Peppermint Oil Usage Guide

A research-based overview of the many benefits of peppermint oil.

Compiled by Dr. Steve Foster for

Essentially KateS

Thank you for your purchase. It is very much appreciated. If this is your first introduction to essential oils, welcome! We're honored that you chose Essentially KateS.

It wasn't that long ago that I was new to essential oils. I remember how amazed I was at all the uses I saw listed on the internet. But being a bit of a skeptic, I went to work to find out what had actually been studied scientifically. The more research I completed, the more impressed I became.

Peppermint oil is a good example, and a good start for someone new to essential oils. It smells great, it's a wonderful all-purpose cleaner, a natural insecticide and fungicide, an insect and rodent repellent, and has been shown by peer-reviewed scientific research to offer potential benefit in many areas of human and animal health.

Unfortunately, I am limited in what I can say about health benefits, due to FDA regulations. Bloggers on the internet can do it, because they are speaking in general. I'm speaking in reference to a particular product. If I were to make some of the health related statements about essential oils that permeate the internet, it would be considered by the FDA as a claim of cure for our product, and place it in the category of a drug, requiring FDA approval.

That is why this guide is written as it is. I can comment and offer direction on those topics that are not under FDA regulation. On health issues, I can only provide information. For that reason, I have put very many hours into assembling the extensive body of research included here. I hope it is helpful.

Please don't hesitate to ask questions, if you have them. You can contact me through support@essentiallykates.com. In addition, if you have knowledge of a use that isn't included here and should be, I would welcome hearing about it. I've learned as much from the kind people like you that buy our products as I have from the scientific research.

Thank you,
Dr. Steve Foster

Repelling Mice, Rats, and Rodents

By far, this is the top usage of peppermint oil that we encounter. Peppermint oil is an effective and humane natural rodent repellent. We've had reports of success repelling mice, rats (tougher), moles, voles, geckos (yes, small lizards), squirrels, and more.

There are many ways it can be applied. Whatever method you use, remember that the greater the "wet" surface area exposed, the more peppermint oil aroma you'll get in the air. Don't think it won't be effective if it doesn't smell so strong it makes your eyes water. You'll tend to "accomodate" (become less sensitive) to the odor the more you're exposed. Let the rodents be the judge.

The most common suggested application is to place saturated cotton balls in several small containers in the areas the rodents frequent. That is often very effective, and in most cases will last one to several weeks. If you want something that's a little less maintenance intensive, I suggest using small lidded plastic food containers, about 4 ounces in size.

Cut a slot across the center of the lid, about 1 1/4 inches by 1/8th of an inch. Cut a corresponding 12 inch by 1 inch strip of absorbent loose weave material that will fit through the slot; something like hurricane lamp wick. I found some loose weave wide old shoelaces that worked great; a burlap type material should work well. The key is that it be absorbent and of a course weave. Double the strip over, and insert the folded end through the slot in the lid from the bottom and pull it about 1 ½ inches through the top.

Pour a 1/2 inch or more of peppermint oil into the bottom of the container and place the lid with the cloth strip onto the container, S-folding the strip so that it makes good contact with the peppermint oil. Separate the two sides of the "wick" to form a 1 inch diameter loop to create more surface area. You'll want to wait 15 to 30 minutes after making the first one to see how well the oil wicks up into the material.

Once you've verified that it's working, make up the rest of the containers, and place them appropriately, near the suspected entry points of the mice, as well as wherever you've seen droppings or other evidence of mice. Check the containers every few weeks, and add more peppermint oil as needed. To increase the effect, pull up more "wick" through the slot, forming it into a larger loop, or add more containers. Try to keep the area you're "treating" as closed up as possible for a few days, to concentrate the effect.

In difficult to get areas, or if you're trying to repel animals in holes, consider cutting up an old sock, scrunching it up and stuffing it into a plastic sandwich bag. Saturate it with peppermint oil, tie off the bag and poke several holes in it. Drop them into the animal holes, or toss them into hard to get spaces. It will last until the peppermint oil evaporates off.

We often hear from people that are using peppermint in their car or camper to keep mice from eating the insulation around the wiring. In moving vehicles, it may be best to use the spray described under "Repelling Spiders," below and/or the sock method described above, but rather than using a plastic bag, wrap the sock with aluminum foil, poke holes in it and wire it or stuff it into a small space from which it is unlikely to escape when the vehicle is in motion. Be sure to place it in a manner that it isn't subjected to high heat. Peppermint oil is still an oil, and as such, flammable.

We get many more reports of success in repelling rodents than we do of failure (~90%+), but it hasn't worked every time. I don't always get to ask questions of those that are unsuccessful, so it's difficult to determine whether it's due to deficiencies in the application, differences in the mice, environment, or some

other variable. Sometimes you have to be creative. If you have difficulties, please don't hesitate to ask for help. We'll both learn from the experience.

Here are some more contributions on this topic, found on the internet.

Mother Earth News: December 2010/January 2011
I live in a 102-year-old house, on a small acreage, which helps explain why I had a problem and needed to know how to get rid of mice in the walls. (It sounded like they were having a party in there!)
The young lady that works where I shop recommended peppermint oil for mice. She'd heard from her grandma that all you need are peppermint-soaked cotton balls scattered about, and mice will split!
So I placed small, peppermint-soaked cotton balls all around the kitchen. I unscrewed two wall plugs and carefully slipped some in behind the sockets and, like magic, no more sounds of mice. Twenty-four hours later, no sign of the mice at all.
Norm Noe Vancouver, Washington

Mother Earth News: June/July 2003
I recently discovered an effective yet humane way to de-mouse my pantry. We live in an old farmhouse, and at the onset of winter, mice invade our home. Our pantry is a favorite target. I put an empty box of peppermint tea in with my paper recyclables and noticed the mouse activity dropped dramatically. To get rid of mice, I now place a few squares of cotton cloth sprinkled with peppermint oil in the pantry, refreshing them as needed. No mice, and it smells wonderful!
Susan Womersly Topeka, Kansas

WikiHow: How to Get Rid of Mice Naturally
Try peppermint oil. Peppermint oil is a natural deterrent. The smell is simply too intense for rodents and they will not try to go near it. It also helps to mask the scent of any tasty morsels that have been missed when cleaning. You can get peppermint oil in most health food stores and even some major grocery stores.
Place a drop or two on a cotton ball. Place the cotton balls in areas where mice are likely to enter your house, by doorways or heat vents, etc.
Another helpful deterrent is to grow peppermint plants near the entryways. You can use the mint in cooking as well as it serving a deterrent purpose.

people.consolidated.net: A Humane, Scentsible Way to Rid Your Home of Rats
There is a more humane and practical remedy for ridding your attic of rats: peppermint and eucalyptus oil. For some reason, rats loathe the fragrant fumes emitted by these oils. It's important to buy actual full strength oils..
Unadulterated peppermint and eucalyptus oils are so strong they may eat into whatever surface you place them on. Unless you happen to have some empty glass baby food jars lying around, buy some aluminum (not plain paper) cupcake liners when you make your peppermint and eucalyptus oil run.
When you get home, carry a bag of cotton balls, your oils, and your cupcake liners up to the attic. Place a couple of cotton balls in each cupcake liner (or baby food jar), saturate one ball with several drops of peppermint oil and the other with eucalyptus oil, and strategically position them around the attic. The oils evaporate quickly and the scent may be a bit overpowering, but in a nice way. If you're suffering from allergies, it may even clear out your sinuses.
The only catch with this solution is that the oils evaporate so quickly, the scent will be gone within a couple of weeks, leaving your attic vulnerable to re-infestations. Once gone, your rats may never return.

However if your attic does suffer a second invasion, you may resort to the slightly more costly Plan B. Purchase a few empty kerosene-style glass lamps and fill the base of each with peppermint oil. Leave off the top portion of the lamp and set the wick so that the oil slowly travels up out of the base to scent the air surrounding the lamp. Depending on how much oil your lamps hold, this method should work for several months. Note that any articles you store in your attic may absorb the scent over time. Imagine bringing down a peppermint-scented Christmas tree in December!

Repelling Spiders

Spider repelling is the second most common usage of peppermint oil that we hear about. We get reports every week of people having great success in repelling spiders with our peppermint oil.

I suggest making up a 1 to 2% solution of peppermint oil and water in a spray bottle by adding 6 (1%) or 12 (2%) drops per ounce of water. There are 50 drops in a teaspoon. Add a few drops of dish soap (preferably unscented) to help the oil and water mix.

If possible, wipe down the areas you intend to spray with a solution of water and 10% white vinegar, or at least brush out the webs with a broom. Shake as you go and spray the peppermint solution where appropriate, including baseboards, windowframes, screens, and corners. Keep in mind that if you spray everything, the spiders will have no choice but to find places "in between" to hole up. Use the spray to "herd" the spiders toward wherever it is you'd like them to go over a few days time, then keep the perimeters of that area well sprayed. In difficult cases, you may achieve greater effect combining peppermint with lavender oil or tea tree oil.

How often you need to spray varies with environment. You'll need to spray outside areas more often, and you'll need to spray more in drier climates. You can also take a sewing pin and "tack" saturated cotton balls or cloth swatches to walls or corners.

Here are some other contributions on this topic, found on the internet.

WikiHow: How to Make Spider Repellent at Home
You can make your own spider repellent to use in your home and garden. There are many natural ingredients you can use that repel spiders that won't harm you, your family or your pets. Natural spider repellents have to be applied more often than pesticides, but they are safer and they have a pleasant smell. All spiders have their taste buds on the tips of their legs and there are certain scents they hate, so using those scents will repel the spiders, both inside and outside your home.
Add up to 5 drops of essential oil and up to 5 drops of natural dish washing liquid to 1 qt. of water. The following essential oils work well as spider repellents (especially citrus): Citrus, Tea tree, Lavender, Cinnamon, Peppermint, Citronella.
Pour the mixture into a spray bottle and shake it well. Spray the areas inside your home where you have seen spiders. For an overall treatment, spray your natural repellent along baseboards and in the corners where the wall meets the ceiling.

Healthy Living: DIY peppermint spider repellent
Spiders don't like strong-smelling herbs like mint, lavender and orange. THEY HATE PEPPERMINT OIL.
Here is one of our most effective spider repellent recipe.

Directions:
Add 10 to 15 drops of peppermint essential oil into a spray bottle with 8 to 12 ounces of water.
Spray around door frames, windows, small cracks, corners of the ceilings and bathrooms.
Use peppermint essential oil without water for a more potent version.
Please do this once a week, your healthy family will thank you! During the summer when the weather is hot do this twice a week.

Everyday Roots: Recipe for All Natural Spider-Stay-Away-Spray
You will need…
-5 to 7 drops of peppermint, tea tree, citrus, lavender, or neem essential oil
-a reusable spray bottle
-liquid dish soap
-warm water
-a dash of white vinegar (optional)*
Directions
Put 5-7 drops of peppermint oil in a spray bottle (about 16 ounces is good), and fill mostly to the top with warm water. Add a squirt of dish soap, place the top on, and give the mixture a good shake. Before using, use the hose attachment of your vacuum to suck up any egg sacs or old webs. Test on an inconspicuous area, and then spray in the corners of window frames, along door cracks, or in dark dingy places spiders may be hiding out. You can also add a dash of white vinegar to the mixture, but keep in mind this could affect some fabrics and surfaces.

Repelling Ants

Ants can be particularly difficult. Use the same spray mix as for spiders. If they have regular paths that you can locate, wipe them down first with full strength white vinegar, then spray.

In difficult cases, if it's in a place where you can wipe it down with full strength peppermint oil after cleaning with vinegar, do so, and repeat until they're gone. As always, if you have difficulty, e-mail me at support@essentiallykates.com.

Repelling Flies, Wasps, Lice, and other Insects

Peppermint oil is an effective insect repellent, inside or out. I received a note from someone last week, saying that their grandmother swore that diffusing peppermint oil in the house kept flies and spiders away. However, when trying to repel insects *outside*, focus on repelling the insects from whatever is drawing them to the area, rather than trying to treat everything.

To repel houseflies inside, spray doorways and other entry points with a 1 to 2% solution of peppermint oil (instructions on mixing above under spider repellent), as well as using your choice of aromatherapy method to get peppermint oil into the air of the house and kitchen. It wouldn't be a bad idea to use aromatherapy in the barn or animal enclosure, for that matter, if the enclosure is well contained.

Peppermint oil has been studied scientifically for use in repelling flies, ticks, lice, and other parasites on pets and livestock, and many of the studies have shown good success.

For pets and livestock, groom a 1 to 2% solution of peppermint oil to carrier oil (rosehip, almond, jojoba, olive, etc.) into the coat of animals. If that's too labor intensive, try spraying with a 1 to 2% solution. It

may not last as long or be as effective against ticks and fleas, but it should keep the flies off. In one study I reviewed, they were dipping sheep in an essential oil solution, and produced very good results, including improved quality of the wool. Be sure to test a small area of any animal first for tolerance, and do your best to keep it away from the eyes and nose.

Here are some short quotes from research abstracts that comment on peppermint oil studied in this capacity. The full abstracts are included in the Research Addendum at the end of this guide. You can also access the full abstract, and in some cases the full article, free atwww.pubmed.com. In most cases, there is a fee for the full article. Enter the title reference in the search bar, and follow the links.

Parasitol Res. 2012 Oct;111(4):1799-805.
Bioefficacy of essential oils of medicinal plants against housefly, Musca domestica L.
"The highest larvicidal activity.. was shown by M. piperita. This oil also exhibited 96.8% repellency at the concentration of 1%. The highest oviposition deterrence activity of 98.1% was also exhibited by M. piperita oil at the concentration of 1%." (M. Piperita is peppermint oil)

Ecotoxicol Environ Saf. 2014 Feb;100:1-6.
Biocontrol potential of essential oil monoterpenes against housefly, Musca domestica (Diptera: Muscidae).
"Bioefficacy against housefly adults revealed highest repellent activity by menthol (95.6 percent) and menthone (83.3 percent)." (These are two primary ingredients of peppermint oil.)

Southeast Asian J Trop Med Public Health. 2013 Mar;44(2):188-96.
Efficacy of herbal essential oils as insecticides against the housefly, Musca domestica L.
"The insecticidal effects of 20 essential oils.. were tested against the housefly species Musca domestica.."
"Ten percent concentrations of Cymbopogon citratus (lemongrass), Mentha piperita (peppermint) and Lavandula angustifolia (lavender) oils were the most effective, showing 100% knockdown at 30 and 60 minutes."

Med Vet Entomol. 2011 Sep;25(3):302-10. Repellent, larvicidal and pupicidal properties of essential oils and their formulations against the housefly, Musca domestica.
"In repellency bioassays, M. Piperita.. was found to be most effective.."
"In pupicidal bioassays, crude oils of M. piperita and E. globulus suppressed the emergence of adult flies by 100%. Field experiments with the M. piperita formulation showed reductions in fly density (number of flies/h) of 96% on treated cattle and 98% on treated plots."

Med Vet Entomol. 2014 Jun;28(2):193-200.
Repellent effectiveness of seven plant essential oils, sunflower oil and natural insecticides against horn flies on pastured dairy cows and heifers.
"All essential oils repelled > 75% of the flies on the treated area for 6 and 8 h on pastured cows and indoor heifers, respectively. Geranium, lemongrass and peppermint stayed effective for a longer duration."

Vet Parasitol. 2009 Oct 14;164(2-4):257-66. Lousicidal, ovicidal and repellent efficacy of some essential oils against lice and flies infesting water buffaloes in Egypt.
All treated lice were killed after 0.5-2 min, whereas with d-phenothrin, 100% mortality was reached only after 120 min." (D-phenothrin is a chemical pesticide.)

Arch Dermatol Res. 2007 Oct;299(8):389-92. Epub 2007 Jul 24.

Effectiveness of lotions based on essential oils from aromatic plants against permethrin resistant Pediculus humanus capitis.
"We found that experimental lotions containing lavender, peppermint and eucalyptus oils in a 5% composition and the combination of eucalyptus and peppermint in a total concentration of 10%.. showed the best knockdown effect."
"lotion containing peppermint oil and eucalyptus oil (1 + 1) 10%, dissolved in ethanol 96%, showed to be as effective as the best commercial lotion now available in Argentina." (Pediculus humanus capitis is the scientific name for human head lice.)

Pest Manag Sci. 2013 Apr;69(4):542-52. doi: 10.1002/ps.3411. Epub 2012 Oct 19.
Essential oils and their compositions as spatial repellents for pestiferous social wasps.
"The study objectives were: (1) to field test potential repellency of common essential oils against several pestiferous social wasps.."
"Of the 21 essential oils tested, 17 showed significant repellency on yellowjackets.. clove, pennyroyal, lemongrass, ylang ylang, spearmint, wintergreen, sage, rosemary, lavender, geranium, patchouli, citronella, Roman chamomile, thyme, fennel seed, anise and peppermint."

J Ethnobiol Ethnomed. 2011 Jul 14;7:21. doi: 10.1186/1746-4269-7-21.
Organic parasite control for poultry and rabbits in British Columbia, Canada.
"Plants used for treating endo- and ectoparasites of rabbits and poultry in British Columbia included.. Mentha piperita.."

Cleaning

Peppermint oil is anti-bacterial, anti-viral, and anti-fungal, a great deodorant, and at the same time repels houseflies, mites, and other insects that transfer bacteria and fungus, so prevents them from landing on treated surfaces. That makes it a great choice for general cleaning. You can add peppermint oil to any cleaner you already use. In our household, we use non-toxic botanic soap for almost everything, and adding a little peppermint oil makes it just that much more pleasant and effective.

For surface cleaning, I suggest mixing a 1 to 2% solution in a spray bottle (6 drops/ounce is 1%; 50 drops to a teaspoon). Add a quarter to a half cup of vinegar (or if you have a water filter that can be set to produce acidic water, use that) and a few drops of dish soap to help the oil and water mix. Use distilled or purified water if available. Shake as you go, spray and wipedown, counters, surfaces, sinks, cupboards, etc.

Here are some short quotes from research abstracts that comment on peppermint oil studied in this capacity. The full abstracts are included in the Research Addendum at the end of this guide. You can also access the full abstract, and in some cases the full article, free atwww.pubmed.com. Enter the title reference in the search bar.

Anti-bacterial
Phytomedicine. 2012 Aug 15;19(11):969-76.
Antimicrobial activity of a traditionally used complex essential oil distillate (Olbas(®) Tropfen) in comparison to its individual essential oil ingredients.
"Plant extracts and essential oils have been widely studied and used as antimicrobial agents in the last decades."

"Olbas displayed a high antimicrobial activity against all test strains used in this study, among them antibiotic resistant MRSA (methicillin-resistant Staphylococcus aureus) and VRE (vancomycin-resistant Enterococcus). Its antimicrobial activity was comparable to that of peppermint oil which was the most potent one of all individual essential oils tested."

Molecules. 2011 Feb 15;16(2):1642-54.
Peppermint oil decreases the production of virulence-associated exoproteins by Staphylococcus aureus.
"The data show that peppermint oil, which contained high contents of menthone, isomenthone, neomenthol, menthol, and menthyl acetate, was active against S. Aureus.."

J Appl Bacteriol. 1995 Jun;78(6):593-600.
Effects of essential oil from mint (Mentha piperita) on Salmonella enteritidis and Listeria monocytogenes in model food systems at 4 degrees and 10 degrees C.
"The effect of mint (Mentha piperita) essential oil (0.5, 1.0, 1.5 and 2.0%, v/w) on Salmonella enteritidis and Listeria monocytogenes in a culture medium and three model foods.."
"In the culture medium supplemented with the essential oil, no growth was observed over 2 d at 30 degrees C..."

Microbios. 1995;84(340):195-9.
Effect of essential oils on the viability and morphology of Escherichia coli (SP-11).
"The four essential oils.. peppermint (Pt) and eucalyptus (Eu) plants were found to be bactericidal to Escherichia coli.."

