JPSCR: *Journal of Pharmaceutical Science and Clinical Research*, **2022**, *01*, 01-14
DOI: 10.20961/jpscr.v7i1.52244

Sterqulia quadrifida R.Br: A Comprehensive Review of Ethnobotany, Phytochemistry, Pharmacology and Toxicology

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Received 21 June 2021, Accepted 01 December 2021, Published 15 March 2022

Abstract: *Sterculia quadrifida*, R.Br. is one of the plants that grows on the mainland of Timor, East Nusa Tenggra. *Sterculia quadrifida*, R.Br. commonly known as Peanut tree in English and *faloak* in Indonesian has various pharmacological activities and has been widely used in traditional medicine. This review article aimed to provide a comprehensive overview of the potential of the *faloak* plant as an herbal medicine by looking at various aspects such as ethnobotany, phytochemicals, pharmacology and toxicity. Literature searches are carried out in scientific databases that are accepted worldwide such as ScienceDirect, Scopus, PubMed, Springer Link, Wiley Online Library and advanced searches on Google scholars, books, abstracts, theses, scientific reports, and several non-impact and non-indexed journals with the search keywords "*Sterculia quadrifida*" or "Peanut tree" or "Red fruit kurajong" or "*Faloak*". From the various literature that has been collected, *faloak* has been shown to have pharmacological activities such as anticancer, antioxidant, antifungal, immunomodulatory, antiviral, antibacterial, antidiabetic, and antipyretic. The existence of this activity cannot be separated from the chemical compounds contained therein such as flavonoids, alkaloids, terpenoids, phenols, tannins and saponins. *Faloak* also has low toxicity with LD_{50}> 5000 mg/kg body weight rats.

Keywords: ethnobotany; pharmacology; phytochemistry; *Sterculia quadrifida*, R.Br; toxicity

1. Introduction

Indonesia is a country that has the largest number of plant species in the world where 7.500 of the 30.000 plants are known to have potential as medicinal plants (Rollando *et al*., 2020). *Sterculia quadrifida*, R.Br. is one of the plants that grows on the mainland of Timor, East Nusa Tenggra. *Sterculia quadrifida*, R.Br. commonly known as Peanut tree in English and *faloak* in Indonesian has various pharmacological activities and has been widely used in traditional medicine. In general, the bark of *faloak* becomes the most commonly used part of the plant in medicine by East Nusa Tenggara people. *Faloak* bark is believed to cure various diseases such as hepatitis, diabetes and indigestion. *Faloak* bark contains natural antioxidant compounds, namely flavonoids and phenolic compounds that can protect the body from free radical attacks (Siswadi *et al*., 2013).

Various studies related to this species have been carried out. Due to the widespread use of *Sterculia quadrifida* for the treatment of various diseases in traditional medicine systems, so the desired benefits need to be critically evaluated. Therefore, this review comprehensively examines the potential of *faloak* as a traditional medicine in terms of ethnobotany, phytochemical, pharmacological activity and toxicity. The information that has been collected is expected to be useful for future research related to *faloak*.

2. Material and Methods

Literature searches were conducted in scientific databases accepted worldwide such as ScienceDirect, Scopus, PubMed, Springer Link, Wiley Online Library, and advanced searches on Google scholar as well as recognized books, theses, abstracts, scientific reports, and several nonimpact and nonindexed journals. The search strings used were "*Sterculia quadrifida*" or "Peanut tree" or "Red fruit kurajong" or "*Faloak*." Further relevant literatures were searched in these databases and selected those with a period of 10 years both in English and Indonesian.

3. Result and Discussion

The authors have studied more than 50 full papers and a total of 42 peer-reviewed papers focusing on ethnobotany aspects (ecology and distribution, plant morphology, habitat, taxonomic classification, vernacular names, propagation, and traditional use), phytochemical, pharmacological activities (anticancer, antioxidant, antifungal, immunomodulatory, antiviral, antibacterial, antidiabetic, and antipyretic) as well as their toxicity effects were selected for this review. This review is useful for improving advanced knowledge of the therapeutic effects of *faloak* and improving future pre-clinical and clinical research plans.

