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Utilization and bioactivity of *Anredera cordifolia* (Ten.) Steenis

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Abstract

Anredera cordifolia (Ten.) Steenis is a multifunctional plant have been used decoration, food and traditional medicine. This study aims to explain the botany and use of *A. cordifolia* as a traditional medicinal plant and its bioactivity. The method used in this study is library research online using the keywords such as: *A. cordifolia*, uses of *A. cordifolia* and bioactivity of *A. cordifolia*. The all of information are synthesized so that explain of botanicals, benefits and bioactivity. The *A. cordifolia* has activity as cure of wound, anti-bacterial, anti-cholesterol and obesity, postpartum, anti-diabetes mellitus, antioxidant and anti-inflammatory, anti-hypertensive, anti-cancer, and lowering uric acid. The *A. cordifolia* contains triterpenoid saponins, steroids, saponins, glycosides, flavonoids, saponins and alkaloids, ursolic acid, ancordin, and apigenin. Saponins have been used to treat diabetes, liver, hepatitis, cardiovascular hypertension, hyper-cholesterol, and physical stress. Utilization of *A. cordifolia* as an anti-microbial has the potential to be used as a food preservative as well as providing healthful effects.

Keywords: *Anredera cordifolia*; Anti-microbial; Saponins; Multifunctional plant

1. Introduction

The *A. cordifolia* is a plant that is easy to found in Indonesia, which used ornament plant in the yard. Recently, *A. cordifolia* leaves to be consumed as vegetables in fresh or processed form, so they have good potential to be developed as an economic commodity. Leliqia et al [1,2] stated that *A. cordifolia* leaves can be consumed safely or non-toxic. The leaves and tubers of *A. cordifolia* are the most widely used parts as food which is prepared in various ways [3].

The use of *A. cordifolia* as a food ingredient only a few have been reported, in contrast to its use as a traditional medicine. Traditionally, *A. cordifolia* is used to treat various diseases such as skin diseases, hypertension, inflammation and gout [4]. The *A. cordifolia* is mainly used for wound healing and fighting fungal infections and other types of infections such as *Staphylococcus aureus* and *Candida albicans* [3]. The leaves of *A. cordifolia* have pharmacological activity as antihyperglycemic, antihyperlipidemic, and antibacterial [5]. The use of *A. cordifolia* as a traditional medicine is related to its bioactivity. Leliqia et al [1,2] reported that *A. cordifolia* has bioactivity in improving kidney function, anti-bacterial, anti-fungal, anti-viral, protease inhibitor, xanthine oxidase inhibitor, anti-diabetic, anti-hypertension, vasodilator, diuretic, anti-obesity, hypolipidemic, anti-oxidant, gastroprotective, hepatoprotective, cytotoxic, anti-inflammatory, analgesic and cure of wound.

The *A. cordifolia* is an unconventional food item, with leaves and tubers used as food prepared in various ways [3]. The *A. cordifolia* contains triterpenoid and steroid saponin compounds and the content of saponins of leaves (28.14 ± 0.22), stems (3.65 ± 0.11) and tubers (43.15 ± 0.10) mg/g [6]. Terpenoids, steroids, glycosides, flavonoids, saponins and alkaloids, ursolic acid, ancordin, apigenin were found in *A. cordifolia* [1,2]. Saponins have been used to treat diabetes, liver, hepatitis, cardiovascular conditions such as high hypertension, hyper-cholesterol, and physical stress [6]. The *A.*

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cordifolia leaf phytochemical screening showed the presence of alkaloids, flavonoids, saponins, tannins, steroids, and phenolic compounds [5]. The ethanol extract of leaves contains vitexin with pharmacogenetic parameters that can be used to standardize its quality [5]. This study aims to explain the potential use of *A. cordifolia* as a traditional medicine and its bioactivity.

2. Research Methods

The method used in this research is online library literature. The main sources used are research reports, journals, and books published on Google Scholar. Some of the keywords used in the search included *A. cordifolia*, uses of *A. cordifolia* and bioactivity of *A. cordifolia*. The information obtained are synthesized so that explain of botanicals, their benefits and bioactivity is explained in a comprehensive manner.

