Research Progress on the Effect of Amomum Volatile Oil on Gastrointestinal Health

Zheng Liu*

College of Food Science and Engineering, Lingnan Normal University, Zhanjiang, 524033, China

*Corresponding author: 2016120719@jou.edu.cn

Abstract. According to statistics, 10 million people worldwide die of gastrointestinal diseases every year, and the incidence of stomach diseases in the population is as high as 80%, among which 120 million people in China suffer from stomach diseases. *Amomum villosum* is a kind of traditional Chinese medicinal materials, is also a kind of medicine and food homologous raw materials, with moistening appetizer, warming spleen and diarrhea, Qi and pain relief effect. The volatile oil of *Amomum villosum*, the main active component of *Amomum villosum* has a variety of biological activities and pharmacological effects. Therefore, under the background of younger gastrointestinal health problems and more attention paid to gastrointestinal problems, it is of great significance to study the relevant effects of effective components of *Amomum villosum*, on gastrointestinal health. This paper focuses on the chemical composition, extraction process and specific mechanism of volatile oil of *Amomum villosum*, in gastrointestinal health, so as to provide certain reference and support for further research and development of volatile oil of *Amomum villosum*, in gastrointestinal health.

Keywords: *Amomum villosum*; Volatile Oil; Gastrointestinal Health.

1. Introduction

Amomum villosum (AV) is a perennial herb belonging to the genus Cardamom in the ginger family. Its all body can be used as medicine. According to historical records, sand kernel was first published in the Theory of Medicinal Properties. AV has been used for more than 1,300 years in China. The ancients often used sand kernel as a snack to clean the mouth or as a seasoning for cooking. Until modern times, people in some parts of China still retained the habit of chewing sand kernel to help digestion after meals. Sand kernel contains flavonoids, polysaccharides, volatile oil and other active ingredients, modern research shows: sand kernel contains resin, protein, cellulose and mineral components. The aroma of AV comes from its volatile oils, such as bornol acetate, camphor, camphor, linalene, limonene, β-pinene, ornerolol, α-pinene, camphene, cineolin, linalol, α-piperene, guaiacol, etc. In China, *Amomum villosum* is mainly grown in Fujian, Guangdong, Guangxi, Hainan and Yunnan provinces, but also in other Southeast Asian countries such as Nepal and Vietnam. *Amomum villosum* has remarkable curative effect on gastrointestinal diseases, among which volatile oil is the most important component.

Nowadays, the pace of contemporary social life is accelerating, people from work, study, life and other aspects of the pressure is relatively large, easy to lead to gastrointestinal function problems. At the same time, smoking, drinking, irregular diet, overeating and other behaviors will also increase the burden of the stomach and intestines. People with abnormal gastrointestinal function often have nausea, heartburn, vomiting and other symptoms, which seriously affect people's health and quality of life. According to statistics, 10 million people worldwide die from gastrointestinal diseases every year. In China, on average, 9 out of every 100 people suffer from stomach problems, the highest incidence in the world. Therefore, gastrointestinal problems have become one of the top three health problems that people are most eager to improve, and the penetration rate of stomach problems among young people aged 18-35 has reached 58%. In addition, gastrointestinal health problems are not limited to intestinal diseases. Studies have shown that an unbalanced gut microbiota can lead to a variety of diseases, including immune diseases such as dermatitis, asthma, and arthritis, which are immune-related diseases; Metabolic diseases, such as obesity, diabetes, hyperlipidemia, and

neurological diseases such as Parkinson's and autism, may be related to the imbalance of microbiota, and a manifestation of gastrointestinal sub-health is the imbalance of intestinal microecology. *Amomum villosum* has a good effect in regulating the function of the gastrointestinal tract. Based on this fact, this paper summarized the chemical composition, extraction process and specific mechanism of volatile oil from *Amomum villosum*, in order to provide reference for further research and development of volatile oil from *Amomum villosum* in gastrointestinal health.

