α-Glucosidase Inhibitor Activity of Some Indonesian Syzygium Extracts

Emma J. Pongoh¹, Rymond J. Rumampuk²*, Astin Lukum², Ardi Kapahang¹

¹Department of Chemistry Manado State University, Tondano, Sulawesi Utara, Indonesia, 95618
²Department of Chemistry Universitas Negeri Gorontalo, Bone Bolango, Gorontalo, Indonesia, 96554

ABSTRAK
Daun dan buah dari tumbuhan Indonesia spesies Syzygium spp diantaranya pakoba putih, pakoba merah dan bombongan telah diekstraksi dengan etanol. Etanol ekstrak dipartisi dengan gradient kepolaran pelarut menggunakan n-heksana, etil asetat dan n-butanol. Setiap fraksi diuji antidiabetes dan memberikan variasi tingkat aktivitas ketika diuji menggunakan metode α-glukosidase. Uji antidiabetes mengindikasikan bahwa fraksi etil asetat dan butanol dari daun pakoba putih, pakoba merah, dan bombongan berpotensi sebagai sumber senyawa aktif antidiabetes.

Kata Kunci: Syzygium; antidiabetes; inhibitor α-glucosidase

ABSTRACT
The leaves and fruits of Indonesian Syzygium spp such as white pakoba, red pakoba and bombongan have been extracted by ethanol. The ethanolic extract was partitioned with polar solvent gradient using n-hexane, ethyl acetate and n-butanol repeatedly. Each fraction was tested for antidiabetic activity and exhibited varying degrees of antidiabetic activity when tested with α-glucosidase method. Antidiabetic test indicated that the ethyl acetate and butanol fractions of the leaves of pakoba white, red pakoba and bombongan has potential as a source of active compounds.

Keywords: Syzygium; antidiabetic; α-glucosidase inhibitor

INTRODUCTION
Diabetes Mellitus (DM) is one of the most prevalent chronic diseases in the world [Kumar et al., 2008]. Its major manifestations include disordered metabolism and inappropriate hyperglycemia [Soon & Tan, 2002]. DM is a chronic metabolic disorder affecting approximately five percent of the population of industrialized nations [Zhang et al., 2008]. Complications are the major cause of morbidity and mortality in DM [Grover et al., 2002], and there are two types of DM in humans. Type 1 DM is due to pancreatic β-cell destruction leading to insulin deficiency and is generally characterized by notable symptoms (weight loss, polyuria, and polydipsia), abrupt onset at a young age but usually after puberty, immune-mediated loss of β-cells by anti-islet cell antibodies, and a need for exogenous insulin therapy [Bellinger et al., 2006]. Type 2 DM is characterized by insulin resistance (IR1) and hyperglycemia and differs from type 1 DM in that patients are generally overweight and asymptomatic in the early stages [Bellinger et al., 2006]. Type 2 DM usually has a slow onset and, until recently, most often occurred in adults

*Corresponding author:
rymondrumampuk@unima.ac.id
Some drugs have been developed for DM, and the best way to control postprandial plasma glucose level is with medication in combination with dietary restriction and an exercise programme. One of the therapeutic approaches for decreasing postprandial hyperglycemia is to retard absorption of glucose by the inhibition of carbohydrate hydrolysing enzymes, for example α-amylase and α-glucosidase, in the digestive organs. Hypoglycemic drugs could have side effects, therefore the management of diabetes without any side effects is still a challenge to the medical system [Kameswararao et al., 2003]. Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them. The ethnobotanical information reports about 800 plants that may possess anti-diabetic potential [Arayne et al., 2007]. One of the medicinal plants in Indonesia is pakoba plant group that grewed in North Sulawesi Province [Lee et al., 1999]. This plants used traditionally as diabetic herbal medicine [Kahiking et al., 2020] but the information of antidiabetic compounds is surprisingly still limited.

MATERIALS AND METHODS

General

For the purposes of antidiabetic activity assay used potassium phosphate buffer (pH 7.0) 100 mM, p-nitrophenyl-α-D-glukopiranosida 20 mM, the enzyme α-glucosidase, bovine serum albumin, and 200 mM Na₂CO₃ solution, and quersetin as comparator compounds. The equipment used in the form of glass tools commonly used in organic chemistry labs, and Rotavapor Buchi evaporation.

Plant

Plant materials used were the leaves and fruit of white pakoba, red pakoba and bombongan which collected from Laikit village, Dimembe district, North Minahasa regency, North Sulawesi Province, Indonesia. The plant samples were determined in the Department of Biology, Institute of Technology Bandung.

