

# Antifertility Effect of *Bougainvillea spectabilis* or Paper Flower

Anisa Ghogar, Wanee Jiraungkoorskul<sup>1</sup>

Mahidol University International College, Mahidol University, Salaya Campus, Nakhon Pathom, <sup>1</sup>Department of Pathobiology, Faculty of Science, Mahidol University, Bangkok, Thailand

## ABSTRACT

*Bougainvillea spectabilis* (Family: Nyctaginaceae), commonly referred to as Great *Bougainvillea* or Paper Flower, is one of the traditional medicinal plants with potential antifertility activity. The aqueous extract and decoction of this plant have been used as fertility control among the tribal people in many countries. Furthermore, it has been shown to possess anticancer, antidiabetic, antihepatotoxic, anti-inflammatory, antihyperlipidemic, antimicrobial, antioxidant, and antiulcer properties. Its phytoconstituents such as alkaloids, essential oils, flavonoids, glycosides, oxalates, phenolics, phlobotannins, quinones, saponins, tannins, and terpenoids were reported as the basis of its efficacious therapeutic properties. The other important constituents which contribute to the remedial properties are bougainvinones, pinitol, quercetagenin, quercetin, and terpinolene. Published information on the antifertility property of *B. spectabilis* was gathered by the use of different database platforms including Google Scholar, ScienceDirect, PubMed, SciFinder, and Scopus. These database platforms were used to provide an up-to-date review on its importance.

**Key words:** Antifertility, *Bougainvillea spectabilis*, paper flower, phytochemical substance, plant

## INTRODUCTION

In 2016, the world population is estimated at 7.4 billion; the number is expected to increase to 9.6 billion in 2050 and 11.2 billion in 2100.<sup>[1]</sup> Fertility control is a significant issue of the global and the national public health.<sup>[2]</sup> Several effective approaches for the induction of infertility have been investigated over a long period including hormonal, chemical, and immunological approaches.<sup>[3,4]</sup> However, these approaches possess various side effects such as obesity,<sup>[5]</sup> thromboembolism,<sup>[6]</sup> and carcinogenic effects.<sup>[7]</sup> Therefore, researchers are interested in natural products such as plants to be used as abortifacient and as contraceptive. An ethnobotanical survey of fertility conditions among the tribal people in many countries was reported, for example, Kamrup District, Assam in India,<sup>[8]</sup> Tswapong North in Eastern Botswana,<sup>[9]</sup> Ebonyi State in Nigeria,<sup>[10]</sup> and Ibadan in Southwest Nigeria.<sup>[11]</sup> Medicinal plants with potential of antifertility activity are bladder cherry, *Physalis alkekengi*;<sup>[12]</sup> crab's eye creeper, *Abrus precatorius*;<sup>[13]</sup> abuta, *Cissampelos pareira*;<sup>[14]</sup> turmeric, *Curcuma longa*;<sup>[15]</sup> climbing milkweed, *Sarcostemma secamone*;<sup>[16]</sup> bellyache bush, and *Jatropha gossypifolia*.<sup>[17]</sup> The present review is to provide an up-to-date information of the properties of *Bougainvillea spectabilis*, one of the plants that are being investigated for diverse health benefits.

## PLANT DESCRIPTION

*B. spectabilis* is sometimes referred to as "Paper Flower" because its bracts are thin and papery. The most common *Bougainvillea* color is purple or

magenta, the others are range from white to orange. It also has two colors on the same tree, for example, pink and white or pink and orange that is called rainbow paper flower [Figure 1].<sup>[18]</sup> Stem is a woody perennial vine, with multitrunked and large clumping stems which spread up to 2–4 m. The clumping stem uses thinning branches attached the curved thorns. The color of growing stems is from green to dark green. The bark is pale and corky. Branching is close and short, giving rise to a very dense plant. The leaves are simple and alternate. The leaf is 5–10 cm long and 2–6 cm wide, with ovate to rounded shapes. Leaves are deep green, leathery in texture, and hairy underneath. The flowers arise in leaf axils, in clusters of three. The color of the flower is white, it is small-slender size with hairy tubes, and surrounded by showy, colorful petaloid bracts. The bracts are crinkled, fairly large, egg-shaped, and possess colors in the rose, rusty-red, magenta, and purple. The elongated five-lobed achene fruit is 1–2 cm long, has a dry, hard fruit cover.<sup>[19]</sup>