Anti-viral
Phytomedicine. 2003;10(6-7):504-10.
Virucidal effect of peppermint oil on the enveloped viruses herpes simplex virus type 1 and type 2 in vitro.
"Peppermint oil exhibited high levels of virucidal activity against HSV-1 and HSV-2 in viral suspension tests."
"Higher concentrations of peppermint oil reduced viral titers of both herpesviruses by more than 90%."

Retrovirology. 2008 Mar 20;5:27.
Aqueous extracts from peppermint, sage and lemon balm leaves display potent anti-HIV-1 activity by increasing the virion density.
"Extracts from lemon balm (Melissa officinalis L.), peppermint (Mentha x piperita L.), and sage (Salvia officinalis L.) exhibited a high and concentration-dependent activity against the infection of HIV-1..."

Anti-Fungal
J Environ Biol. 2013 Jan;34(1):17-22.
Screening of some essential oils against Trichosporon species.
"The results showed that the maximum anti-yeast activity against T. asahii and T. cutaneum was demonstrated by oil of Mentha piperita showing full inhibition of both the fungi..."

Phytochemistry. 2006 Jun;67(12):1249-55.
Biochemical activities of Iranian Mentha piperita L. and Myrtus communis L. essential oils.
"The oils had good to excellent antimicrobial activities against Escherichia coli, Staphylococcus aureus and Candida albicans with the oil of M. piperita being more active."

Molecules. 2009 Jan 7;14(1):238-49.
Chemical composition of essential oils of Thymus and Mentha species and their antifungal activities.
"The commercial fungicide, bifonazole, used as a control, had much lower antifungal activity than the oils.."
"It is concluded that essential oils of Thymus and Mentha species possess great antifungal potential and could be used as natural preservatives and fungicides."

Food Preservation

Due to its anti-microbial, anti-fungal, and antioxidant properties, peppermint oil solution makes a great soak for perishable foods. Scientific studies have shown that fruits, vegetables, and even meats stay fresh longer if soaked (or in some cases sprayed) in a peppermint oil solution. The insect repellent activity is another added benefit.

Fill a large bowl with warm water, and add twenty drops (or more) of peppermint oil. If you have a botanic or a non-toxic soap, add a few drops of that as well to help the oil and water mix. Immerse fruits, vegetables, and meats for five to ten minutes each, stirring periodically. Rinse and store as usual.

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Meat Sci. 2012 Dec;92(4):667-74.
Antioxidant and antibacterial effects of Lavandula and Mentha essential oils in minced beef inoculated with E. coli O157:H7 and S. aureus during storage at abuse refrigeration temperature.
"Both EOs caused a significant decrease of bacterial growth in minced beef.."
"results showed that the addition of EOs significantly extended fresh meat odor even at abuse temperature."

Pak J Biol Sci. 2008 Sep 1;11(17):2054-61.
The potential application of plant essential oils as natural preservatives against Escherichia coli O157:H7.
"Zataria multiflora was the most effective essential oil against the bacterium in all concentrations, followed by Mentha piperita and Carum carvi. The maximum inhibitory effects of all essential oils were seen at 1% concentration."
"The 1% concentration of Mentha piperita.. showed bacteriostatic effect on growth of Escherichia coli O157:H7 at 35 degrees C."
"It is concluded that selected plant essential oils have promising inhibitory effects on Escherichia coli O157:H7 in chicken soup and could be considered as natural food preservatives."

Pharmacogn Mag. 2010 Jul;6(23):147-53.
Protective effects of bioactive phytochemicals from Mentha piperita with multiple health potentials.
Mentha piperita essential oil was bactericidal in order of E. coli> S. aureus > Pseudomonas aeruginosa > S. faecalis > Klebsiella pneumoniae."

"The essential oil of mint may be exploited as a natural source of bioactive phytopchemicals bearing antimicrobial and antioxidant potentials that could be supplemented for both nutritional purposes and preservation of foods."

Molecules. 2009 Jan 7;14(1):238-49.
Chemical composition of essential oils of Thymus and Mentha species and their antifungal activities.
"It is concluded that essential oils of Thymus and Mentha species possess great antifungal potential and could be used as natural preservatives and fungicides."

J Food Prot. 2014 Oct;77(10):1819-23.
Acaricidal activity of constituents derived from peppermint oil against Tyrophagus putrescentiae.
"The acaricidal activities of peppermint oil and menthol isomers against mites in stored food were evaluated using fumigant and contact bioassays and were compared with the activity of benzyl benzoate as a synthetic acaricide."
"menthol (0.96 µg/cm(2)) was approximately 12.18 times more effective than benzyl benzoate.."
"These results indicate that peppermint oil and menthol isomers could be effective natural acaricides for managing mites in stored food."

Personal care

There are many uses for peppermint in personal care, from brushing your teeth to adding it to your shampoo, mixing your own shaving lotion, showering, foot care, sock and shoe care, etc. You'll find many more on the internet.

Toothpaste: For fresher breath, add a drop to your toothbrush before applying toothpaste, or better yet, make up your own toothpaste. There are many recipes available online. I use a combination of a diluted non-toxic botanic soap and peppermint oil.

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J Int Soc Prev Community Dent. 2013 Jan;3(1):29-31.
Evaluation of the use of a peppermint mouth rinse for halitosis by girls studying in Tehran high schools.
"A total of 43 students in group 1 received a peppermint mouth rinse and 41 students in another group were given placebo."
"In the mouth rinse group, after 1 week 23 students didn't exhibit halitosis, and 11 students in the placebo group were halitosis positive."
"Based on the results of this study, it can be said that a peppermint mouth rinse can reduce halitosis."

Phytother Res. 2007 Jul;21(7):641-3.
Reduction of mouth malodour and volatile sulphur compounds in intensive care patients using an essential oil mouthwash.
These findings suggest that mouth care using an essential oil mixture of diluted tea tree, peppermint and lemon may be an effective method to reduce malodour.."

Eur J Dent. 2013 Sep;7(Suppl 1):S71-7.
Antimicrobial efficacy of five essential oils against oral pathogens: An in vitro study.
"Out of five essential oils, eugenol oil, peppermint oil, tea tree oil exhibited significant inhibitory effect.." "Peppermint, tea tree and thyme oil can act as an effective intracanal antiseptic solution against oral pathogens."

Shaving: I use the same botanic soap / peppermint oil mix that I brush my teeth with as shaving cream. It leaves my face feeling fresh and tingly.

In the Shower: Wait until the water is warm/hot, and sprinkle a few drops of peppermint oil on the floor. Guaranteed to help you wake up in the morning!

Hair Care: Add a few drops to your shampoo for a very stimulating scalp massage. Peppermint oil has also been shown, in at least one study (included here), to promote hair growth.

Here are some quotes from that study. The full abstract is included in the Research Addendum at the end of this guide. You can access the full article free atwww.pubmed.com. This is provided for informational purposes only, and not a recommendation for treatment, or a claim ofcure. Enter the title reference in the search bar.

Toxicol Res. 2014 Dec;30(4):297-304.
Peppermint Oil Promotes Hair Growth without Toxic Signs.
"The animals were randomized into 4 groups based on different topical applications: saline (SA), jojoba oil (JO), 3% minoxidil (MXD), and 3% peppermint oil (PEO). The hair growth effects of the 4-week topical applications were evaluated.."
"Of the 4 experimental groups, PEO group showed the most prominent hair growth effects; a significant increase in dermal thickness, follicle number, and follicle depth."

Lip Balm: Warm some coconut oil and mix in a few drops of peppermint oil, then refrigerate to solidify, for a very refreshing lip balm.

Foot Bath: Make up a warm sea salt or epsom salt foot bath, and add ten to twenty drops of peppermint oil. Use a small brush to brush it in around the cuticles and under the nails.

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Nihon Ishinkin Gakkai Zasshi. 2007;48(1):27-36.
Combined effect of heat, essential oils and salt on fungicidal activity against Trichophyton mentagrophytes in a foot bath.
"This work was originally undertaken to determine the effective conditions of essential oils against Trichophyton mentagrophytes in vitro for the treatment of tinea pedis in a foot bath."
"The order of the fungicidal activity of 11 essential oils was oregano, thyme thymol, cinnamon bark > lemongrass > clove, palmarose, peppermint, lavender > geranium Bourbon, tea tree > thyme geraniol oils. MFCs were further reduced to 1/2 - 1/8 by the addition of 10% sodium chloride."

"Thermotherapy combined with essential oils and salt would be promising to treat tinea pedis in a foot bath."

Socks and Shoes: Wash your socks in a separate washing machine load. Add peppermint oil to a warm rinse cycle, and also spray down a washcloth with peppermint oil spray and throw it in the dryer with the socks. You could also drip a few drops of peppermint oil into your shoes every once in a while.

Mosquito Repellent

Many essential oils are natural mosquito repellents, and peppermint oil is one of the best.

You can simply dab a few spots of peppermint oil on your body or clothing (remember it is oil and will tend to stain clothing). I put a good dose on my hat when I go fishing, and a little on the backs of my hands. I get many reports of people using it in this manner with great effectiveness.

For a spray, start with 6 (1% solution) to 12 (2% solution) drops per ounce of distilled water, along with a few drops of botanic soap (or dish soap) to help the oil and water mix. Shake and spray as appropriate, taking care to avoid the eyes and the fingers, so that it isn't transferred to the eyes. If you have other essential oils on hand, you might trial different combinations, as the effect of combining oils always seems to be synergistic in scientific study.

For a cream, mix up a one to two percent solution of peppermint oil to the carrier oil of your choice. I suggest rosehip oil, because it's so good for the skin. Coconut oil is another good choice. It would make the cream thicker, so may make it easier to apply due to the higher melting point. It has also been shown to increase the repellent activity of other essential oils. Just warm it a little when you initially mix it, so that it liquifies. A little goes a long way, and because it's entirely oil, this does entail the risk of staining clothing.

Here are some short quotes from research abstracts that comment on peppermint oil studied in this capacity. The full abstracts are included in the Research Addendum at the end of this guide. You can also access the full abstract, and in some cases the full article, free atwww.pubmed.com. Enter the title reference in the search bar.

Asian Pac J Trop Biomed. 2011 Apr;1(2):85-8.
Bioefficacy of Mentha piperita essential oil against dengue fever mosquito Aedes aegypti L.
"The measured area of one arm of a human volunteer was applied with the oil and the other arm was applied with ethanol. The mosquito bites on both the arms were recorded for 3 min after every 15 min."
"The application of oil resulted in 100% protection till 150 min. After next 30 min, only 1-2 bites were recorded as compared with 8-9 bites on the control arm."

Pest Manag Sci. 2008 Mar;64(3):290-5.
Insecticidal activity of menthol derivatives against mosquitoes.
"The insecticidal activity of essential oil of Mentha piperita L. emend. Huds. against local mosquitoes as disease vectors was recognized and found to be due to the presence of menthol, which is the major aroma compound of the oil."

Parasitol Res. 2014 May;113(5):1813-20.
A rationale to design longer lasting mosquito repellents.

"Recently, research has been focused on repellents of natural origins, both crude essential oils and their main constituents."
"a 1% solution of one of such derivatives can still reduce mosquito bites by 90% after 2 h, while DEET provides the same performance only for 15 min.."

Parasitol Res. 2011 Oct;109(4):1125-31.
Oviposition-altering and ovicidal potentials of five essential oils against female adults of the dengue vector, Aedes aegypti L.
"The oviposition deterrence and ovicidal potential of five different essential oils, peppermint oil (Mentha piperita).. were assessed against female adults of the dengue vector, Aedes aegypti L."
"The use of 10% oil resulted in the maximum deterrence of 97.5% as shown by the M. piperita oil while other oils caused 36-97% oviposition deterrence as against the control."

Here's more information about making your own mosquito repellent, found on the internet.

jacope.hubpages.com: My Favorite Mosquito Repellent, Peppermint
I still had the bottles of peppermint and spearmint essential oils so I took a small bottle and filled it almost full with olive oil, which is was I used to cook with, and added a few drops of each essential oil to it and shook it up to mix it. I coated every piece of bare skin in the oil. Oh boy did I reek of peppermint, it was a little (okay a lot) strong. But when I went outside and went for a walk I had almost not mosquito bites when I got home. I was thrilled. I had been gone for almost an hour and was nearly bite free. To this day peppermint, and spearmint but I prefer the peppermint, is my number one favorite repellent. I no longer make it so strong it's enough to drive people away as well as mosquitoes, but it is still just as effective. I like it even better since it also doesn't have the chemicals that most repellents do so I can use it on my daughter as well. This is a big plus for me since my daughter would end up with welts the size of quarters whenever she got bit by a mosquito. I don't think there is much of anything worse than seeing your baby covered in welts from bug bites.

EHow: How to Use Peppermint Oil as an Insect Repellent
Peppermint oil, while unusually fragrant to humans, acts as a repellent to most insects, especially mosquitoes and fleas. You can apply dabs of concentrated peppermint oil to focal points on your skin or clothes, or use a diluted formula to spray over broader areas.
Purchase peppermint oil in its pure, concentrated form, and apply a few drops to focal points on your clothing. You can add a little peppermint oil inside pockets, and on areas where perspiration may attract mosquitoes and fleas, such as under your arms or around your collar. Test a few drops of peppermint oil on a hidden part of your clothing to ensure that it will not stain the fabric.
Dilute 1 part peppermint oil with 10 parts rubbing alcohol and place the solution in a plastic spray bottle. This will allow you to use peppermint oil in broader applications, such as on plants, pets and clothing. You can also spray the solution on your skin, although you may want to rub a little on your forearm first to make sure it does not irritate your skin.
Mix peppermint oil with other types of natural oils that act as an insect repellent, such as rosemary oil, lemongrass oil and lemon eucalyptus oil. Using a mixture of more than one oil ensures that a greater variety of pests can be repelled, and that the potency of the formula will last longer as well. Lemon eucalyptus oil, in particular, can extend the length of protection from pests to 5 or 6 hours. Use peppermint oil as an insect repellent by breaking open a few Vitamin E capsules and mixing the oil with peppermint oil. A Vitamin E and peppermint oil mixture will keep your skin smooth and soft, and will act

as an effective and natural insect repellent as well. You may need to re-apply the solution once every 1 to 2 hours, however, for best results.
Wash the peppermint oil from your skin thoroughly with soap and hot water once you return indoors. While peppermint oil is relatively safe in moderate quantities, it can irritate your skin if overused.

Alertness, Wakefulness, and Concentration

Peppermint oil is a natural stimulant. Ideas abound, from diffusing peppermint oil where the kids do their homework, to sprinkling a few drops into your cars ventilation system on long drives or late at night. Peppermint oil has also been studied for its effect on some elements of cognitive function.

Here are some short quotes from research abstracts that comment on peppermint oil studied in this capacity. The full abstracts are included in the Research Addendum at the end of this guide. As before, this is provided for informational purposes only, not as a recommendation for treatment or a claim of cure. You can also access the full abstract, and in some cases the full article, free atwww.pubmed.com. Enter the title reference in the search bar.

Int J Neurosci. 2008 Jan;118(1):59-77.
Modulation of cognitive performance and mood by aromas of peppermint and ylang-ylang.
"Peppermint was found to enhance memory.."
"peppermint increased alertness.."

Percept Mot Skills. 2003 Dec;97(3 Pt 1):1007-10.
Improved performance on clerical tasks associated with administration of peppermint odor.
"Analysis indicated significant differences in the gross speed, net speed, and accuracy on the typing task, with odor associated with improved performance. Alphabetization also improved significantly under the odor condition.."
"These results suggest peppermint odor may promote a general arousal of attention, so participants stay focused on their task and increase performance."

Neurosci Lett. 2005 Nov 25;389(1):35-40.
Olfactory facilitation of dual-task performance.
"The results showed a significant performance improvement in the presence of peppermint odor.."

Cephalalgia. 1994 Jun;14(3):228-34; discussion 182.
Effect of peppermint and eucalyptus oil preparations on neurophysiological and experimental algesimetric headache parameters.
"The combination of peppermint oil, eucalyptus oil and ethanol increased cognitive performance and had a muscle-relaxing and mentally relaxing effect.."

J Clin Exp Neuropsychol. 1998 Apr;20(2):227-36.
Effects of olfactory stimulation on the vigilance performance of individuals with brain injury.
"The false alarm rate of observers with brain injury increased precipitously toward the end of the vigil in the unscented air condition. However, exposure to the scent of peppermint rendered the false alarm scores of observers with brain injury similar to that of controls.."

Int J Psychophysiol. 2005 Mar;55(3):291-8.
Preliminary investigation of the effect of peppermint oil on an objective measure of daytime sleepiness.

"When compared with a no-odour condition, the presence of peppermint oil limited the increase in sleepiness during 11 min spent in a darkened room. "
"It seems that in conditions that favour an increase in daytime sleepiness, peppermint oil can indeed reduce sleepiness."

Sleep

I always breathe better when peppermint oil is in the air, and I like to use it at night, in part for that reason.

Spray a washcloth with peppermint oil spray and slip it inside your pillowcase, or use another method of getting peppermint oil into the air where you sleep. You could place an open shallow bowl of peppermint oil, use a diffuser, or a simmering pot.

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Biol Psychol. 2006 Mar;71(3):341-9. Epub 2005 Sep 6.
Sleep changes vary by odor perception in young adults.
"Peppermint reduced fatigue and improved mood and was rated as more pleasant, intense, stimulating, and elating than water. These perceptual qualities associated with sleep measures: subjects rating peppermint as very intense had more total sleep than those rating it as moderately intense, and also showed more slow-wave sleep (SWS) in the peppermint than control session."

Aromatherapy Options

There are several options for getting peppermint oil aroma into the air.
1. Sniff it from the bottle (not the best choice; it always seems to smell better outside the bottle).
2. Apply a small amount beneath the nostrils (be careful if you're sensitive).
3. Place open containers of peppermint.
4. Use a diffuser or hot water bath (simmering pot).

Diffusers do not heat the oil, which is considered as an advantage by some. However, I have been unable to find evidence that moderate heating in a water bath alters the characteristics of the oil. Diffusers require more attention. Depending on their size, they must be refilled as often as every few hours. They also go through more oil.

I have seen studies in which aromatherapy was performed by leaving an open container near the subject, by wearing a small peppermint oil sachet on the lapel, by use of oxygen mask infusion, by diffuser, and even by heating it in a "simmering pot."

I maintain a small heated ceramic pot in my office which I purchased at WalMart for $10. It is easily maintained. I add a few drops of oil each morning (from a large selection), and about a half cup of distilled water every 3 to 4 days. I do empty it and clean it occasionally, but it isn't really necessary, as the oils keep it clean. It is set on a timer that comes on an hour before we arrive, and shuts off an hour before we leave. Rarely a day goes by that someone doesn't say "It always smells so good in here!"

Houseplants and Garden

Chemical insecticides are, in general, harmful to the environment and the consumer. Peppermint oil has been shown to be insecticidal (including mites), fungicidal, and anti-bacterial. I love being able to manage my indoor plants and garden without chemical insecticides.

Peppermint has been shown effective in protecting fruit and vegetables in general from fungal and bacterial infections, while at the same time increasing fruit quality. The more concentrated, the greater the protection, but always test small areas of each plant first for tolerance.

Start with a 2% solution of peppermint oil to water (12 drops per ounce), shake well before use, and test on one or two leaves of each plant species to verify tolerance.
Here are some short quotes from research abstracts that comment on peppermint oil studied in this capacity. The full abstracts are included in the Research Addendum at the end of this guide. You can also access the full abstract, and in some cases the full article, free atwww.pubmed.com. Enter the title reference in the search bar.

J Insect Sci. 2013;13:142. doi: 10.1673/031.013.14201.
Insecticidal activity of plant essential oils against the vine mealybug, Planococcus ficus.
"The essential oils from the following aromatic plants were tested for their insecticidal activity against P. ficus: peppermint, Mentha piperita L.." .
"The essential oils from citrus, peppermint and thyme leaved savory were more or equally toxic compared to the reference product, whereas the lavender and basil essential oils were less toxic than the paraffin oil."

