

Pharmacology and Phytochemistry Overview on *Sauropus androgynous*

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ABSTRACT

Active compounds of natural ingredients need to be extensively explored to get their properties. *Sauropus androgynous* is widely grown in southern Asia and Southeast Asia. The aim of this study was to provide an overview of *S. androgynous* profiles, pharmacological compound and their phytopharmacological activity. The method used to collect literature is the Science Direct, PubMed and Google Scholar search engines with keywords. The active compounds of *S. androgynous* which can be detected i.e. sauroposide and some secondary metabolites i.e. alkaloids, flavonoids, phenols, terpenoids, glycosides, and some vitamins i.e. carotenoids, thiamine, ascorbic acid and α -tocopherol. Many studies showed that *S. androgynous* has efficacy as an antioxidant, analgesic, antipyretic, anti-inflammatory, antimicrobial, antibacterial, cytotoxicity, aphrodisiac, lactation

enhancer, antidiabetic and hypoglycaemic, anti-cholesterol, and wound healing activity. Further research needs to be done to make pharmaceutical preparations in the form of patent drugs with appropriate therapeutic doses.

Keywords: Katuk leaf, Pharmacology, Phytochemistry, *Sauropus androgynous*

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INTRODUCTION

Natural materials are alternative products to increase productivity, prevent and treat diseases worldwide. Natural materials developed into various drugs and multifunctional forms of therapy, especially for people who are not familiar with modern medicine.¹ Potential natural materials have three main criteria, namely having new entities to be synthesized into alternative products, types of diseases that can be treated, and frequency of treatment.²

Katuk leaves (*Sauropus androgynous*) are found to be very abundant in Indonesia. Some people use *S. androgynous* as traditional herbal medicine and animal feed. *S. androgynous* can be a supplement to increase breastmilk production. Some kinds of beauty products also use *S. androgynous* as raw material. *S. androgynous* are known by the Javanese people as vegetables and food coloring. *S. androgynous* are only planted as home decorations on fences and courtyards, but extensification methods can be developed on special plantations.³ The aim of this study was to provide an overview of the profiles of *S. androgynous*, chemical compounds and their phytopharmacological actions.

HABITAT AND DISTRIBUTION

S. androgynous can grow in a humid atmosphere. It is widely found in the tropics of Southern Asia. According to the United States Department of Agriculture (USDA), released data on *S. androgynous* plants spread in the countries of South Asia i.e. China, India, Sri Lanka and Southeast Asia i.e. Vietnam, Indonesia, Malaysia, Papua New Guinea and Philippines.⁴ It is commonly known as Katuk (Indonesia), Mani Cai (China), Cekur Manis (Malaysia), Pak-Wanban (Thailand), Raungot (Vietnam), and Simani (Minangkabau). In Indonesia, it can grow with enough water and a house fence. It can grow with the ideal environment, i.e. an air temperature of 21-32°C, a relative humidity rate (RH) of 50-80% and rainfall between 750-2500 mm/year. It can decrease in the dry season more than six consecutive months. *S.*

androgynous grows in lowlands up to 120 m above sea level and in forests as wild plants. In West Java, this plant can be found in fields with an altitude of 1300 m. Stem cuttings can be used to improve the vegetative process.⁵

MORPHOLOGY

S. androgynous includes clumped shrub plants with a height of 3-5 m. (Figure 1)

The stem – grows tall and has a strong cambium. Can grow new branches quickly.

Leaves – are small like Moringa leaves, green, have a width of 5-10 cm.

Flowers – are small, dark red to yellowish, with red spots. The flower will produce white fruit in which there are black seeds.⁵

TAXONOMICAL CLASSIFICATION

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Malpighiales

Family: Phyllanthaceae

Genus: *Sauropus*

Species: *androgynous*

Binomial name: *Sauropus androgynous*.⁶

PHYTOCHEMICAL STUDIES

According to the Ministry of Health of the Republic of Indonesia and research on Free Radical Scavenging activity of Multivitamins, *S. androgynous* contains many nutrients that can be used as the human diet (Table 1).⁷