## TAXONOMICAL CLASSIFICATION

The taxonomy of *B. spectabilis* is in the Kingdom: *Plantae*; Subkingdom: *Viridiplantae*; Infrakingdom: *Streptophyta*; Superdivision: *Embryophyta*; Division: *Tracheophyta*; Subdivision: *Spermatophytina*; Class: *Magnoliopsida*; Superorder: *Caryophyllene*; Order: *Caryophyllales*; Family: *Nyctaginaceae*; Genus: *Bougainvillea*; Species: *B. spectabilis*.<sup>[20]</sup> Genus: *Bougainvillea* was first discovered in Brazil by a French navigator named Louis Antoine de *Bougainvillea*, in 1786.<sup>[19,21]</sup> This genus has 18 species: *Bougainvillea berberidifolia*, *Bougainvillea buttiana*, *Bougainvillea campanulata*, *Bougainvillea glabra*, *Bougainvillea herzogiana*, *Bougainvillea infesta*, *Bougainvillea lehmanniana*, *Bougainvillea lehmannii*, *Bougainvillea malmeana*, *Bougainvillea modesta*, *Bougainvillea pachyphylla*, *Bougainvillea peruviana*, *Bougainvillea pomacea*, *Bougainvillea praecox*, *B. spectabilis*, *Bougainvillea spinosa*,

### Correspondence:

Dr. Wanee Jiraungkoorskul,  
Department of Pathobiology, Faculty of Science,  
Mahidol University, Bangkok 10400, Thailand.  
E-mail: pathobiologymu@gmail.com

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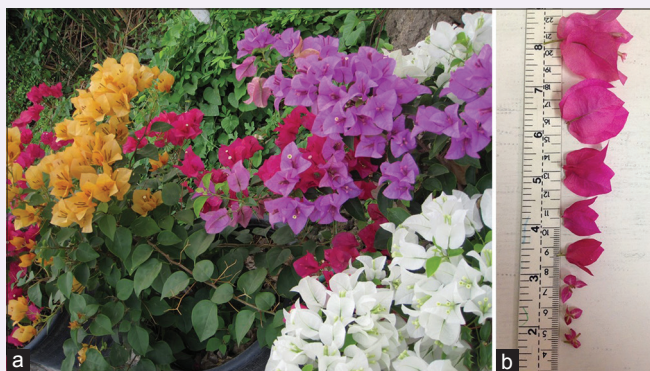
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**Figure 1:** Variety color (a) and size (b) of *Bougainvillea* spp. Flowers

*Bougainvillea stipitata*, and *Bougainvillea trollii*. The important species in horticulture are *B. spectabilis*, *B. glabra*, and *B. peruviana*.<sup>[22,23]</sup>

## NOMENCLATURE

*B. spectabilis* is a native plant of South America, and it is popular in South America, Asia, Africa, and other areas that spread throughout the tropical and warm climates.<sup>[24]</sup> The vernacular name of *B. spectabilis* is known as Great *Bougainvillea*, paper flower (English); Bagan Bilash (Bengali); mao bao jin, jiu chong ge, san jiao hua, ye zi hua (Chinese); bougainvillier (French), booganbel (Hindi); buganvillea (Italian); buganvil, kembang kertas, bunga kertas (Indonesian); felila (Japanese); bougainvillea (Konkani); buganvil, buginvila, pokok bunga kertas (Malay); Cherei (Manipuri); buganvilla, veranera (Spanish); bugambilia, bogambilya (Tagalog); kagithala puvvu (Telugu); fuang fah (Thai); and hoa giay, bong giay (Vietnamese).<sup>[18]</sup>

## PHYTOCHEMICAL SUBSTANCES

The phytochemical substances that are extracted from stem, flowers, and leaves of *B. spectabilis* are alkaloid, flavonoids, furanoids, glycosides, phenols, phlobotannins, quinones, saponins, steroids, tannins, and terpenoids.<sup>[25]</sup> The other active constituents are bougainvinones peltogynoids,<sup>[26]</sup> essential oils including methyl salicylate, terpinolene,  $\alpha$ -(E)-ionone,<sup>[27]</sup> pinitol,  $\beta$ -sitosterol, quercetin, and quercetin-3-O-rutinoside.<sup>[28,29]</sup> In addition, the phytochemical constituents of *B. spectabilis* leaf extract revealed that tannins (27.64%), saponins (14.08%), glycosides (11.49%), flavonoids (10.05%), alkaloids (4.10%), phytate (49.27%), and oxalate (27.65%) contents are present.<sup>[30]</sup>

