Results

Formula	Viscosity (cps)			Average
	Replication 1	Replication 2	Replication 3	
Control	36.52	36.53	36.53	36,53±0,01
Formula 1	62.27	62.25	62.26	62,26±0,01
Formula 2	65.60	65.50	65.60	65,57±0,06
Formula 3	67.86	67.86	67.85	67,86±0,01

Table 2 shows that the average viscosity of controls, formulas 1, 2 and 3 were 36.53 ± 0.01 cps, 62.26 ± 0.01 cps, 65.57 ± 0.06 cps and 67,86 ± 0.01. The greater the content of propylene glycol added to the formula, the viscosity of syrup increases. Research conducted by (Lisprayatna et al., 2015) also shows an increase in the concentration of propylene glycol increases the thickness of syrup.

Table 3. Pourability Test Results

Formula	Pouring ease (seconds)			Average
	Replication 1	Replication 2	Replication 3	
Control	2,5	2,3	2,5	2,43±0,12
Formula 1	2,6	3,1	2,6	2,76±0,23
Formula 2	2,8	3,1	2,9	2,92±0,12
Formula 3	3,4	2,7	3,1	3,05±0,38

The syrup pouring test is known through the syrup pouring time profile (table 3). The pouring time (flow) of the control formula was 2.43 ± 0.12, formula 1 = 2.76 ± 0.23, formula 2 = 2.92 ± 0.12 and formula 3 was 3.05 ± 0.38. The higher levels of propylene glycol in syrup formulas, the longer time needed for the syrup pouring time, because the fluidity or ability of a liquid to flow inversely to viscosity. These four syrup formulas are relatively easy to pour because the thickness of the syrup formula is not too high (Lisprayatna et al., 2015).

Table 4. Antioxidant Activity Test

Formula	Value IC_{50}			Average IC_{50} (ppm)	AAI
	Replication 1	Replication 2	Replication 3		
Control	140	142	143	142±1,5	0,070
1	120	126	156	134±19,28	0,074
2	133	126	126	128±4.04	0,078
3	100	121	124	115±13.07	0,087

The antioxidant activity test was conducted using the DPPH method according to Molyneux with a slight modification. This method is simple, easy fast and sensitive and requires a small sample in testing (Molyneux, P., 2004). IC_{50} Control Data, Formula 1, Formula 2 and Formula 3 were 142 ± 1.5, 134 ± 19.28, 128 ± 4.04 and 115 ± 13.07 respectively. IC_{50} data shows that the higher the concentration of propylene glycol the greater the antioxidant power, it can be caused by an increase in the solubility of the extract in the syrup preparation (Padmawar, A., et al., 2018). Antioxidant activity based on AAI values is weak if the AAI value <0.5; moderate antioxidant activity if 0.5 <AAI <1; Strong antioxidant activity if 1 <AAI <2 and antioxidant activity very strong if

AAI> 2 (Scherer & Godoy, 2009) so that all three formulas and Control have weak antioxidant activity.

4. CONCLUSION

The increase in propylene glycol affects the viscosity and ease of pouring but not the organoleptic properties, while the antioxidant activity is not significantly different from the increase in propylene glycol. It is recommended to do a hedonic test for all three formulas in further research.

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