

Review on Health Benefits of Spearmint (*Mentha spicata L.*) and Its Inter-cropping Advantage with Maize (*Zea mays L.*)

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Abstract

Traditional medicine provides an important health care service and can be used as an alternate therapy. Plants are rich in phytochemical compounds that offer a source of dietary ingredients used to treat various ailments and problems. Spearmint (*Mentha spicata L.*) belongs to the family Lamiaceae and is a rich source of polyphenols. These polyphenols have shown numerous biological activities and health benefits. Also, conserve biodiversity and manage soil-borne pests as well as enhance soil and plant health. Therefore, the review of the present study shows the bioactivity, health effects, and inter-cropping advantages of spearmint.

Keywords: mentha spicata; health benefit; inter-cropping; slender spikes; bioactivity; aromatic herbaceous; thiobarbituric acid

Introduction

Spearmint (*Mentha spicata L.*), is an aromatic herbaceous, rhizomatous, and perennial herb belonging to the Lamiaceae family [4]. The plants of this family are a rich source of polyphenols and thus possessing strong antioxidant properties [20,8]. Spearmint is indigenous to northern England [46] and is cultivated in areas with a climate ranging from tropical to temperate, such as America, Europe, China, South Africa, and [20,39]. Nowadays, spearmint is widely grown throughout all regions of the world [15]. Spearmint is also known as brown mint, garden mint, lady's mint, and sage of Bethlehem [48]. Spearmint is a creeping rhizomatous and herbs [24,28]. The leaves are broad and sharply serrate. The trademark of the mint family is the square-shaped stem [11]. Spearmint produces rightly and long pink or white flowers in slender spikes. Spearmint leaves possess a characteristic aromatic odor and pungent taste. However, in contrast to peppermint and Japanese mint, the cooling after-effect is absent in spearmint [11,24].

Mentha plants are one of the most popular herbs that have been used for their medicinal and aromatherapeutic properties since ancient times. Spearmint has a long tradition of medicinal use. It was taken as a tea to treat general digestive problems. Spearmint is widely used in a commercially manufactured product, cooking, and medicine for its aromatic and flavorsome qualities. There are numerous health benefits of spearmint essential oil such as it can reduce fever, provide relief from depression and asthma [12]. Mint was originally used as a medicinal herb to treat stomach ache and chest pains, and it is commonly used in the form

of tea as a home remedy to help alleviate stomach pain. During the middle Ages, powdered mint leaves were used to whiten teeth. Its tea is a strong diuretic. Also aids digestion, in a way that it breaks down the fats. In recent years, it has been often recommended for treating obesity. It has been well known that spearmint essential oils have antimicrobial and antioxidant effects [44]. Also, a common need is the availability of natural extracts with a pleasant taste or smell combined with a preservative action, aimed to avoid lipid deterioration, oxidation, and spoilage by microorganisms [49]. It is essential oil did not show any evidence of mutagenicity in the Ames test [1]. Spearmint has also been described as having excellent antioxidant activity comparable to BHT [30]. Due to both its antioxidant activity and its common use to season lamb in South Asian cuisine, it has been studied as an additive to radiation-processed lamb meat and was found effective in delaying oxidation of fats and reducing the formation of harmful substances, which can be detected using thiobarbituric acid as a reagent [30]. Spearmint has been studied for antifungal activity; it is essential oil was found to have some antifungal activity, although less than oregano [1].

Spearmint is mainly consumed and used in Mediterranean, European, and Indian cultures as a flavor ingredient in tea, beverage, and cooked meat preparations [38,56]. Recently, *M. spicata* has become a subject of scientific interest because of other potential uses of its essential oil and extracts, for the most part, as antimicrobial and antioxidant agents [40].

In addition to the health benefit of spearmint as explained by [6] intercropping spearmint with maize at a 42cm inter-row spacing of

spearmint followed by 36cm inter-row spacing is biologically efficient, economically feasible, and more profitable and provides opportunities for the producers than planting alone. However, recent scientific studies showed spearmint consumption its associated health benefits and advantages in the cropping system especially with maize which needs scientific evidence in an advance and through intensive research. With these in mind, the main aim of this review was to reports works done with

a wide-ranging overview of the health benefits of spearmint and its intercropping advantages with maize.

