CHAPTER II

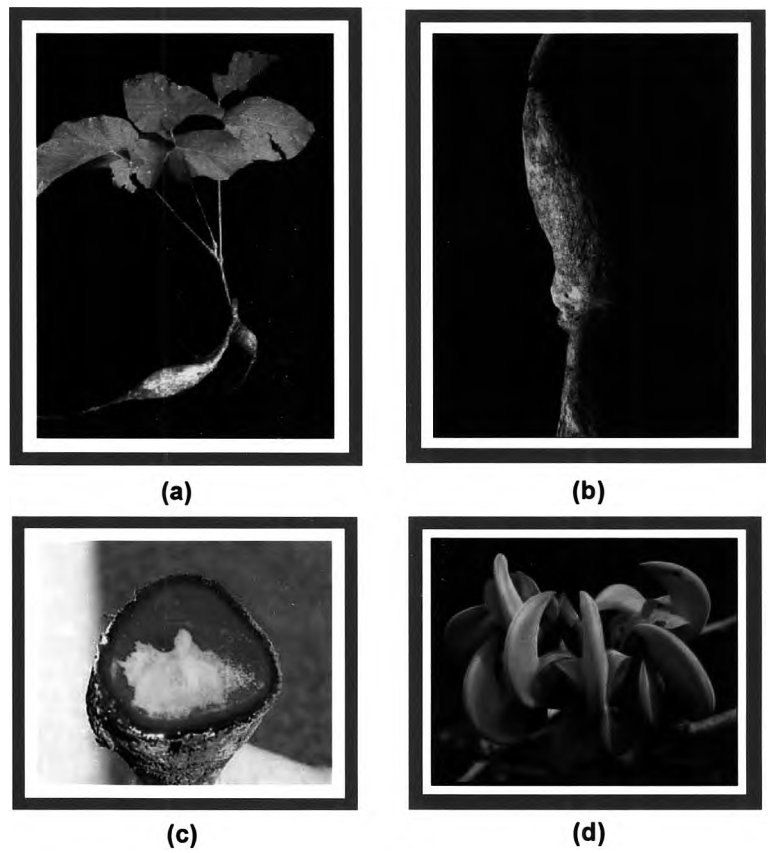
LITERATURE REVIEW

2. The red Kwao Krua (*B. superba* Roxb.)

B. superba Roxb. is one of the well-known Kwao Krua plant in Thailand, with the common name of "red Kwao Krua". The plant had been referred in the pamphlet as rejuvenating traditional medicines for man. The tuberous root and stem of *B. superba* are used traditional medicines for mature people and are believed that it could help strength, power and increase the male sexual performance. Thus, it is medicinal herb that known as one type of miracle herb **[3, 4]**.

2.1 The botanical characteristics of *B. superba* Roxb.

B. superba Roxb. is a plant in the Family Leguminosae with local names of Kwao Krua, Jan Krua, Tan Jom Thong and Thong Krua **[5]**. The botanical characteristics of *B. superba* Roxb. are climbing plant that grows as independence, and wrapping it's around large trees. One branch have three leaves, the flowers are a yellowish orange color and open within the winter to summer. An oblong pod has 3 to 4 inches long, that it has silvery down and has only one seed inside. The roots of the mature plant are 8 to 9 inches long, before they turn into tubers in the tubular shape. On cutting, the tuberous roots release red sap. In reproduction, it can reproduce through seeds and stem cutting. This plant is often found in the mountains in the Northern, Eastern and North-eastern part of Thailand. The pictures of tuberous roots, tree, leaves and flowers of *B. super*ba Roxb. are shown in Figure 1.



Plant (a), Tuber (b), Tuber cross section (c) and Flower (d)

Figure 1 red Kwao Krua (*B. Superba* Roxb.)

2.2 Hierarchical position of the Genus *Butea* [6]

Regnum ***Plantae***

common name: The plant kingdom

Division ***Magnoliophyta*** Cronquist

syn. *Angiospermophyta / Anthophyta*

common name: *Angiosperms*

Subdivision ***Magnoliophytina*** Frohne & U. Jensen ex Reveal

common name: *Angiosperms*

Classis ***Rosopsida*** Batsch

Subclassis ***Rosidae*** Takht.

SuperOrdo ***Fabanae*** R. Dahlgren ex Reveal

Ordo ***Fabales*** Bromhead

common name: *legumes*

Familia ***Leguminosae*** Juss.