Based on physical analysis and spectroscopic data, *S. androgynous* contains a lignan diglycoside, (-)-isolaricresinol 3 α -O- β -apiofuranosyl-(1 \rightarrow 2)-O- β -glucopyranoside and a megastigmane glucoside. Sauroposide (Figure 2) were isolated from the aerial part of *S. androgynous*

together with (+)-isolariciresinol 3 α -O- β -glucopyranoside, (-)-isolariciresinol 3 α -O- β -glucopyranoside, (+)-syringaresinol di-O- β -glucopyranoside, guanosine and corchoionoside C.⁸

The active compound of *S. androgynous* has been characterized with several compounds i.e. 9, 12, 15-octadecatrienoic acid, ethyl ester, (Z, Z, Z)- (14.48%), Phytol (13.08%), Glycerin (2.52%), 1-methyl-2-pyrrolidineethanol (2.27%), Acetic acid (1.81%), Pent-1-en-3-one, 1-(2-furyl)-5-dimethyl-ylamino (1.69%), Benzofuran, 2, 3-dihydro- (1.65%), 2-Acetylpyrrolidine (1.51%), 4-O-methylmannose (1.46%), N-Ethyl-2-carbomethoxyazetidine (1.43%), 9-Ethoxy-10-oxatricyclo [7.2.1.0 (1, 6)] dodecan-11-one (1.36%), 1H-Indole, 5-fluoro- (1.30%), Hexadecanoic acid (1.18%), Oleic acid (1.18%), Heptaethylene glycol monododecyl ether (1.12%), N, N-Dimethyl-2-aminoethanol (1.05%), 2-Methoxy-4-vinylphenol (0.97%), L-Phenylalanine (0.95%), Pentaethylene glycol (0.95%), 4, 6-Di-O-methyl- α -d-galactose (0.94%), Octadecanoic acid (0.85%), Thiophene, tetrahydro-2-methyl (0.82%), 3-Hexanol, 2, 5-dimethyl- (0.79%), Phenol (0.76%), Tetradecanoic acid (0.75%), Benzophenone, 3-methoxy- 4'-methyl (0.75%), Ethylidenecycloheptane (0.75%), β -sitosterol (0.68%), 9, 12-Octadecadienoic acid, methyl ester, (E, E)- (0.63%), 2-pyrrolidinone (0.50%), Morpholine (0.48%), N-Chloroacetyl-d-phenylalanine (0.47%), 1-butanol, 2-ethyl- (0.44%), 4, 6-Di-O-methyl- α -d-galactose (0.40%) Unidentified compounds (38.03%).⁹

α -tocopherol content was evaluated used high-performance liquid chromatography (HPLC) method in *S. androgynous* leaves for 426.8 mg/kg edible portion.¹⁰ Secondary metabolite content i.e. alkaloids, flavonoids, phenols, terpenoids and glycosides have been evaluated contained in *S. androgynous* leaves.¹¹

PHYTOPHARMACOLOGICAL STUDIES

Antioxidant activity

Antioxidants have several functions i.e. neutralize free radicals, prevent inflammatory reactions in infectious diseases, aging and degenerative diseases. Leaves function as antioxidants because the vitamin C content was relatively high around 239 mg.⁷

Polyphenols and flavonoids in *S. androgynous* extract have potential antioxidant properties and are able to treat free radical-mediated diseases. Antioxidant activity was found in 20 μ g/ml flavonoid doses of *S. androgynous*.¹² Total phenol of *S. androgynous* of 1.52 mg GAE/100 g was used as an alternative antioxidant. Antioxidant activity measured by ferric cyanide reducing power, DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS (2,2'-azino-bis-(3-ethylbenzthiazoline-6-sulphonic acid) scavenging, and inhibition of linoleic acid oxidation.¹³

Analgesic, antipyretic and anti-inflammatory activity

Administration of *S. androgynous* ethanol extract 400 mg/kg/body weight showed an anti-inflammatory effect on rat hind edema.¹⁴ Protein denaturation is the cause of increasing rat body temperature. Increased body temperature causes fever due to inflammation and infiltration of

neutrophils. These neutrophils have lysosome and anti-inflammatory activity which are found in many plants. Other lysosome derivatives including bactericidal enzymes and extracellular released proteinases cause significant inflammation and tissue damage. The *S. androgynous* extract shows the efficacy of flavonoids and the related inhibits the release of lysosomal content from polyphenolic neutrophils and contributes significantly as an anti-inflammatory at the site of inflammation.¹⁵