Major Chemical Compounds of Spearmint

The constituents found in spearmint are shown in (Table 1) below.

| Compound | Percentage (%) | Compound | Percentage (%) |
|---------------------|----------------|-----------------------|----------------|
| β - myrcene | 0.25 | Trans-carveol | 0.30 |
| Limonene | 11.50 | Carvone | 78.76 |
| Γ -terpinene | 0.16 | Dihydrocarvyl acetate | 0.57 |
| Menthone | 1.01 | L-carveol | 0.32 |
| Menthol | 1.00 | β – bourbonene | 1.23 |
| Terpinen-4-ol | 0.99 | Trans-caryophyllene | 1.04 |
| Δ -terpinol | 0.31 | γ – amorphene | 0.21 |
| Dihydrocarveol | 0.22 | α -amorphene | 0.16 |
| Cis-dihydrocarveol | 1.43 | Other compounds | 0.11 |
| Dihydrocarvone | 0.43 | Total | 100.00 |

(Adapted from Shahbazi, 2015)

Table 1. Result of MS essential oil analysis by gas chromatography-mass spectrometry

The main flavor compounds present in spearmint are limonene, dihydro carvone, dihydrocarveol carveol, and carvone [38,56]. The most abundant compound in spearmint oil is R (-) carvone, which gives spearmint its distinctive smell. Spearmint oil also contains significant amounts of limonene, dihydro carvone, and 1,8-cineol [25]. Spearmint has a flavor and pungent taste due to the high content of essential oils like carvone [47]. Carvone, a phenolic compound, is the main constituent found in spearmint oil, followed by limonene [20,28]. Carvone is reported to be potential in inhibiting bacterial growth, as well as to act as fungicide and insect repellent. Carvone also reversibly suppresses the sprouting in stored potatoes or flower bulbs.

Carvone renders the characteristic smell of spearmint. The smell is smooth and near analogous to fennel oil. However, (S)-carvone and (R)-carvone contribute to the odor of spearmint and caraway seeds respectively. Both are enantiomers of biological material but elicit a different response. Also, S-carvone possesses high antioxidant activity [11].

Bioactivity

Phenolic compounds extracted from *Mentha* have various applications in the food and pharmaceutical industries, including antioxidant properties due to the presence of phenolic compounds such as caffeic acid, eugenol, rosmarinic acid, and α -tocopherol [2]. The main bioactive compounds in spearmint oil are phenolic compounds, essential oils, and long-chain hydrocarbons. It is reported that spearmint possesses antioxidant activity [9] on account of the presence of phenolic acids, flavonoids, carvone, and ascorbic acid in leaves. According to [51] spearmint can become an alternate form for synthetic antioxidants that bring harmful effects. The biological activities of spearmint also include anti-inflammatory, antimicrobial, and sedative [31]. The good antimicrobial activity is attributed to the high concentration of carvone [51]. Besides, spearmint is carminative, antispasmodic, and diuretic [57].

The contents of phenolic compounds in spearmint oil are 8.9mg/100g for caffeic acid, 1344mg/100g for rosmarinic acid, and 16.8mg/100 g for luteolin [62]. Many volatile compounds have been identified in spearmint including flavonoid, thymonin, carvone, and limonene [3]. Reported that

extracted phenolic compounds from spearmint have been used for medical purposes.

The major extracted phenolic compounds from *Mentha aquatica* L. are luteolin-7-O-glucoside, eriocitrin, and rosmarinic acid, whereas hesperidin, luteolin-7-O-glucoside, eriocitrin, and rosmarinic acid are the major phenolic compounds in *Mentha piperita* L. [9,17,34,41,60] reported that rosmarinic acid is the predominant phenolic identified in different species of *Mentha*.

The Excellent Benefits of Spearmint:

Both fresh and dried spearmint plants are widely used in a variety of applications [37]. Since ancient times, both western and eastern cultures have been practiced spearmint as medical and aromatic plants [44]. In terms of biological uses, spearmint acts as insecticides [49], antispasmodics, and anti-platelets [58]. Moreover, spearmint is used as antimicrobial [55] and antioxidant agents [40].

In terms of medicinal benefits, spearmint is considered as an herbal medicine in folkloric remedies for treating colds and flu, respiratory tract problems, gastralgia, hemorrhoids, and stomachache [7,57,59]. Spearmint is extracted in the form of oil and is regularly used in medicine [7] states that spearmint leaves are generally taken as a tea in which its carminative properties can help to treat digestive disorders, fever, and minor ailments [46]. Furthermore, spearmint has broadly been applied to treat various illnesses. For instance, nausea, vomiting, and gastrointestinal disorders [26,36]. Also, spearmint flavonoids, thymonin, caffeic acid, rosmarinic acid, carvone, and limonene, have been used for medical purposes to address such issues as smooth muscle spasms, increase blood circulation, relieve pain, antiseptic, morning sickness, nausea, menstrual cramps, flatulence, flu, and vomiting [3]. Recently, phenolic compounds in mint have been investigated to repair DNA damage in cancer. Non-volatile components of *Mentha* species have beneficial effects in human health due to antimicrobial, antioxidant, anti-inflammatory, and antiallergic properties [9,19,28,41,53,56].

