Folk Medicine, Pharmacological and Biological Activities

Protein extracted from *Alisma canaliculatum* by saline has a strong protective effect on the denaturation of α-chymotrypsin in solution. The protein was not hydrolyzed by α-chymotrypsin and was very weakly antigenic against rabbit serum (Woo and Seu, 1970).

Alisma orientalis has been reported to possess anti-allergic (Kubo *et al*., 1997) and anti-complementary (Matsuda *et al*., 1998) effects. The three polysaccharides (glucan and two acidic ones) isolated from *Alisma orientalis* exhibited significant reticuloendothelial system-potentiating activity as well a pronounced anti-complementary activity (Tomoda *et al*., 1993, 1994; Shimizu *et al*., 1994). In Chinese medicine, the plant is used as diuretic agent to remove dampness and promote water-metabolism in the body (Zhao *et al*.., 2008). The pharmacological studies of the plant revealed, not only the diuretic effect, but also activities of inhibition of renal stone formation, anti-cardiovascular disorder, hepatoprotective effect, and induced cell apoptosis (Zhou *et al*., 2010).

The inhibition of the formation of urinary calcium oxalate calculus (stone) by the ethyl acetate extract or the active constituents of *Alisma orientalis* has been reported (Cao *et al*.,

2003-2005; Gao and Hu, 2005; Wu *et al*., 2009; Liu and Yin, 2010).

The methanolic extract from the rhizome of *Alisma orientalis* was found to exhibit activity of nitric oxide production in lipopolysaccharide-activated macrophages (Matsuda *et al*., 1999).

Alisol and some other triterpenes, isolated from *Alisma orientalis* exhibited inhibitory activity *in vitro* on hepatitis B virus (Jiang *et al*., 2006). Alisol B showed significant cytoxicity (Lee *et al*., 2001). The methanolic extract of the plant showed hepatoprotective effects on non-alcoholic fatty liver disease (Hong *et al*., 2006). The hypocholesterolemic activity of alisol A, isolated from *Alisma orientalis* has been reported (Miyamoto *et al*., 1969). In decreasing order of potency, dietary alisol A 23,24-diacetate, alisol A 24-monoacetate, alisol C 23-monoacetate, alisol A, 23-*O*-methylalisaol A, 25 anhydroalisol A, and *epi*-alisol A showed hypocholesterolemic activity in rats (Imai *et al*., 1970).

Alismol inhibited contractile responses to angiotensin I in rabbit thoracic aorta strips (Yamahara *et al*., 1986). The study of alismol on calcium-induced contraction in the rabbit thoracic aorta suggested that it inhibited mainly calcins influx through a voltage-dependent calcins channel (Matsuda *et al*., 1987). It caused a sustained, though weak, antihypertensive action in rats, but did not significantly affect the plasma rennin activity, angiotensin-converting enzyme activity, or the level of aldosterone (Yamahara *et al*., 1989). Alisol B and its monoacetate inhibited contractions induced by 5-isoleucine-angiotensin, bradykinin and acetylcholine in isolated rat ileum (Yun *et al*., 1981). Sulfoorientalols a-d were found to inhibit the carbachol-induced contraction of isolated bladder smooth of guinea pig (Yoshikawa *et al*., 1994). Alisol B has been reported to prevent bone loss in mice (Lee *et al*., 2010).

Fang *et al*. (2005) reported that alisol B 23-acetate and *Alisma orientalis* extract can be used for reversing cancer cell multidrug resistance caused by P-glycoprotein over expression. Both alisol B 23-monoacetate and extracts have synergic effects with anticancer drugs as they can inhance the activity of tumor cells to anticancer drugs. Also, some other triterpenes isolated from the same species showed weak antitumor activity (Hu *et al*., 2008a). Some protostane triterpenoids of the plant may be developed as drug with immunosuppressive function (Zhang *et al*., 2009b). Alisol B has been reported as an antitumor (Law *et al*., 2010).

16-Ketoalisol A or 13,17-epoxyalisol A is useful for treatment of liver disorders (Kimura *et al*., 1992a). Alismalactone 23-acetate and alismaketone A-23-acetate were found to show inhibitory activity on the contractions induced by a high concentration of K^+ in isolated aortic strips from rats (Yoshikawa *et al*., 1997). Protostane-type terpenoids, isolated from *Alisma orientalis*, are inhibitory in experimental models of type I-IV allergies, and also inhibit nitric oxide production, and have a positive hypocholesterol effect, anti-complementary activities, and antinephretic action (Hur *et al*., 2007). The methanol extract of *Alisma orientalis* rhizomes and its major component alisol B-23acetate enhanced the activities of hepatic antioxidant enzymes (Hur *et al*., 2007). Medicines for regulating blood lipid and reducing plasma fibrin (Zhang *et al*., 2001) and for treating apocrine sweat gland bromhidrosis (Liu, 2001) contain *Alisma* species as one of their ingredients. Dried rhizomes of *Alisma orientalis* is traditionally used in China for diabetic treatment, as either single herb or component herbs in a traditional formula used for diabetes treatment. The *in vitro* investigation of the antidiabetic activity of the rhizomes of *Alisma orientalis* (Lau *et al*., 2008) provided scientific evidence to support traditional use of this herb.