3.1. Ethnobotany aspect

Ethnobotany aspects discussed in this review include the ecology and distribution of *faloak* plants, morphology, habitat, taxonomic classification, vernacular names, propagation, and traditional use by the community.

3.1.1. Ecology and distribution

Sterculia quadrifida comes from Australia and spreads from northeastern New South Wales, to Queensland to Papua New Guinea and the Northern Territory, as well as Western Australia. Aboriginal people use *faloak* leaves to treat wounds and stings, canker sores, skin problems, and eye pain. While the seeds are used as food and the bark is used for weaving baskets and other products. The inner bark of this tree is also widely used to make ropes, nets and fishing ropes. In Indonesia, *faloak* can be found in East Nusa Tenggara, while in Timor island the distribution includes the districts of Belu, South Central Timor, North Central Timor, Kupang and Kupang City as many as 6.92 trees/hectare. Data collected from 2 populations of *faloak* trees, namely Hambala and Kanatang, were 6.2 trees/hectare, while in Alor Regency,

faloak was found on Pantar Island as many as 4.68 trees/hectare. The optimal growth of *faloak* occurs at an altitude of 0-450 masl, but can still be found at an altitude of 889 masl in Netpala Village, South Central Timor regency (Siswadi, 2015). The most potential *faloak* is found in Timor Island, which is spread from Belu Regency and West Timor Island / City and Kupang Regency (Siswadi *et al*., 2015). The most widely used part of the *faloak* tree is its bark, mainly to treat liver disease. In the market, *faloak* is sold for IDR 1,600/piece. The traders also sell *faloak* skin mixed with other simplicia at a price of IDR 5,000/can (Siswadi *et al*., 2016).

3.1.2. Morphology

Faloak tree can reach a height of up to 15 m or more, the crown is spread out, the bark is light gray, and secretes lymph when it is split. The flowering season is between April-June and the fruiting season is between June-October each year. The leaves are dark green and have an oval shape with a length of 5-12 cm and a width of 4-8 cm. The fruit has an oval shape like a star on the outer surface, yellow, red or orange in adulthood (Siswadi, 2015). The seeds are ellipsoid-shaped about 10 mm and covered with a thin black epidermis. When it is ripening, the *faloak* seeds are protected by the green skin of the fruit. After the flowering period ends at the age of 3-4 months the fruit skin will turn orange, which will then turn brown after 1-3 weeks later which indicates the seeds are old and the fruit skin opens into two parts. In one fruit there are usually between 4-8 seeds wrapped by a layer of black epidermis, with the position of the seeds in the fruit lined up and sticking to the skin of the fruit, they will be easily peeled when the seeds are old. The seeds are edible and taste like raw nuts (Siswadi *et al*., 2012).

3.1.3. Habitat

Faloak is a small tree that grows in rainforest, scrubs, and gallery forests. *Faloak* that grows in semi-arid land at an altitude of 0-900 masl can reach a height of up to 20 m. The *faloak* tree (*Sterculia quadrifida*, R.Br.) is one of the plants known to East Nusa Tenggara people that grows wildly in forest areas and around settlements that grow on rocky soil (Soeharto & Tenda, 2018). The climatic and tread conditions in the East Nusa Tenggara region which are classified as semi arid are thought to exert pressure on *faloak* growth, thus potentially producing a large secondary metabolites (Siswadi *et al*., 2016).

3.1.4. Taxonomic classification

Kingdom : Plantae
Phylum : Tracheophyta
Class : Magnoliopsida
Subclass : Sterculioideae
Order : Malvales
Family : Malvaceae

Genus : Sterculia L.

Species : *Sterculia quadrifida*, R.Br. (1844) (Siswadi *et al*., 2013)

3.1.5. Vernacular names

Sterculia quadrifida, R.Br. known by various names such as Peanut Tree (UK), Red-Fruit Kurajong (Australia), *Kuman*, and *Komila* (Timor Leste). In addition, this plant also has several local names, namely *Faloak* (Kupang), *Nitaen* or *Mitaen* (Belu), *Flolo* (North Central Timor), *Kawarid* (Central Sumba), *Penil* (Alor), *Ago* (Doromeli Village, Flores), *Klengis* or *Slengit* (East Flores), *Bangilan* (Manado), *Mangiladu* (Gorontalo), *Kalimana Olimana* (Tobelo), *Kaita* (Maluku), *Lahea* (Mangas Island), *Pani Wood* (Buru Island), and *Susulangit* (Seram Island) (Siswadi & Saragih, 2017).