Golden benefits of spearmint according to [45] consumption of a proprietary spearmint extract (PSE) can sustainably improve cognitive

performance in young, healthy adults. Many published works of literature support that PSE can improve aspects of attention [42]. Consumption of PSE has been shown to improve attention and concentration when administered both acutely and chronically for 30 days in an open-label trial of older individuals with self-reported memory impairment [42]. Moreover, 3 small-scale studies in healthy men and women between the ages of 18 and 50 found trends for improvements in objective measures of attention as well as subjective reporting of increased feelings of alertness after acute supplementation with PSE [42]. In addition to the existing human clinical data, the polyphenol molecules contained in PSE have been shown to increase neurotransmitter levels in the brain related to attention [13,61]. Specifically, the polyphenols rosmarinic acid and

salvianolic acid B have both been shown to inhibit the enzyme that breaks down acetylcholine in the brain [13,61]. In an animal model, rosmarinic acid has been shown to increase levels of acetylcholine in the brain following acute administration [13]. Although the role of acetylcholine in learning and memory has been known for some time, more recent studies have revealed the additional function of acetylcholine for attention in both human and animal studies [33]. In the current study, daily supplementation with spearmint led to an 11% increase in sustained attention performance. So, sustained attention is an essential component of daily life and refers to the capacity to maintain focus on a specific item or task over an extended period [50]. (Table 2)

| Parameter | Mean (SEM) | P-value ² |
|-------------------|------------|----------------------|
| Memory | 3.7 (0.2) | 0.500 |
| Attention | 3.5 (0.2) | 0.125 |
| Speed of thinking | 3.4 (0.3) | 0.125 |
| Average score | 3.5 (0.2) | 0.063 |

Abbreviations: SEM, standard error of the mean.

Table 2. Subject Global Impression (SGI) scale of cognition questionnaire scores at the end of treatment in response to spearmint supplementation [29].

The SGI questionnaire was administered at the end of the 30-day treatment and subjects were asked to compare their current condition to their condition before inclusion in the study. Scores were coded as: 1 = very much improved, 2 = much improved, 3 = minimally improved, 4 = no change, 5 = minimally worse, 6 = much worse, 7 = very much worse.

P-values were calculated from Wilcoxon sign rank test, testing the difference from 4 (no change; n = 10) at the end of treatment in the modified intention-to-treat sample.

According to [35] aqueous spearmint extract, containing higher rosmarinic acid content relative to extracts from typical commercial lines, was well-tolerated and bioavailable in older subjects (50-70 years) with self-reported memory impairment. In addition, the aqueous spearmint extract may have implications in cognitive health and warrant further investigation.

Spearmint is commonly used as a domestic herbal remedy. A tea made from the leaves has traditionally been used in the treatment of fevers, headaches, digestive disorders, and various minor ailments [14]. The herb is antiemetic, antispasmodic, carminative, diuretic, restorative, stimulant, and stomachic [10,16,39]. The leaves should be harvested at the time of flower initiation of the plant and can be dried for later use [16]. The essential oil of the plant is antiseptic, though it is toxic in large doses [14]. The essential oil and the aerial stems are often used in folk remedies for cancer and a poultice prepared from the leaves (macerated leaves) is said to remedy tumors [10].

Phenolic compounds are among the bioactive food components with potential health benefits [21]. Dietary phenolics are well documented to decrease the risk of chronic diseases (e.g., type 2 diabetes, cardiovascular diseases, gastrointestinal diseases, and some cancers), and to have antiviral, antibacterial, antifungal, laxative, and anti-inflammatory activities [21].

Another benefit in terms of food uses, spearmint is used in food, confectionery, and chewing gum industries [7,26,37]. Spearmint

contributes to food preservation [52] and imparts food taste and aroma [26]. Spearmint is used in Iran as a flavoring agent in food products such as cheese and dough [54]. Besides, spearmint is added in Indian and Italian cuisine, either in fresh or dried form, to fish and shellfish plates before or after cooking [32,57]. Owing to the antioxidant, antiradical and chelating properties it possesses, the incorporation of spearmint in food can help to maintain the equilibrium of redox status in an organism as well as to improve safety and effect on human wellbeing [20]. Spearmint has been used broadly in cosmetics and soap [7,26,37] as well as toothpaste, breath freshener, an antiseptic mouth rinse [26,36].