J Sci Food Agric. 2013 Jan;93(2):348-53.
Essential oils to control Botrytis cinerea in vitro and in vivo on plum fruits.
"peppermint oils at all applied concentrations inhibited B. cinerea growth on plum fruits compared with the control."
"all three oils at higher concentrations showed positive effects on fruit quality characteristics.."
"This research confirms the antifungal effects of black caraway, fennel and peppermint essential oils both in vitro and in vivo on plum fruits postharvest. Therefore these essential oils could be an alternative to chemicals to control postharvest phytopathogenic fungi on plum fruits."

Pak J Biol Sci. 2010 Nov 1;13(21):1023-9.
Antifungal activity of some plant extracts on Alternaria alternata, the causal agent of alternaria leaf spot of potato.
"extracts of eucalyptus, peppermint and lavandula had impressive antifungal effects in inhibiting the mycelial growth as well as spore germination of the pathogen."

Exercise Performance

I have found two articles by the same author studying the effect of peppermint oil on exercise performance. Both are impressive, and in both cases, you can access the full article of these two studies at www.pubmed.com by searching the respective title in the search bar and following the links. I did find one dissenting study, that measured no effect. I did not include that here.

Here are some short quotes from the two research abstracts. The full abstracts are included in the Research Addendum at the end of this guide. You can also access both full articles free atwww.pubmed.com. Enter the title reference in the search bar.

Avicenna J Phytomed. 2014 Jan;4(1):72-8.
Instant effects of peppermint essential oil on the physiological parameters and exercise performance.
"Our results revealed significant improvement in all of the variables after oral administration of peppermint essential oil. Experimental group compared with control group showed an incremental and a significant increase in the grip force (36.1%), standing vertical jump (7.0%), and standing long jump (6.4%). Data obtained from the experimental group after five minutes exhibited a significant increase in the forced vital capacity in first second (FVC1)(35.1%), peak inspiratory flow rate (PIF) (66.4%), and peak expiratory flow rate (PEF) (65.1%).."

J Int Soc Sports Nutr. 2013 Mar 21;10(1):15. doi: 10.1186/1550-2783-10-15.
The effects of peppermint on exercise performance.
"Exercise performance evaluated by time to exhaustion (664.5±114.2 vs. 830.2±129.8s), work (78.34 ±32.84 vs. 118.7±47.38 KJ), and power (114.3±24.24 vs. 139.4±27.80 KW) significantly increased ($p<0.001$)."
"The results of the experiment support the effectiveness of peppermint essential oil on the exercise performance, gas analysis, spirometry parameters, blood pressure, and respiratory rate in the young male students. Relaxation of bronchial smooth muscles, increase in the ventilation and brain oxygen concentration, and decrease in the blood lactate level are the most plausible explanations."

Dilution Ratio Chart

Desired Dilution Ratio	1%	2%	3%	5%	10%	25%
Drops of oil per 1 teaspoon (5 ml, 1/6 oz.)	1	2	3	5	10	25
Drops of oil per 2 teaspoons (10 ml, 1/3 oz.)	2	4	6	10	20	50
Drops of oil per 3 teaspoons (15 ml, 1/2 oz.)	3	6	9	15	30	75
Drops of oil per 4 teaspoons (20 ml, 2/3 oz.)	4	8	12	20	40	100
Drops of oil per 5 teaspoons (25 ml, 5/6 oz.)	5	10	15	25	50	125
Drops of oil per 5 teaspoons (30 ml, 1 oz.)	6	12	18	30	60	150

Research Addendum

There is a substantial body of research showing health benefits of peppermint oil. However, it is not possible for me to offer specific recommendations or to advocate usage of our peppermint oil in any human or animal health related capacity. To do so would place our product in the category of a drug, subject to FDA approval and regulation.

Therefore, in no instance is the information provided in this guide intended to diagnose, treat, mitigate, or cure any human or animal health complaint or disease that is under the regulation of the FDA. The reseach abstracts and comments included here are provided for informational purposes only.

These research abstracts were discovered by exhaustive word search at www.pubmed.com. If there is a particular topic of interest to you, you may find more information by searching in the same manner at www.pubmed.com.

In some cases, the full article is available free, and the link will show when you view the abstract at pubmed. The full article is almost always available for purchase, if you're willing to pay for it. You can also e-mail me at support@essentiallykates.com with requests for information on specific topics. If I know of related research, or have information on the topic, I'll be glad to send it to you.

I have attempted to organize these abstracts into categories, but you'll find that there is a lot of overlap. Please don't let the technical terminology discourage you. This is the best information available on these topics. If you have questions, don't hesitate to ask.

Headache

Int J Clin Pract. 2010 Mar;64(4):451-6.
Cutaneous application of menthol 10% solution as an abortive treatment of migraine without aura: a randomised, double-blind, placebo-controlled, crossed-over study.
OBJECTIVE: To investigate the efficacy and safety of thecutaneous application of menthol 10% solution for the abortive treatment of migraine.
BACKGROUND: Peppermint and its active ingredient menthol have long been used for the treatment of various pain conditions including headache.
METHODS: This is a randomised, triple-blind, placebo-controlled, crossed-over study conducted in the neurology Clinic ofNemazee Hospital, affiliated withShiraz University of Medical Sciences,Shiraz, southern Iran, from March 2007 to March 2008. The patients were recruited via local newspaper advertisements. Eligible patients werecategorised into two groups and a 10% ethanol solution of menthol (as drug) and 0.5% ethanol solution of menthol (as placebo) were applied to the forehead and temporal area in a crossover design. Pain free, pain relief, sustained pain free and sustained pain relief end-points were measured by questionnaires using a visual analogue scale.

RESULTS: The intent-to-treat population consisted of 35 patients (80% women, 20% men, mean age: 29.6 +/- 6.2) with 118 migraine attacks. In the intent-to-treat population, the menthol solution was statistically superior to the placebo on 2-h pain free (p = 0.001), 2-h pain relief (p = 0.000), sustained pain free and sustained pain reliefend-points (p = 0.008). The menthol solution was also more efficacious in the alleviation of nausea and/or vomiting andphonophobia and/or photophobia (p = 0.02). In the per-protocol population, there was significantly higher number of patients who experienced at least one pain free/pain relief after the application of menthol rather than the placebo (p = 0.002). No significant difference was seen between the adverse effects of the drug and the placebo groups (p = 0.13).
CONCLUSION: Menthol solution can be an efficacious, safe and tolerable therapeutic option for the abortive treatment of migraine.

Phytomedicine. 1995 Oct;2(2):93-102.
Essential plant oils and headache mechanisms.
The rationale for using essential oils to alleviate headache is based on several assumptions. Especially for peppermint oil certain analgesic mechanisms were recently described.Local application of peppermint oil generates a long-lasting cooling effect on the skin,caused by a steric alteration of the calcium channels of the cold-receptors. Further it was shown that peppermint oil inhibitsnon-competively 5-hydroxytryptamin (Serotonine) and substance P induced smooth muscle contraction in animal-models. It is alsoknown that peppermint oil induces a significant increase of the skin blood flow of the forehead after local application, measured by laser doppler. Assuming that a clinical relevant analgesic action exists, this ought to be observable in experimentalalgesimetric human tests. Therefore the effects of peppermint oil and eucalyptus oil preparations on neurophysiological, psychological and experimentalalgesimetric parameters were investigated in 32 healthy subjects in a double-blind, placebo-controlled, randomized cross-over design. Four different test preparations were used: preparation 1 (LI1701) consisted of 10 g peppermint oil and 5 g eucalyptus oil plus ethanol 90% to 100 g; preparation 2 (LI1702) of 10 g peppermint oil and traces of eucalyptus oil plus ethanol 90% to 100g; preparation 3 (LI1703) of traces of peppermint oil and 5 g eucalyptus oil plus ethanol 90% to 100 g; and preparation 4 (placebo) of traces of peppermint oil and traces of eucalyptus oil plus ethanol 90% to 100 g. The test preparations were applied to large areas of the forehead and temples using a small sponge.The treatment effect of the preparations was evaluated by comparing baseline and treatment measurements.The combination of peppermint oil, eucalyptus oil and ethanol can increase cognitive performance while having a muscle-relaxing and mentally relaxing effect, but has little influence on pain sensitivity.A significant analgesic effect with a reduction in sensitivity to headache is however produced by the combination of peppermint oil and ethanol.The essential plant oil preparations can thus be shown by laboratory tests to exert significant effects on mechanisms associated with the pathophysiology of clinical headache syndromes.Further, to investigate the efficacy of essential oil preparations compared to usual analgesics (paracetamol or acetylsalicylicacid) a double blind, placebo controlled, randomized study should be performed.

Cephalalgia. 1994 Jun;14(3):228-34; discussion 182.
Effect of peppermint and eucalyptus oil preparations on neurophysiological and experimental algesimetric headache parameters.
The effects of peppermint oil and eucalyptus oil preparations onneurophysiological, psychological and experimental algesimetric parameters were investigated in 32 healthy subjects in a double-blind, placebo-controlled, randomized cross-over design. Four different test preparations were applied to large areas of the forehead and temples using a small sponge and their effect was evaluated by comparing

baseline and treatment measure. The combination of peppermint oil, eucalyptus oil and ethanol increased cognitive performance and had a muscle-relaxing and mentally relaxing effect, but had little influence on pain sensitivity. A significant analgesic effect with a reduction in sensitivity to headache was produced by a combination of peppermint oil and ethanol. The essential plant oil preparations often used in empiric medicine can thus be shown by laboratory tests to exert significant effects on mechanisms associated with the pathophysiology of headache.

Memory, Mental Performance, Alertness, Cognitive Function, Sleep

Int J Neurosci. 2008 Jan;118(1):59-77.
Modulation of cognitive performance and mood by aromas of peppermint and ylang-ylang.
This study provides further evidence for the impact of the aromas of plant essential oils on aspects of cognition and mood in healthy participants.One hundred and forty-four volunteers were randomly assigned to conditions of ylang-ylangaroma, peppermint aroma, or no aroma control. Cognitive performance was assessed using the Cognitive Drug Research computerized assessment battery, with mood scales completed before and after cognitive testing. The analysis of the data revealed significant differences between conditions on a number of the factors underpinning the tests that constitute the battery. Peppermint was found to enhance memory whereas ylang-ylangimpaired it, and lengthened processing speed. In terms of subjective mood peppermint increased alertness andylang-ylangdecreased it, but significantly increased calmness. These results provide support for the contention that the aromas of essential oils can produce significant and idiosyncratic effects on both subjective and objective assessments of aspects of human behavior. They are discussed with reference to possible pharmacological and psychological modes of influence.

Percept Mot Skills. 2003 Dec;97(3 Pt 1):1007-10.
Improved performance on clerical tasks associated with administration of peppermint odor.
Previous research indicates the presence of certain odors is associated with enhanced task performance. The present study investigated use of peppermint odor during typing performance, memorization, and alphabetization. Participants completed the protocol twice--once with peppermint odor present and once without. Analysis indicated significant differences in the gross speed, net speed, and accuracy on the typing task, with odor associated with improved performance. Alphabetization also improved significantly under the odor condition but not typing duration or memorization. These results suggest peppermint odor may promote a general arousal of attention, so participants stay focused on their task and increase performance.

Neurosci Lett. 2005 Nov 25;389(1):35-40.
Olfactory facilitation of dual-task performance.
We investigated the differential effects of olfactory stimulation on dual-task performance under conditions of varying task difficulty. Participants detected visually presented target digits from amongst a stream of visually presenteddistractor letters in a rapid serial visual presentation (RSVP) task. At the same time, participants also made speeded discrimination responses tovibrotactile stimuli presented on the front or back of their torso. The response mapping was either compatible or incompatible (i.e., lifting their toes for front vibrations and their heel for back vibrations, or vice versa, respectively). Synthetic peppermint odor or clean air (control) was delivered periodically for 35 s in every 315 s.The results showed a significant performance improvement in the presence of peppermint odor(as compared to air) when the response

mapping was incompatible (i.e., in the difficult task) but not in the compatible condition (i.e., in the easy task). Our results provide the first empirical demonstration that olfactory stimulation can facilitate tactile performance, and also highlight the potentialmodulatory role of task-difficulty in odor-induced task performance facilitation.

Cephalalgia. 1994 Jun;14(3):228-34; discussion 182.
Effect of peppermint and eucalyptus oil preparations on neurophysiological and experimental algesimetric headache parameters.
The effects of peppermint oil and eucalyptus oil preparations onneurophysiological,psychological and experimental algesimetric parameters were investigated in 32 healthy subjects in a double-blind, placebo-controlled, randomized cross-over design. Four different test preparations were applied to large areas of the forehead and temples using a small sponge and their effect was evaluated by comparing baseline and treatment measure. The combination of peppermint oil, eucalyptus oil and ethanol increased cognitive performance and had a muscle-relaxing and mentally relaxing effect,but had little influence on pain sensitivity. A significant analgesic effect with a reduction in sensitivity to headache was produced by a combination of peppermint oil and ethanol. The essential plant oil preparations often used in empiric medicine can thus be shown by laboratory tests to exert significant effects on mechanisms associated with the pathophysiology of headache.

J Clin Exp Neuropsychol. 1998 Apr;20(2):227-36.
Effects of olfactory stimulation on the vigilance performance of individuals with brain injury.
Observers with brain injury and control participants performed a vigilance task during which they received periodic whiffs of unscented air or air scented with peppermint. Under both fragrance conditions, controls reduced the frequency of commissive errors (false alarms) over the course of the vigil, an adaptive strategy given the low probability of signals employed (0.04).The false alarm rate of observers with brain injury increased precipitously toward the end of the vigil in the unscented air condition. However, exposure to the scent of peppermint rendered the false alarm scores of observers with brain injury similar to that of controls, a result which is consistent with evidence that olfactory stimulation activates brain areas vital for planning and judgment.

Int J Psychophysiol. 2005 Mar;55(3):291-8.
Preliminary investigation of the effect of peppermint oil on an objective measure of daytime sleepiness.
The assertion, often quoted in the popular literature, that peppermint has invigorating properties has been investigated through objective assessment of daytime sleepiness.Pupillary fatigue oscillations have been used to give an index of pupillary unrest that can be used as a reliable measure of daytime sleepiness.When compared with a no-odour condition, the presence of peppermint oil limited the increase in sleepiness during 11 min spent in a darkened room. This significant difference in sleepiness between the peppermint oil and the no-odour conditions was shown not to be related to differences in subjective ratings of initial sleepiness, from the Stanford Sleepiness Scale(SSS). Neither was it related to differences in initial pupillary unrest or mean pupil size. It seems that in conditions that favour an increase in daytime sleepiness, peppermint oil can indeed reduce sleepiness.However, the mechanisms by which peppermint oil has its effect and the applicability of these findings to situations in everyday life will require further empirical investigation.

Biol Psychol. 2006 Mar;71(3):341-9. Epub 2005 Sep 6.
Sleep changes vary by odor perception in young adults.
Peppermint, a stimulating odor, increases alertness while awakeand therefore may inhibit sleep. This study examined peppermint's effects onpolysomnographic (PSG) sleep, alertness, and mood when presented before bedtime. Twenty-one healthy sleepers (mean age +/-S.D., 20.1 +/- 2.0 years) completed three consecutive laboratory sessions (adaptation, control, and stimulus nights).Peppermint reduced fatigue and improved mood and was rated as more pleasant, intense, stimulating, and elating than water. These perceptual qualities associated with sleep measures: subjects rating peppermint as very intense had more total sleep than those rating it as moderately intense, and also showed more slow-wave sleep(SWS) in the peppermint than control session. Furthermore, subjects who found peppermint stimulating showed more NREM and less REM sleep while those rating it as sedating took longer to reach SWS. Peppermint did not affect PSG sleep, however, when these perceptual qualities were not considered. Peppermint also produced gender-differentiated responses: it increasedNREM sleep in women, but not men, and alertness in men, but not women, compared with the control. Thus, psychological factors, including individual differences in odor perception play an important role in physiological sleep and self-rated mood and alertness changes.

Phytother Res. 2012 Jun;26(6):884-91. doi: 10.1002/ptr.3665. Epub 2011 Nov 15.
Evaluation of the effects of plant-derived essential oils on central nervous system function using discrete shuttle-type conditioned avoidance response in mice.
Although plant-derived essential oils(EOs) have been used to treat various mental disorders, their central nervous system (CNS) acting effects have not been clarified.The present study compared the effects of 20 kinds of EOs with the effects of already-known CNS acting drugs to examine whether the EOs exhibited CNS stimulant-like effects,CNS depressant-like effects, or neither. All agents were tested using a discrete shuttle-type conditioned avoidance task in mice.Essential oils of peppermint and chamomile exhibited CNS stimulant-like effects that is, they increased the response rate (number of shuttlings/min)of the avoidance response. Linden also increased the response rate, however, the effect was not dose-dependent. In contrast, EOs of orange, grapefruit, and cypress exhibitedCNS depressant-like effects; that is, they decreased the response rate of the avoidance response. Essential oils of eucalyptus and rose decreased the avoidance rate (number of avoidance responses/number of avoidance trials) without affecting the response rate, indicating that they may exhibit someCNS acting effects. Essential oils of 12 other plants, including juniper, patchouli, geranium, jasmine,clary sage, neroli, lavender, lemon, ylang-ylang,niaouli, vetivert and frankincense had no effect on the avoidance response in mice.

Halitosis (Bad Breath) & Dental Health

J Int Soc Prev Community Dent. 2013 Jan;3(1):29-31.
Evaluation of the use of a peppermint mouth rinse for halitosis by girls studying in Tehran high schools.
BACKGROUND AND AIM: Oral malodor is one of the most common complaints among dental patients. It often creates serious personal and social embarrassment for the afflicted individual. Therefore, a dentist must be able to diagnose the etiology of halitosis and treat it or refer an individual to a specialist. The aim of this study was to evaluate the prevalence of halitosis and the effect of a peppermint mouth rinse on it. MATERIALS AND METHODS: This study was performed in two steps. At the first step, in a cross-sectional study, 504 students who were 14-18 years old were examined to define the students who

suffered from halitosis, and then at the second step, the selected 84 students with halitosis were divided into two groups randomly. A total of 43 students in group 1 received a peppermint mouth rinse and 41 students in another group were given placebo. The students in two groups washed their mouth with 15-20 ml of the given solutions three times in a 1-week period (after breakfast, after lunch or on returning to home, before sleeping) and didn't eat anything for 30 min after rinsing. After 1 week, the students were examined again.
RESULTS: The prevalence of halitosis was 24.4% totally. In the mouth rinse group, after 1 week 23 students didn't exhibit halitosis, and 11 students in the placebo group were halitosis positive. A chi-square test showed that this difference was significant.
CONCLUSION: Based on the results of this study, it can be said that a peppermint mouth rinse can reduce halitosis.

Phytother Res. 2007 Jul;21(7):641-3.
Reduction of mouth malodour and volatile sulphur compounds in intensive care patients using an essential oil mouthwash.
The aim of this study was to explore the effect of an essential oil solution on levels of malodour and production of volatile sulphur compounds (VSC) in patients nursed in intensive care unit (ICU). Thirty two patients received 3 min of oral cleaning using an essential oil solution (mixture of tea tree, Melaleuca alternifolia, peppermint, Mentha piperita and lemon, Citrus limon) on the first day, and Tantum (benzydamine hydrochloride) on the second day. Two trained nurses measured the level of malodour with a 10 cm visual analogue scale (VAS) and VSC with a Halimeter before (Pre), 5 min after (Post I) and 1 h following treatment (Post II). The level of oral malodour was significantly different following the essential oil session, and differed significantly between two sessions at Post I ($p < 0.005$) and Post II ($p < 0.001$). Differences between the two sessions were significant (Tantum, $p < 0.001$; essential oil, $p < 0.001$) in the level of VSC and significantly lower in the essential oil session than Tantum at the Post II ($p < 0.05$). These findings suggest that mouth care using an essential oil mixture of diluted tea tree, peppermint and lemon may be an effective method to reduce malodour and VSC in intensive care unit patients.

