

Mini Review

Progress of chemical components and biological activities of *Fructus Amomi*

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Abstract

Fructus Amomi is “one of the top four south authentic Traditional Chinese Plant Medicines”, widely distributed in tropical and subtropical districts of China, such as Fujian, Guangdong, Guangxi, Hainan, etc., which has ever been used in clinical for treatment of the digestive diseases. In addition, it has also been used as spices. In recent years, some research about its components together with pharmacological activities have been reported. In this Mini review, we mainly describe the recent progress of the components and pharmacological activities of *Fructus Amomi*, to provide the reference for the relevant researchers.

Introduction

Fructus Amomi is “one of the top four south authentic Traditional Chinese Plant Medicines”. It is also an important species included in Chinese Pharmacopoeia (2010). *Fructus Amomi* is a perennial herb of amomum, zingiberaceae, which has a history of over 1300 years in medicine and food [1]. It is widely distributed in tropical and subtropical districts of China, such as Fujian, Guangdong, Guangxi, Hainan, Yunnan etc [2] and southeast Asia. However, there are some differences about the names of the *Fructus Amomi* planted in different places: *Amomun villosum* Lour. (Planted in Guangdong province, China), *A. villosum* Lour. var. *xanthioides* T. L. Wu et Senjen (Planted in Yunnan province, China; some also planted in southeast Asia), *A. longiligulare* T. L. Wu (Planted in Hainan province, China) and *A. xanthioides* Wall (Planted in southeast Asia) [3]. Modern pharmacological studies showed that *Fructus Amomi* has ever been used in clinical for treatment of digestive diseases: such as protecting gastric mucosa, improving gastrointestinal function, relieving pain, preventing diarrhea, promoting the secretion of digestive juice and so on. It is reported that the quality and medical efficacy of *Amomun villosum* Lour planted in Guangdong province is with much higher activities than others [4,5].

Some work about the chemical components together with pharmacological activities of *Fructus Amomi* have been

reported. In this minireview, we focused on describing the progress of its chemical components and pharmacological activities to provide the reference for the relevant researchers.

Chemical components

The main chemical component of *Fructus Amomi* is volatile oil. Other chemical components such as flavonoids, carbohydrate, organic acids and inorganic components were also isolated and reported.

Volatile oil: Zhang, et al. [6] extracted the volatile oils from the dried seeds and fruit shells of *Fructus Amomi* respectively, and identified their chemical components and the contents by GC-MS. The results showed that 138 chemical constituents were identified from the four different volatile oils. The main components and their contents are: bornyl acetate (5% - 47%), camphor (4% - 17%), borneol (1.5% - 6%), camphene (0.2% - 3%), alpha-pinene (0.2% - 3%), beta-pinene (0.2% - 5%) and alpha-copaene (0.1% - 2%) (Representative structures listed in figure 1). The content of the total alkene accounts for 10% - 40%.

Yu, et al. [7] obtained the fat-soluble fraction from the extraction of *Amomun villosum* Lour by silica gel

More Information

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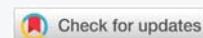
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chromatography, and identified its components by GC-MS. The results showed that the compounds of the contents over 1% are: bornyl acetate, camphor, camphor, cinene, camphorene, alpha-terpineol, myrcene and camphene (their structures listed in figure 2).

Zeng, et al. [8] obtained the volatile oils from the *Amomun villosum Lour*, *A. villosum Lour. var. xanthioides T. L. Wu et Senjen* and *A. xanthioides Wall* respectively, and identified their chemical components and the contents respectively. The results showed that bornay acetate is higher amount in volatile oil of *Amomun villosum Lour*. With the content of 59.6%, while camphor is the highest amount in the volatile oil of *A. villosum Lour. var. xanthioides T. L. Wu et Senjen* and *A. xanthioides Wall*, with the contents of 63.02% and 60.23% respectively.

Flavonoids: Quercetin-3-rohamnoside, isoquercitrin and quercetin (Figure 3) were isolated and confirmed from the water-soluble extraction of *Amomun villosum Lour*. [9,10].