2. Chemical Constituents of AV Volatile Oil

Volatile oil contains many components and is one of the most active substances in AV. The chemical composition of AV Volatile Oil from different places and varieties is slightly different (Fig 1). For example, the content of bornyl acetate in AV from Yangchun, Guangdong, China is significantly higher than that of other varieties. Dai D N et al. used water distillation method to extract the essential oil from Vietnam ambrose kernel, and then carried out gas chromatography analysis on the essential oil. The report demonstrated the most important components of ambrose kernel essential oil were monoterpene hydrocarbons, accounting for more than 70%, followed by oxygenated monoterpene hydrocarbons, sesquiterpene hydrocarbons and oxygenated sesquiterpene hydrocarbons. Among these, monoterpene hydrocarbons, represented by β-pinene and α-pinene, are found primarily in leaf oil, and oxygenated hydrocarbons, represented by camphor and bornyl acetate and their derivatives, are found in other locations [1]. Sabulal N et al. reported the main components of Amomum SPP volatile oil. The type of plant, collection season and methods, isolation and analytical techniques will affect the quality of volatile oil from AV. Prabodh Satyal et al. performed gas chromatographic analysis of volatile oil from Nepal AV. The results showed that The essential oil was dominated by The monoterpenoids 1,8-cineole, α-pinene, β-pinene, and α-terpineol. The essential oils of AV seed and outer bark were slightly different in substance content, the former contained more 1, 8-Cineole and α-pinene [2].

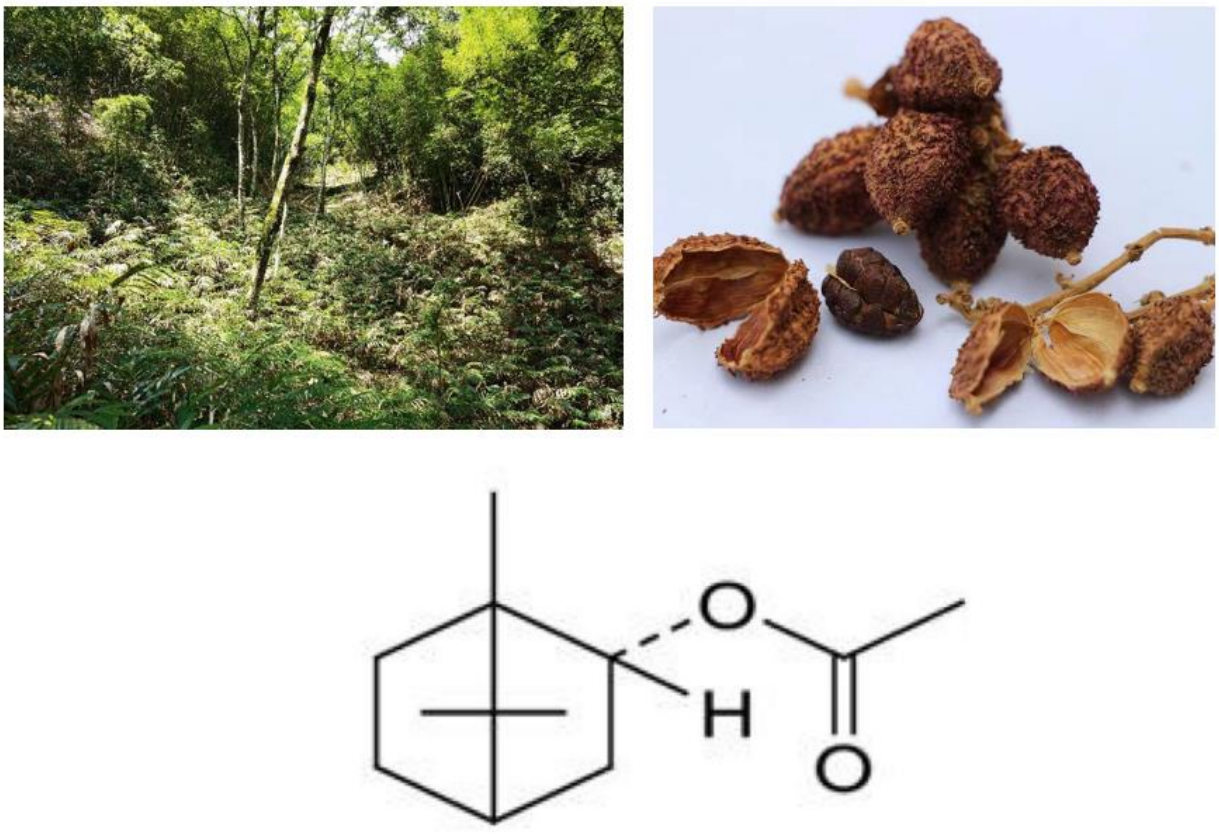

Fig. 1 Plant, fruit and main active substance structure of AV [3]