Oral Microbiol Immunol. 1994 Aug;9(4):202-8.
The antimicrobial activity of essential oils and essential oil components towards oral bacteria.
A method for reproducibly determining minimal inhibitory concentrations and minimal bactericidal concentrations of plant extracts towards fastidiously and facultatively anaerobic oral bacteria, predicated upon measurements of optical densities in microtitre plate wells, was devised. The antimicrobial properties of some botanical oils were surveyed; of these, Australian tea tree oil, peppermint oil, and sage oil proved to be the most potent essential oils, whereas thymol and eugenol were potent essential oil components.

Nat Prod Res. 2008 Mar 20;22(5):428-39.
Phytotherapeutic inhibition of supragingival dental plaque.
Antimicrobial activities and biofilm-formation preventive properties of Mentha piperita and Cuminum cyminum essential oils and chlorhexidine were assessed against Streptococcus mutans and Streptococcus pyogenes. Gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) analysis led to the identification of 26 and 32 compounds in the essential oils of M. piperita and C. cyminum, respectively. Minimal bactericidal concentrations (MBC) of the oils and chlorhexidine and microbial decimal reduction time (D value) were determined. Antibacterial and in vivo biofilm preventive efficacies of all the concentrations of M. piperita oil were significantly ($p<0.001$) higher. The biofilm inhibitory properties in

planktonic cultures were in M. piperita > chlorhexidine> C. cyminum order. In vivo experiments conducted on male and female volunteers who brushed with essential oil blended toothpastes indicated that lower concentrations of the oils, in particular the M. piperita oil, were significantly higher ($p<0.001$) and effective during the course of the study as compared to chlorhexidine. In conclusion, there may be a potential role for essential oils in the development of novel anticaries treatments.

Digestive Dysfunction

Prescrire Int. 2008 Jun;17(95):121-3.
Herbal remedies for dyspepsia: peppermint seems effective.
Functional dyspepsia is extremely common, yet few if any treatments have been shown to be effective. This review examines the potential benefits and risks of using herbal products in treating symptoms of dyspepsia. (2) About forty plants have been approved in France in the composition of products traditionally used for dyspepsia. (3) The clinical efficacy of most of these plants has not been assessed. Some essential oils can cause severe adverse effects, including seizures. Herbal teas appear to be safe when used appropriately. (4) A few randomised controlled clinical trials suggest that peppermint essential oil is effective in reducing abdominal pain, flatulence and diarrhea in patients with "irritable bowel syndrome". Peppermint tea, containing essential oil, has no known adverse effects.(5) There is no sound reason to discourage patients from using herbal teas made from plants such as lemon balm, German chamomile or star anise.

Nihon Rinsho. 2010 Nov;68(11):2126-34.
[Peppermint oil reduces gastric motility during the upper gastrointestinal endoscopy].
Hyperperistalsis during upper gastrointestinal endoscopy may interfere with accurate diagnosis and lead to failure to detect microcarcinoma. Therefore it frequently necessitates the use of antispasmodic agents, but these drugs have side effects. In this review, the author notes note the effectiveness of peppermint oil administration to the gastric mucosa resulted in inhibiting the gastric peristalsis in Japanese individuals undergoing upper gastrointestinal endoscopy.

Phytomedicine. 1996 Mar;2(4):285-91. doi: 10.1016/S0944-7113(96)80070-5.
Phytotherapy in functional upper abdominal complaints Results of a clinical study with a preparation of several plants.
Efficacy and tolerance of Lomatol® drops (a preparation with extracts of the fruits of Carum carvi [caraway], fruits of Foeniculum vulgare [fennel], leaves of Menta piperita [peppermint] and the herb of Artemisia absinthium [wormwood] in the treatment of upper abdominal complaints was compared with the efficacy and tolerance of metoclopramide drops in a controlled, randomized, double-blind study. Their impact on the symptoms of pain, nausea, heartburn, retching and gastrospasms were assessed on a 5-point rating scale. During the two weeks of treatment and observation the phytodrug demonstrated statistically significant better results than the synthetic preparation in relieving all the symptoms. These findings were confirmed by subjective assessment of the general condition by the patient. Moreover, Lomatol® caused significantly fewer adverse drug reactions than metoclopramide and was statistically significantly better tolerated. Thus, this plant combination can be recommended for upper abdominal complaints without any restrictions. The same is also true for similarly composed Lomatol® coated tablets.

J Gastroenterol. 2007 Jul;42(7):539-42. Epub 2007 Jul 25.
Early effects of peppermint oil on gastric emptying: a crossover study using a continuous real-time 13C breath test (BreathID system).
BACKGROUND: The aim of this study was to determine whether there was a correlation between peppermint oil and gastric emptyingby using a novel noninvasive technique for measuring gastric emptying with a continuous real-time (13)C breath test (BreathID system, Oridion, Israel).
METHODS: Ten healthy male volunteers participated in this randomized, two-way crossover study. The subjects were randomly assigned to receive a test meal (200 kcal per 200 ml) containing 0.64 ml of peppermint oil or the test meal alone, after fasting overnight. A(13)C-acetic acid breath test was continuously performed with the BreathID system, which monitors gastric emptying, for 4 h after the administration of the test meal. UsingOridion Research Software (beta version), the time for emptying of 50% of the labeled meals (T 1/2), the analog to the scintigraphy lag time for 10% emptying of the labeled meal (T lag), the gastric emptying coefficient(GEC), and the regression-estimated constants (beta and kappa) were calculated. The parameters between two occasions were compared using the Wilcoxon signed-rank test.
RESULTS: After peppermint oil intake, the T lag and beta constant were significantly decreased. No significant differences in T 1/2,GEC, or kappa were observed between the two occasions.
CONCLUSIONS: The decrease in the T lag and beta constant suggests acceleration of gastric emptying during the early phase. This study showed that peppermint oil enhances gastric emptying, suggesting the potential use of peppermint oil in clinical settings for patients with functional gastrointestinal disorders.

Altern Med Rev. 2011 Jun;16(2):116-33.
Gastroesophageal reflux disease (GERD): a review of conventional and alternative treatments.
Gastroesophageal reflux disorder (GERD), a common disorder in the Western world, can lead to complications that include esophageal stricture and esophagealadenocarcinoma. Multiple challenges are associated with GERD treatment. First, lack of symptoms does not correlate with the absence of or the healing of esophageal lesions. Second, proton pump inhibitors, the current standard of care forGERD, are ineffective for the majority ofGERD patients who have non-erosive disease. This article discusses these challenges, investigates the mechanisms of damage inGERD, and explores the existing data on unconventional forms of treatment, includingmelatonin, acupuncture, botanicals, and dietary interventions.
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Excerpt of article: While ingesting spearmint does not appear to improve or worsenGERD symptoms,52 peppermint oil might have some benefits. Peppermint oil is reported to accelerate the early phase of gastric emptying, increase relaxation time of the pyloric valve, and decrease the resting lower esophageal sphincter pressure.105

J Clin Gastroenterol. 2001 Jul;33(1):27-31.
Peppermint oil improves the manometric findings in diffuse esophageal spasm.
BACKGROUND: Diffuse esophageal spasm (DES) is an uncommon condition that results in simultaneous esophageal contractions. Current medical treatment of DES is frequently unsatisfactory. We hypothesized that, as a smooth muscle relaxant, peppermint oil may improve themanometric findings in DES.
STUDY: Eight consecutive patients with chest pain or dysphagia and who were found to have DES were enrolled during their diagnostic esophagealmanometry. An eight-channel perfusionmanometry system was used. Lower esophageal sphincter pressure and contractions of the esophageal body after 10 wet swallows were assessed before and 10 minutes after the ingestion of a solution containing five drops of peppermint

oil in 10 mL of water. Each swallow was assessed for duration (seconds), amplitude (mm Hg), and proportion of simultaneous and multiphasic esophageal contractions.
RESULTS: Lower esophageal sphincter pressures and contractile pressures and durations in both the upper and lower esophagus were no different before and after the peppermint oil. Peppermint oil completely eliminated simultaneous esophageal contractions in all patients ($p < 0.01$). The number of multiphasic, spontaneous, and missed contractions also improved. Because normal esophageal contractions are characteristically uniform in appearance, variability of esophageal contractions was compared before and after treatment. The variability of amplitude improved from 33.4 +/- 36.7 to 24.9 +/- 11.0 mm Hg ($p < 0.05$) after the peppermint oil. The variability for duration improved from 2.02 +/- 1.80 to 1.36 +/- 0.72 seconds ($p < 0.01$). Two of the eight patients had chest pain that resolved after the peppermint oil.
CONCLUSIONS: This data demonstrates that peppermint oil improves the manometric features of DES.

Aliment Pharmacol Ther. 2002 Oct;16(10):1689-99.
Systematic review: herbal medicinal products for non-ulcer dyspepsia.
BACKGROUND: Non-ulcer dyspepsia is predominantly a self-managed condition, although it accounts for a significant number of general practitioner consultations and hospital referrals. Herbal medicinal products are often used for the relief of dyspeptic symptoms.
AIMS : To critically assess the evidence for and against herbal medicinal products for the treatment of non-ulcer dyspepsia.
METHODS: Systematic searches were performed in six electronic databases and the reference lists located were checked for further relevant publications. No language restrictions were imposed. Experts in the field and manufacturers of identified herbal extracts were also contacted. All randomized clinical trials of herbal medicinal products administered as supplements to human subjects were included.
RESULTS: Seventeen randomized clinical trials were identified, nine of which involved peppermint and caraway as constituents of combination preparations. Symptoms were reduced by all treatments (60-95% of patients reported improvements in symptoms). The mechanism of any anti-dyspeptic action is difficult to define, as the causes of non-ulcer dyspepsia are unclear. There appear to be few adverse effects associated with these remedies, although, in many cases, comprehensive safety data were not available.
CONCLUSIONS: There are several herbal medicinal products with anti-dyspeptic activity and encouraging safety profiles. Further research is warranted to establish their therapeutic value in the treatment of non-ulcer dyspepsia.

J Dig Dis. 2011 Aug;12(4):295-301.
Preliminary experimental research on the mechanism of liver bile secretion stimulated by peppermint oil.
OBJECTIVE: To investigate the choleretic effect and molecular mechanisms of action of peppermint oil (PO), the main component of Danshu capsules (Sichuan Jisheng tang Pharmaceutical Co., Ltd., Pengzhou, Sichuan Province, China).
METHODS: Bile secretion was measured by biliary drainage in rats. Total bile acids, total cholesterol and bilirubin in bile were determined. Cholesterol 7a-hydroxylase (CYP7A1), and farnesoid X receptor (FXR) messenger ribonucleic acid (mRNA) levels were assessed in HepG2 cells (a human hepatocellular carcinoma cell line) by reverse transcription polymerase chain reaction (RT-PCR).
RESULTS: PO significantly promoted bile and bile acid secretion in rats. It also increased bile acid efflux and decreased cholesterol levels ($P < 0.01$) in bile. In HepG2 cells the mRNA levels of CYP7A1 and FXR were significantly upregulated after treatment with PO.

CONCLUSIONS: PO stimulates bile fluid secretion and thus has acholeretic effect. PO might play a role in upregulating CYP7A1 and FXR mRNA levels, suggesting that the molecular mechanisms are related to gene expression involved in bile acid synthesis.

Irritable Bowel Syndrome

Can Fam Physician. 2009 Feb;55(2):143-8.
Complementary and alternative medicine for treatment of irritable bowel syndrome.
OBJECTIVE: To review the evidence supporting selected complementary and alternative medicine approaches used in the treatment of irritable bowel syndrome (IBS).
QUALITY OF EVIDENCE: MEDLINE (from January 1966), EMBASE (from January 1980), and the Cochrane Database of Systematic Reviews were searched until March 2008, combining the terms irritable bowel syndrome or irritable colon with complementary therapies, alternative medicine, acupuncture, fiber, peppermint oil, herbal, traditional, yoga, massage, meditation, mind, relaxationprobiotic, hypnotherapy, psychotherapy, cognitive therapy, or behavior therapy. Results were screened to include only clinical trials, systematic reviews, and meta-analyses. Level I evidence was available for most interventions.
MAIN MESSAGE: Soluble fibre improves constipation and global IBS symptoms.Peppermint oil alleviates IBS symptoms, including abdominal painProbiotic trials show overall benefit for IBS but there is little evidence supporting the use of any specific strain. Hypnotherapy andcognitive-behaviouraltherapy are also effective therapeutic options for appropriate patients. Certain herbal formulas are supported by limited evidence, but safety is a potential concern. All interventions are supported by systematic reviews or meta-analyses.
CONCLUSION: Several complementary and alternative therapies can be recommended as part of an evidence-based approach to the treatment of IBS; these might provide patients with satisfactory relief and improve the therapeutic alliance.
Gastroenterol Hepatol (N Y). 2010 Nov;6(11):705-11.
Complementary and alternative medicine modalities for the treatment of irritable bowel syndrome: facts or myths?
Due to unsatisfactory results from conventional treatment of irritable bowel syndrome (IBS), complementary and alternative medicine (CAM) modalities are increasingly popular treatment alternatives. Unfortunately, most CAM clinical trials have been of poor quality, and theefficaciesof these therapies have not been adequately elucidated, even through systematic reviews or meta-analyses. There is also a general lack of understanding of their mechanisms of action.Currently, insufficient evidence exists to support the use of traditional Chinese medicine, acupuncture, meditation, and reflexology for treatment of IBS. However, there is some evidence supporting the use of peppermint oiland gut-directed hypnotherapy for IBS treatment. Due to mounting evidence of the microbiologicand immunologicbasis of IBS, probiotics and exclusion diets are also becoming promising treatment modalities. This paper will review the current literature on various CAM practices for IBS treatment and appraise their advantages and disadvantages in clinical practice.

J Gastroenterol. 2014 Aug;49(8):1193-205.
Treatment of abdominal pain in irritable bowel syndrome.
Functional abdominal pain in the context of irritable bowel syndrome (IBS) is a challenging problem for primary care physicians,gastroenterologists and pain specialists. We review the evidence for the current

and future non-pharmacological and pharmacological treatment options targeting the central nervous system and the gastrointestinal tract. Cognitive interventions such as cognitive behavioral therapy and hypnotherapy have demonstrated excellent results in IBS patients, but the limited availability and labor-intensive nature limit their routine use in daily practice. In patients who are refractory to first-line therapy, tricyclic antidepressants (TCA) and selective serotonin reuptake inhibitors are both effective to obtain symptomatic relief, but only TCAs have been shown to improve abdominal pain in meta-analyses. A diet low in fermentable carbohydrates and polyols (FODMAP) seems effective in subgroups of patients to reduce abdominal pain, bloating, and to improve the stool pattern. The evidence for fiber is limited and only is phagula may be somewhat beneficial. The efficacy of probiotics is difficult to interpret since several strains in different quantities have been used across studies. Antispasmodics, including peppermint oil, are still considered the first-line treatment for abdominal pain in IBS. Second-line therapies for diarrhea-predominant IBS include the non-absorbable antibiotic rifaximin and the 5HT3 antagonists alosetron and ramosetron, although the use of the former is restricted because of the rare risk of ischemic colitis. In laxative-resistant, constipation-predominant IBS, the chloride-secretion stimulating drugs lubiprostone and linaclotide, a guanylate cyclase C agonist that also has direct analgesic effects, reduce abdominal pain and improve the stool pattern.

Phytother Res. 2006 Aug;20(8):619-33.
A review of the bioactivity and potential health benefits of peppermint tea (Mentha piperita L.).
Peppermint (Mentha piperita L.) is one of the most widely consumed single ingredient herbal teas, or tisanes. Peppermint tea, brewed from the plant leaves, and the essential oil of peppermint are used in traditional medicines. Evidence-based research regarding the bioactivity of this herb is reviewed. The phenolic constituents of the leaves include rosmarinic acid and several flavonoids, primarily eriocitrin, luteolin and hesperidin. The main volatile components of the essential oil are menthol and menthone. In vitro, peppermint has significant antimicrobial and antiviral activities, strong antioxidant and antitumor actions, and some antiallergenic potential. Animal model studies demonstrate a relaxation effect on gastrointestinal (GI) tissue, analgesic and anesthetic effects in the central and peripheral nervous system, immunomodulating actions and chemopreventive potential. Human studies on the GI, respiratory tract and analgesic effects of peppermint oil and its constituents have been reported. Several clinical trials examining the effects of peppermint oil on irritable bowel syndrome (IBS) symptoms have been conducted. However, human studies of peppermint leaf are limited and clinical trials of peppermint tea are absent. Adverse reactions to peppermint tea have not been reported, although caution has been urged for peppermint oil therapy in patients with GI reflux, hiatal hernia or kidney stones.

J Clin Gastroenterol. 2014 Jul;48(6):505-12.
Peppermint oil for the treatment of irritable bowel syndrome: a systematic review and meta-analysis.
GOALS: The aim of this study was to assess the efficacy and safety of enteric-coated peppermint oil capsules compared with placebo for the treatment of active irritable bowel syndrome (IBS).
BACKGROUND: IBS is a common disorder that is often encountered in clinical practice. Medical interventions are limited and the focus is on symptom control.
STUDY: Randomized placebo-controlled trials with a minimum treatment duration of 2 weeks were considered for inclusion. Cross-over studies that provided outcome data before the first cross-over were included. A literature search up to February 2013 identified all applicable randomized-controlled trials. Study quality was evaluated using the Cochrane risk of bias tool. Outcomes included global improvement

of IBS symptoms, improvement in abdominal pain, and adverse events. Outcomes were analyzed using an intention-to-treat approach.
RESULTS: Nine studies that evaluated 726 patients were identified. The risk of bias was low for most of the factors assessed. Peppermint oil was found to be significantly superior to placebo for global improvement of IBS symptoms (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 peppermint oil patients were significantly more likely to experience an adverse event, such events were mild and transient in nature. The most commonly reported adverse event was heartburn.
CONCLUSIONS: Peppermint oil is a safe and effective short-term treatment for IBS. Future studies should assess the long-term efficacy and safety of peppermint oil and its efficacy relative to other IBS treatments including antidepressants and antispasmodic drugs.