Carbohydrate: Fan, et al. [11] identified four monosaccharides (arabinose, mannose, glucose and galactose) (Figure 4) from *Amomun villosum Lour* and the relative proportion of these four monosaccharides was 1:0.68:0.97:0.81.

Organic acids: The main organic acids in *Fructus Amomi* are vanillic acid, stearic acid and palmitic acid (Figure 5) [7].

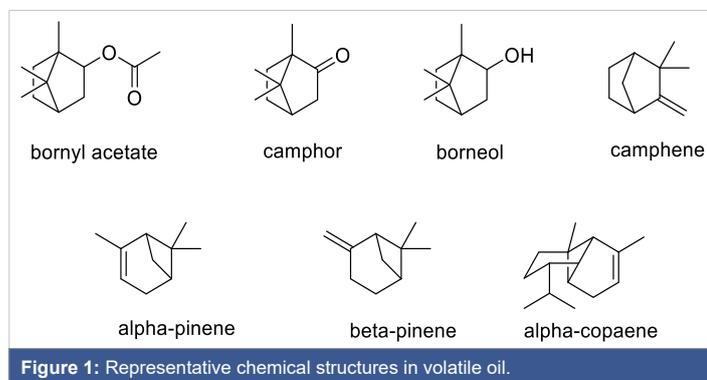


Figure 1: Representative chemical structures in volatile oil.

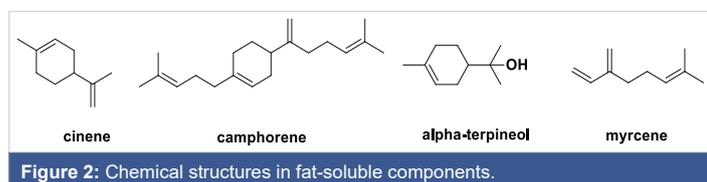


Figure 2: Chemical structures in fat-soluble components.

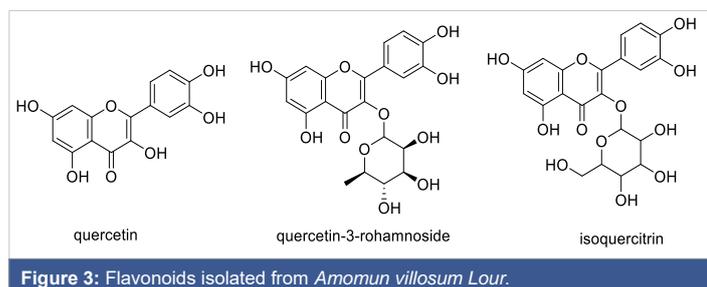


Figure 3: Flavonoids isolated from *Amomun villosum Lour*.

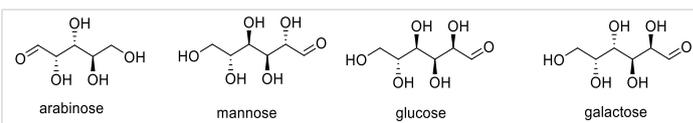


Figure 4: Carbohydrate isolated from *Amomun villosum Lour*.

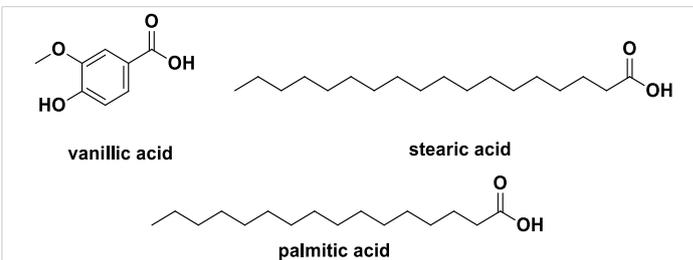


Figure 5: Organic acids isolated from *Amomun villosum Lour*.

