Chapter 72
Mentha haplocalyx Briq. 薄荷 (Bohe, Mint)

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72.1 Botanical Identity

Bohe or mint, the dried aerial parts of *Mentha haplocalyx* Briq, is one of the most popular Chinese herbal medicines in the Lamiaceae family and is used as a raw material in dietary supplements. It is a special plant of economic value and originates from the Mediterranean and Europe and now is commonly grown in America, Spain, Italy and France. In China, the genuine Bohe grows in Yunnan, Jiangsu, Zhejiang and Jiangxi provinces. Its major and legal source is recorded in the Pharmacopeia of People's Republic of China and TCM literature. Stems of Bohe stand erect, about 30–60 cm in height, and are shaped as four diamonds, and the lower section has a number of fine fibres and horizontal creeping rhizome. Elongated leaves are oblong-lanceolate in shape, 3–5 cm in length and 0.8–3 cm in width. They bloom from June to September, and bear fruits in October each year (Fig. 72.1). The stems and leaves of Bohe are usually harvested and dried in summer and autumn, typically twice a year. The first harvest is usually in late June to early July, but no later than mid July, or the second harvest would be affected [1].

72.2 Chemical Constituents

Volatile oils (also known as peppermint oil) are the major bioactive components contained in Bohe. These volatile oils include menthol (**1**), menthone (**2**), menthenone (**3**), isomenthone (**4**), limonene (**5**), decylacetate, menthylacetate, methylbenzoate, pinene, 3-pentol, 2-hexanol, 3-octanol, myrcene, cineole, neterpineol,

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Fig. 72.1 Flowering plant (**a**) and crude drug (**b**) of *Mentha haplocalyx* Briq

etc. Bohe also contains flavonoids including isoraifolin, luteolin-7-glucoside and methoside. In addition, organic acids are also found in this medicinal herb, including lusmarinic acid, caffeic acid, aspartic acid, glutamic acid, alanine, asparagine, valine, leuine, isoleucine, phenylalanine, methionine, and lysine [2, 3]. Representative structures of these constituents are shown in Fig. 72.2.

72.3 Pharmacological Studies

A number of pharmacological studies have evaluated the effects of volatile oils, the primary components contributing to the bioactivity of Bohe. Studies showed that peppermint oil was active against *Staphylococcus aureus* with minimal inhibitory

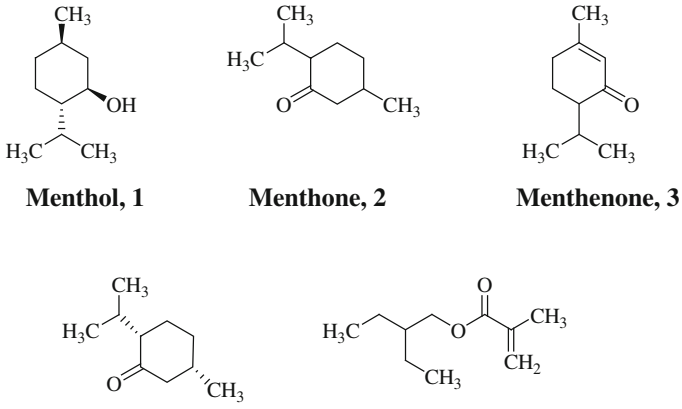

Fig. 72.2 Chemical structures of representative components of *Mentha haplocalyx* Briq

concentrations ranging from 64 to 256 μg/mL, and the production of *S. aureus* exotoxins was decreased by sub-inhibitory concentrations of peppermint oil in a dose-dependent manner. These findings suggested that peppermint oil may potentially be used to aid in the treatment of *S. aureus* infections [4]. Other data showed that peppermint oil significantly promoted the secretion of bile and bile acid in rats, increased bile acid efflux, and decreased cholesterol levels in bile, suggesting that peppermint oil stimulates bile fluid secretion and thus has a choleretic effect [5].

The principal pharmacodynamic effect of peppermint oil relevant to the gastrointestinal tract is a dose-related antispasmodic effect on the smooth musculature due to the interference of menthol with the movement of calcium across the cell membrane. The choleretic and anti-foaming effects of peppermint oil may play an additional role in the medicinal use of Bohe. Peppermint oil is relatively rapidly absorbed after oral administration and eliminated mainly via the bile. The major biliary metabolite is menthol glucuronide, which undergoes enterohepatic circulation. The urinary metabolites result from hydroxylation at the C-7 methyl group and/or at C-8 and C-9 of the isopropyl moiety, forming a series of mono- and dihydroxy menthols and carboxylic acids, some of which are excreted in part as glucuronic acid conjugates. Studies with tritiated I-menthol indicated equal excretion in feces and urine in rats. The main metabolite identified was menthol-glucuronide. Additional metabolites are mono- or di-hydroxylated menthol derivatives [6].

72.4 TCM Applications and Dietary Usage

72.4.1 TCM Applications

Bohe is commonly used in TCM for the treatment of influenza, headache, red eyes, fever, sore throat, etc. It is also used for neuropathic pain, pruritus, rash and eczema. The commonly used formulations of Bohe in clinical context include the following: (a) Compound Menthol injection: as menthol interacts with nerve membrane and narrows sodium channel, the drug is used as a local anesthetic agent; (b) Menthol Calamine lotion: used for treatment of red miliaria in children; (c) Cooling oil: for relieving pain and itching; (d) Compound Menthol nasal drops: used for nasal lubrication, and also for the treatment of atrophic rhinitis and nasal bleeding; (e) Bohe is also clinically used as adjuvant treatment for bronchial pneumonia in inhalation form for infants and young children [7].