3.1.6. Propagation

Sterculia quadrifida can be propagated generatively by seed. The results revealed that pretreatment or scarification of *Sterculia quadrifida* seeds was needed to increase the rate of germination. In the planting process, the most suitable medium for planting *Sterculia quadrifida* seedlings is a combination medium of black soil (grumusol), sand, and manure with a ratio of 1:1:1 (Siswadi *et al*., 2012). In addition, S*terculia quadrifida* can also be propagated by vegetative methods (shoot cuttings, stems and pruning gardens), but the vegetative development success is still low. *Faloak* has a hypogeal germination type and the scarification process can be done by soaking the seeds in cold water for 12 hours (Siswadi *et al*., 2013).

3.1.7. Traditional use

Traditionally, bark and roots extracts of *Sterculia quadrifida* have been commonly used to treat various diseases such as diabetes, liver and cancer (Lulan *et al*., 2018). Meanwhile, based on a survey conducted on people in East Nusa Tenggara, *Faloak* is most commonly used for the treatment of liver dysfunction (55%), stamina recovery (13%), treating back pain (7%), ulcers (7%), lumbago (6%), malaria (6%), and blood purifiers (6%) (Siswadi *et al*., 2016). The harvesting technique carried out by the community is by slicing or peeling tree bark with certain dimensions or sizes, then drying and boiling it using water. Some of the boiling processes use pure *faloak* stem bark, but some also use a mixture of other ingredients such as garlic, onion, turmeric, lemongrass, sand ginger, and cinnamon (Siswadi *et al*., 2015).

3.2. Phytochemical review

Faloak can be used in traditional medicine because it contains various secondary metabolites compounds such as terpenes, alkaloids, flavonoids, phenols, and tannins (Dillak *et al*., 2019). Flavonoids, terpenoids, alkaloids, phenolics and steroids have also been reported in other species of the genus Sterculia. Some other chemical elements that have also been reported from the Sterculia genus plant are sitosterol and betulinic acid from *Sterculia striata* isolates,

sterculinine I and sterculinine II from *Sterculia lychnophora* isolates, and 1,6-diferuloyl glucose from *Sterculia foetida* isolates (Sola & Hafid, 2018).

3.2.1. Alkaloid

The preliminary test results of chloroform extract of *faloak* bark showed a positive content of alkaloid compounds indicated by the presence of a white precipitate after being given Mayer's reagent. The separation results using PTLC were obtained by one fraction which was expressed as a single compound after being identified by two dimensional TLC which was suspected as an alkaloid compound. The results of the analysis by UV Spectrophotometry indicate the presence of I band at a wavelength of λ max 263,30 nm indicating the presence of a conjugated double bond which is thought to be an alkaloid compound (Firawati & Hidayat, 2017).

3.2.2. Flavonoid

Almost various studies that have been conducted have shown that *faloak* contains flavonoid compounds. *Faloak* bark contains natural antioxidant compounds, namely flavonoids and phenolic compounds that can protect the body from free radical attacks (Siswadi *et al*., 2013). Methanol extract of *S. quadrifida* showed a total flavonoid content of 661.85 mg equivalent to quercetin per 100 g extract and showed a high total phenolic content of 116.84 mg equivalent to gallic acid per 100 g extract (Lulan *et al*., 2018). Phytochemical screening on 70% ethanol extract showed that the plant parts of roots, bark, stems, leaves, fruits, and seeds contained flavonoid compounds. The highest total flavonoids were found in the bark of 62.76 mg/g, while the lowest was found in seeds (1.55 mg/g). Total flavonoids in the leaves and fruit are in the range of 11-12 mg/g (Dillak *et al*., 2019). Other studies also showed that the total flavonoids of 96% ethanol extract of *faloak* bark were 3.60 ± 0.35 mg QE/g sample (Munawaroh *et al*., 2018). While the water extract of *faloak* bark contains flavonoids in the form of epicatechin 875 mg/kg which is soluble in water and can be an antiviral candidate against HCV JFH1 (Dean *et al*., 2019).