Table 1: Correlation between the content of inorganic elements and volatile oil.

| Contents | <i>Amomun villosum Lour</i> | | |
|-------------------------|-----------------------------|----------------------|----------------------|
| | place 1 ^a | place 2 ^b | place 3 ^c |
| Mn ($\times 10^{-6}$) | 486.0 | 330.2 | 343.8 |
| Zn ($\times 10^{-6}$) | 107.3 | 78.4 | 84.9 |
| Volatile oil (%) | 3.70 | 3.52 | 3.24 |

^aJinhuakeng; ^bChunwan; ^cYongning

Inorganic components: Wu, et al. [12] determined the trace elements in *Fructus Amomi* and the trace elements are: cobalt, lead, nitrogen, silver, magnesium, potassium, iron, boron, copper, nickel, zinc, manganese and phosphorus. The elements content of zinc and manganese was positively correlated with the quality of the volatile oil (Table 1).

Pharmacological activities

Fructus Amomi is "one of the top four south authentic Traditional Chinese Plant Medicines". Different biological studies of *Fructus Amomi* have been carried out and it exhibited a wide spectrum of biological activities, such as: anti-bacteria, antiulcer effect, effect on gastrointestinal motility, effect of bioelectricity on gastrointestinal cells, sedative, anti-inflammatory, antidiarrheal effect, and anti-oxidation activities. The details list below.

Anti-bacteria activity: Zhang, et al. [6] obtained the volatile oil from the *Fructus Amomi* and tested its biological activities against fungi and bacteria. The results showed that the volatile oil exhibited significant inhibition to trichophyton rubrum, trichophyton mentagrophytes, microsporum gypseum, staphylococcus aureus and enterococcus faecalis. What's the most important is that the volatile oil expressed different inhibitory effects on different fungi and bacteria: the inhibitory efficacy on fungi is better than bacteria, while the efficacy on gram-positive bacteria is better than gram-negative bacteria. Tang, et al. [14] found that some extractions of *Fructus Amomi* exhibited higher inhibition to klebsiella, staphylococcus, pseudomonas aeruginosa, salmonella, escherichia coli and bacillus subtilis. In addition, they also exhibited strong antioxidation activity. Yan, et al. [15] found that the water extraction of *Fructus Amomi* expressed significant restoring effect on the imbalance of intestinal flora caused by antibiotics. Cao, et al. [16] obtain

the different extractions (petroleum ether extraction, ethyl acetate extraction, n-butanol extraction and water layer) and evaluated their antibacterial activity. The results showed that different extraction exhibited different antibacterial efficacy: the antibacterial efficacy sequences were: petroleum ether extraction > ethyl acetate extraction > n-butanol extraction > water layer. It means that the nonpolar extraction is more potent than the polar extractions.

Antiulcer effect: It is reported that some active components of the *Fructus Amomi* could inhibit gastric mucosal cell dysfunction and acute gastric mucosal injury (caused by hydrochloric acid) through inhibiting proteins and enzymes in gastric ulcers [17]. Gao, et al. [18] reported that the extraction of *A. longiligulare T. L. Wu* could protect the gastric mucosal injury of the rats and the mechanism may be related to improving the expression of TFF1 and TFF1 RNA proteins. Jafri, et al. [19] reported that the volatile oil of *Fructus Amomi* could reduce the secretion of gastric acid and pepsin, which had a protective effect on gastric mucosa.

Effect on gastrointestinal motility: Zhu, et al. [20] found that the extraction of *Fructus Amomi* could significantly promote the gastric emptying and intestinal transport, and its prokinetic efficacy was almost the same as the reference drug cisapride. Zhang, et al. [21] observed and recorded the effect of *Fructus Amomi* on 40 patients with functional dyspepsia. He found that *Fructus Amomi* could quickly alleviate the clinical symptoms of patients, while the main mechanism maybe that the *Fructus Amomi* could promote releasing the substance P and motilin.

