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Review : Bioactive Compounds From The Leaves of *Cordyline fruticosa* (L.) A. Chev.

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Abstract

Bioactive compounds are certain chemical compounds found in plants and animals that are used as medicinal ingredients because they have physiological effects on other organisms. One of the plants is Ti plant or Hanjuang (*Cordyline fruticosa* (L.) A. Chev.) which is commonly used as an ornamental plant, a hedge plant and is often used as traditional medicine. Based on empirical data, the leaves of Hanjuang are efficacious for treating diarrhea, bleeding hemorrhoids, fever and many other diseases. There is no summary of researches on Hanjuang's bioactive compounds. Behalf of that, the purpose of this review article is to review the bioactive compounds that have been isolated from the leaves of *Cordyline fruticosa* (L.) A. Chev. The method of writing this article review uses online literature studies such as e-books, national research journals and international journals that are accredited and have ISSN about the active compounds that have been isolated from *Cordyline fruticosa* (L.) A. Chev. Search and collection of libraries is generated from various search engines such as Google Scholar, Science direct, Garuda, Pubmed and several other websites using various keywords. The results of the review concluded that the bioactive compounds of *Cordyline fruticosa* (L.) A. Chev. leaves were the steroidal sapogenin spirostan with binds D-fucopiranoside and L-rhamnopyranoside which have antitumor and antibacterial activity, steroidal saponin Fruticoside H, I and J which have cytotoxic activity (Fruticoside H and J) and antibacterial activity (Fruticoside I and J), then 7-hydroxy- 2'-methoxyflavanone and stigmasterol which have antifeedant activity against insects.

Keywords: *Cordyline fruticosa, Cordyline terminalis, bioactive compound*

Introduction

Indonesia is a country with mega-biodiversity that is rich in sources of natural ingredients including traditional medicines that need to be explored, researched and developed. That activity includes identification and isolation of secondary metabolites or bioactive compounds found in medicinal plants [1].

Plant bioactive compounds are substances produced by plants that have pharmacological or toxicological effects in humans and animals. Although nutrients (e.g. vitamins and minerals) have pharmacological or toxicological effects when consumed in large doses, nutrients in plants are not usually considered bioactive plant compounds. Secondary metabolites are the main sources of bioactive chemicals in plants. Thus, secondary plant metabolites generating pharmacological or toxicological effects in humans and animals are defined as bioactive molecules in plants [2].

One of the medicinal plants that has benefits and is widely used by Indonesian community as traditional medicine is Ti plant or Hanjuang or *Cordyline fruticosa* (L.) A.Chev., synonym *Cordyline terminalis* (L.) Kunth). Andong, Endong (Javanese name) or Hanjuang (Sundanese name) is tropical species that grows in a warm and humid environment from the lowlands to the mountainous areas. This plant belongs to Asparagaceae is originated from Southeast Asia and Papua New Guinea. It has been cultured in many countries including Indonesia [3]. Hanjuang use to cure sore throat, neck pain, bleeding hemorrhoids, diarrhea, fever and many other diseases [4].

For the Sundanese (West Java), planting a red varieties of this plant is trusted as a host plant or repellent to ward off evil spirits. This plant was also used to wrap beans. In the village of Lok Lahung, South Borneo, this plant has many utilities i.e. repellant reinforcements, funerals, rituals rice, drugs and toiletries [5].

Many researches on the metabolites contained in Hanjuang have been carried out. Lim, T.K. (2015) summarizes that the plant contains the following metabolites: 1 unit of D - glucose and about 13 of D - fructose was found in tuber; tyramine, shikimic, quinic acids, thymidine, steroidal sapogenins of smilagenin, sarsasapogenin, 5β-spirostanes and cholestane glycoside in leaves.

There is no summary of researches on Hanjuang's bioactive compounds. Behalf of that, this article aims to review the bioactive compounds found in the Hanjuang plant, especially in the leaves.

Methods

The method of making this article review uses an online literature study. The libraries used are e-books, national research journals and international journals that are accredited and have ISSN about the active compounds that have been isolated from Hanjuang plant (*Cordyline fruticosa* (L.) A. Chev.). Search and library collection were generated from various search engines such as Google scholar, Science direct, Garuda, PubMed and several other websites using the keywords: "*Cordyline fruticosa*", "*Cordyline terminalis*", "*Cordyline fruticosa* (L.) A. Chev. isolation", and "*Cordyline fruticosa* activity".

Determination of the main journal (primary journal) from several journals produced is seen from journals that display active compounds isolated from the Hanjuang plant and the activities possessed by these compounds. Then the determination of supporting journals (secondary journals) is seen from the supporting journals and e-books related to the main journal.