Extraction and Fractionation

Samples of fresh leaves of white pakoba (2000 g), fruit white pakoba (1000 g), red pakoba leaves (2000 g), fruit red pakoba (2500 g), leaf bombongan (3000 g), and fruit bombongan (2500 g) each each blended and macerated with 70% ethanol for 3 x 24 hours and filtered. The filtrate was evaporated to obtain the ethanolic extracts of white pakoba leaves (75 g), white pakoba fruit (78 g), red pakoba leaves (120 g), red pakoba fruit (132.5 g), bombongan leaves (200 g), and bombongan fruit (192 g). The ethanol extract of white pakoba leaves (50 g), white pakoba fruit (35 g), red pakoba leaves (50 g), red pakoba fruit (10 g), bombongan leaves (40 g), and bombongan fruit (50 g), were respectively dissolved in 100 mL distilled water and then partitioned with polar solvent gradient using n-hexane, ethyl acetate and n-butanol repeatedly. Each fraction was evaporated and then each fraction tested antidiabetic activity [Lee & Lee, 2001].

Antidiabetic procedure

Analysis of α-glucosidase inhibition enzymatically performed as follows: 1.0 mg of enzyme α-glucosidase (Saccharomyces cerevisiae) was dissolved in 100 mL phosphate buffer pH 7.00 containing 200 mg of bovine serum albumin. The enzyme was diluted 10 times using phosphate buffer pH 7.00 before assay. The reaction mixture containing 250 mL 20 mM
p-nitrophenyl-α-D-glucopyranoside, 495 mL 100 mM phosphate buffer, and 5 mL of sample solution. The reaction mixture is then preincubation for 5 min at 37 °C for temperature adjustment, then added α-glucosidase enzyme of 250 mL. After that, the reaction was stopped by the addition of 1000 mL solution of 0.02 M Na₂CO₃. The number of p-nitrophenol released was measured with a UV spectrophotometer using the absorbance at λ 400 nm. The percentage inhibition activity was calculated using equation 1.

\[
\text{%inhibition} = \left( \frac{C-S}{C} \right) \times 100
\]  

C = The absorbance of the enzyme activity without sample, S = The absorbance of enzyme activity addition of the sample.

Concentration (IC₅₀) value was calculated using the straight-line equation \( y = ax + b \) of the curve between % inhibition and concentration (ppm) by the following equation 2.

\[
\text{IC}_50 = \frac{y-b}{a}
\]

\( y = 50 \), \( a = \) a slope, \( b = \) intercept.

RESULTS AND DISCUSSION

Three species of traditional medicine plants, locally name are white pakoba, red pakoba, and bombongan are Syzigium family distributed at North Sulawesi Province, Indonesia, was used as antidiabetic therapy. The selection of these three species is caused by the ease and availability of parts to get the fruit, which coincided with the fruiting season.

| No | Type Samples         | Fresh Samples (gram) | EtOH Extract (gram) | Yield (%) |
|----|----------------------|----------------------|---------------------|-----------|
| 1  | White Pakoba Leaves  | 2000                 | 75                  | 3.75      |
| 2  | White Pakoba Fruits  | 1000                 | 78                  | 7.80      |
| 3  | Red Pakoba Leaves    | 2000                 | 120                 | 6.00      |
| 4  | Red Pakoba Fruits    | 2500                 | 132.5               | 5.30      |
| 5  | Bombongan Leaves     | 3000                 | 200                 | 6.67      |
| 6  | Bombongan Fruits     | 2500                 | 192                 | 7.68      |

Parts of the plant are used for research is the leaves and fruit. The number of samples collected fresh plant varies between 1000-3000 grams (Table 1). All samples were cleaned and smoothed the way blended with ethanol. Extraction is performed on the leaves and fruit of white pakoba, red pakoba and bombongan using 70% of ethanol to obtain the ethanolic extracts with varying yields ranging from 3.75 to 7.80% as shown in Table 1. Each ethanolic extract was fractionated
by solvent gradient system ranging from non-polar to polar solvents, namely n-hexane, ethyl acetate, and butanol respectively. The number of ethanolic extracts partitioned ranging from 10-50 g (Table 2). The results further partition evaporated to obtain the fraction of n-hexane, ethyl acetate, and butanol from each of the ethanol extract of the leaves and fruit of white pakoba, red pakoba, and bombongan.

| No | Plant Samples          | IC50 (ppm)†          |
|----|------------------------|----------------------|
|    |                        | EtOH | n-Hex | EtOAc | n-BuOH | H2O  |
| 1  | White Pakoba Leaves    | 15,51* | 78,60 | 11,25* | 12,50* | 40,56 |
| 2  | White Pakoba Fruits    | 84,21  | 120,25| 33,69  | 35,50  | 55,60 |
| 3  | Red Pakoba Leaves      | 19,39* | 80,36 | 15,50* | 15,65* | 50,76 |
| 4  | Red Pakoba Fruits      | 158,56 | 95,65 | 36,75  | 34,55  | 60,56 |
| 5  | Bombongan Leaves       | 16,27* | 68,95 | 12,45* | 12,00* | 45,50 |
| 6  | Bombongan Fruits       | 61,84  | 70,56 | 28,56  | 32,30  | 50,55 |

†Quercetin: 22,40 ppm as control positive
*IC50: Value of the extract and fractions are active antidiabetic.