Genus ***Butea Roxb.*** ex Willd.

common name: *butea*

Specie ***Butea superba*** Roxb.

common name: *red kwao krua*

2.3 Previous works of the genus *Butea*

In 1969, Razdan and coworkers **[7]** investigated the anti-fertility effects and pharmacological actions from seed extracts of *Betea fronosa*; an alcoholic extract, chloroform extract and an aqueous extract. They found that only the alcohol extract is active. It has a distinct anti-fertility effect in rats but without a clear-cut of dose-response relationship. Estrous cycle was unaffected by the extracts. Differences between controls and treated groups were insignificant regarding anti-estrogenic activity and androgenic activity. Pharmacological and toxic effects are probably unrelated to the anti-fertility action of the extract.

In 1983, Mehta and coworkers **[8]** studies isolation and in *vitro* antimicrobial efficiency from seed's oil in *Butea monosperma* on human pathogenic bacteria and phytopathogenic fungi. The in *vitro* antimicrobial efficiency was studied by the filter paper disk method against several human pathogenic bacteria and fungi. Result showed that the oil given a significant bactericidal and fungicidal effect.

In 1986, Bhargava **[9]** isolated butin from seeds of *Butea monosperma* and administered orally to adult female rats at the doses of 5, 10 and 20 mg/rat from day 1 to day 5 of pregnancy showed anti-implantation activity in 40%, 70% and 90% of the treated animals, respectively. Besides, butin showed a weak estrogen.

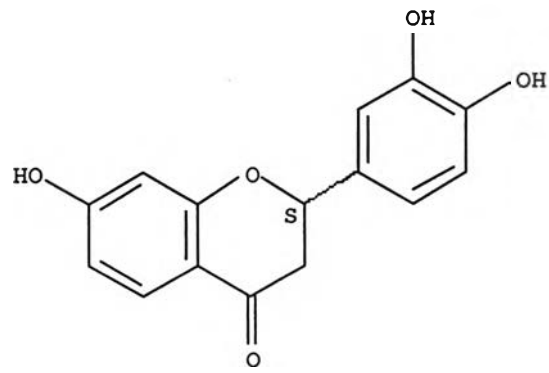


Figure 2 Structure of Butin from seeds of *Butea monosperma*

In 1989, Bandara and coworker **[10]** isolated the petroleum and ethyl acetate crude extracts from stem barks of *Butea monosperma*. They found medicarpin compound that it showed significant antifungal activity against *Cladosporium cladosporioides*.

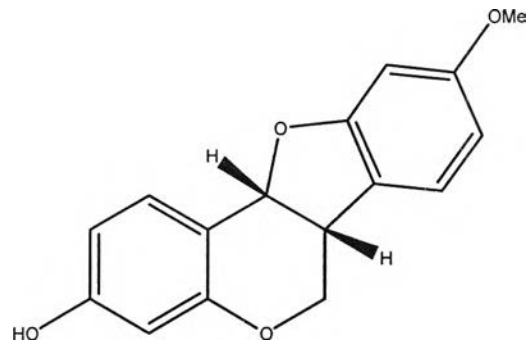


Figure 3 Structure of Medicarpin from stem barks of *Butea monosperma*

In 2001, Prashanth and coworker **[11]** investigated the methanol extract from seeds of *Butea monosperma* in India, tested in *vitro*, showed significantly anthelmintic activity.

In 2004, Soman and coworker **[12]** studies effect from the leave extract of *Butea frondosa* on stress, anxiety, and cognition in rats. The results showed that the aqueous and the alcoholic extracts of the leaves from *B. frondosa* possess anti-stress activity. In the same year, Ramachandran and coworker **[13]** investigated the aphrodisiac activity of bark extract from *B. frondonsa* in male rats. They report that the extract can reduced and increased significantly on the aphrodisiac activity in male rats.

In 2005, Yadava and Tiwari **[14]** found a potential antiviral flavone glycoside, which has been isolated from seeds of *Butea monosperma* O. Kuntz, its structure determined as 5,2′-dihydroxy-3,6,7-trimethoxyflavone-5-*O*-β-D-xylopyranosyl-(1→4)

-*O*-β-D-glucopyranoside **(1)** by various spectral analysis and chemical degradations. In the same year, Gunakkunru and coworkers **[15]** investigated the anti-diarrhea potential of the ethanol extract from stem barks of *Butea monosperma* (Lam) Kuntz, and that evaluated using several experimental models in Wistar albino rats. The results obtained establish the efficacy and substantiate the use of this herbal remedy as a non-specific treatment for diarrhea in folk medicine. Besides, Sumitra and coworkers **[16]** investigated an alcoholic extract from stem barks of *B. monosperma* (Lam) Kuntz for healing as a fundamental response to tissue injury in rats. The results showed that *B. monosperma* possesses antioxidant properties, by its ability to reduce lipid peroxidation. The results clearly substantiate the beneficial effects of the topical application of *B. monosperma* in the acceleration of wound healing.