Results and Discussion

Based on research by Bogoriani et al (2008), *Cordyline fruticosa* (L.) A. Chev. leaves were macerated using methanol as solvent, where the resulting filtrate was evaporated and a thick methanol extract was obtained. The resulting viscous extract was tested for cytotoxic activity and obtained an LC50 value of 61.09 ppm which has potential as an antitumor because a substance can be said to have cytotoxic activity if the LC50 value is <1000 ppm so that the compound can be categorized as having an inhibitory power against cancer growth. Then the separation of the components from the thick methanolic extract started by partitioning using water, n-butanol, n-hexane, and chloroform. After that, each fraction

was tested for cytotoxicity and from the four fractions, it showed that the n-butanol fraction had an LC50 value of 87.68 ppm which was declared the most active value. Furthermore, the n-butanol fraction was separated and purified using gravity column chromatography with chloroform-methanol-water (3:1:0,1) as a mobile phase which obtained 50 fractions. The fraction separation using TLC obtained 3 groups of fractions. After that, the cytotoxic activity was tested on 3 fractions which showed that the most active fraction was fraction B with a LC50 value of 41.64 ppm. The purity test on fraction B by TLC showed 1 spot and was supported by foam and steroid tests which showed that fraction B contained steroidal saponins. The results of identification and characterization of isolates had m/z values of 889 [M + Na]+ and 869 [M + H]+ which shows that the isolate binds 3 sugars (central sugar and terminal sugar) derived from methylpentose, then on the 1H NMR spectrum, and 13C NMR there are exomethylene groups, C2H4 groups, and 3 signals from anomeric protons, so it is suspected that isolates contains steroidal saponins derived from spirostanes and binds to fucose sugars by -D-fucopyranoside bonds and rhamnose sugars by -L-rhamnopyranoside bonds [6].

Several steroidal saponins have also been isolated from *Cordyline fruticosa* by Fouedjou et al. (2014). Andong leaves were extracted with methanol. After being concentrated, the extract was suspended with distilled water, then partitioned using n-hexane, ethyl acetate, and n-butanol. Some of the concentrated ethyl acetate extract was fractionated by silica gel column chromatography using a gradient mobile phase of ethyl acetate in n-hexane followed by methanol in ethyl acetate which produced 10 fractions (A-J). The H fraction was chromatographed on a silica gel column with EtOAc–MeOH (98–2) as eluent. The results were concentrated and recrystallized to produce Fruticoside H compounds. Furthermore, Fruticoside I and Fruticoside J compounds were produced by further silica gel column chromatography on the 10 fractions above. The three compounds were structurally elucidated with mainly NMR data, then activity tested on human cell lines: MDA-MB 231 cells (human breast adenocarcinoma cells), A375 cells (human malignant melanoma cell), and HCT116 cells (human breast cancer cell). Fruticoside H and Fruticoside I showed a moderate cytotoxic activity. The three compounds were also tested for antimicrobials against S. aureus, E. coli, P. aeruginosa, E. faecalis, and C. albicans. Fruticoside I showed antibacterial activity against E. faecalis. The presence of SO3H group at C-40 and the absence of the double bond at C-5 can considerably lower the MIC value of the molecules against enterococcal species, according to the small structural differences between Fruticoside H and Fruticoside I [7]

Meanwhile, based on the research of Utami et al. (2017), Hanjuang leaves were extracted using the maceration method with methanol solvent which produced methanol extract. The extract was tested for antifeedant activity on *Epilachna sparsa* with a concentration of 6 ppm obtained 83.33% so that the extract has potential as an antifeedant because compounds that have antifeedant properties are compounds whose test percentage is more or equal to 25% [8]. Then the components of the methanol extract were separated through multilevel partitioning using methanol, n-hexane, ethylacetate, and dichloromentane, followed by testing the antifeedant activity on *Epilacha sparsa*. The test results on the four fractions showed that the dichloromentane fraction had the most active antifeedant activity with a percentage of 89.58%, then, fractional separation using liquid vacuum chromatography with dichloromentane: ethylacetate as mobile phase (4:6) obtained fraction A. Then the separation of fraction A was continued by gravity column chromatography with ethylacetate: dichloromentane as mobile phase (5:5) to obtain fraction A.4 which had the best separation pattern. The purity test on the A.4 fraction with 1-dimensional and 2-dimensional TLC showed the presence of a single spot and was supported by an antifeedant activity test for the A.4 fraction which yielded 92.71% with a concentration of 6 ppm. Identification and characterization of isolates produced wavelengths of 281 nm and 249 nm which indicated the presence of single bonds and double bonds as well as the presence of functional groups, then at wave numbers 1747.38 cm-1 the presence of carbonyl, 2854.44 cm-1 and 2931.58 cm- 1 the presence of alkyl groups, at 3020.30 cm-1 the

presence of –OH, and at 929.62-667.32 cm-1 finger print for typical flavonoids. Then the 1H NMR and 13C NMR spectra gave an aromatic signal, a methoxy signal and a chemical shift of 6.5-8.0 ppm for flavonoids and a chemical shift of 0.5-3.2 ppm on steroids, and based on the Japan SDBS data it showed that the isolates had the same characterization as stigmasterol so that the isolate was predicted to be a 7-hydroxy-2'-methoxyflavanone compound and a stigmasterol compound [9].