Effect of bioelectricity on gastrointestinal cells: *Fructus Amomi* can affect the bioelectric activity of gastrointestinal cells. Ding, et al. [22] treated the rats (with syndrome of deficiency of spleen qi) with the water extraction of *Fructus Amomi*. The results showed that the water extraction of *Fructus Amomi* could increase the amplitude of pacemaker potential, thereby affecting the electrical activity of Cajal cells, repairing the damage of Cajal mesenchymal cells and signal pathway in small intestine of rats with syndrome of deficiency of spleen qi and improving gastrointestinal motility disorders.

Sedative, anti-inflammatory and antidiarrheal effect: Li, et al. [23] reported that bornyl acetate, the main component in the volatile oil of *Fructus Amomi*, could inhibit the diarrhea, relieved the pain of the tested mice and smooth muscle movement in isolated small intestine of the tested rabbits. But it did not show the significant effect on gastric emptying of the tested mice. Wu, et al. [24] reported that the extraction of *Fructus Amomi* expressed significant analgesic and anti-inflammatory activities. Zhang, et al. [25] evaluated the effects of the volatile oil from *Fructus Amomi* on intestinal mucositis induced by 5-fluorouracil (5-FU). The results showed that *Fructus Amomi* and bornyl acetate significantly increased the rats' body weight, relieved diarrhea, and reversed histopathological changes in the gut and inflammation.

Ding, et al. [26] obtained the volatile oil of *Amomum villosum Lour* planted in Yunnan, and studied its antidiarrheal activity. The result showed that the volatile oil exhibited higher antidiarrheal activity in dose-dependent manner, and the highest dose is 270 mg/kg. Lee, et al. [27] reported that the extraction of *Fructus Amomi* showed strong antiviral activity and protected cell survival in CVB3 infection.

Anti-oxidation: Sand kernel possess higher antioxidant activity and can be used as a safe and cheap natural antioxidant [28]. Zhao, et al. [29] reported that *A. longiligulare T. L. Wu* exhibited good antioxidant activity. Zhang, et al. [30] reported that the polysaccharides isolated from *Fructus Amomi* possessed a strong free radical scavenging activity, and it could significantly inhibit the formation of malondialdehyde *in vitro* and enhance antioxidant enzyme activity in mice with liver injury induced by carbon tetrachloride.

Other effects: Xiong, et al. [31] reported that the low dose of salt sunburn *Fructus Amomi* had the significant effect on reducing urine of the water-loaded mouse model, and preliminarily confirmed the accuracy of the processing theory of traditional Chinese medicine "salt sunburn into kidney" through pharmacological experiments. Huang, et al. [32] showed that the oil of *Fructus Amomi* leaf could significantly shorten the wound healing cycle of rabbits and promote wound healing with intact new epidermis, fewer inflammatory cells and less tissue lesions.

Zhao, et al. [33] reported that water extraction of *A. villosum Lour. var. xanthioides T. L. Wu et Senjen* could reduce the blood glucose of diabetic rats. Lee, et al. [34] reported that *A. villosum L* could be used to treat the growth retardation during adolescence by the experiment (*Amomum villosum* induces longitudinal bone growth in adolescent female rats). It is also reported that *Amomum villosum Lour* exhibited higher inhibitory effects on transplanted tumors (S180 and H22) of the experimental mice during anti-tumor experiments, while it did not exhibit remarkable effect on the immune function of the mice [35].

Conclusion

Fructus Amomi is "one of the top four south authentic traditional Chinese medicines", widely used in clinical in China. Its main functions are to moisten the appetite, warm the spleen and prevent diarrhea, regulate qi and tocolysis. There are many kinds of components of *Fructus Amomi* together with a variety of pharmacological activities. In recent years, some chemical isolation and pharmacological studies of the *Fructus Amomi* have been carried out. But there are also some imperfections: (1) no new structures of compounds were isolated; (2) the action sites and the mechanism of pharmacological activities are not clear; (3) most of the work focused on the volatile oil, the research on other components and their biological activities are rare. Thus, we should carry out the deep work about the isolation of new structure compounds and further biological evaluation, to develop the



new drugs or drug candidates from this Chinese Traditional Plant Medicines.

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