3. Results and discussion

3.1. Botany of *Anredera cordifolia* (Ten.) Steenis

The *A. cordifolia* synonymous with *Boussingaultia cordifolia* Ten is a species in the Basellaceae. Basellaceae has 4 genera namely *Anredera* Juss., *Basella* L., *Tournonia* Moq. and *Ullucus* Caldas [7]. The genus *Anredera*, family Basellaceae, includes up to 12 species of perennial, twining or climbing, succulent or mucilaginous, often tuberous vines [8]. The *A. cordifolia* is a species of the genus *Anredera* which is easily found and widely used in Indonesia. The *A. cordifolia* is an indogenous plant of Argentina Northeast, Argentina Northwest, Bolivia, South Brazil, Brazil Southeast, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, but this plant has long been used in Indonesia [7]. The *A. cordifolia* is considered a serious environmental weed because of the structural damage it causes to native vegetation [9].

Description: has a habitus of climbing herbs. The stem is slender, coiled and hairless about 30 m long, initially green-pink-red and herbaceous, later becomes brown, flaky and woody and reaches 2-3 cm in age and diameter (Figure 1). Produces fine tubers on both roots (rhizome up to about 2 cm in diameter) and at nodes on aerial stems. Small irregularly sized 'warty' air bulbs are light brown or green in color and vary in size from 5 mm to about 25 cm in diameter, often bearing numerous axillary buds.



Figure 1 Habitus of *binahong* (*Anredera cordifolia* (Ten.) Steenis) showing a climbing habitus with vegetative organs

The leaves is subsessile, sub-chordate, heart-shaped or with petioles to 1–12 cm (and less frequently up to 15 cm), alternate, broadly ovate, or occasionally lanceolate, heart-shaped ± soft to succulent depending on exposure; blunt apex. The lamina is light green, darker green on upper surface, glossy, moist to touch, 1–15 cm long and 0.8–11 cm broad. The flowers resemble lamb's tails, and are a 6–65 cm long, drooping raceme; simple or branched 2-4. The flowers are about 3-5 mm in diameter, fragrant, greenish white to creamy white, numerous and short lived. The crown is white, fluffy,

ovate-oblong to elliptical lobes, 1-3 mm long; blunt apex. The stalks and anthers are white. The filaments are triangular in shape with a size of 1.5–3 mm. Single drupe fruit round, slightly compressed to triangular, 0.9–1.1 mm long [10].

3.2. Utilization and Bioactivity

The local communities in Indonesia have long used *A. cordifolia* as a traditional medicine or as a food ingredient. Its use as a traditional medicine is more prominent than the others. In the following, we will further explain the bioactivity of *A. cordifolia* as treating wounds, anti-bacterial, anti-cholesterol and obesity, postpartum, anti-diabetes mellitus, antioxidant and anti-inflammatory, anti-hypertensive, anti-cancer, and lowering uric acid.

3.2.1. Cure Wounds

The open wounds are one way to pathogenic microbes to infection of body. Various types of wounds that are commonly found include burns, injuries due to sharp objects, collisions with blunt objects, postpartum wounds and injuries due to tooth extraction. Wound healing is a normal process in response to injury to skin tissue [11]. The *A. cordifolia* is widely used as a treatment in Asia, some of which is to heal wounds [12]. The *A. cordifolia* is traditionally used to treat various diseases, including skin diseases, hypertension, inflammation and gout [4].

The wound healing is a normal biological process in response to skin injury. The application of *A. cordifolia* gel accelerate the expression of HIF-1 α and FGF-2 after tooth extraction in Wistar mice [12]. The bioactivity of *A. cordifolia* to treat wounds and anti-microbial. The wound healing is related to the formation of a network of fibroblasts and collagen, because natural ingredients that stimulate these tissues have the potential to heal wounds [13]. The cure of wound healing without scarring be obtained by applying a gel containing ethanol extract of *A. cordifolia* leaves and a cyclooxygenase-2 inhibitor [14].

The bioactivity of *A. cordifolia* in wound healing is related to fibroblast formation or proliferation. The fibroblast cell proliferation increased from 0 to 72 hours after application of *A. cordifolia* ethanol extract [13]. The ethanol extract of *A. cordifolia* leaf at concentrations of 20% and 40% had better guinea pig wound healing activity than negative and positive controls [15]. An artificial incision on the rat's back with a wound length of 20 mm and a depth of 2 mm was then applied with an ointment of ethanol extract of *A. cordifolia* leaves cure of wounds at a concentration of 10% - 15%, the reduction in wound length occurred on the 7th day the higher the concentration of the extract the effect of wound healing getting bigger [11]. The ethanol extract of *A. cordifolia* leaves stimulate the formation of fibroblasts and collagen which will speed up the wound healing process [13]. Gel containing *A. cordifolia* alcohol extract added with cyclooxygenase-2 celecoxib inhibitor showed wound healing with statistically smaller size of newly formed epidermis compared to leaves *A. cordifolia*.