Discov Med. 2011 May;11(60):425-33.
Diagnosis and treatment of irritable bowel syndrome.
Irritable bowel syndrome (IBS) is a chronic functional disorder of the gastrointestinal tract. The exact cause is unknown. The diagnosis should be made on clinical grounds, using symptom-based criteria such as the Manning or Rome criteria, unless symptoms are thought to be atypical. Excluding celiac disease in all patients consulting with symptoms suggestive of IBS is worthwhile, but evidence for performing other investigations to exclude organic disease is not convincing. No medical therapy for IBS has been shown to alter the disease course, and treatment has traditionally been directed towards symptom relief. The aim should be to improve the predominant symptom reported by the patient. Fiber, peppermint oil, or antispasmodic agents are beneficial as first-line therapies in some patients. Where these fail, emerging data have confirmed the efficacy of antidepressants, drugs acting on the 5-hydroxytryptamine receptor, and probiotics in the short-term treatment of IBS. There are a number of novel therapies under development that show promise, including non-absorbable antibiotics, lubiprostone, and linaclotide. This article will provide a summary of diagnostic criteria for IBS, evidence to support investigations to exclude organic disease, and current and emerging therapies in this field.
Free full text

Digestion. 2014;89(4):253-67. doi: 10.1159/000362405. Epub 2014 Jul 2.
Medication management of irritable bowel syndrome.
BACKGROUND:
Irritable bowel syndrome (IBS) is a complex syndrome that is difficult to manage. Here we present the evidence supporting medication treatments for specific IBS symptoms, discuss evidence-based management of IBS with medications including dose regimens and adverse effects and review progress on research for new IBS treatments.
SUMMARY:
Currently, there is evidence to support improvements in specific IBS symptoms following treatment with loperamide, psyllium, bran, lubiprostone, linaclotide, amitriptyline, trimipramine, desipramine, citalopram, fluoxetine, paroxetine, dicyclomine, peppermint oil, rifaximin, ketotifen, pregabalin, gabapentin and octreotide and there are many new medications being investigated for the treatment of IBS. Key Message: Of the medications with demonstrated improvements for IBS symptoms, rifaximin, lubiprostone, linaclotide, fiber supplementation and peppermint oil have the most reliable evidence supporting their use for the treatment of IBS. Onset of efficacy for the various medications has been noted to be as early as 6

days after initiation; however, the efficacy of most medications was not assessed prospectively at predefined periods. Additional studies of currently available and new medications are ongoing and are needed to better define their place in therapy and expand therapeutic options for the treatment of IBS. The most promising new medications for IBS include a variety of novel pharmacologic approaches, most notably the dual μ-opioid receptor agonist and d-opioid antagonist, JNJ-27018966.
Free full text

BMC Complement Altern Med. 2013 Nov 28;13:338. doi: 10.1186/1472-6882-13-338.
Comparison of the antibacterial activity of essential oils and extracts of medicinal and culinary herbs to investigate potential new treatments for irritable bowel syndrome.
BACKGROUND: Irritable bowel syndrome (IBS) is a common functional gastrointestinal disorder, which may result from alteration of the gastrointestinal microbiota following gastrointestinal infection, or with intestinal dysbiosis or small intestinal bacterial overgrowth. This may be treated with antibiotics, but there is concern that widespread antibiotic use might lead to antibiotic resistance. Some herbal medicines have been shown to be beneficial, but their mechanism(s) of action remain incompletely understood. To try to understand whether antibacterial properties might be involved in the efficacy of these herbal medicines, and to investigate potential new treatments for IBS, we have conducted a preliminary study in vitro to compare the antibacterial activity of the essential oils of culinary and medicinal herbs against the bacterium, Esherichia coli.
METHODS: Essential oils were tested for their ability to inhibit E.coli growth in disc diffusion assays and in liquid culture, and to kill E.coli in a zone of clearance assay. Extracts of coriander, lemon balm and spearmint leaves were tested for their antibacterial activity in the disc diffusion assay. Disc diffusion and zone of clearance assays were analysed by two-tailed t tests whereas ANOVA was performed for the turbidometric assays.
RESULTS: Most of the oils exhibited antibacterial activity in all three assays, however peppermint, lemon balm and coriander seed oils were most potent, with peppermint and coriander seed oils being more potent than the antibiotic rifaximin in the disc diffusion assay. The compounds present in these oils were identified by gas chromatography mass spectrometry. Finally, extracts were made of spearmint, lemon balm and coriander leaves with various solvents and these were tested for their antibacterial activity against E.coli in the disc diffusion assay. In each case, extracts made with ethanol and methanol exhibited potent antibacterial activity.
CONCLUSIONS: Many of the essential oils had antibacterial activity in the three assays, suggesting that they would be good candidates for testing in clinical trials. The observed antibacterial activity of ethanolic extracts of coriander, lemon balm and spearmint leaves suggests a mechanistic explanation for the efficacy of a mixture of coriander, lemon balm and mint extracts against IBS in a published clinical trial.
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Rev Med Brux. 2012 Sep;33(4):430-5.
[Irritable bowel syndrome: diet and complementary medicine therapies?].
[Article in French]
Irritable bowel syndrome (IBS) is a frequent and invalidating functional bowel disorder with entangled mechanisms. Its therapeutic approach is therefore complex. Classical therapies, prescribed alone or in combination in light of the predominant symptom, consist of antispasmodics, fibers, laxatives, antidiarrheals, and psychotropic agents. Other emerging pharmacological therapies, such as prokinetics, prosecretory or serotoninergic agents, bile acid modulators and antibiotics have been recently studied in clinical trials. Dietary measures can include reduction of short-chain poorly absorbed carbohydrates

(FODMAPs) and gluten restriction. Assessment of food allergy can be proposed in a subgroup of IBS patients. Complementary and alternative medicine therapies, that are generally low cost and safe, appear to be appreciated by patients. Probiotics have demonstrated action on the gut microbiote modulation, and may be helpful in a subset of patients.Peppermint oil has an established visceral analgesic effect. Hypnotherapy represents an original, global and effective approach. Finally, education, reassurance and listening to the patient, leading to a solid therapeutic relationship, represents an essential backdrop of remedy or diet effectiveness.

Dig Dis Sci. 2012 Sep;57(9):2379-84. doi: 10.1007/s10620-012-2194-4. Epub 2012 May 6.
Peppermint oil solution is useful as an antispasmodic drug for esophagogastroduodenoscopy, especially for elderly patients.
BACKGROUND: Although hyoscine butyl bromide (HB) and glucagon (GL) are often used as antispasmodic drugs during esophagogastroduodenoscopy (EGD), these agents may cause adverse effects. Recently, it was reported that peppermint oil solution (PO) was very effective and had few side effects.
AIM: We clarified the efficacy and usefulness of PO as an antispasmodic during upper endoscopy, especially for elderly patients.
METHODS: This study was a non-randomized prospective study. The antispasmodic score (1-5, where 5 represents no spasm) was defined according to the degree of spasms of the antrum and difficulty of biopsy. We compared the antispasmodic scores between non-elderly patients (younger than 70) and elderly patients (70 years old or older) according to the antispasmodic agent.
RESULTS: A total of 8,269 (Group PO: HB: GL: NO (no antispasmodic) = 1,893: 6,063: 157: 156) EGD procedures were performed. There was no significant difference in the antispasmodic score between Group PO (mean score ± standard deviation: 4.025 ± 0.925) and Group HB (4.063 ± 0.887). Among the non-elderly patients, those in Group PO (n = 599, 3.923 ± 0.935) had a worse antispasmodic score than those in Group HB (n = 4,583, 4.062 ± 0.876, $P < 0.001$). However, among the elderly patients, those in Group PO (n = 1,294, 4.073 ± 0.917) had similar scores to those in Group HB (n = 1,480, 4.064 ± 0.921, $P = 0.83$), and significantly better scores than those in Group GL (n = 69, 3.797 ± 0.933, $P < 0.05$).
CONCLUSION: Peppermint oil was useful as an antispasmodic during EGD, especially for elderly patients.

Appetite

Neurogastroenterol Motil. 2013 Apr;25(4):e263-71.
Effect of acute peppermint oil administration on gastric sensorimotor function and nutrient tolerance in health.
BACKGROUND: Menthol reduces intestinal motility in animal studies, an effect that is probably mediated by transient receptor potential channels. Peppermint oil (PO), with menthol as a major constituent, is widely used as a spasmolytic agent in irritable bowel syndrome. In the current study, we investigated the effect of acute PO administration on intragastric pressure (IGP) profiles and gastric sensorimotor functions in health.
METHODS: Healthy volunteers underwent IGP measurement before and during continuous intragastric infusion of a nutrient drink (n = 13), and gastric barostat studies (n = 13). A single capsule of PO (182 mg) or placebo was administered during the studies in a randomized controlled crossover design. Throughout

the studies, healthy volunteers scored 11 epigastric symptoms on a visual analogue scale (VAS); satiation was scored on a 6-point Likert scale during intragastric infusion.
KEY RESULTS: During fasting, IGP and motility index (MI) of the proximal stomach decreased significantly after PO administration compared with placebo ($P < 0.0001$ and <0.05, respectively). In contrast, during intragastric infusion of the nutrient drink, no significant differences were detected between PO and placebo in IGP profiles, MI, satiation scores, and epigastric symptoms. The maximum infused volume, gastric compliance or sensitivity to balloon distention did not differ between both treatment arms. However, reduced appetite scores were seen during fasting after PO treatment, as compared with placebo ($P = 0.01$). Postprandial VAS scores were similar between PO and placebo.
CONCLUSIONS & INFERENCES: Peppermint oil reduces IGP, proximal phasic contractility, and appetite, with negligible effects on gastric sensitivity, tone, accommodation, and nutrient tolerance in health.

Upper Respiratory Tract

Evid Based Complement Alternat Med. 2011;2011:690346.
Treatment of upper respiratory tract infections in primary care: a randomized study using aromatic herbs.
This study is a prospective randomized double-blind controlled trial whose aim was to investigate the clinical effects of aromatic essential oils in patients with upper respiratory tract infectionsThe trial was conducted in six primary care clinics in northern Israel. A spray containing aromatic essential oils of five plants (Eucalyptus citriodora, Eucalyptus globulus, Mentha piperita, Origanum syriacum, and Rosmarinus officinalis)as applied 5 times a day for 3 days and compared with a placebo spray. The main outcome measure was patient assessment of the change in severity of the most debilitating symptom (sore throat, hoarseness or cough). Sixty patients participated in the study (26 in the study group and 34 in the control group). Intention-to-treat analysis showed that 20 minutes following the spray use, participants in the study group reported a greater improvement in symptom severity compared to participants in the placebo group ($P = .019$). There was no difference in symptom severity between the two groups after 3 days of treatment ($P = .042$). In conclusion, spray application of five aromatic plants reported in this study brings about significant and immediate improvement in symptoms of upper respiratory ailment. This effect is not significant after 3 days of treatment.

J Infect Chemother. 2001 Dec;7(4):251-4.
Screening of the antibacterial effects of a variety of essential oils on respiratory tract pathogens, using a modified dilution assay method.
The purpose of this study was to examine the antibacterial effects of a wide variety of essential oils on major respiratory tract pathogens. The antibacterial activity of 14 essential oils and their major components was evaluated by agar-plate dilution assay under sealed conditions, with agar used as a stabilizer for homogeneous dispersion. Of the selected strains of four major bacteria causing respiratory tract infection, Haemophilus influenzae was most susceptible to the essential oils, followed by Streptococcus pneumoniae and Streptococcus pyogenes. Staphylococcus aureus was less susceptible. No cross-resistance was observed between penicillin-sensitive and penicillin-resistant S pneumoniae. Escherichia coli, used as a control bacterium, showed the lowest susceptibility. Essential oils containing aldehyde or phenol as a major component showed the highest antibacterial activity, followed by the essential oils containing terpene

alcohols. Other essential oils, containingterpene ketone, or ether, had much weaker activity, and an oil containing terpene hydrocarbon was inactive. Based on these findings,thyme (wild, red, and geraniol types), cinnamon bark, lemongrass, perilla, and peppermint oils were selected for further evaluation of their effects on respiratory tract infection.

J Ethnopharmacol. 2009 Jul 30;124(3):630-4.
Secretory response induced by essential oils on airway surface fluid: a pharmacological MRI study.
Using pharmacological magnetic resonance imaging, we have performed an invivo evaluation of the secretory response induced by essential oils in the rat airway. Aim of the work was to establish a computerized method to assess the efficacy of volatile compounds in spatially localized areas without the bias derived by subjective evaluation. Magnetic resonance experiments were carried out using a 4.7 T horizontal magnet. In the trachea, airway surface fluid was easily identified for its high intensity signal. The tracheal glands were also easily visible. Theoesophageal lumen was usually collapsed and was identifiable only in the presence of intraluminalliquid. Scotch pine essential oil inhalation significantly increased the surface fluid in the middle portion of the trachea and the increase was visible at both 5 and 10 min. A lesser secretory response was detected after rosemary essential oil inhalation even though the response was significant with respect to the control in particular at 10 min. Nosecretory response was detected after peppermint essential oil inhalation both at 5 and 10 min.The data obtained in the present work demonstrate a chemically induced airway secretion. The availability of a pharmacological magnetic resonance imaging approach opens new perspectives to test the action of volatile compounds on the airway.

Biol Pharm Bull. 2002 Feb;25(2):256-9.
Antiallergic effect of flavonoid glycosides obtained from Mentha piperita L.
Six flavonoid glycosides, eriocitrin (1), narirutin (2), hesperidin (3), luteolin-7-O-rutinoside (4), isorhoifolin (5), diosmin (6), rosmarinic acid (7) and 5,7-dihydroxycromone-7-O-rutinoside (8), were isolated from the aerial part of Mentha piperita L. Among these compounds, compound 4 showed a potent inhibitory effect on histamine release induced by compound 48/80 and antigen-antibody reaction. This compound was more effective than luteolin and luteolin-7-O-glucoside in inhibiting histamine release from rat peritoneal mast cells. Compound 4 also caused a dose-related inhibition of the antigen-induced nasal response and significant effects were observed at doses of 100 and 300 mg/kg. These results indicate that compound 4 may be clinically useful in alleviating the nasal symptoms of allergic rhinitis.

Biol Pharm Bull. 2001 Jan;24(1):92-5.
Effects of peppermint (Mentha piperita L.) extracts on experimental allergic rhinitis in rats.
The present study was carried out to clarify the effects of extracts of the leaves ofMentha piperita L. on experimental allergicrhinitis. The 50% EtOH extract of peppermint inhibited histamine release from rat peritoneal mast cells induced by compound 48/80. The effect was dose-dependent and significant inhibition was observed at a concentration of 3 microg/ml. In addition, the 50% EtOH eluate separated from the 50% EtOH extract of peppermint by column chromatography (DIAION HP-20) was also effective in inhibiting histamine release at a concentration of 1 microg/ml. Nasal symptoms, sneezing and nasal rubbing induced by antigen challenge in actively sensitized rats were inhibited by oral administration of the 50% EtOH eluate. Significant inhibition of sneezing and nasal rubbing was observed at doses of 300 and 1000 mg/kg, p.o., respectively. Furthermore, the 50% EtOH eluate inhibited dye leakage into the nasal cavity of rats

induced by antigen in a dose-dependent manner. These results suggested that extracts of Mentha piperita L. may be clinically effective in alleviating the nasal symptoms of allergic rhinitis.

Anti-Fungal

J Environ Biol. 2013 Jan;34(1):17-22.
Screening of some essential oils against Trichosporon species.
White Piedra is a superficial mycoses characterized by nodules on the hair shaft, caused by the basidiomycetous yeast Trichosporon species. In this study 25 essential oils were extracted and screened against two Trichosporon species i.e. Trichosporon asahii and Trichosporon cutaneum. Both these fungi procured from MTCC Chandigarh were maintained on yeast malt agar plates and tubes at 25 degrees C. Two screening methods viz., agar well diffusion assay and minimum inhibitory concentration were adopted for the study. The results showed that the maximum anti-yeast activity against T.asahii and T. cutaneum was demonstrated by oil of Mentha piperita showing full inhibition of both the fungi Melaleuca alternifolia with an inhibition zone of 45 and 40 mm, Cymbopogon winterians with inhibition zone of 45 and 45 mm and Cymbopogon flexuosus with 35 and 30 mm inhibition zones. The oil of Trachyspermum ammi exhibited 10 and 20 mm, Abelmoschus moschatus exhibited 30 and 20 mm, Salvia sclarea showed 20 and 18 mm and Jasminum officinale exhibited 25 and 15 mm inhibition zones showing moderate activity. The oil of Cyperus scariosus, Pogostemon patchouli and Rosa damascene showed no inhibition zone against both the fungi while Vetiveria zizanoides exhibited no inhibition in case of T.asahii and inhibition zone of 10 mm in case of T. cutaneum demonstrating comparatively low activity against both the fungi. These results support that the essential oils can be used to cure superficial mycoses and these oils may have significant role as pharmaceuticals and preservatives.

Nihon Ishinkin Gakkai Zasshi. 2007;48(1):27-36.
Combined effect of heat, essential oils and salt on fungicidal activity against Trichophyton mentagrophytes in a foot bath.
This work was originally undertaken to determine the effective conditions of essential oils against Trichophyton mentagrophytes in vitro for the treatment of tinea pedis in a foot bath. Agar blocks implanted with T. mentagrophytes were immersed in 0.1% aqueous agar containing two-fold dilutions of essential oils with or without sodium chloride at 27 degrees C, 37 degrees C and 42 degrees C for 10 and 20 min. The number of surviving mycelia on the agar blocks was determined from the standard curves of the colony diameter and original inocula of the conidia. At the same time, the thermal effect on the cellular morphology was examined using SEM. Most fungal mycelia (99.7%) were killed after treatment at 42 degrees C for 20 min without essential oil. The fungicidal activity of essential oils was markedly enhanced by treating at 42 degrees C for 20 min as compared with that at 27 degrees C, showing 1/4 - 1/32-fold reduction of minimum fungicidal concentration (MFC to kill 99.99%). The order of the fungicidal activity of 11 essential oils was oregano, thyme thymol, cinnamon bark > lemongrass > clove, palmarose, peppermint, lavender > geranium Bourbon, tea tree > thyme geraniol oils. MFCs were further reduced to 1/2 - 1/8 by the addition of 10% sodium chloride. The salt effect was explained, at least partly, by an increase in mycelial adsorption of antifungal constituents in the presence of sodium chloride. Considerable hyphal damage was done at 27 degrees C by the essential oils, but no further alteration in morphology of the hyphae treated at 42 degrees C with or without oil was observed by SEM. The inhibitory effect of heat

and oils was also observed against mycelia of T.rubrum and conidia of T. mentagrophytes. Thermotherapy combined with essential oils and salt would be promising to treattinea pedis in a foot bath.

Braz J Microbiol. 2012 Oct;43(4):1347-54.
Inhibitory effect of essential oils against Trichosporon ovoides causing Piedra Hair Infection.
Piedra, is an asymptomatic fungal infection of the hair shaft, resulting in the formation of nodules of different hardness on the infected hair. The infection also known asTrichomycosis nodularis is a superficial fungal infection arising from the pathogen being restricted to the stratumcorneum with little or no tissue reaction. The nodules are a concretion of hyphae and fruiting bodies of the fungus. Two varieties ofPiedra may be seen, Black Piedra and White Piedra. The fungus Trichosporon ovoides is involved in the occurrence of both types of Piedras. The purpose of this study was to examine the effectiveness of selected essential oils for the control of growth of the fungus and to determine whether the antifungal effect was due to the major compounds of the oils. Two screening methods viz. Agar well diffusion assay and Minimum Inhibitory Concentration were adopted for the study. MIC andMFC were determined by tube dilution method. Essential oils from Eucalyptus,Ocimum basilicum,Mentha piperita, Cymbopogon flexuosus, Cymbopogon winterians, Trachyspermum ammi, Zingiber officinalis,Citrus limon, Cinnamomon zeylanicum,Salvia sclarea, Citrus aurantifolia, Melaleuca alternifolia,Citrus aurantium, Citrus bergamia, Pogostemon pathchouli, Cedrus atlantica, Jasminum officinale,Juniperus communis, Abelmoschus moschatus, Cyperus scariosus, Palargonium graveolens, Boswellia carterii, Rosa damascene, Veteveria zizanoides and Commiphora myrrha were evaluated. The essential oils ofCymbopogon winterians, Mentha piperita, Cinnamomum zeylanicum,Melaleuca alternifolia and Eucalyptus globulus were proved to be most effective against the fungus Trichosporon ovoides.

ISRN Pharm. 2012;2012:718645.
Chemical Composition, Antifungal and Antibiofilm Activities of the Essential Oil of Mentha piperita L.
Variations in quantity and quality of essential oil (EO) from the aerial parts of cultivatedMentha piperita were determined. The EO of air-dried sample was obtained by ahydrodistillationmethod and analyzed by a gas chromatography/mass spectrometry (GC/MS). The antifungal activity of the EO was investigated by broth microdilution methods as recommended by Clinical and Laboratory Standards Institute. Abiofilm formation inhibition was measured by using anXTT reduction assay. Menthol (53.28%) was the major compound of the EO followed by Menthyl acetate (15.1%) and Menthofuran (11.18%). The EO exhibited strong antifungal activities against the examined fungiat concentrations ranging from 0.12 to 8.0μL/mL. In addition, the EO inhibited the biofilm formation of Candida albicans and C. dubliniensisat concentrations up to 2μL/mL. Considering the wide range of the antifungal activities of the examined EO, it might be potentially used in the management of fungal infections or in the extension of the shelf life of food products.

Mycoses. 2009 Mar;52(2):135-40.
An investigation on the anticandidal activity of some traditional medicinal plants in Turkey.
Methanol and chloroform extracts obtained from eight plant species belonging to six families, which were selected depending on their use in Turkish folk medicine, includingMentha longifolia L. (Labiatae), Mentha piperita L. Hudson (Labiatae), Prongos ferulaceae (Umbelliferae),Galium verum L. (Rubiaceae), Salvia limbata C. A Meyer (Labiatae), Artemisia austriaca Jacq. (Artemiceae), Plantago lanceolata L. (Plantaginaceae) and Urtica dioica L. (Urticaceae) were evaluated for their in vitro anticandidal activity.