Spearmint Intercropping Advantages with Maize

Many studies have emphasized the advantage of medicinal plants in intercropping systems, such as cassava/okra, Okra with chili pepper, saffron with chamomile, and spearmint with maize, were also reported. Also, to conserve the biodiversity, presence of medicinal plants in intercropping will also enhance their yield quantity. For instance, intercropping peppermint plants with soybean produced a significantly higher amount of essential oil when compared to monoculture plants, and the oil yield increased by 50%. Also, intercropping of spearmint with maize has advantages on weed suppression. Spearmint increased soil organic C and N by 32% and 47% within 2 years, respectively.

According to [6] in intercropping of maize with spearmint there was no significant ($p > 0.05$) yield variation in the two consecutive two cropping years. Similarly, the overall pooled mean showed there was no significant variation between intercropped and sole treatments and between each intercropped treatment. Even if no significant variation was observed in the pooled mean, the highest yield was recorded at 42cm inter row spacing of spearmint intercropped with maize which was similar to the individual harvesting seasons. This was possibly due to no shading effect of spearmint on maize and less competitiveness for the resources from the associated crops. Similar finding was reported by Prasad and Brook (2004) who observed that maize yield was not significantly influenced by soybean in maize- soybean intercropping systems under various densities of maize. (Figure 1)

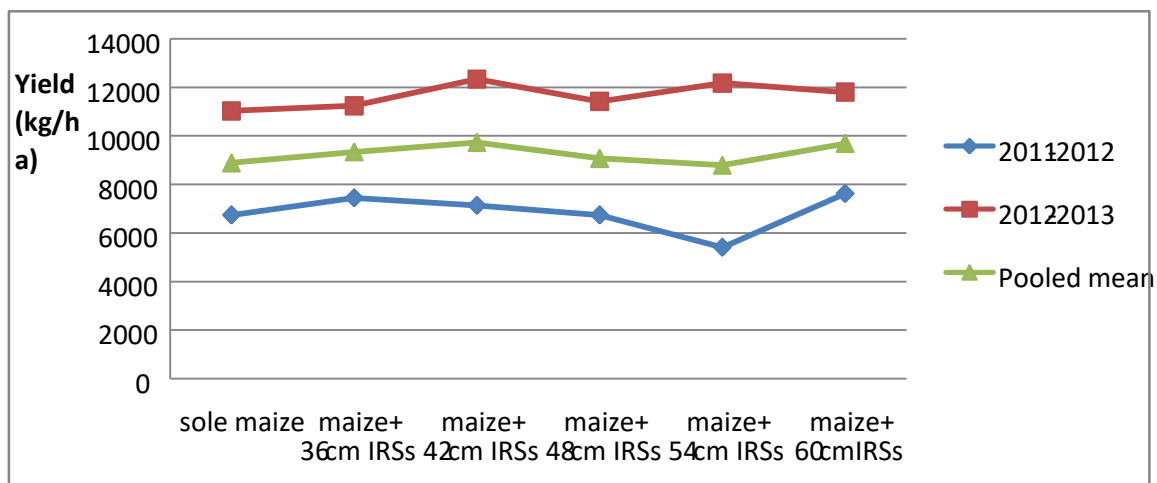


Figure 1. Influence of maize-spearment intercropping on grain yield of maize

The benefits of spearmint in an intercropping system suggest that mint may benefit the management of soil-borne pests as well as enhance soil and plant health. Soil health is the capacity of a soil to function within its

ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health [60]. (figure 2)



Sources: Lulie et al. (2014)

Figure 2. Mint plants in the field

Summary and Conclusion

Spearmint is an aromatic herbaceous, rhizomatous, and perennial herb belonging to the Lamiaceae family. The main flavor compounds present in spearmint are limonene, dihydro carvone, dihydrocarveol, and carvone. Also, the main bioactive compounds in spearmint oil are phenolic compounds, essential oils, and long-chain hydrocarbons. Phenolic compounds in spearmint were exhibited many biological activities. Thus, spearmint has great potential to be used in medical value especially according to Paul consumption of a proprietary spearmint extract can sustainably improve cognitive performance in young, healthy adults and functional foods applications. Spearmint has benefits in the intercropping system by sustaining biological productivity, maintain environmental quality, and promote plant and animal health. But the updated information worldwide about health benefits and its intercropping advantages of spearmint was scanty. So, further studies and

advanced researches are needed to enhance its cropping system, properties, and increase its applications.

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