7-hydroxy-2'-methoxyflavanone is a flavonoid compound of the flavanone group which contains various glycosides derived from three main aglycones as naringenin, eriodictyol and hesperitin. Compounds of the flavanone group cannot be found in all foods and in general, flavanones are glycolyzed at position 7 by glycosides [10]. While Stigmasterol is one of the sterol group compounds found in plants so it is called a phytosterol compound and has a structure similar to cholesterol. The phytosterol group includes sitosterol, ergosterol, stigmasterol, and fucosterol, where stigmasterol has 29 carbon atoms [11]. 7-hydroxy-2'-methoxyflavanone and stigmasterol compounds that have been isolated indicate that these compounds have antifeedant properties against *Epilachna sparsa* which work by disrupting the respiratory system and disrupting the digestive system. Flavanone compounds in the form of entering the respiratory tract through the sprirakel found at the end of the trachea of insects that cause respiratory tract work disorders [12]. In addition, flavonoid compounds can cause protein denaturation which causes a decrease in permeability to cell walls in the digestive tract, so that nutrient transport is disrupted and insect growth is inhibited which causes insects to die [13]. While the antifeedant properties of stigmasterol work by interfering with digestion, where the steroid is widely distributed in plants and animals in both free and bound forms (saponins). Steroids cause lysis of the intestinal mucosa of insects, resulting in an increase in cell membrane permeability and insects die [14].

Conclusion

The bioactive compounds of Cordyline fruticosa (L.) A. Chev. leaves that have been isolated were the steroidal sapogenin spirostan with binds D-fucopiranoside and L-rhamnopyranoside which have antitumor and antibacterial activity, steroidal saponin Fruticoside H, I and J which have cytotoxic activity (Fruticoside H and J) and antibacterial activity (Fruticoside I and J), then 7-hydroxy- 2'-methoxyflavanone and stigmasterol which have antifeedant activity against insects.

References

1. Sholikhah, E.N. (2016). Indonesian medicinal plants as sources of secondary metabolites for pharmaceutical industry, J Med Sci, 48(4), 226-239.
2. Bernhoft, A. (2010). A brief review on bioactive compounds in plants, In: Bioactive compounds in plants – benefits and risks for man and animals, Proceedings from a symposium held at The Norwegian Academy of Science and Letters, Oslo, 13 – 14 November 2008.
3. Lim, T.K. (2015). *Cordyline fruticosa*. In: Edible Medicinal and Non Medicinal Plants. Springer, Dordrecht.
4. Naher, S, Aziz, M.A., Akter, M.I, Rahman, S.M.M, Sajon, S.R, & Mazumder, K. (2019). Anti-diarrheal activity and brine shrimp lethality bioassay of methanolic extract of *Cordyline fruticosa* (L.) A. Chev. Leaves. Clinical Phytoscience, 5(15).
5. Gunawan. (2013). Study Ethnobotany Andong Plants of the Genus *Cordyline* in the Dayaknese of Meratus Lok Lahung Village, Loksado, South Borneo. Proceeding ICGRC. 4th International Conference on Global Resource Conservation & 10th Indonesian Society for Plant Taxonomy Congress Brawijaya University, February 7-8th, 2013.
6. Bogoriani, N.W., Santi, S.R., & Asih, A.A. (2008). Isolasi Dan Identifikasi Glikosida Steroid Dari Daun Andong (*Cordyline terminalis Kunth*). Jurnal Kimia 2(1), 40–44.
7. Fouedjou, R.T., Teponno, R.B., Quassinti, L., Bramucci, M., Petrelli, D., Vital,i L.A., Fiorini, D., Tapondjou, L.A., & Barboni, L. (2014). Steroidal Saponins from the Leaves of *Cordyline fruticosa* (L.) A. Chev. and Their