The anticandidal activity of extracts against 99 human pathogenic clinical isolates belonging to 35 Candida albicans, 33 Candida tropicalis and 31 Candida glabrata and standard strains of Candida spp. (C. albicans ATCC 10231, C. glabrata ATCC 80030 and C. tropicalis ATCC 22019) were tested by disc diffusion method and the active extracts were assayed for the minimal inhibitory concentration (MIC). Chloroform extracts of plants have no inhibitory effect against both clinical and standard strains of Candida spp., whereas methanol extracts exhibited good activity. Among the plants tested, M. piperita showed the highest anticandidal activity with 12.3 mm inhibition zone and 1.25 mgml(-1) MIC value against C. albicans, M. longifolia, P. lanceolata and A. austriaca also displayed activity against C.albicans and C. tropicalis.

Phytochemistry. 2006 Jun;67(12):1249-55.
Biochemical activities of Iranian Mentha piperita L. and Myrtus communis L. essential oils.
GC-MS analysis of essential oils of Iranian Mentha piperita and Myrtus communis extracted by hydrodistillation lead to identification of 26 and 32 compounds, respectively. The oils had good to excellent antimicrobial activities against Escherichia coli, Staphylococcus aureus and Candida albicans with the oil of M. piperita being more active. The findings suggest feasibility of application of Mpiperita oil in treatment of the infections caused by C. albicans and E. coli. D-values on exposure to M. piperita and Myrtus communis oils were (2.14 and 2.8min), (1.4 and 12.8min) and (4.3 and 8.6min) for E. coli, S. aureus and C. albicans, respectively. The oils were screened for their possible antioxidant activities by two complementary test systems, namely DPPH free radical scavenging and beta-carotene/linoleic acid systems. M. piperirta oil exerted greater antioxidant activity than that of M. communis. Phytochemical and phytobiological characteristics of these oils may lead to extraction and production of active compounds in single or combined forms with useful applications.

Molecules. 2009 Jan 7;14(1):238-49.
Chemical composition of essential oils of Thymus and Mentha species and their antifungal activities.
The potential antifungal effects of Thymus vulgaris L., Thymus tosevii L., Mentha spicata L., and Mentha piperita L. (Labiatae) essential oils and their components against 17 micromycetal food poisoning, plant, animal and human pathogens are presented. The essential oils were obtained by hydrodestillation of dried plant material. Their composition was determined by GC-MS. Identification of individual constituents was made by comparison with analytical standards, and by computer matching mass spectral data with those of the Wiley/NBS Library of Mass Spectra. MIC's and MFC's of the oils and their components were determined by dilution assays. Thymol (48.9%) and p-cymene (19.0%) were the main components of T. vulgaris, while carvacrol (12.8%), a-terpinyl acetate (12.3%), cis-myrtanol (11.2%) and thymol (10.4%) were dominant in T. tosevii. Both Thymus species showed very strong antifungal activities. In M. piperita oil menthol (37.4%), menthyl acetate (17.4%) and menthone (12.7%) were the main components, whereas those of M. spicata oil were carvone (69.5%) and menthone (21.9%). Mentha sp. showed strong antifungal activities, however lower than Thymus sp. The commercial fungicide, bifonazole, used as a control, had much lower antifungal activity than the oils and components investigated. It is concluded that essential oils of Thymus and Mentha species possess great antifungal potential and could be used as natural preservatives and fungicides.

J Microbiol Immunol Infect. 2010 Oct;43(5):447-51.
Effect of plant oils on Candida albicans.

BACKGROUND/PURPOSE: Candida species, notably Candida albicans, is the major fungal pathogen in humans. It is a dimorphic fungus capable of causing superficial mucosal infections, as well as systemic infections, in immunocompromised individuals. The factors responsible for its pathogenesis are still not fully understood and increasing resistance to commonly used antifungal agents necessitates the search for new formulations.
METHODS: The inhibitory effect of 30 different plant oils on Candida albicans isolated from clinical samples was evaluated. The antifungal agent fluconazole was used as a positive control. Plant oils were tested at concentrations from 0.03% to 3% (v/v) to determine the minimum inhibitory concentration and minimum fungicidal concentration (MFC) using agar dilution and macro broth dilution assays.
RESULTS: Of the 30 plant oils tested, 18 were found to be effective and 12 were ineffective. Based on their MFCs, effective oils were placed into three categories: most effective, moderately effective and least effective. Eucalyptus and peppermint oils were most effective, with MFC values of 0.12% and 0.15% (v/v), respectively.
CONCLUSION: The significant antifungal activity of these oils suggests that they could serve as a source of compounds with therapeutic potential against Candida-related infections.

Mycopathologia. 2008 Jan;165(1):13-9.
Prevention of Candida albicans biofilm by plant oils.
The inhibitory effect of 30 plant oils was evaluated against biofilm forming Candida albicans strain (CA I) isolated from clinical samples, which was sensitive to 4 microg/ml of fluconazole, used as a positive control. The standard strain (MTCC 227, CA II) used in this study was found to be highly resistant to fluconazole, 3,000 microg/ml of which was required to inhibit the growth of this strain partially, and complete inhibition could not be achieved. Eighteen among the 30 plant oils tested were found to show anti-Candida activity by disc diffusion assay. Effective plant oils were assessed using XTT (2, 3-bis [2-Methoxy-4-nitro-5-sulphophenyl]-2H-tetrazolium-5-carboxanilide) reduction assay for biofilm quantification. Four oils eucalyptus, peppermint, ginger grass and clove showed 80.87%, 74.16%, 40.46% and 28.57% biofilm reduction respectively. Minimum inhibitory concentration (MIC) values were calculated using agar dilution assay. Scanning electron microscopic (SEM) analysis further revealed reduction in C. albicans biofilm in response to effective oils. The substantial antifungal activity shown by these plant oils suggests their potential against infections caused by C. albicans.

Anti-Bacterial

Molecules. 2011 Feb 15;16(2):1642-54.
Peppermint oil decreases the production of virulence-associated exoproteins by Staphylococcus aureus.
The present study aimed to evaluate the antimicrobial activity of peppermint oil against Staphylococcus aureus, and further investigate the influence of peppermint oil on S. aureus virulence-related exoprotein production. The data show that peppermint oil, which contained high contents of menthone, isomenthone, neomenthol, menthol, and menthyl acetate, was active against S. aureus with minimal inhibitory concentrations (MICs) ranging from 64-256 μg/mL, and the production of S. aureus exotoxins was decreased by subinhibitory concentrations of peppermint oil in a dose-dependent manner. The findings suggest that peppermint oil may potentially be used to aid in the treatment of S. aureus infections.

J Mycol Med. 2014 Mar;24(1):34-43.
Antimicrobial activity of Mentha piperita and Saturenja hortensis in a murine model of cutaneous protothecosis.
BACKGROUND: To date there is no defined pharmacologic treatment protocol available against cutaneous protothecosis, which is difficult to combat using conventional drugs
OBJECTIVES: Our experiment aimed to comparatively investigate the effect of two essential oils (Mentha piperita and Saturenja hortensis) against cutaneous protothecosis experimentally induced by Prototheca zopfii in mice.
MATERIALS AND METHODS: Immunosuppressed BALB/c female mice, were divided into six experimental groups, infected with P. zopfii, and then treated for 21 days against the infection. The effectiveness of the different treatments was assessed clinically and histologically by quantifying the degree of inflammation (immunohistochemical quantification of macrophages, T lymphocytes and neutrophils) and fibrosis.
RESULTS: Skin lesions in experimental protothecosis from non-treated mice were more severe as compared to the four groups of treated animals. Both M. piperita and S. hortensis have proved to be efficient in vivo in the treatment of cutaneous protothecosis by reducing the clinical signs and significantly reducing the degree of inflammation ($P<0.05$ for the number of macrophages, T lymphocytes and neutrophils) and fibrosis as compared to untreated animals.
CONCLUSION: Interestingly, our study shows that M. piperita and S. hortensis could represent a potential source of natural antimicrobial products in the treatment of cutaneous protothecosis.

J Appl Bacteriol. 1995 Jun;78(6):593-600.
Effects of essential oil from mint (Mentha piperita) on Salmonella enteritidis and Listeria monocytogenes in model food systems at 4 degrees and 10 degrees C.
The effect of mint (Mentha piperita) essential oil (0.5, 1.0, 1.5 and 2.0%, v/w) on Salmonella enteritidis and Listeria monocytogenes in a culture medium and three model foods; tzatziki (pH 4.5), taramosalata (pH 5.0) and pâté (pH 6.8), inoculated at 10(7) cfu g-1, at 4 degrees and 10 degrees C for ca 1 week was studied. In the culture medium supplemented with the essential oil, no growth was observed over 2 d at 30 degrees C determined by a conductance method with a Malthus 2000 growth analyser. Salmonella enteritidis died in tzatziki in all treatments and declined in the other foods except for pâté at 10 degrees C as judged with viable counts. Listeria monocytogenes populations showed a declining trend towards the end of the storage period but was increased in pâté. Mint essential oil antibacterial action depended mainly on its concentration, food pH, composition, storage temperature and the nature of the micro-organism.

Microbios. 1995;84(340):195-9.
Effect of essential oils on the viability and morphology of Escherichia coli (SP-11).
The four essential oils (aromatic plant products) from palmarosa (Pm), lemongrass (Lg), peppermint (Pt) and eucalyptus (Eu) plants were found to be bactericidal to Escherichia coli strain SP-11, at a concentration of 1.66 (Pm, Lg and Eu) or 2.5 (Pt) microl ml-1. This effect was observed both at 37 degrees C and 4 degrees C and was not prevented by immediate tenfold dilution or by the presence of 0.5 M sucrose. Pm and Pt but not Lg or Eu induced the formation of elongated filamentous forms, some measuring 60-70 micrometers long.

Eur J Dent. 2013 Sep;7(Suppl 1):S71-7. Antimicrobial efficacy of five essential oils against oral pathogens: An in vitro study.

OBJECTIVES: This study was aimed to find out the minimum inhibitory concentration (MIC) of five essential oils against oral pathogens and to find out the minimum bactericidal concentration (MBC) and minimum fungicidal concentration (MFC) of five essential oils against oral pathogens.
MATERIALS AND METHODS: The antimicrobial activities by detecting MIC and MBC/MFC of five essential oils such as tea tree oil, lavender oil, thyme oil, peppermint oil and eugenol oil were evaluated against four common oral pathogens by broth dilution method. The strains used for the study were Staphylococcus aureus ATCC 25923, Enterococcus fecalis ATCC 29212, Escherichia coli ATCC 25922 and Candida albicans ATCC 90028.
RESULTS: Out of five essential oils, eugenol oil, peppermint oil, tea tree oil exhibited significant inhibitory effect with mean MIC of 0.62 ± 0.45, 9.00 ± 15.34, 17.12 ± 31.25 subsequently. Mean MBC/MFC for tea tree oil was 17.12 ± 31.25, for lavender oil 151.00 ± 241.82, for thyme oil 22.00 ± 12.00, for peppermint oil 9.75 ± 14.88 and for eugenol oil 0.62 ± 0.45. E. fecalis exhibited low degree of sensitivity compared with all essential oils.
CONCLUSION: Peppermint, tea tree and thyme oil can act as an effective intracanal antiseptic solution against oral pathogens.

Phytochemistry. 2006 Jun;67(12):1249-55. Epub 2006 Jun 14.
Biochemical activities of Iranian Mentha piperita L. and Myrtus communis L. essential oils.
GC-MS analysis of essential oils of Iranian Mentha piperita and Myrtus communis extracted by hydrodistillation lead to identification of 26 and 32 compounds, respectively. The oils had good to excellent antimicrobial activities against Escherichia coli, Staphylococcus aureus and Candida albicans with the oil of M. piperita being more active. The findings suggest feasibility of application of M piperita oil in treatment of the infections caused by C. albicans and E. coli. D-values on exposure to M. piperita and Myrtus communis oils were (2.14 and 2.8min), (1.4 and 12.8min) and (4.3 and 8.6min) for E. coli, S. aureus and C. albicans, respectively. The oils were screened for their possible antioxidant activities by two complementary test systems, namely DPPH free radical scavenging and beta-carotene/linoleic acid systems. M. piperirta oil exerted greater antioxidant activity than that of M. communis. Phytochemical and phytobiological characteristics of these oils may lead to extraction and production of active compounds in single or combined forms with useful applications.

Phytomedicine. 2012 Aug 15;19(11):969-76. doi: 10.1016/j.phymed.2012.05.014. Epub 2012 Jun 26.
Antimicrobial activity of a traditionally used complex essential oil distillate (Olbas(®) Tropfen) in comparison to its individual essential oil ingredients.
Plant extracts and essential oils have been widely studied and used as antimicrobial agents in the last decades. In our study we investigated the antimicrobial activities of Olbas(®) Tropfen (in the following named Olbas), a traditionally used complex essential oil distillate, in comparison to its individual essential oil ingredients. Olbas (10 g) consists of three major components such as peppermint oil (5.3 g), eucalyptus oil (2.1 g), and cajuput oil (2.1 g) and of two minor constituents like juniper berry oil (0.3 g) and wintergreen oil (0.2 g). The composition of Olbas and the five individual essential oils were characterized by GLC-MS. According to GLC-MS analysis 1,8-cineol is the main component of the complex essential oil distillate followed by menthol and menthone. The minimum inhibitory and minimum microbicidal concentrations of Olbas and each of the single essential oils were evaluated in 17 species/strains of bacteria and fungi. Time-kill assay was performed to compare the microbicidal activity of Olbas and peppermint oil during several time intervals. Olbas displayed a high antimicrobial activity against all test strains used in this study, among them antibiotic resistant MRSA (methicillin-resistant Staphylococcus aureus) and VRE

(vancomycin-resistant Enterococcus). Its antimicrobial activity was comparable to that of peppermint oil which was the most potent one of all individual essential oils tested. In the time kill assay Olbas as well as peppermint oil demonstrated similar microbicidal activities. Based on its wide antimicrobial properties Olbas can be a useful agent for the treatment of uncomplicated infections of skin and respiratory tract.

Anti-Viral

HNO. 2011 Dec;59(12):1176-84.
Efficacy of plant products against herpetic infections.
Essential oils from various aromatic medicinal plants are highly active against some viral infections, e.g. labial herpes caused by herpes simplex virus type 1. Balm oil, tea tree oil and peppermint oil demonstrate in vitro a significant antiherpetic activity, mainly related to a direct drug-virus particle interaction, some essential oils also act directly virucidal. Interestingly, these essential oils are also highly active against acyclovir-resistant herpes simplex virus strains. In clinical studies, tea tree oil has been shown to possess antiherpetic, anti-inflammatory and pain-relieving properties, as well as to accelerate the healing process of herpes labialis. Applying diluted essential oils three to four times daily for the antiherpetic treatment of affected areas is recommended. Some companies have marketed plant products, e.g. from Melissa, for the treatment of recurrent herpetic infections.

Phytomedicine. 2003;10(6-7):504-10.
Virucidal effect of peppermint oil on the enveloped viruses herpes simplex virus type 1 and type 2 in vitro.
The virucidal effect of peppermint oil, the essential oil of Mentha piperita, against herpes simplex virus was examined. The inhibitory activity against herpes simplex virus type 1 (HSV-1) and herpes simplex virus type 2 (HSV-2) was tested in vitro on RC-37 cells using a plaque reduction assay. The 50% inhibitory concentration (IC50) of peppermint oil for herpes simplex virus plaque formation was determined at 0.002% and 0.0008% for HSV-1 and HSV-2, respectively. Peppermint oil exhibited high levels of virucidal activity against HSV-1 and HSV-2 in viral suspension tests. At noncytotoxic concentrations of the oil, plaque formation was significantly reduced by 82% and 92% for HSV-1 and HSV-2, respectively. Higher concentrations of peppermint oil reduced viral titers of both herpesviruses by more than 90%. A clearly time-dependent activity could be demonstrated, after 3 h of incubation of herpes simplex virus with peppermint oil an antiviral activity of about 99% could be demonstrated. In order to determine the mode of antiviral action of the essential oil, peppermint oil was added at different times to the cells or viruses during infection. Both herpesviruses were significantly inhibited when herpes simplex virus was pretreated with the essential oil prior to adsorption. These results indicate that peppermint oil affected the virus before adsorption, but not after penetration into the host cell. Thus this essential oil is capable to exert a direct virucidal effect on HSV. Peppermint oil is also active against a acyclovir resistant strain of HSV-1 (HSV-1-ACV(res)), plaque formation was significantly reduced by 99%. Considering the lipophilic nature of the oil which enables it to penetrate the skin, peppermint oil might be suitable for topical therapeutic use as virucidal agent in recurrent herpes infection.

Retrovirology. 2008 Mar 20;5:27.
Aqueous extracts from peppermint, sage and lemon balm leaves display potent anti-HIV-1 activity by increasing the virion density.

BACKGROUND: Aqueous extracts from leaves of well known species of the Lamiaceae family were examined for their potency to inhibit infection by human immunodeficiency virus type 1 (HIV-1). RESULTS: Extracts from lemon balm (Melissa officinalis L.), peppermint (Mentha x piperita L.), and sage (Salvia officinalis L.) exhibited a high and concentration-dependent activity against the infection of HIV-1 in T-cell lines, primary macrophages, and in ex vivo tonsil histocultures with 50% inhibitory concentrations as low as 0.004%. The aqueous Lamiaceae extracts did not or only at very high concentrations interfere with cell viability. Mechanistically, extract exposure of free virions potently and rapidly inhibited infection, while exposure of surface-bound virions or target cells alone had virtually no antiviral effect. In line with this observation, a virion-fusion assay demonstrated that HIV-1 entry was drastically impaired following treatment of particles with Lamiaceae extracts, and the magnitude of this effect at the early stage of infection correlated with the inhibitory potency on HIV-1 replication. Extracts were active against virions carrying diverse envelopes (X4 and R5 HIV-1, vesicular stomatitis virus, ecotropic murine leukemia virus), but not against a non-enveloped adenovirus. Following exposure to Lamiaceae extracts, the stability of virions as well as virion-associated levels of envelope glycoprotein and processed Gag protein were unaffected, while, surprisingly, sucrose-density equilibrium gradient analyses disclosed a marked increase of virion density.
CONCLUSION: Aqueous extracts from Lamiaceae can drastically and rapidly reduce the infectivity of HIV-1 virions at non-cytotoxic concentrations. An extract-induced enhancement of the virion's density prior to its surface engagement appears to be the most likely mode of action. By harbouring also a strong activity against herpes simplex virus type 2, these extracts may provide a basis for the development of novel virucidal topical microbicides.

Anti-Parasitic

Immunobiology. 2014 Aug;219(8):627-32.
Immunological and parasitological parameters in Schistosoma mansoni-infected mice treated with crude extract from the leaves of Mentha x piperita L.
Schistosomiasis is a chronic disease caused by an intravascular trematode of the genus Schistosoma. Praziquantel is the drug used for treatment of schistosomiasis; nevertheless failure of treatment has been reported. Consequently, the identification of new effective schistosomicidal compounds is essential to ensure the effective control of schistosomiasis in the future. In this work we investigated the immunomodulatory and antiparasitic effects of the crude leaves extract of Mentha x piperita L. (peppermint) on murine Schistosomiasis mansoni. Female Balb/c mice were infected each with 50 S. mansoni cercariae and divided into three experimental groups: (I) untreated; (II) treated daily with M. x piperita L. (100mg/kg) and III) treated on 1/42/43 days post-infection with Praziquantel (500mg/kg). Another group with uninfected and untreated mice was used as a control. Subsequently, seven weeks post-infection, S. mansoni eggs were counted in the feces, liver and intestine. Worms were recovered by perfusion of the hepatic portal system and counted. Sera levels of IL-10, IL-5, IL-13, IFN-?, IgG1, IgE and IgG2a were assayed by ELISA. Animals treated with a daily dose of M. x piperita L. showed increased sera levels of IL-10, IFN-?, IgG2a and IgE. Besides, M. x piperita L. treatment promoted reduction in parasite burden by 35.2% and significant decrease in egg counts in the feces and intestine.