The leaves *A. cordifolia* contain flavonoids as bioactive substances which are efficacious for treating wounds and diseases caused by bacteria [14]. The leaf of *A. cordifolia* extract contains saponins, tannins, alkaloids, triterpenoids, flavonoids, phenolics, steroids, and glycosides which are effective as wound healing agents that stimulate fibroblast cell proliferation [13]. The flavonoids contained in *A. cordifolia* leaves is 8-glucopyranosyl-4'5'7-trihydroxyflavone or vitexin [16].

3.2.2. Anti-Bacterial

Anti-bacterial are compounds that inhibit the growth or cause the death of bacteria. The *A. cordifolia* bioactivity as an anti-bacterial is associated with its efficacy to treat wounds. The bacterial infections be cured using antibiotics, but excessive causes bacteria to resistant [17], so antimicrobial exploration. The *Shigella flexneri* is bacteria that causes dysentery [17], *Streptococcus mutans* infection to dental caries [18] and *Candida albicans* cause vaginal discharge. Nosocomial infection by *Pseudomonas aeruginosa*, which bacteria that infects burns, due to length of hospitalization [19]. The bioactivity of *A. cordifolia* as an anti-microbial has the potential to be developed as a natural preservative. The quality of pasteurized milk be improved by providing natural ingredients such as the addition of *A. cordifolia* leaf extract and sucrose because inhibited the growth of *Escherichia coli* and *Staphylococcus aureus* [20].

The extract of *A. cordifolia* inhibited the growth of *Staphylococcus aureus* [1-3,21,22], *Bacillus subtilis* and *B. cereus* [1,2], *S. flexneri* [17], *Streptococcus mutans* [18], *C. albicans* [3], *E. coli* [1,2,22,23], *Porphyromonas gingivalis* dan *Prevotella intermedia* [22]. The *A. cordifolia* extract has bioactivity as an anti-microbial is influenced by the type of solvent and concentration used [1,2,17,19,21]. Administration of topical *A. cordifolia* extract accelerates burn wound healing, increases IL-6 increases VEGF production in burns infected by *Pseudomonas aeruginosa* [19]. The n-hexane and ethyl acetate extracts have a broad spectrum of antibacterial activity that can inhibit the growth of *S. aureus*, MRSA, *B. subtilis*,

P. aeruginosa, and *E. coli* [1,2]. The extracts and fractions leaves of *A. cordifolia* showed bacteriostatic and bactericidal activity, but the n-hexane extract had the strongest bactericidal activity compared to other extracts [1].

The ability of *A. cordifolia* to inhibit of microbial growth is related to its secondary metabolite [8] and its endophytic bacteria [24]. The endophytic bacteria of leaves of *A. cordifolia* contain *P. aeruginosa* which is thought to be related to inhibition against *B. cereus*, *S. aureus*, *E. coli*, *P. mirabilis*, and *P. aeruginosa* [24]. Some of the secondary metabolites contained in *A. cordifolia* leaf extract include steroids/triterpenoids, ursolic [1,2], flavonoids, terpenoids, alkaloids, saponins [18,25], triterpenoid, and sitosterol [25]. The essential oils show weak inhibitory activity against Gram-positive pathogens [8].

3.2.3. Anti-Cholesterol and Anti-Obesity

Cholesterol is a complex fatty compound produced by the body with various functions, including to make sex hormones, adrenal cortex hormones, vitamin D, and to make bile salts which help the intestines absorb fat, but if there is excess cholesterol in the body, it will cause a condition called atherosclerosis, namely narrowing or hardening of the arteries [26]. A high cholesterol diet causes an increase cholesterol and hypercholesterolemia [27]. The overweight or obesity is a health problem that increase the risk of cardiovascular disease such as hypertension, hyperlipidemia, atherosclerosis, and diabetes mellitus [28]. The ethanol extract of *A. cordifolia* leaves has the greatest activity in reducing cholesterol levels in vitro proportional [26]. The ethanol extract of *A. cordifolia* leaves at a dose of 100 mg/kg has potential as an anti-obesity agent by inhibiting the increase in body weight of obese rats induced by a high-carbohydrate diet, without affecting appetite and bowel movements [28].