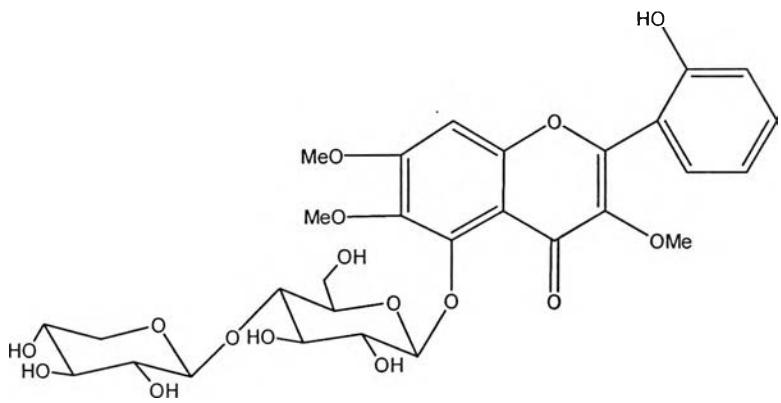


Figure 4 Structure of 5,2′-dihydroxy-3,6,7-trimethoxyflavone-5-*O*-β-D-xylopyranosyl-(1→4)-*O*-β-D-glucopyranoside from stem barks of *Butea monosperma*

2.4 Previous works of *B. superba* Roxb.

In 1995, Ruksilp **[17]** investigated the tuberous root of *B. superba* Roxb. collected from Lampang province. It was finely crushed and extracted with hexane, chloroform, methanol and water. The fraction of crude extracts by column chromatography led to the isolation of five compounds. These compounds were

a mixture of carboxylic acids (C_{22}-C_{26}) **(1)**, mixture of steroids (campesterol, stigmasterol and *β*-sitosterol) **(2)**, mixture of steroid glycosides (*β*-sitosterol-3-*O*-β-D-glycopyranoside and Stigmateryl-3-*O*-β-D- glycopyranoside) **(3)**, 3,7,3′-trihydrox-4′-methoxyflavone **(4)** and 3,5′-dihidroxy-4′-methoxyflavone-7-*O*-β-D-glycopyranoside **(5)**. In 2000, Roengsumran and coworkers **[18]** found two compounds, 3,7,3′-trihydrox-4′-methoxyflavone **(4)** and 3,5′-dihidroxy-4′-ethoxyflavone-7-*O*-β-D-glycopyranoside **(5)**, which they also showed inhibition of cAMP phosphodiesterase activity at IC_{50} value of 190 and 58 μg/ml, respectively, which were capable of stimulating the function of the central nervous system.

In 1998, Yadava RN and Reddy KI **[19]** discovered a new bio-active flavonol glycoside, 3,5,7,3′,4′-pentahydroxy-8-methoxy-flavonol-3-*O*-β-D-xylopyranosyl(1→2) -α-L-rhamnopyranoside **(1)**, which it was isolated from stem barks of *B. superba* Roxb.. This compound showed antimicrobial activity against plant pathogenic fungi *Trich viride*, *Asprgillus fumigatus*, *A. niger*, *A. terreus*, *Penicillium expansum*, *Helmitnhosporium oryzae*, *Botxitis cinerea*, *Rhizopus oligosporus*, *R. chinensis*, *Kelbsiella pneumoniae*, *Fusearium moniliforme* and gram-positive bacteria *Streplococcus pyogenes*, *Staphylococcus aureus*, *Bacillus subtilis* gram-negative bacteria *Escherichia coli*, *Proteus vulgaris*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*. The maximum inhibitory effect was shown by *H. oryzae*, *A. niger*, *B. cinera* and gram-positive bacteria.

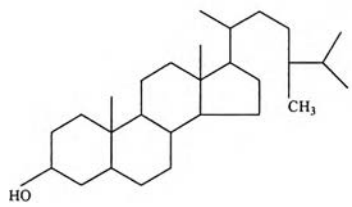
In 2002, Pongpanparadon and coworkers **[20]** studied to determine the primary toxicological effects of *B. superba* Roxb. Dried powder by micronucleus and dominant lethal tests was undertaken. The results showed that 1,000 mg/kg/day of aqueous solution was significantly more effective in inducing the formation of micronuclei in polychromatic erythrocytes than the control (p<0.01). The *B. superba* Roxb solutions had no effect on the body weights of the treated rats. In the same year, Boongapim **[21]** assess the vasodilating effect and mode of action of ethanol extract from *B. superba*

Roxb., isolated human umbilical vein was used. The results showed inhibitory effect of *B. superba* Roxb. extract on KCl (high concentration) and histamine-induced vascular contraction. Moreover, the inhibitory effect showed time and concentration-dependent manner, and it was related endothelium function. Suwansatien **[22]** studied the testability of acute toxicity from *B. superba* Roxb. extract, *Aedes aegypti* larvae and *Culex quinquefasciatus* larvae were used. The result showed preliminary data, which was useful for selection of alternative bio-pesticides to use instead of chemical insecticides.