Exp Parasitol. 2007 Jan;115(1):25-31. Epub 2006 Jul 14.

Giardia lamblia: the effects of extracts and fractions from Mentha x piperita Lin. (Lamiaceae) on trophozoites.
Giardia lamblia is a parasite that causes giardiasis in humans and other mammals. The common treatment includes different classes of drugs, which were described to produce unpleasant side effects. Mentha x piperita, popularly known as peppermint, is a plant that is frequently used in the popular medicine to treat gastrointestinal symptoms. We examined the effects of crude extracts and fractions from peppermint against G. lamblia (ATCC 30888) on the basis of trophozoite growth, morphology and adherence studies. The methanolic, dichloromethane and hexanic extracts presented IC(50) values of 0.8, 2.5 and 9.0 microg/ml after 48h of incubation, respectively. The aqueous extract showed no effect against the trophozoites with an IC(50)>100 microg/ml. The aqueous fraction presented a moderate activity with an IC(50) of 45.5 microg/ml. The dichloromethane fraction showed the best antigiardial activity, with an IC(50) of 0.75 microg/ml after 48h of incubation. The morphological and adhesion assays showed that this fraction caused several alterations on plasma membrane surface of the parasite and inhibited the adhesion of G. lamblia trophozoites. Cytotoxic assays showed that Mentha x piperita presented no toxic effects on the intestinal cell line IEC-6. Our results demonstrated antigiardial activity of Mentha x piperita, indicating its potential value as therapeutic agent against G. lamblia infections.

Rev Bras Parasitol Vet. 2007 Jan-Mar;16(1):57-9.
[Effects of aqueous extracts of Mentha piperita L. and Chenopodium ambrosioides L. leaves in infective larvae cultures of gastrointestinal nematodes of goats].
Phitotherapy has been frequently utilized in parasitism control for numerous animal species. The aim of this experiment was to evaluate the in vitro effects of aqueous extracts of Mentha piperita L. and Chenopodium ambrosioides L. leaves in larvae cultures of gastrointestinal nematodes of goats. Six different concentrations of M. piperita extracts (196; 150.7; 115.9; 89.1; 68.5 e 52.7 mg/mL) and C. ambrosioides extracts (110,6; 85; 65,3; 50,2; 38,6 e 29,6 mg/mL) were used for the treatment of larvae cultures, in triple assays. Distilled water and doramectin were used in larvae cultures as negative and positive controls, respectively. The results revealed a reduction of more than 95% of the infective larvae when M. piperita extracts were used in the concentrations of 115.9 and 196 mg/mL, and C. ambrosioides extract in the concentration of 110.6 mg/mL, supporting the effect of these extracts in the in vitro treatment of gastrointestinal nematodes of goats.

Pain

Clin J Pain. 2002 May-Jun;18(3):200-2.
A novel treatment of postherpetic neuralgia using peppermint oil.
BACKGROUND: Postherpetic neuralgia remains a difficult problem to treat. A number of therapies have been shown to be effective, but some patients have intractable pain.
PATIENT: The case of a 76-year-old woman whose pain had been resistant to standard therapies is described. The pattern of quantitative sensory testing results for this patient led the authors to believe that she had an "irritable nociceptor" type of pathophysiology.
INTERVENTION: The patient was instructed to apply neat peppermint oil (containing 10% menthol) to her skin, resulting in an almost immediate improvement in her pain. This pain relief persisted for 4-6 hours after application of the oil.

RESULTS: The patient was successfully treated with topical peppermint oil. During 2 months of follow-up she has had only a minor side effect, with continuing analgesia. The authors believe this is the first evidence of peppermint oil (or menthol) having a strong analgesic effect on neuropathic pain. The possible mechanisms of action of peppermint oil are discussed.

Libyan J Med. 2012;7. doi: 10.3402/ljm.v7i0.16205. Epub 2012 Mar 27.
Antinociceptive activity of Mentha piperita leaf aqueous extract in mice.
BACKGROUND: Mentha piperita L. (Labiatae) is an herbaceous plant, used in folk medicine for the treatment of several medical disorders.
METHODS AND RESULTS: In the present study, the aqueous extract of Mentha piperita leaf, at the i.p doses 200 and 400 mg/kg, showed significant analgesic effects against both acetic acid-induced writhing and hot plate-induced thermal stimulation in mice, with protection values of 51.79% and 20.21% respectively. On the contrary, the Mentha piperita leaf aqueous extract did not exhibit anti-inflammatory activity against carrageenan induced paw oedema.
CONCLUSION: These findings indicate that Mentha piperita has a potential analgesic effect that may possibly have mediated centrally and peripherally, as well as providing a pharmacological evidence for its traditional use as a pain reliever.
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Taehan Kanho Hakhoe Chi. 2005 Feb;35(1):186-94.
The effects of aromatherapy on pain, depression, and life satisfaction of arthritis patients.
PURPOSE: The purpose of this study was to investigate the effect of aromatherapy on pain, depression, and feelings of satisfaction in life of arthritis patients.
METHOD: This study used a quasi-experimental design with anon-equivalent control group, pre-and post-test. The sample consisted of 40 patients, enrolled in the Rheumatics Center,Kangnam St. Mary's Hospital, South Korea. The essential oils used were lavender, marjoram, eucalyptus, rosemary, and peppermint blended in proportions of 2:1:2:1:1. They were mixed with a carrier oil composed of almond (45%), apricot(45%), and jojoba oil(10%) and they were diluted to 1.5% after blending. The data were analyzed using an 2-test, Fisher's exact test, t-test and paired t-test.
RESULT: Aromatherapy significantly decreased both the pain score and the depression score of the experimental group compared with the control group. However, aromatherapy didn't increase the feeling of satisfaction in life of the experimental group compared with the control group.
CONCLUSION: The result of this study clearly shows that aromatherapy has major effects on decreasing pain and depression levels. Based on our experiment's findings, we suggest that aromatherapy can be a useful nursing intervention for arthritis patients.

Pregnancy

Int Breastfeed J. 2007 Apr 19;2:7.
Effect of peppermint water on prevention of nipple cracks in lactating primiparous women: a randomized controlled trial.
BACKGROUND: Nipple pain and damage inbreastfeeding mothers are common causes of premature breastfeeding cessation. Peppermint water is popularly used for the prevention of nipple cracks in the North West of Iran. The aim of this study was to determine the effectiveness of peppermint water in the

prevention of nipple cracks during breastfeeding in comparison with the application of expressed breast milk (EBM).
METHODS: One hundred and ninety-six primiparous breastfeeding women who gave birth between February and May 2005 in a teaching hospital in Tabriz, Iran, were randomized to receive either peppermint water or EBM. Each woman was followed for up to three visits or telephone calls within 14 days and then by telephone call at week six postpartum.
RESULTS: Women who were randomized to receive peppermint water were less likely to experience nipple and areola cracks (9%) compared to women using EBM (27%; $p < 0.01$). Women who used the peppermint water on a daily basis were less likely to have a cracked nipple than women who did not use peppermint water (relative risk 3.6, 95%CI: 2.9, 4.3). Nipple pain in the peppermint water group was lower than the expressed breast milk group (OR 5.6, 95% CI: 2.2, 14.6; $p < 0.005$).
CONCLUSION: This study suggests that peppermint water is effective in the prevention of nipple pain and damage. Further studies are needed to assess the usefulness of peppermint water in conjunction with correct breastfeeding techniques.

Med Sci Monit. 2007 Sep;13(9):CR406-411.
A randomized trial of peppermint gel, lanolin ointment, and placebo gel to prevent nipple crack in primiparous breastfeeding women.
BACKGROUND: Sore nipples are common during lactation and remain the major reason for failing to establish successful breastfeeding. To formulate a peppermint gel and to evaluate its effect on the prevention of nipple crack associated with breast-feeding, a randomized double-blinded clinical trial comparing the above formulation with modified lanolin and a neutral ointment was carried out.
MATERIAL/METHODS: Two hundred and sixteen primiparous participants were assigned randomly to three groups. Each group applied only one of the above three preparations on both breasts for 14 days. Each group consisted of 72 primiparous mothers and was seen for a maximum of four follow-up visits within 14 days and a final visit at week 6. The rate of nipple and areola crack and pain was evaluated.
RESULTS: The study groups were comparable in mean age and route of delivery. Nipple crack were less in mothers who received peppermint gel than in those who received lanolin ointment or placebo ($chi(2)=16.8$, $df=6$, $P=0.01$). Relative risk of nipple crack in the lanolin group (RR: 2.41, 95%CI: 1.20-3.01) was higher than in the peppermint group (RR: 1.85, 95%CI: 1.64-3.10).
CONCLUSIONS: Prophylactic peppermint gel in breastfeeding lactating women is associated with fewer nipple cracks and is more effective than lanolin and placebo. It could be recommended for preventing of nipple crack along with teaching better breastfeeding technique at the initiation of breastfeeding.

Iran J Pharm Res. 2012 Fall;11(4):1073-7.
The effect of peppermint oil on symptomatic treatment of pruritus in pregnant women.
Itching is one of the most common skin symptoms. Generalized pruritus occurs in 1-8% of pregnant women. It can create unpleasant feeling for these women especially at nights. Most pregnant women avoid using synthetic drugs because of their side effects. Peppermint is a plant which has been used as a traditional drug in Iran. It decreases skin's temperature. This study was done to determine the effects of peppermint oil on symptomatic treatment of pruritus in pregnant women attending to Rasoul Akram Hospital in Rasht, 2011. In this triple-blind clinical trial, 96 randomly selected subjects diagnosed with pruritus gravidarum were studied (47 cases and 49 controls). A bottle containing 60 mL of peppermint oil 0.5% in sesame oil and identical placebos were provided to be taken twice a day during 2 weeks by the case and control groups, respectively. The severity of the itch was assessed and compared before and after

the study by VAS system. The results were analyzed bySPSS. Statistical methods such as descriptive analysis, independent samples't-test, paired samples' t-test and Chi-square were employed. The severity of the itch in the treated group with peppermint oil in comparison with the placebo group, showed a significant statistical difference (p = 0.003). In accordance with the results of this study, it seems that peppermint oil can be effective in reducing the severity ofPruritus Gravidarum. More studies with larger sample sizes are required to confidently declare the mentioned results.

Inflammation

PLoS One. 2014 Dec 10;9(12):e114767.
Chemical Composition and Anti-Inflammatory, Cytotoxic and Antioxidant Activities of Essential Oil from Leaves of Mentha piperita Grown in China.
The chemical composition, anti-inflammatory,cytotoxic and antioxidant activities of essential oil from leaves of Mentha piperita (MEO) grown in China were investigated. UsingGC-MS analysis, the chemical composition of MEO was characterized, showing that it was mainly composed of menthol,menthone and menthy acetate. MEO exhibited potent anti-inflammatory activities in acroton oil-induced mouse ear edema model. It could also effectively inhibit nitric oxide (NO) and prostaglandin E2(PGE2) production in lipopolysaccharide(LPS)-activated RAW 264.7 macrophages. The cytotoxic effect was assessed against four human cancer cells. MEO was found to be significantly active against human lung carcinomaSPC-A1, human leukemia K562 and human gastric cancerSGC-7901 cells, with an IC50 value of 10.89, 16.16 and 38.76 μg/ml, respectively. In addition, MEO had moderate antioxidant activity. The results of this study may provide an experimental basis for further systematic research, rational development and clinical utilization of peppermint resources.

Nausea

J Holist Nurs. 2012 Jun;30(2):90-104; quiz 105-6.
Examination of the effectiveness of peppermint aromatherapy on nausea in women post C-section.
PURPOSE: This study examined the effect of peppermint spirits on postoperative nausea in women following a scheduledC-section.
DESIGN: A pretest-posttest research design with three groups was used. The peppermint group inhaled peppermint spirits, the placebo aromatherapy control group inhaled an inert placebo, green-colored sterile water, and the standard antiemetic therapy control group received standard antiemetics, usually intravenous ondansetron or promethazine suppositories.
METHODS: Women were randomly assigned to a group on admission to the hospital. If they became nauseated, nurses on the mother-baby unit assessed their nausea (baseline), administered the assigned intervention, and then reassessed participants' nausea 2 and 5 minutes after the initial intervention. Participants rated their nausea using a 6-point nausea scale.
FINDINGS: Thirty-five participants became nauseated post-operatively. Participants in all three intervention groups had similar levels of nausea at baseline. The nausea levels of participants in the peppermint spirits group were significantly lower than those of participants in the other two groups 2 and 5 minutes after the initial intervention.

CONCLUSIONS: Peppermint spirits may be a useful adjunct in the treatment of postoperative nausea. This study should be replicated with more participants, using a variety of aromatherapies to treat nausea in participants with different preoperative diagnoses.

Complement Ther Nurs Midwifery. 2004 Feb;10(1):30-6.
Use of anti-emetic herbs in pregnancy: women's choices, and the question of safety and efficacy.
The majority of North American pregnant women experience some degree of nausea and vomiting, usually in the first few months of pregnancy. Women utilize many coping strategies, including self-treatment with herbal medicine and other alternative therapies. In a qualitative study of self-care in pregnancy, birth and lactation within a non-random sample of 27 women in British Columbia, Canada, 20 women (74%) experienced pregnancy-induced nausea. Ten of these women used anti-emetic herbal remedies, which included ginger, peppermint, and Cannabis. The safety and efficacy of each of these herbal remedies is discussed here. Only ginger has been subjected to clinical trials among pregnant women, though all three herbs were clinically effective against nausea and vomiting in other contexts, such as chemotherapy-induced nausea and post-operative nausea. While safety concerns exist in the literature for all three herbs with regards to their use by pregnant women, clinical evidence of harm is lacking.

Ecancermedicalscience. 2013;7:290.
Antiemetic activity of volatile oil from Mentha spicata and Mentha × piperita in chemotherapy-induced nausea and vomiting.
BACKGROUND: This study is aimed at determining the efficacy of Mentha spicata (M. spicata) and Mentha × piperita (M. × piperita) in preventing chemotherapy-induced nausea and vomiting (CINV).
METHODS: This was a randomised, double-blind clinical trial study. Prior to the study, patients were randomly assigned into four groups to receive M. spicata or M. × piperita. Statistical analysis included the ?(2) test, relative risk, and Student's t-test. Fifty courses were analysed for each group that met our eligibility criteria. The treatment and placebo groups applied essential oils of M spicata, M. × piperita, or a placebo, while the control group continued with their previous antiemetic regimen. Patients or guardians recorded the number of emetic events, the intensity of nausea over 20 h of chemotherapy, as well as any possible adverse effects that occurred during this time.
RESULTS: There was a significant reduction in the intensity and number of emetic events in the first 24 h with M. spicata and M. × piperita in both treatment groups ($p < 0.05$) when compared with the control and no adverse effects were reported. The cost of treatment was also reduced when essential oils were used.
CONCLUSION: M. spicata or M. × piperita essential oils are safe and effective for antiemetic treatment in patients, as well as being cost effective.

Cancer

J Sci Food Agric. 2011 Aug 15;91(10):1849-54. doi: 10.1002/jsfa.4394. Epub 2011 Mar 30.
Anti-tumorigenic activity of five culinary and medicinal herbs grown under greenhouse conditions and their combination effects.
BACKGROUND:
Herbs and spices have been used as food preservatives, flavorings, and in traditional medicines for thousands of years. More and more scientific evidence supports the medicinal properties of culinary herbs. Colon cancer is the third leading cause of cancer death in the USA, and the fourth most common form of

cancer worldwide. The objectives of this study were to evaluate the antitumor activity of five selected herbs grown under greenhouse conditions, and to study the potential synergistic effects among different herbal extract combinations.
RESULTS:
Thyme, rosemary, sage, spearmint, and peppermint extracts significantly inhibited SW-480 colon cancer cell growth, with sage extracts exhibiting the highest bioactivity, with 50% inhibition at 35.9 μg mL?¹, which was equivalent to 93.9 μg dried leaves mL?¹ of culture medium. Some mixtures of different herbal extracts had combination effects on cancer cell growth. The inhibitory effects of peppermint + sage combinations at a 1:1 ratio were significantly higher than rosemary + sage combinations at 1:1 ratio, although peppermint extracts showed lower inhibition than rosemary extracts.
CONCLUSION:
Extracts from herb species (thyme, rosemary, sage, spearmint and peppermint) can significantly inhibit the growth of human colon cancer cells. Mixtures of herb extracts can have combination effects on cancer cell growth. The study suggests that these five herbs may have potential health benefits to suppress colon cancer.

J Oral Pathol Med. 2014 Aug;43(7):484-91.
Chemopreventive effect of Mentha piperita on dimethylbenz[a]anthracene and formaldehyde-induced tongue carcinogenesis in mice (histological and immunohistochemical study).
OBJECTIVE: Cancer chemoprevention is defined as the use of chemicals or dietary components to block, inhibit, or reverse the development of cancer in normal orpre-neoplastic tissue. Mentha extract (ME) has antioxidant and antiperoxidant properties. This study was held to investigate the protective and anticancer effect of Mentha leaves aqueous extract on oral epithelium of mice tongues.
DESIGN: A total of 80 Egyptian albino mice were divided into three groups. Group I served as control (not subjected to any kind of treatment), and groups II and III were subjected to two-stage chemical carcinogenesis through topical application of dimethylbenz[a]anthracene(DMBA) followed by formaldehyde on dorsal and ventral surfaces of tongues for 9 weeks.Mentha leaves extract was administrated to group III at the same time of cancer induction. Histological changes were assessed in H&E sections at 3-week intervals. The anticarcinogenic effect of Mentha piperita was tested using immunostain with anticaspase antibody.
RESULTS: The oral administration of ME reduced the appearance of dysplastic cellular changes with 61% and inhibited tumor incidence with 100%.Group I showed moderate-to-strong cytoplasmic caspase expression. At 6-week interval, group II showed weak-to-moderate caspase expression, while sections from group III showed moderate-to-strong caspase expression. High significant statistical difference in the total score of caspase 3 expression was found between specimens obtained from animals sacrificed at 6 weeks in groups I, II, and III (P = 0.001**).
CONCLUSION: Our study demonstrated that Mentha piperita has inhibited the initiation and promotion of oral dysplastic lesions.

Environ Mol Mutagen. 2006 Apr;47(3):192-8.
Modulatory effects of Mentha piperita on lung tumor incidence, genotoxicity, and oxidative stress in benzo[a]pyrene-treated Swiss albino mice.
Mentha piperita or peppermint is currently used for alleviating nausea, flatulence, and vomiting. In the present investigation, we evaluated the chemopreventive, antigenotoxic, and antioxidative effects of an aqueous extract of Mentha piperita leaves. One-day-old Swiss albino mice were treated with a single

subcutaneous injection of 0.5 mg benzo[a]pyrene (BP) and then given either water or a Mentha extract (ME; 1 g/kg body weight) by gavage starting at 3 weeks of age (weaning). The mice were killed at 9 weeks of age and tested for lung tumor incidence (chemoprevention); bone marrow micronucleus and chromosome aberration frequency (antigenotoxicity); and levels of liver and lung sulfhydral groups, superoxide dismutase (SOD) and catalase (CAT) activity, and lipid peroxidation (LPO) (antioxidative properties). The ME treatment resulted in a significant reduction in the number of lung adenomas from an incidence of 67.92% in animals given only BP to 26.31%, an inhibition of 61.26%. Tumor multiplicity was 1.22 in the BP-alone group and 1.15 in the BP + ME group. In addition, compared with the animals in the BP-alone group, ME reduced the frequency of chromosomal aberrations and micronuclei in bone marrow cells and decreased the levels of LPO and increased reduced glutathione content, and SOD and CAT activities in liver as well as lung. The results of this study indicate that ME is chemopreventive and antigenotoxic when given subsequent to an initiating dose of BP in newborn Swiss albino mice. The chemopreventive action and antigenotoxic effects observed in the present study may be due to the antioxidative properties of ME.