3.2.4. Postpartum

Postpartum known as the puerperium periods is needed to restore the health of the reproductive organs after childbirth. The postpartum period causes changes for the mother, both physiological changes and psychological changes including uterine sub-involution, local obstruction, and postpartum hemorrhage [29]. Several facts often found various physical disorders (injuries) and psychological (depression) during childbirth, this has resulted in the exploration of plants to restore the stamina of mothers after childbirth continues to be carried out. Silalahi et al [30] reported that the Batak ethnic group in North Sumatra performs a traditional sauna known as *oukup* which utilizes various types of plants to restore maternal stamina after childbirth.

The *A. cordifolia* leaves are used as a wound healing medicine and the boiled water is able to heal perineal wounds [29]. Supplementation of *A. cordifolia* can accelerate postpartum estrus in rabbits, characterized by changes in behavior and appearance of forming salivary mucus and cervical mucus [31]. The *A. cordifolia* leaf extract can increase the number of children born and can reduce the number of children who die yang thought to be associated with an increase increase leukocyte profiles and progeny production [32].

3.2.5. Anti Diabetes Mellitus

Diabetes mellitus is a metabolic disorder that results in blood glucose levels above normal, so it is referred to as hyperglycemia. The *A. cordifolia* has been long a traditional medicinal plant used for the treatment of hyperglycemia [33,34]. The bioactivity of *A. cordifolia* as an anti-diabetes mellitus is related to inhibition of the α -glycosidase enzyme in vitro and anti-diabetic activity in alloxan-induced rats [4,34]. The ethyl acetate extract of *A. cordifolia* leaves has an inhibition of the α -glycosidase enzyme of 81.23 g/mL [34].

Administration of *A. cordifolia* leaf extract to rats lowered blood glucose levels in male rats induced by sucrose similar to positive controls [35,35]. The bioactivity of *A. cordifolia* as an antidiabetic is related to the content of flavonoids such as orientoside [4]. The orientoside has activity to α -glycosidase enzyme inhibitory with IC50 value of 20.23 g/mL and has the ability to lower blood glucose in alloxan-induced mice [4]. The methanol extract of *A. cordifolia* leaves (50- 200 mg/kg BW) reduced blood glucose levels in mice and repaired damage to cells - pancreas [34].

3.2.6. Anti Hypertension

Hypertension is a condition of above normal blood pressure which often has implications for metabolic disorders in the body. The *A. cordifolia* leaf extract 50 mg/kg bw significantly reduces heart rate induced by adrenaline (increases heart rate) and provides a weak diuretic effect compared to furosemide (a standard drug for diuretics) [36]. The ethanolic extract of *A. cordifolia* showed vasodilation in the rabbit aortic ring possibly through facilitating the role of endogenous compounds such as nitric oxide (NO) and showed vasodilation in frog heart to be mediated by inhibition of 1-adrenoceptors [37].

3.2.7. Anti-cancer

The apoptosis inducers function in cell survival or repair of signaling pathways in response to cellular stress [38]. The leaf of *A. cordifolia* extract has cytotoxic activity and induces apoptosis in cervical cancer cells. The leaf extract showed cytotoxic activity and triggered apoptosis in HeLa cells with an IC50 value of 75 g/mL. The cytotoxic activity of *A. cordifolia* leaf extract on HeLa cells via the p53-independent pathway [39].

3.2.8. Reduce Uric Acid

The uric acid is the end product of catabolism (breakdown) of a substance called purine. Gout is a disease caused by the accumulation of uric acid, especially in bone joints. Gout is the most common form of inflammatory arthropathy [40,41]. The 70% ethanol extract of *A. cordifolia* leaves exhibited xanthine oxidase (XO) inhibitory activity and the ability to lower serum uric acid (ACE) levels. Anti-hyperuricemia test conducted in vivo on male Wistar rats induced by a diet high in purines and potassium oxonate (PO). The value of IC50 ACE has xanthine oxidase inhibitory and anti-hyperuricemia activity [42].

4. Conclusion

- *Anredera cordifolia* has activities as wound healing, anti-bacterial, anti-cholesterol and obesity, postpartum, anti-diabetes mellitus, antioxidant and anti-inflammatory, anti-hypertensive, anti-cancer, and lowers uric acid.
- *Anredera cordifolia* contains triterpenoid saponins, steroids, saponins, glycosides, flavonoids, saponins alkaloids, ursolic acid, ancordin, and apigenin.

Compliance with ethical standards

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