3.2.3. Terpenoid

The presence of terpenoid compounds in *faloak* bark can be detected in four fractions namely acetone, ether, ethyl acetate, and hexane fractions (Siswadi *et al*., 2013). Terpenoids are formed from aisonapra and serve as plant protectors against insects. One class of terpenoids that act as antimicrobials are triterpenoids which are widely used to treat skin disorders, antifugus, insecticide, antibacterial and antiviral. Triterpenoids were at least selected into four groups including triterpane, steroids, glycosides and saponins (Robinson, 1995).

3.2.4. Phenolic

Phytochemical screening of ethanol extract 70% *faloak* showed that the plant parts of the roots, bark, leaves, fruit, and seeds contained phenolic compounds. The highest phenol (82.90 mg/g) is found in the roots, while the smallest phenol is in the seeds (2.89 mg/g) (Dillak *et al*., 2019). The water fraction of the *faloak* bark metanolic extract has a total phenolic content of 6.97 ± 0.17 mg gallic acid equivalent per gram (Rollando & Monica, 2018). Fraction 2 has the largest total phenolic content of all fractions (34.16 ± 0.76 mg GAE) and has the highest antioxidant activity (Susanto, 2019). In addition to the previously mentioned compounds, the results of isolation of the active compounds from the *faloak* bark (*Sterculia quadrifida*, R.Br.) obtained three isolates which are derivates from gallic acid which have activity as antibiofilms (Rollando, 2017). Scopoletin is a phenolic compound that belongs to the coumarin compounds and is present in the most active fractions, namely hexane and ethyl acetate fractions where this compound is responsible for increasing the phagocytic activity of macrophages (Munawaroh *et al*., 2020).

3.2.5. Tannin

Tannins are one of the active compounds of secondary metabolites of the polyphenol group produced by plants. Tannin compounds are found in almost all parts of the faloak plant. Phytochemical screening of ethanol extract 70% *faloak* showed that parts of plants such as roots, barks, leaves, and fruits contained tannin compounds. The highest tannins (71.26 mg/g) were found in the roots while the smallest tannins were in the leaves (10.52 mg/g) (Dillak *et al*., 2019).

3.2.6. Saponin

Saponin is a glycoside, which is a mixture of simple carbohydrates and aglycones found in various plants. Several studies have shown the presence of saponin compounds in faloak plants. Based on the results of phytochemical screening, saponin compounds have been found in faloak simplicia powder (Ranta, 2011). In addition, the identification results also showed the presence of high levels of saponin compounds in ethanolic extract and methanol extract of faloak bark (Nitbani *et al.*, 2019; Saefudin *et al*., 2013).

3.2.7. Quinones

Naphtoquinone is one of the quinone compounds that have been isolated from faloak plants. The successfully isolated naphthoquinones derivative is kaempferol 3,4'-dixylide from water extract, 2-iminoethyl 2-(2-(1-hydroxypentan-2-yl)phenyl) acetate from ethyl acetate fraction of *faloak* bark and 2,3-dihydro-6-hydroxy-2-methylenenaphtho[1,2-b] furan -4.5-dione from 96% ethanol extract (Moi Sola, 2019; Rollando *et al*., 2018; Rollando & Prilianti, 2017).

3.2.8. Fatty Acid

Based on the measurements of H-NMR and C-NMR, it is suspected that the bioactive compounds in faloak seeds are derivatives of hydrolylated fatty acids. The results of *faloak* isolation was also found the presence of 3-hydroxyoctadecanoic acid compound which has antifungal properties against *C. albicans* (Ranta *et al*., 2012).