S. androgynous is beneficial during the inflammatory response, pain and fever. The presence of alkaloids, steroids and terpenoids is alleged to be a counter-response to pain and fever.¹⁶ Phytoconstituent derivatives were found in *S. androgynous* i.e. saponins, tannins, triterpenoids and coumarin associated with Non-steroidal anti-inflammatory drugs (NSAIDs) properties. The presence of secondary metabolites from constituent derivatives can be antinociceptive and analgesic in traditional medicine.¹⁷

Antimicrobial and antibacterial activity

The antibacterial activity of *S. androgynous* leaf extract in methanol and ethanol can inhibit the growth of *Bacillus cereus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* and *Salmonella typhimurium*. Whereas, aqueous Extract showed moderate activity against *Salmonella typhimurium* and *Klebsiella pneumoniae*.¹⁸ Methanol leaf extract *S. androgynous* showed a more significant inhibitory effect on gram-positive bacteria when compared with ethanol extract. Methanol leaf extract also showed a more significant inhibitory effect on gram negative bacteria when compared with ethanol and aqueous extracts.¹⁹ Antibacterial activity is supported by multivitamins and peptides, glycosides, alkaloids, saponins, terpenoids, and flavonoids.²⁰

Cytotoxicity

S. androgynous was evaluated for toxic effects on the culture of human mesenchymal stem cells originating from the bone marrow (hMSCs-BM). Cell cultures were incubated for 72 hours with extract concentrations of 250-2500 mg L⁻¹. *S. androgynous* extract is less cytotoxic to hMSCs-BM with a dose of IC₅₀ 2450 mg L⁻¹. The mechanism of inhibiting cell viability is done through the apoptotic pathway. *S. androgynous* extract was shown to have a percentage of viability in hMSCs-BM cell cultures 37% to 75%.²¹

Cytotoxicity and genotoxicity reactions were also evaluated in studies using Chinese hamster lung (CHL) cells for 24, 48 and 72 hours. The extract dose used i.e. 250; 2500; 5000; 10000; 20000; 40000 μ g/ml, respectively. Observations were made on chromosome aberration. The results showed that the lower the dose showed the higher the effect of cytotoxicity. Conversely, the higher the dose shows the lower the cytotoxicity effect.²²

Aphrodisiac activity

The effusion effect of *S. androgynous* leaves on libido in male rats as an aphrodisiac was measured by a libido meter. The results were obtained that orally administration effusion for 14 days was effective in increasing male libido.²³ *S.*

androgynus leaves contain steroid biosynthesis. These compounds were androstan-17-one and 3-ethyl-3-hydroxy-5- α , which can increase the concentration of androgen-binding protein (ABP) through increased concentrations of steroid hormones, especially testosterone in plasma.²⁴

Lactation enhancer

S. androgynus leaf extract traditionally used by Indonesians to increase breast milk production.²⁵ The lactation process is stimulated by increasing levels of the hormone prolactin and oxytocin.²⁶ Vitamin A is sourced from carotenoids from *S. androgynus* extract. Vitamin A synthesizes retinol which reacts with fatty acids to trigger the release of the hormone prolactin. The presence of the hormone prolactin stimulates the development of secretory glands in the intralobular duct. Increased activity of secretory glands with lipids and unilocular fat tissue can prepare mammary glands before the time of let down milk.²⁷

Antidiabetic and hypoglycaemic activity

Aqueous *S. androgynus* extract of 10g/200ml water used in animal models showed a decrease in blood glucose. Measurements using the glycemic index (GI) score showed a 50% decrease in activity compared to normal blood glucose.²⁸ In another study used a dose of 250 mg/kg Body weight of ethanol *S. androgynus* extract can reduce blood glucose and liver glycogen in mice induced by alloxan. Decreased total cholesterol and triglycerides showed the same dose. Decreased levels of ALT, AST and ALP enzymes showed a decrease in oxidative activity in the liver.²⁹ Alloxan acts as an insulin inhibitor secreting pancreatic- β cells and increases the α -glucosidase enzyme during metabolism of polysaccharides. The hypoglycemia activity of *S. androgynus* ethanol extract can inhibit the release of the α -glucosidase enzyme during the regeneration of pancreatic- β cells.³⁰