3. Extraction Technology of Volatile Oil From Amomum villosum

The essential oil of *Amomum villosum* is mainly terpenoids and their oxygen-containing derivatives, which are insoluble in water. Different extraction processes can affect the extraction yield of volatile oil from *Amomum villosum*. Therefore, the extraction methods and technological parameters of volatile oil from *Amomum villosum* have been optimized in recent years. Wei Ronghua et al. used different solvents to extract volatile oil from sand kernel under microwave assisted conditions, and found that the solvent with low polarity and low boiling point had a better extraction effect, and ether was the best. Fan Yaming et al. used ether as solvent and microwave heating method to enhance the extraction process of volatile oil from *Amomum villosum*. The best extraction process was solid-liquid ratio of 1:5, extraction temperature of 45℃, extraction time of 180 s, and the yield was 3.2% [4]. Wang Ling et al. used organic solvent hot leaching method and microwave extraction method to extract volatile components from *Amomum villosum*, and found that both methods could effectively extract volatile oil from *Amomum villosum*, but the microwave extraction method had a high extraction rate (3.28%) and saved time and effort [5] Zhang Jibin optimized the extraction of bornyl acetate from volatile oil, and obtained the best extraction conditions: solid-liquid ratio of 1∶15, soaking time of 30 min, extraction time of 6 h, and the yield of 2.5% [6]. Bui B. Thinh et al. used three different methods (hydrocut, steam cut, and Microwave-assisted hydrocut) to extract volatile oil. Indeed, the outcome indicated that the content of the essential oil obtained by different extraction methods may differ significantly. Indeed, the essential oil extracted with Microwave-assisted hydrocut may retain the most active ingredient in the process and exhibit higher antimicrobial activity. Deep eutectic solvents system to effectively improve the active substance content in essential oils.

Due to the poor stability of volatile oil from *Amomum villosum*, it is not conducive to further study of activity mechanism, so the embedding technology should be used after extracting the volatile oil from *Amomum* villosum. At present, hydroxypropyl - β-cyclodextrin is used to embed volatile oil. The embedded volatile oil of *Amomum villosum* usually has better bioactivity.

4. Health Effects of Volatile Oil of AV

The volatile oil of AV has a variety of beneficial effects on gastrointestinal health, which can be mainly summarized as enhancing gastrointestinal motility, reducing inflammation, regulating intestinal flora and repairing gastric ulcer.

4.1. Enhance Gastrointestinal Motility

Gastric motility refers to the contractile creep force of the stomach wall muscle, including the strength and frequency of stomach muscle contractions, which produce ingastric pressure that increases the original drive for gastric emptying. Abnormal gastric motility often leads to functional dyspepsia. ZHANG N et al. found that low concentration of volatile oil from *Amomum villosum* was better than high concentration of volatile oil from *Amomum villosum*, while high concentration of volatile oil from *Amomum villosum* was better than low concentration of volatile oil from *Amomum villosum* in promoting gastric emptying [7]. Zhang Fengyu found that the volatile oil of *Amomum villosum* can effectively treat functional dyspepsia, and its mechanism is to promote the secretion and release of SP and MTL in the body, thereby enhancing gastrointestinal motility. The cases of abdominal distension, belching, nausea and vomiting and loss of appetite after treatment were less than those before treatment [8].

4.2. Anti-inflammatory Effects

A microbial infection is frequently the cause of gastroenteritis. Additionally, medications or chemical toxins may be the reason. Chen Zhu et al. found that volatile oil of *Amomum villosum* could significantly reduce the intestinal inflammatory response induced by TNBS in IBD rats, and the mechanism may be related to the effective regulation of inflammatory cytokines and improvement of

intestinal immune system disorder by volatile oil [9]. Nguyen Hai Dang et al. showed that volatile oil of *Amomum villosum* had obvious anti-inflammatory effect [10]. Guo-dong Huang et al. applied the volatile oil of *Amomum villosum* to Helicobacter pylori associated gastritis. The outcomes demonstrated a noticeably higher overall effective rate for individuals treated with AV volatile oil, and the contents of hexosamine and phospholipid were increased. The mechanism may be related to the up-regulation of PS2 or down-regulation of PAF, which can cause gastric membrane damage.