3.3. Pharmacological studies

Widely reported research on *faloak* is also associated with the potential of the bark as an antibacterial, antifungi, antitumor, antiviral and antioxidant agent. Plant extract studies of the genus Sterculia showed several biological activities such as antidiabetic activity of *S. villosa*, anti-inflammatory and anti-fertility activity of *S. foetida*, larvicidal activity of *S. guttata*, and antiproliferative activity of *S. tavia* (Lulan *et al*., 2018).

3.3.1. Antioxidant activity

Various studies have been conducted to look at the antioxidant activity of the *faloak* plant. The ethanol extract of *faloak* bark (*S. quadrifida* R.Br.) tested with DPPH showed strong antioxidant activity with IC_{50} value of 4.81 ppm while vitamin C as a positive control had strong antioxidant activity with IC_{50} value of 3.49 ppm (Amin *et al*., 2016). Antioxidant activity is classified as very strong if IC_{50} value is <50 μg/mL, strong if IC_{50} value is 51-100 μg/mL, moderate if IC_{50} value is 101-150 μg/mL, and week if IC_{50} value is >150 μg/mL. The roots and bark of *faloak* are parts of plants that have very strong antioxidant activity with IC_{50} values of 20.55 ± 0.42 μg/ml and 14.17 ± 0.55 μg/ml, respectively (Dillak *et al*., 2019). The *faloak* root methanol extract showed radical scavenging activity against DPPH and ABTS IC_{50} values of 3.11 μg/mL and 7.29 μg/mL respectively (Lulan *et al*., 2018). *Faloak* bark methanol extract and water fraction of *Faloak* bark methanol extract were reported to have antioxidant activity against DPPH with IC_{50} 91.72% (Saefudin *et al*., 2013) and 45.63 ± 1.47 μg/mL (Rollando & Monica, 2018), and both were classified as very strong antioxidant activities. In addition, *faloak* leaf methanol extract has IC_{50} value of 69.19% and is classified as a strong antioxidant activity (Saefudin *et al*., 2013). The extracts obtained from newly regrown bark have higher antioxidant activity than other parts. The IC_{50} value of new regrowed bark (2.51 μg/ml) is even stronger than the IC_{50} value of vitamin C (4.74 μg/ml) (Saragih & Siswadi, 2019). The antioxidant activity of *S. quadrifida* is also stronger than other plants such as *Pterospermum reticulatum* (182 μg/ml) and *Pterospermum rubiginosum* (166 μg/ml) (Jacob & Sreejith, 2019). Groups of compounds that are suspected to be strong influence on antioxidant activity (free radical redction) are phenolic and flavonoids compounds (Leliqia *et al*., 2020).

However, the opposite happened in the testing of *faloak* bark which was made into instant drinks and tested for antioxidant activity with DPPH resulting IC_{50} values of 2,307.77 ppm ±

58.20 ppm or 2,249.57-2,365.97 ppm which indicates weak antioxidants (Soeharto & Tenda, 2018). The combination of instant *faloak* with ginger also showed weak antioxidant activity tested with DPPH resulting in IC_{50} 2,044.20 ppm ± 32.84 or 2,011.42-2,077.10 ppm (Tenda *et al*., 2019).

3.3.2. Anticancer activity

Anticancer activity is classified as very active if IC_{50} value is <5 μg/mL, active if IC_{50} value is 5-10 μg/mL, moderate if IC_{50} value is 11-30 μg/mL, and inactive if IC_{50} value is >30 μg/mL. The results showed that fraction 4 of ethanol extract of *faloak* bark had the potential to be an anticancer in moderate category with IC_{50} of 21.89 μg/mL in T47D cancer cells (Rollando & Siswadi, 2016). The result of isolation from *faloak* stem bark obtained isolate derivatives of naptoquinone compounds namely 2,3-dihydro-6-hydroxy-2-methylenenaphtho[1,2-b] furan -4.5-dione that has anticancer activity against T47D breast cancer cells with IC_{50} 9.88 μg/mL and a selectivity index value of 30.23 (Rollando & Alfanaar, 2017). Isolate compound 2-iminoethyl 2-(2-(1-hydroxypentan-2-yl)phenyl) acetate from ethyl acetate fraction had cytotoxic activity against T47D breast cancer cells with IC_{50} 7.12 μg/mL and selectivity index value of 47.53 (Rollando *et al*., 2018). Ethyl acetate fraction of 96% ethanol extract of *faloak* bark had the greatest cytotoxic activity against T47D breast cancer cells compared to hexane fraction and diethyl ether fraction with IC_{50} 24.88 μg/mL and selectivity index value of 15.58. Ethyl acetate fraction accumulated T47D breast cancer cells in the S phase (27.43%) and was able to induce apoptosis so that it could be developed as a chemotherapy agent in improving the effectiveness of breast cancer treatment (Rollando & Prilianti, 2017). Another study showed that the ethyl acetate fraction had the highest cytotoxic activity against T47D, MCF7 and HepG2 cells with IC_{50} of 9.56; 7.62 ; 3.24 μg/mL while the selectivity index was 2.01; 2.52; 5.94 respectively (Hertiani *et al*., 2019).