Fractionation performed for all ethanol extracts to obtain fraction of n-hexane, ethyl acetate, butanol, and water. Antidiabetic test results for all fractions (Table 3) indicated that the ethyl acetate and butanol fractions of the leaves of pakoba white, red pakoba and bombongan has potential as a source of active compounds with antidiabetic indicated IC50 values lower by comparison quercetin. As for the ethyl acetate and butanol fractions of the fruit showed an increase in activity compared to ethanol extracts. This indicates that the possibility of such
fractions containing antidiabetic compounds but in small concentrations. The separation and purification of the active compounds still in progress.

CONCLUSION

The ethyl acetate and butanol fractions of the leaves of white pakoba, red pakoba and bombongan has potential as a source of antidiabetic compounds.

ACKNOWLEDGEMENT

Authors would like to thank the Directorate General of Higher Education, Ministry of Education for funding this research through Competence Grant.

REFERENCES

Arayne, M. S., Sultana, N., Mirza, A. Z., Zuberi, M. H., Siddiqui, F. A. (2007). In vitro hypoglycemic activity of methanolic extract of some indigenous plants. Pakistan Journal of Pharmaceutical Sciences. Vol 20: 261-268.

Bellinger, D. A., Merricks, E. P., Nichols, T. C. (2006). Swine Models of Type 2 Diabetes Mellitus: Insulin Resistance, Glucose Tolerance, and Cardiovascular Complications. ILAR Journal. Vol 47: 243-258.

Grover, J. K., Yadav, S., Vats, V. (2002). Medicinal plants of India with anti-diabetic potential. Journal of Ethnopharmacology. Vol 81: 81-100.

Kahiking, G., Rumampuk, R. J., Pongoh, E. J. (2020). Isolation and Identification of Flavonoid Derivative Compounds from n-Butanol Fraction of Red Pakoba (Syzygium sp.). Fullerene Journal Of Chemistry. Vol.5 No.2: 53-57.

Kameswararao, B., Kesavulu, M. M., Apparao, C. (2003). Evaluation of antidiabetic effect of Momordica cymbalaria fruit in alloxan-diabetic rats. Fitoterapia. Vol 74: 7–13.

Kaufman, F. R. (2005). Type 2 diabetes in children and youth. Endocrinology and Metabolism Clinics of North America. Vol 34: 659-676, ix-x.

Kumar, S., Kumar, D., Deshmukh, R. R., Lokhande, P. D., More, S. N., Rangari, V. D. (2008). Antidiabetic potential of Phyllanthus reticulatus in alloxan-induced diabetic mice. Fitoterapia, Vol 79: 21-23.

Lee, D. S., & Lee, S. H. (2001). Genistein a Soy Isoflavone is a Potent α-glucosidase Inhibitor. FEBS Letters. Vol 501: 84-86.

Lee, R., Riley, J., Suyatno, N. (1999).Tangkoko-Duasudara Nature Reserve North Sulawesi, Indonesia: Biological surveys and management recommendations. Department of Forestry (PKA)-The Wildlife Conservation Society.

Soon, Y.Y., & Tan, B. K.H. (2002). Evaluation of the Hypoglycemic and Anti-Oxidant Activities of Morinda officinalis in Streptozotocin-induced Diabetic Rats. Singapore Medical Journal. Vol 43: 077-085.
Zhang, L., Hu, J. J., Du, G. H. (2008). Establishment of a cell-based assay to screen insulin-like hypoglycemic drugs. Drug Discoveries & Therapeutics. Vol 2: 229-233. eserve North Sulawesi, Indonesia: Biological surveys and management recommendations. Department of Forestry (PKA)-The Wildlife Conservation Society.

Soon, Y.Y., & Tan, B. K.H. (2002). Evaluation of the Hypoglycemic and Anti-Oxidant Activities of Morinda officinalis in Streptozotocin-induced Diabetic Rats. Singapore Medical Journal. Vol 43: 077-085.

Zhang, L., Hu, J. J., Du, G. H. (2008). Establishment of a cell-based assay to screen insulin-like hypoglycemic drugs. Drug Discoveries & Therapeutics. Vol 2: 229-233.