Cytotoxic and Antimicrobial Activity. Phytochemistry Letters, 7(1),62–68.
8. Mandana, M.G.A, Puspawati, N.M, & Santi, S.R. (2013). Identifikasi Golongan Senyawa Aktif Antimakan dari Daun Tenggulun (*Protium javanicum* Burm. F.) terhadap larva *Epilachna sparsa*, L. Jurnal kimia
9. Utami, N. T., Widiyantoro, A., Zaharah, T.A. (2017). Senyawa Antifeedant dari Daun Andong (*Cordyline fruticose*) terhadap Epilachna sparsa. Jurnal Kimia Khatulistiwa, 6 (2), 14-21.
10. Chaoyun, L., & Schluesener, H. (2017). Health-Promoting Effects of the Citrus Flavanone Hesperidin. Critical Reviews in Food Science and Nutrition, 57(3), 613–31.
11. Yuan, L., Fan, Z., Shuo, J., Xie, J., & Mingyue S. (2019). Differences between phytosterols with different structures in regulating cholesterol synthesis, transport and metabolism in Caco-2 cells. Journal of Functional Foods, 65, 103715
12. Embrikawentar, Z.C., & Ratnasari, E. (2019). The Effectivenes of Leaves Extract of Breadfruit (*Artocarpus altilis*) on the Mortality of Paddy Bug Pest *(Leptocorisa acuta*). Lentera Bio, 150-154.
13. Lodjo, L., Lamangantjo, C.J., & Zakaria, Z. (2020). The Effect Of Stem Siam Weed *(Chromolaena odorata*) Filtrate On Antifeedant Grayak *Catterpillar Spodoptera* litura (Lepidoptera: Noctuidae). Jambura Edu Biosfer Journal, 2(2), 37–43.
14. Lumowa, S.V.T., & Bardin, S. (2018). Uji Fitokimia Kulit Pisang Kepok (*Musa paradisiaca* L.) Bahan Alam Sebagai Pestisida Nabati Berpotensi Menekan Serangan serangga Hama Tanaman Umur Pendek. Jurnal Sains dan Kesehatan, 1(9), 465-469.

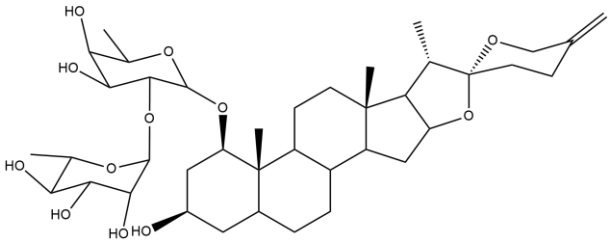

Figure 1. The structure of the Spirostan Steroid Sapogenin compound that binds D-fucopyranoside and L-rhamnopyranoside.

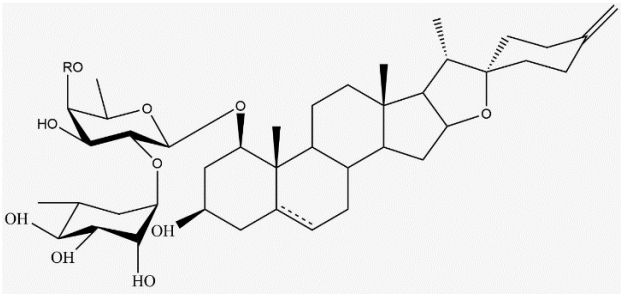

Figure 2. Structure of Fruticoside H and I

R:H Fruticoside H

R:SO3H Fruticoside I

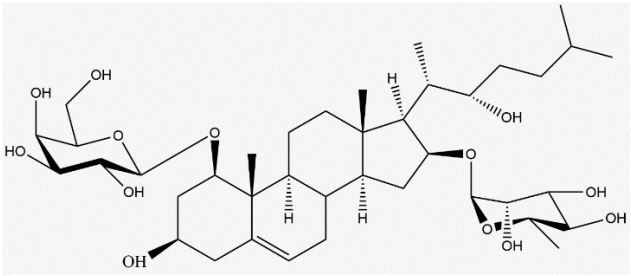

Figure 3. Structure of Fruticoside J

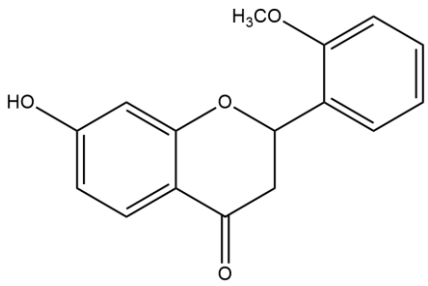

Figure 4. Structure of 7-hydroxy-2'-methoxyflavanone

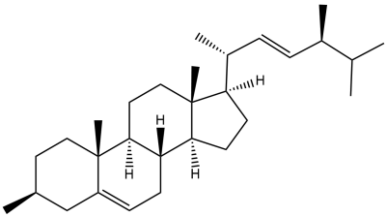

Figure 5. Structure of Stigmasterol