3.3.3. Antifungal activity

The results of *faloak* bark isolation was also found the presence of 3-hydroxyoctadecanoic acid compound which has anti-fungal properties against *C. albicans* (Ranta *et al*., 2012). Methanol extract: water (0.44:0.56) of *faloak* bark also showed antifungal activity against *C. albicans* fungus with inhibitory potential of 0.67 cm (Rollando *et al*., 2019).

3.3.4. Immunomodulatory activity

Decoction of *faloak* bark have been shown to have immunomodulatory activity *in vivo*, which can increase macrophage phagocytosis activity and nitric oxide production but cannot increase lymphocyte proliferation and production of IgG (Winanta *et al*., 2019). Water extract, ethanol extract, and ethanol-water extract significantly increased macrophage phagocytosis but had no effect on lymphocyte proliferation in vitro (Hertiani *et al*., 2019). Ethyl acetate fraction

at a concentration of 250 µg/mL is the active fraction of ethanolic extract of *Faloak* bark which has *in vitro* immunomodulatory activity of 51.94 ± 4.67% (Munawaroh *et al*., 2018). Scopoletin compounds were found in the most active fractions, namely the hexane and ethyl acetate fractions where these compounds are responsible for increasing the phagocytic activity of macrophages (Munawaroh *et al*., 2020).

3.3.5. Antivirus activity

Anti-Hepatitis C Virus (HCV) test results showed that water extracts, 70% ethanol extracts, and methanol extract were active against HCV with IC_{50} value of 6.06 µg/ml, 9.44 µg/ml, and 10.39 µg/ml, respectively. Fractionation of water extract as the most active extract produces seven fractions. Fractions 5 and 6 showed the highest activity with IC_{50} value of 7.60 µg/ml and 8.87 µg/ml, respectively. Furthermore, the cytotoxicity of these two active fractions did not show any toxicity with a value of CC_{50}> 2,000 µg/ml. Methanol extract, 70% ethanol extract, water extract, fraction 5, and fraction 6 aqueous extract of *faloak* bark have potential activity as anti-HCV (Sola *et al*., 2018). Another study on *faloak* bark water extract also had the inhibitory power of HCV genotype 2a strain JFH1 with an IC_{50} value of 11.57 µg/mL and the toxicity of *faloak* bark water extract in Huh7it cell hepatocytes of CC_{50} >1000 µg/mL. The mechanism action of *faloak* bark water extract is by inhibiting all stages of the HCV life cycle. The first stage is that the step entry has 93.97% inhibition, the post-entry step has 96.75% inhibition, and the combination step (entry and post-entry step) has 100% inhibition (Dean *et al*., 2019).