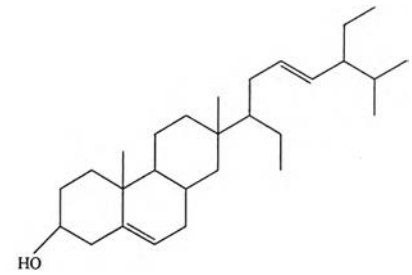
In 2003, Ingkaninan and coworkers **[23]** searched new acetylcholinesterase (AChE) inhibitor from 32 plants that used in Thai traditional rejuvenating and neurotonic remedies, as a drug for the symptomatic treatment of Alzheimer's disease. They reported that the methanol extract from stem barks of *B. superba* Roxb. showed 50–65% inhibitory activity on AChE. In the same year, Cherdshewasart and Nimsakul **[24]** study the effect of *B. superba* Roxb. on erectile dysfunction (ED) in Thai males, 3 month randomized double-blind clinical trial was carried out in volunteers with ED, aged 30-70 years. The result showed that 82.4% of the patients exhibited noticeable improvement, which it had obtained to improve the erectile function in ED patients and no apparent toxicity.

In 2004, Cherdshewasart, Cheewasopit and Picha **[25]** investigated ethanol extract of *B. superba* Roxb with proliferation and an anti-proliferation effect on the growth of MCF-7 cells at 10, 100 and 1000 μg/ml with an ED_{50} value of 370.91μg/ml, which was evaluated after 4 days of incubation. So, these results had been showing to relation with a possible anti-estrogen mechanism or a potent cytotoxic effect.

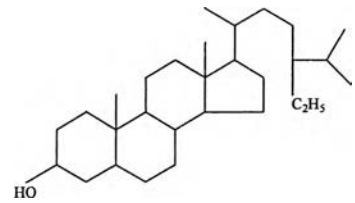
Steroids and Steroid glycosides group [17]



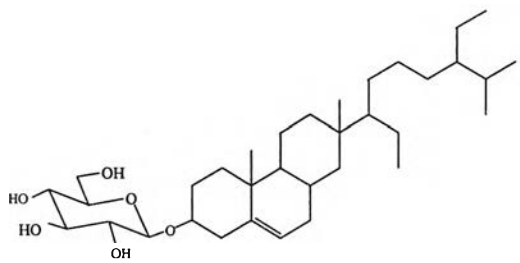
Campesterol



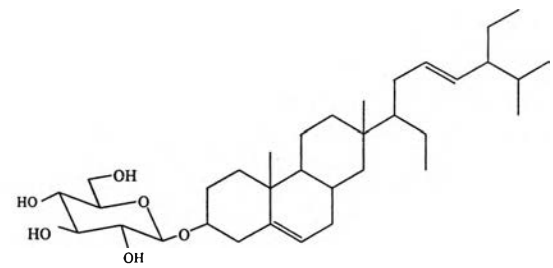
Stigmasterol



β-sitosterol



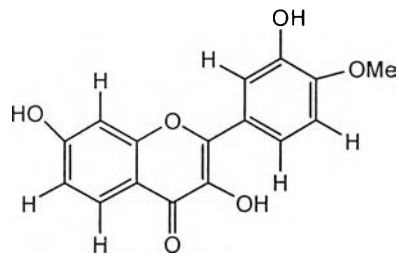
β-sitosterol-3-*O*-β-D-glycopyranoside



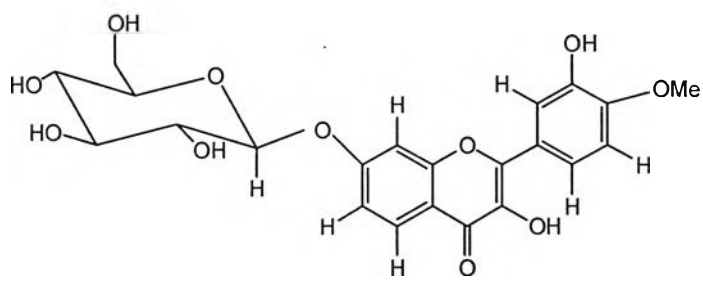
Stigmateryl-3-*O*-β-D-glycopyranoside

Figure 5 Structure of the chemical constituents of *Butea superba* Roxb.

Flavonoid and Flavonoid glycoside [17]



3,7,3′-trihydroxy-4′-methoxyflavone



3,3′-dihydroxy-4′-methoxyflavone-7-*O*-β-D-glycopyranoside

Figure 5 Structure of the chemical constituents of *Butea superba* Roxb. (Continued)