Anti-cholesterol activity

Administration of *S. androgynus* feed in a 10% diet of broiler chicken body weight can reduce carcass cholesterol levels by 58.48 mg/100 g.³¹ In another study used administration of *S. androgynus* supplementation of 90 mg/kg of diet can reduce HDL, LDL, VLDL cholesterol and atherogenic index. The alkaloid and non-alkaloid effects of *S. androgynus* leaves have dose dependence. Alkaloid and non-alkaloid supplementation reduces the risk of atherosclerosis indicated by a lower atherogenic index.³²

Wound healing activity

Topical administration of *S. androgynus* 5% in incision and excision wounds can increase wound closure in albino rats. Carotenoids, thiamine, ascorbic acid, toluene and thymol are promoters of the wound healing process. Carotenoids play a role in maintaining epithelial integrity. Thiamine acts as a co-factor for collagen synthesis and the main cross-linking for wound closure. Ascorbic acid as an antioxidant is very important for collagen synthesis and prevents vitamin C deficiency. Thymol is a stimulant for wound healing and the re-epithelialization process.³³

CONCLUSION

The study of literature has widely explained the efficacy of *S. androgynus* as traditional herbal medicine, breast milk inducer, wound healing, and antioxidants. The content of sauroposide and some secondary metabolites i.e. alkaloids, flavonoids, phenols, terpenoids, glycosides, and some vitamins i.e. carotenoids, thiamine, ascorbic acid and α -tocopherol are useful in many traditional treatments of *S. androgynus* extract. The simplest application of extracting simplicia was aqueous extract by boiling the leaves, flowers and seeds. Although many studies have been conducted to evaluate the efficacy of *S. androgynus*, further studies still need to be done to make pharmaceutical preparations in the form of patent drugs that can be used as therapy.

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ABBREVIATIONS

ABP: Androgen-binding protein; ABTS: 2,2'-azino-bis- (3-ethylbenzthiazoline-6-sulphonic acid; ALP: Alkaline phosphatase; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; CHL: Chinese hamster lung; DPPH: 2,2-diphenyl-1-picrylhydrazyl; GAE: Gallic acid equivalent; GI: Glycemic index; HDL: High-density lipoprotein; hMSCs-BM: Human mesenchymal stem cells originating from the bone marrow; HPLC: High-performance liquid chromatography; LDL: Low-density lipoprotein; NSAIDs: Non-steroidal anti-inflammatory drugs; RH: Relative humidity; USDA: United States department of agriculture; VLDL: Very low-density lipoprotein.



Figure 1: *S. androgynous* with leaves and flowers in the rainy season

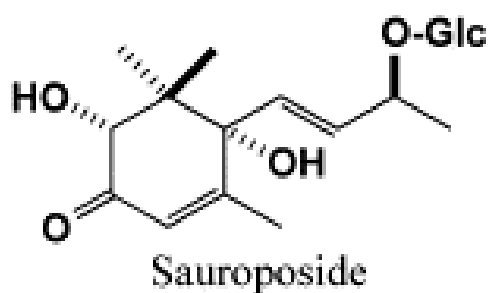


Figure 2: Structure of Sauroposide present in *S. androgynous*

Table 1: Nutrition of *S. androgynous* in 100 grams of fresh ingredients

Types of nutrients	Value
Calories (cal)	59.00
Protein (g)	4.80
Fat (g)	1.00
Carbohydrate (g)	11.00
Calcium (mg)	204.00
Phosphor (mg)	83.00
Iron (mg)	2.70
Vitamin A (IU)	10370.00
Vitamin B1 (mg)	0.10
Vitamin C (mg)	239.00
Water (g)	81.00
Edible parts (%)	40.00