3.3.6. Antibacterial activity

Fraction 3 showed high antibacterial activity (IC_{50}) in *B. subtilis* (90.51 µg/mL), *E. coli* (80.12 µg/mL), *S.aureus* (77.87 µg/mL), and *S.thypi* (61.23 µg/mL) (Rollando, 2015). The results of the analysis of *faloak* bark ethanol extract at a concentration of 100% w/v were able to inhibit the growth of *Staphylococcus aureus* bacteria most effectively with an average diameter of the inhibition zone of 2.13 cm (Tenda *et al*., 2017). Inhibition test of biofilm formation showed isolates 1-3 had antibiofilm activity with minimum inhibitory concentration (MIC_{90}) of 100 µg/mL isolates. Isolate 1 has an IC_{50} of 46.87 µg/mL, isolate 2 has an IC_{50} of 45.87 µg/mL, and isolate 3 has an IC_{50} of 42.65 µg/mL (Rollando, 2017). The acetone extract of *faloak* showed antibacterial activity against *Staphylococcus aureus* and *Bacillus cereus* with inhibition zones of 15.17 mm and 16.17 mm, respectively (Ranta, 2011).

3.3.7. Antidiabetic activity

Ethanol extract of *faloak* bark at doses of 150 mg/kg body weight, 300 mg/kg body weight, 600 mg/kg body weight may affect blood glucose reduction in glucose-induced male white mice (Fernandez & Edel, 2017). Ethanol extract of *faloak* bark at a dose of 260 mg /kg

was able to reduce blood glucose levels by 46.07% in alloxan-induced wistar male rats and was no different from the comparison group (glibenkmalid). While the dose group of 65 mg/kg and 130 mg/kg reduced blood glucose by 26.32% and 38.09% respectively (Diki-Dongga *et al*., 2016).

3.3.8. Antipyretic activity

Ethanol extract of *faloak* bark at doses of 150 mg/kg and 300 mg/kg has activity comparable to paracetamol, while the dose of 600 mg/kg has more optimal antipyretic activity than paracetamol dose 1.3 mg/20 g body weight (Yuliani *et al*., 2016). Compounds that can act as antipyretics are flavonoids and tannins (Faizah *et al*., 2021). both compounds are found in faloak plants.

3.4. Toxicity

Acute toxicity tests have been conducted on male white rats Sprague-Dawley strain at doses of 40 mg/kg body weight, 200 mg/kg body weight, 1000 mg/kg body weight and 5000 mg/kg body weight. The results of observation for 24 hours no rats died, so the pseudo LD_{50} value of ethanol extract *faloak* bark was >5,000 mg/kg body weight. Observations continued for 14 days to observe the delayed toxic effects. Administration of ethanol extract *faloak* bark for 14 days was able to reduce ALT AST levels. Meanwhile, histopathological observations of rat liver showed the occurrence of liver cell necrosis at a treatment dose of 200-5000 mg/kg body weight (Siswadi & Saragih, 2018). Toxicity tests conducted on male wistar rats with standardized *faloak* bark ethanol extract at doses of 500 mg/kg body weight, 1000 mg/kg body weight, and 2000 mg/kg body weight showed that no deaths occurred after 14 days of treatment. In general, there were no significant changes in animal behavior, body weight, food and water consumption compared to the control group. Histological observations found no sign of toxicity in vital organs. The LD_{50} value obtained from the acute toxicity test results of *faloak* ethanol extract (*Sterculia quadrifida*, R.Br.) is higher than 2000 mg/kg body weight and is categorized as having a low toxicity level (Noviyanah *et al*., 2021).

4. Conclusion

This review is useful for improving advanced knowledge about the therapeutic effects of *Faloak* and improving future experimental and clinical research plans. *Faloak* has major chemical constituents such as flavonoids, alkaloids, terpenoids, phenols, tannins and saponins which are responsible for various pharmacological activities. Several studies on *faloak* both *in vitro* and *in vivo* have shown various potentials such as antibacterial, immunomodulator, antidiabetic, antiviral, anticancer, antifungal, antipyretic, and antioxidant agent. Several new chemical constituents isolated from *Sterculia quadrifida*, R.Br. also exhibits various biological activities. In addition, *Faloak* also has low toxicity with LD_{50} >5000 mg/kg body weight rats.

From various sources that have been collected, *faloak* has great potential as a traditional medicine and in the future, further evaluation can be carried out so that it can be developed into herbal products that can be utilized by the community at large.

Acknowledgement

The authors thanked the team from the faculty of pharmacy of Gadjah Mada University who have given suggestions and inputs in writing this review.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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