72.4.2 Dietary Usages

Since Bohe is a common herb, it has been widely used in daily diet. Its dietary usages include Bohe wine, Bohe soup, porridge, mint herbal tea, mint cake, etc. These dietary forms of preparations can be easily made at home.

72.4.2.1 Bohe Porridge

Fresh Bohe (30 g) or dried Bohe (15 g), put into a span, add water to 1 L, cook with a medium heat until the remaining water is about 0.5 L. After cooling down, the mint material is removed. Then the mint decoction is added to a rice porridge made from 150 g of rice. Add small amount of sugar when the porridge is done. Bohe porridge may stimulate appetite and help with digestion.

72.4.2.2 Bohe Soup

Clean mint leaves, chopped, scalded with boiling water, and then put a little salt and sesame oil. Bohe soup can be used for relieving inflammation.

72.4.2.3 Bohe Cake

Prepare 500 g of rice, 500 g of green beans, 15 g of mint, 25 g of sugar and a small amount of sweet-scented *osmanthus*. First, boil the green beans to be thoroughly cooked, then add some sugar, sweet-scented *osmanthus* and chopped mint leaves to make the stuffing. Then cook the rice, and pack the stuffing with sticky rice bean paste. Bohe cake may help with sore throat.

72.5 Clinical Evidences

Several clinical studies have been carried out to evaluate the therapeutic effects of peppermint oil on some syndromes in humans. Nine studies evaluating 726 patients with irritable bowel syndrome showed that peppermint oil was significantly superior to placebo for global improvement of irritable bowel syndrome (5 studies, 392 patients, relative risk 2.23; 95 % confidence interval, 1.78–2.81) and improvement in abdominal pain (5 studies, 357 patients, relative risk 2.14; 95 % confidence interval, 1.64–2.79). Although patients receiving peppermint oil were more likely to experience some adverse effects, such events were mild and transient in nature. The most commonly reported adverse event was heartburn. These studies

indicated that peppermint oil is a safe and effective short-term treatment for irritable bowel syndrome [8].

There is also a clinical investigation addressing the efficacy and usefulness of peppermint oil as an antispasmodic during upper endoscopy, especially for elderly patients. A total of 8,269 esophagogastroduodenoscopy procedures were performed. There was no significant difference in the antispasmodic score between peppermint oil group and hyoscine butyl bromide group. Among the non-elderly patients, those in peppermint oil group had a worse antispasmodic score than those in hyoscine butyl bromide group. However, among the elderly patients, those in peppermint oil group had similar scores to those in hyoscine butyl bromide group [9]. These data suggest that peppermint oil is useful as an antispasmodic during esophagogastroduodenoscopy, especially for elderly patients.

72.6 Safety Evaluation and Toxicity Issues

Peppermint oil is safe for human within a certain dose range. After mice took pennyroyal (2.3 mL/kg) orally, hepatic functional parameters gradually increased over time, including total bilirubin, alkaline phosphatase (ALP), alanine transarninase (ALT) and aspartate aminotransferase (AST). These trends peaked at 24–48 h, and then gradually decreased, while they could recover to nearly normal levels at 72 h. The studies of dose-effect relationship showed that a single oral medium dose of peppermint oil could lead to elevated serum ALP and liver cell edema, and a single high dose of pennyroyal orally could not only make serum ALP, ALT, AST and liver index rise, but also make liver cells appear serious edema, fatty degeneration, focal necrosis, patchy necrosis, and so on. However, after mice took the low dose of pennyroyal orally, there were no obvious effects on the liver. These results indicate that taking peppermint oil, exceeding a certain amount, can cause acute liver injury. Liver injury could be expressed as changes in liver function and even in liver tissue pathology, and showed a dose-effect relationship, and the damage peak appeared at 24–48 h after taking peppermint oil. In the pathological changes of liver cells resulted from pennyroyal treatment, oxidative damage may be one of underlying mechanisms [10]. According to different time points or different dosages, examination of serum ALT and other liver function parameters were carried out after oral administration in rats. Liver histology and hepatic cell ultrastructure changes were evaluated under light microscope or electron microscope. Compared with the normal group, liver function indexes (e.g. serum ALT) of peppermint oil group increased and peaked at 24–48 h after taking peppermint oil. With the increase of dose, ALT and other liver function indexes increased. In high dose of peppermint oil treatment group, liver injury was obvious, showing ultrastructural changes. The results showed that a single high dose of peppermint oil orally could cause acute liver toxicity and have some toxic limitations [11].

Peppermint oil is easily available as a constituent of medicines. A nearly fatal case due to ingestion of toxic dose of oral peppermint oil has been reported. The

patient came in a comatosed state and was in shock. She was managed with mechanical ventilation and ionotropes. Her vital parameters reached normal levels within 8 h and she became conscious by 24 h. The side effects of peppermint oil were considered to be mild but this case indicates a warning that ingestion of oral toxic doses of peppermint oil could be dangerous [12].

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