## TRADITIONAL USES

From review literature regarding the traditional uses or phytochemical properties of *B. spectabilis* are antibacterial,<sup>[31-33]</sup> anticancer,<sup>[34]</sup> antidiabetic,<sup>[35-37]</sup> antifertility,<sup>[38-40]</sup> antifungal,<sup>[41]</sup> anti-inflammatory,<sup>[42,43]</sup> antihyperlipidemic,<sup>[23,44]</sup> antioxidant,<sup>[45-47]</sup> antiulcer,<sup>[48]</sup> antiviral,<sup>[49,50]</sup> hepatoprotective,<sup>[51]</sup> and thrombolytic activities.<sup>[52]</sup>

## ANTIFERTILITY PROPERTY OF BOUGAINVILLEA SPECTABILIS

Mishra *et al.*<sup>[38]</sup> evaluated the effect of the 800 mg/kg/day of oral administration of *B. spectabilis* leaves on reproductive organs and fertility of male and female Swiss albino mice for 30 days. They reported that this plant can reduce the caudal epididymal sperm count from  $5.05 \times 10^6$  per ml in the control group to  $0.65 \times 10^6$  per ml in the treatment group (87.13%). From histology study, this plant

treatment revealed the reduction in the size of seminiferous tubules along with the thickness of germinal epithelial cells and the hypertrophy of interstitial cells of Leydig. Moreover, the lumen of the tubules was found to be devoid of sperms. In female, it disrupted the estrous cycle, prolonged metestrus phase from 10.6 h in the control group to 25.0 h in the treated group. The most significant change has been due to 145.28% increase in metestrus phase along with 75.44% in estrus and 11.43% in diestrus phase. Both hormones, testosterone and estrogen levels were significantly decreased. In the same dosage Hembrom *et al.*<sup>[40]</sup> evaluated the effect of 800 mg/kg/day of oral administration of *B. spectabilis* leaves on the fertility of male Swiss albino mice for 50 days. They reported that the anodic protein concentration was a significant increase in seminal plasma from cauda epididymis compared to the control group. This mechanism may increase more negative charges on the sperm surface membrane that might inhibit the capacitation and fertilization of the sperm. The other mechanism of this plant is to increase the M-isozymes of lactate dehydrogenase from 3.31 units/ml/h in the control group to 5.68 units/ml/h in the treatment group. The tissue is shifted from aerobic to anaerobic respiration, made pyruvate changed into lactate in the seminal plasma, and undesirably disturbs the sperm activity in the epididymis. Moreover, Ikpeme *et al.*<sup>[30]</sup> studied the effect of 65 days consumed of various concentrations (150, 300, 450, and 600 mg/kg/day) of *B. spectabilis* leaves on reproductive organs and fertility of male rats. They reported the significant reduction in the sperm count ( $9.38 \times 10^6$  per ml in control group to  $6.76 \times 10^6$  per ml in treatment group), viability (86.55% in control group to 63.91% in treatment group), and motility (65.75% in control group to 42.75% in treatment group). They also reported the highest dose group (600 mg/kg/day) showed the highest abnormalities of sperm (8.75%) compare to that of control (2.75%), and the testes weight was significantly reduced from 1.38 g in control to 1.10 g. From literature reviews, they were revealed that the antifertility property of this plant was from the various phytochemical substances such as saponins<sup>[53]</sup> and alkaloids.<sup>[54]</sup> The antifertility property of this plant was not only reported in research studies but also in the several review articles.<sup>[55-60]</sup>

## CONCLUSION

The antifertility property of *B. spectabilis* has inhibited the spermatogenic pathways that lead to decrease the number, motility, and viability of sperm. It also affects female by disrupting the estrous cycle. This plant also decreases both the sex hormones: testosterone and estrogen. This review article has attempted to compile the new medicinal plant *B. spectabilis*, to be one of the choices in the fertility regulation.

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## Conflicts of interest

There are no conflicts of interest.

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