4.3. Regulate the Gut Microbiota

Intestinal tract is not only the important digestive organs, but also the largest immune organ in human body, including the balance of intestinal flora stability with nutrition, metabolism, immune, nerve is closely related to disorder of flora system will lead to many diseases, including intestinal disease, diarrhea, constipation, irritable bowel syndrome, colitis, colon cancer and so on. The volatile oil of *Amomum villosum* can effectively regulate intestinal flora [11]. Ting Zhang et al. found that the volatile oil of *Amomum villosum* and its main active component bornol acetate could significantly inhibit the apoptosis of cells in the small intestine, effectively regulate the balance of intestinal microorganisms, increase the abundance of probiotics, and thus achieve the effect of reducing intestinal mucosal inflammation [3].

4.4. Antibacterial Activity

At the same time, the researchers also found that the volatile oil of *Amomum villosum* exhibited significant antibacterial activity against some pathogenic bacteria and spoilage bacteria. Cailin Tang found that volatile oil from *Amomum villosum* could effectively reduce the survival rate of S. aureus by inhibiting ATP synthesis and key enzyme activities, thus interfering with the normal metabolism of S. aureus, and Amomum Oil inhibited the growth of gram-Positive bacteria [12]. Wen-rui DIAO et al. found that volatile oil of *Amomum villosum* could exert antibacterial effect on *B. subtilis* and *E. coli*. by destroying the permeability of specific bacterial cell wall membrane and making intracellular substances flow out [13].

4.5. Repair Gastric Ulcer

Gastric ulcer is a common ulcerative disease of the digestive system. It refers to mucosal defects deep into the submucosa caused by gastric acid accumulation and destruction of the gastric mucosa under certain circumstances. It is most common in the stomach and duodenum, and its clinical manifestations are stomach pain and loss of appetite. M. A. Jafri et al. found that the volatile oil of *Amomum villosum* can improve the secretion of gastric acid and gastric protein, protect gastric mucosa, and thus has a good therapeutic effect on gastric ulcer [14]. Huang Guodong et al. found that *Amomum villosum* volatile oil can prevent the formation of gastric ulcer and recurrence, the mechanism is that *Amomum villosum* volatile oil can improve the level of gastric ulcer rats bone mucosa PS2, while the PS2 is a kind of gastric mucosal protective factor, at the same time, the essential oil can improve gastric mucosa amino hexose and phospholipid content, which affect gastric mucosal hydrophobicity to improve the quality of ulcer healing [15].

4.6. Other

Chen Heru et al. found that volatile oil embedded in *Amomum villosum* had a significant alleviating effect on pain induced by glacial acetic acid in mice by changing the number of writhing body of mice after drug administration [16]. Yue Jianjun et al. reported that the volatile oil of *Amomum villosum* could induce the apoptosis of gastric cancer cells in MFC mice and had significant anti-tumor activity, so they proposed the idea that the volatile oil of *Amomum villosum* could be used in the treatment of gastric cancer [17].

5. Conclusion

The pharmacodynamic components of *Amomum villosum* can be divided into volatile and non-volatile components. Volatile components also direct hair oil. The volatile oil of *Amomum villosum* contains many components, mainly terpenoids and their oxygen-containing derivatives. Identifying the chemical composition of the volatile oil of *Amomum villosum* is helpful to identify the effective active components of the volatile oil and provide a theoretical basis for establishing different quality standards of *Amomum villosum*. Different extraction processes will affect the extraction rate of volatile oil from AV, and the volatility of each component in *Amomum villosum* volatile oil is different. At present, there is a lack of simple and effective extraction process to achieve efficient separation of multiple components. The traditional method of extracting volatile oil takes longer time and is difficult to collect, so it is of great significance to study an efficient extraction method. For now, many studies have reported the beneficial effects of *Amomum villosum* volatile oil on gastrointestinal health, which are various, including enhancing gastrointestinal motility, reducing inflammation, regulating intestinal flora and repairing gastric ulcer, etc. However, the application of *Amomum villosum* volatile oil in functional food has not been seen. In addition, due to the high planting requirements and the low yield of *Amomum villosum*, the development of *Amomum villosum* industry is limited to a certain extent. Therefore, in-depth understanding and development of the non-medicinal parts of *Amomum villosum* and the waste seed shells generated in the planting and production can make rational and green use of the resources of *Amomum villosum*.

In short, in order to fully understand *Amomum villosum*, which is called "the same origin of medicine and food", the content, efficacy and pharmacodynamic mechanism of its different components should be further explored. In the context of the pursuit of general health and food safety, the green, rapid and efficient extraction process, as well as the potential structure-activity relationship and functional activity of *Amomum villosum* active components will still be the focus of future research.

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