Mutagenesis. 2006 Jan;21(1):61-6. Epub 2006 Jan 6.
Protective effects of Mentha piperita Linn on benzo[a]pyrene-induced lung carcinogenicity and mutagenicity in Swiss albino mice.
The chemopreventive and antimutagenic effects of an aqueous extract of Mentha piperita leaves were evaluated by using 9 week medium term model of benzo[a]pyrene (BP)-induced lung tumors. Lung tumors were induced by a single subcutaneous injection in the scapular region with BP in newborn Swiss albino mice (<24 h old). The oral administration of Mentha extract (ME) showed a significant reduction in the number of lung tumors from an incidence of 67.92% in animals given only BP to 26.31%. The inhibition rate was 61.26% in ME treated group with respect to reference group (BP-alone). However, tumor multiplicity was reduced from 0.83 in the BP-alone group to 0.31 in the BP+ME group. Also, ME treatment reduced the frequency of BP-induced chromosomal aberrations and micronuclei in bone marrow cells and decreased the levels of lipoperoxides and increased sulfhydryl groups in liver as well as lung. In cell-free assays, ME showed strong scavenging activity for both the DPPH* and ABTS*+ radicals. ME had an IC50 value of 272 microg/ml in the DPPH* assay. The chemopreventive action and antimutagenic effects observed in the present study is attributed to the antioxidative and radical scavenging properties of ME.

Int J Toxicol. 2011 Mar;30(2):225-36.
Evaluation of cytotoxicity and anticarcinogenic potential of Mentha leaf extracts.
We examined the possible molecular mechanisms underlying the cytotoxicity and anticarcinogenic potential of Mentha leaf extracts (petroleum ether, benzene, chloroform, ethyl acetate, methanol, and water extracts) on 6 human cancer (HeLa, MCF-7, Jurkat, T24, HT-29, MIAPaCa-2) and normal (IMR-90, HEK-293) cell lines. Of all the extracts tested, chloroform and ethyl acetate extracts of M piperita showed significant dose- and time-dependent anticarcinogenic activity leading to G1 cell cycle arrest and mitochondrial-mediated apoptosis, perturbation of oxidative balance, upregulation of Bax gene, elevated expression of p53 and p21 in the treated cells, acquisition of senescence phenotype, while inducing pro-inflammatory cytokines response. Our results provide the first evidence of direct anticarcinogenic activity of Mentha leaf extracts. Further, bioassay-directed isolation of the active constituents might provide basis for mechanistic and translational studies for designing novel anticancer drugs to be used alone or as adjuvant for prevention of tumor progression and/or treatment of human malignancies.

Int J Mol Sci. 2014 Sep 15;15(9):16302-19.
Extraction, preliminary characterization and evaluation of in vitro antitumor and antioxidant activities of polysaccharides from Mentha piperita.
This study describes the extraction, preliminary characterization and evaluation of the in vitro antitumor and antioxidant activities of polysaccharides extracted from Mentha piperita (MPP). The optimal parameters for the extraction of MPP were obtained by Box-Behnken experimental design and response surface methodology (RSM) at the ratio of water to raw material of 20, extraction time of 1.5 h and extraction temperature at 80 °C. Chemical composition analysis showed that MPP was mainly composed of glucuronic acid, galacturonic acid, glucose, galactose and arabinose, and the molecular weight of its two major fractions were estimated to be about 2.843 and 1.139 kDa, respectively. In vitro bioactivity experiments showed that MPP not only inhibited the growth of A549 cells but possessed potent inhibitory action against DNA topoisomerase I (topo I), and an appreciative antioxidant action as well. These results indicate that MPP may be useful for developing safe natural health products.

Epilepsy

Epilepsy Res Treat. 2013;2013:532657.
Increased seizure latency and decreased severity of pentylenetetrazol-induced seizures in mice after essential oil administration.
The effect of pretreatment with essential oils (EOs) from eight aromatic plants on the seizure latency and severity of pentylenetetrazol- (PTZ-) induced seizures in mice was evaluated. Weight-dependent doses of Rosmarinus officinalis, Ocimum basilicum, Mentha spicata, Mentha pulegium, Lavandula angustifolia, Mentha piperita, Origanum dictamnus, and Origanum vulgare, isolated from the respective aromatic plants from NE Greece, were administered 60 minutes prior to intraperitoneal (i.p.) injection of a lethal dose of PTZ to eight respective groups of Balb-c mice. Control group received only one i.p. PTZ injection. Motor and behavioral activity of the animals after EOs administration, development of tonic-clonic seizures, seizure latency and severity, and percentage of survival after PTZ administration were determined for each group. All groups of mice treated with the EOs showed reduced activity and stability after the administration of the oil, except for those treated with O. vulgare (100% mortality after the administration of the oil). After PTZ administration, mice from the different groups showed increased latency and reduced severity of seizures (ranging from simple twitches to complete seizures). Mice who had received M. piperita demonstrated no seizures and 100% survival. The different drastic component and its concentration could account for the diversity of anticonvulsant effects.

Colic

Evid Based Complement Alternat Med. 2012;2012:981352.
Effectiveness of Mentha piperita in the Treatment of Infantile Colic: A Crossover Study.
Background. Infantile colic is a distressing and common condition for which there is no proven standard treatment. Objective. To compare the efficacy of Mentha piperita with simethicone in treatment for infantile colic. Methods. A double-blind crossover study was performed with 30 infants attending IMIP, Recife, Brazil. They were randomized to use Mentha piperita or simethicone in the treatment of infantile colic during 7 days with each drug. Primary outcomes were mother_s opinion about responses to the treatment, number of daily episodes of colic, and time spent crying, measured by a chronometer.

Mann-Whitney and chi-square tests were used to compare the results. This study was previously approved by the Ethical Committee in Research atIMIP. Results. At baseline daily episodes of infantile colic was 3.9 (±1.1) and the mean crying time per day was 192 minutes (±51.6). At the end of the study daily episodes of colic fell to 1.6 (±0.6) and the crying duration decreased to 111 (±28) minutes. All mothers reported decrease of frequency and duration of the episodes of infantile colic and there were no differences between responses to Mentha piperita and simethicone. Conclusions. These findings suggest thatMentha piperita may be used to help control infantile colic. However, these results must be repeated by others studies.

Hair Growth

Toxicol Res. 2014 Dec;30(4):297-304. doi: 10.5487/TR.2014.30.4.297.
Peppermint Oil Promotes Hair Growth without Toxic Signs.
Peppermint (Mentha piperita) is a plant native to Europe and has been widely used as acarminativeand gastric stimulant worldwide. This plant also has been used in cosmetic formulations as a fragrance component and skin conditioning agent. This study investigated the effect of peppermint oil on hair growth in C57BL/6 mice. The animals were randomized into 4 groups based on different topical applications: saline (SA), jojoba oil (JO), 3% minoxidil(MXD), and 3% peppermint oil (PEO). The hair growth effects of the 4-week topical applications were evaluated in terms of hair growth,histological analysis, enzymatic activity of alkalinephosphatase (ALP), and gene expression of insulin-like growth factor-1(IGF-1), known bio-markers for the enhanced hair growth. Of the 4 experimental groups, PEO group showed the most prominent hair growth effects; a significant increase in dermal thickness, follicle number, and follicle depth. ALP activity and IGF-1 expression also significantly increased inPEO group. Body weight gain and food efficiency were not significantly different between groups.These results suggest that PEO induces a rapid anagen stage and could be used for a practical agent for hair growth without change of body weight gain and food efficiency.
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Diabetes

Plant Foods Hum Nutr. 2008 Mar;63(1):27-33.
Determination of in vitro antidiabetic effects, antioxidant activities and phenol contents of some herbal teas.
In this research, some herbal teas and infusions traditionally used in the treatment of diabetes in Turkey, have been studied for their antidiabetic effects on in vitro glucose diffusion andphenolic contents and antioxidant activities. Ten aqueous herbal tea extracts were examined using an in vitro method to determine their effects on glucose movement across the gastrointestinal tract.Total phenol content of herbal teas was analyzed byFolin-Ciocalteu'sprocedure. Antioxidant activities of herbal teas were evaluated by the effect of extracts on DPPH radical and hydrogen peroxide scavenging. Antioxidant activity was defined as the amount of the sample to decrease the initialDPPH concentration by 50% as efficient concentration, EC50. Antiradical activity [AE] was calculated as 1/EC50. Values were evaluated statistically. Results support the view that none of the herbal teas showedantidiabetic effect on glucose diffusion using in vitro model glucose absorption. Teas were arranged in the order of green tea > peppermint > thyme > black tea > relax tea >absinthium> shrubby blackberry > sage >roselle > olive leaves according to their total phenol contents. Among ten herbal teas, green tea had the highest

hydrogen-donating capacity against to DPPH radical. Ranking of the herbal teas with respect to their DPPH radical scavenging activity were green tea > peppermint > black tea > thyme > relax tea > absinthium > roselle > olive leaves > sage > shrubby blackberry. It was determined that adding flavoring substances such as lemon, bergamot, clove and cinnamon, which are commonly used in preparation of black tea in Turkey resulted to have synergistic effect on total antioxidant activities of black and peppermint teas. The highest hydrogen peroxide inhibition value (65.50%) was obtained for green tea at a 250 microl/ml concentration. The H2O2 scavenging activity of herbal teas decreased in the order green tea > peppermint > relax tea > black tea > thyme > olive leaves > sage >absinthium> shrubby blackberry > roselle. In particular, their phenolic compounds and antioxidant activities may be useful for meal planning in type 2 diabetes. They could contribute to sustain plasma antioxidant level because antioxidants present in plants and herbs prevent the development of vascular diseases seen in type 2 diabetes.

Evid Based Complement Alternat Med. 2011;2011:430237. doi: 10.1155/2011/430237. Epub 2011 Apr 7.
Metabolic Profile of Offspring from Diabetic Wistar Rats Treated with Mentha piperita (Peppermint).
This study aimed at evaluating glycemia and lipid profile of offspring from diabetic Wistar rats treated with Mentha piperita (peppermint) juice. Male offspring from nondiabetic dams (control group: 10 animals treated with water and 10 treated with peppermint juice) and from dams with streptozotocin-induced severe diabetes (diabetic group: 10 animals treated with water and 10 treated with peppermint juice) were used. They were treated during 30 days, and, after the treatment period, levels of glycemia, triglycerides, total cholesterol, and fractions were analyzed in the adult phase. The offspring from diabetic dams treated with peppermint showed significantly reduced levels of glucose, cholesterol, LDL-c, and triglycerides and significant increase in HDL-c levels. The use of the M. piperita juice has potential as culturally appropriate strategy to aid in the prevention of DM, dyslipidemia, and its complications.
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Radiation Exposure

J Cancer Res Ther. 2010 Jul-Sep;6(3):255-62.
Radioprotective potential of mint: a brief review.
Radiation is an important modality in cancer treatment and estimates are that between one third and one half of all patients will require ionizing irradiation therapy during some point in their clinical management. However, the radiation-induced damage to the normal tissues restricts the therapeutic doses of radiation that can be delivered to tumors and thereby limits the effectiveness of the treatment. The use of chemical compounds (radioprotectors) represents an obvious strategy to improve the therapeutic index in radiotherapy. However, most of the synthetic radioprotective compounds studied have shown inadequate clinical application owing to their inherent toxicity and high cost. These observations necessitated a search for alternative agents that are less toxic and highly effective. Studies in the recent past have shown that some medicinal plants possess radioprotective effects. Two species of the commonly used aromatic herb mint, Mentha piperita and M. arvensis protected mice against the gamma-radiation-induced sickness and mortality. Detail investigations have also shown that the aqueous extract of M. piperita protected the vital radiosensitive organs: the testis, gastrointestinal and hemopoetic systems in mice. The radioprotective effects are possibly due to free radical scavenging, antioxidant, metal chelating, anti-inflammatory,

antimutagenic, and enhancement of the DNA repair processes. This review for the first time summarizes the observations and elucidates the possible mechanisms responsible for the beneficial effects. The lacunae in the existing knowledge and directions for future research are also addressed.

Cytotechnology. 2013 Jan;65(1):145-56.
Mentha piperita as a pivotal neuro-protective agent against gamma irradiation induced DNA fragmentation and apoptosis : Mentha extract as a neuroprotective against gamma irradiation.
Ionizing radiation is classified as a potent carcinogen, and its injury to living cells, in particular to DNA, is due to oxidative stress enhancing apoptotic cell death. Our present study aimed to characterize and semi-quantify the radiation-induced apoptosis in CNS and the activity of Mentha extracts as neuron-protective agent. Our results through flow cytometry exhibited the significant disturbance and arrest in cell cycle in % of M1: SubG1 phase, M2: G0/1 phase of diploid cycle, M3: S phase and M4: G2/M phase of cell cycle in brain tissue ($p < 0.05$). Significant increase in % of apoptosis and P53 protein expression as apoptotic biomarkers were coincided with significant decrease in Bcl(2) as an anti-apoptotic marker. The biochemical analysis recorded a significant decrease in the levels of reduced glutathione, superoxide dismutase, deoxyribonucleic acid (DNA) and ribonucleic acid contents. Moreover, numerous histopathological alterations were detected in brain tissues of gamma irradiated mice such as signs of chromatolysis in pyramidal cells of cortex, nuclear vacuolation, numerous apoptotic cell, and neural degeneration. On the other hand, gamma irradiated mice pretreated with Mentha extract showed largely an improvement in all the above tested parameters through a homeostatic state for the content of brain apoptosis and stabilization of DNA cycle with a distinct improvement in cell cycle analysis and antioxidant defense system. Furthermore, the aforementioned effects of Mentha extracts through down-regulation of P53 expression and up-regulation of Bcl(2) domain protected brain structure from extensive damage. Therefore, Mentha extract seems to have a significant role to ameliorate the neuronal injury induced by gamma irradiation.

J Radiat Res. 2007 Nov;48(6):523-8. Epub 2007 Oct 13.
Protection against radiation induced hematopoietic damage in bone marrow of Swiss albino mice by Mentha piperita
The protective effects of Mentha piperita (Linn) extract against radiation induced hematopoietic damage in bone marrow of Swiss albino mice have been studied. Mice were given either double distilled water or leaf extract of M. piperita orally (1 g/kg b.wt./day) once a day for three consecutive days, and after 30 min of treatments on the third day were exposed to 8 Gy gamma radiation. Mice were autopsied at 12, 24, 48 hrs and 5, 10 and 20 days post-irradiation to evaluate the percentage of bone marrow cells, frequency of micronuclei and erythropoietin level in serum. An exposure to gamma radiation resulted in a significant decline in the number of bone marrow cells such as leucoblasts, myelocytes, metamyelocytes, band/stab forms, polymorphs, pronormoblasts and normoblasts, lymphocytes, and megakaryocytes. Pretreatment with leaf extract of M. piperita followed by radiation exposure resulted in significant increases in the numbers of leucoblasts, myelocytes, metamyelocytes, band/stab forms, polymorphs, pronormoblasts and normoblasts, lymphocytes, and megakaryocytes in bone marrow as compared to the control group. Pretreatment with leaf extract of M. piperita followed by radiation exposure also resulted in significant decreases in micronucleus frequencies in bone marrow of Swiss albino mice. A significant increase in erythropoietin level was observed at all the studied intervals in leaf extract of M.piperita pretreated irradiated animals as compared to control animals (radiation alone).The results of the present investigation

suggest the protective effects of leaf extract of M. piperita against radiation induced hematopoietic damage in bone marrow may be attributed to the maintenance ofEPO level in Swiss albino mice.

Exercise Performance

Avicenna J Phytomed. 2014 Jan;4(1):72-8.
Instant effects of peppermint essential oil on the physiological parameters and exercise performance.
OBJECTIVE: Effect of peppermint on exercise performance was previously investigated but equivocal findings exist. This study aimed to investigate the effects of peppermint ingestion on the physiological parameters and exercise performance after 5 min and 1 h.
MATERIALS AND METHODS: Thirty healthy male university students were randomly divided into experimental (n=15) and control (n=15) groups. Maximum isometric grip force, vertical and long jumps, spirometric parameters, visual and audio reaction times, blood pressure, heart rate, and breath rate were recorded three times: before, five minutes, and one hour after single dose oral administration of peppermint essential oil (50 µl). Data were analyzed using repeated measuresANOVA.
RESULTS: Our results revealed significant improvement in all of the variables after oral administration of peppermint essential oil. Experimental group compared with control group showed an incremental and a significant increase in the grip force (36.1%), standing vertical jump (7.0%), and standing long jump (6.4%). Data obtained from the experimental group after five minutes exhibited a significant increase in the forced vital capacity in first second(FVC1)(35.1%), peak inspiratory flow rate (PIF) (66.4%), and peak expiratory flow rate (PEF) (65.1%), whereas after one hour, only PIF shown a significant increase as compare with the baseline and control group. At both times, visual and audio reaction times were significantly decreased.Physiological parameters were also significantly improved after five minutes. A considerable enhancement in the grip force,spiromery, and other parameters were the important findings of this study. Conclusion : An improvement in thespirometric measurements (FVC1, PEF, and PIF) might be due to the peppermint effects on the bronchial smooth muscletonicity with or without affecting the lung surfactant. Yet, no scientific evidence exists regarding isometric force enhancement in this novel study.
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J Int Soc Sports Nutr. 2013 Mar 21;10(1):15. doi: 10.1186/1550-2783-10-15.
The effects of peppermint on exercise performance.
BACKGROUND: Enhancing athletic performance is a great desire among the athletes, coaches and researchers. Mint is one of the most famous natural herbs used for its analgesic, anti-inflammatory, antispasmodic, antioxidant, and vasoconstrictor effects. Even though inhaling mint aroma in athletes has been investigated, there were no significant effects on the exercise performance.
METHODS: Twelve healthy male students every day consumed one500ml bottle of mineral water, containing 0.05ml peppermint essential oil for ten days.Blood pressure, heart rate, and spirometry parameters including forced vital capacity(FVC), peak expiratory flow rate (PEF), and peak inspiratory flow (PIF) were determined one day before, and after the supplementation period. Participants underwent a treadmill-based exercise test with metabolic gas analysis and ventilation measurement using the Bruce protocol.
RESULTS: The FVC (4.57±0.90 vs. 4.79±0.84; p<0.001), PEF (8.50±0.94 vs. 8.87±?0.92; p<0.01), and PIF (5.71±?1.16 vs. 6.58 ±1.08; p<?0.005) significantly changed after ten days of supplementation.

Exercise performance evaluated by time to exhaustion(664.5±114.2 vs. 830.2±129.8s), work (78.34 ±32.84 vs. 118.7±47.38 KJ), and power (114.3±24.24 vs. 139.4±27.80 KW) significantly increased ($p<0.001$). In addition, the results of respiratory gas analysis exhibited significant differences in VO_2 (2.74±0.40 vs. 3.03±0.351L/min; $p<0.001$), and VCO_2 (3.08±0.47 vs. 3.73±0.518L/min; $p<0.001$). CONCLUSIONS: The results of the experiment support the effectiveness of peppermint essential oil on the exercise performance, gas analysis,spirometry parameters, blood pressure, and respiratory rate in the young male students. Relaxation of bronchial smooth muscles, increase in the ventilation and brain oxygen concentration, and decrease in the blood lactate level are the most plausible explanations.
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Bratisl Lek Listy. 2009;110(12):782-7.
The effect of inhaling peppermint odor and ethanol in women athletes.
The purpose of this study was to determine whether inhaling peppermint odor has effects on time of running, maximum heart rate(MHR), maximum oxygen consumption(VO_2max), oxygen consumption (VO_2), minute ventilation(VE) and respiratory exchange ratio (RER) during acute intensive exercise or not. 36 women soccer player were chosen for participating in this research. They were randomly divided in 3 groups (control, inhaling peppermint, inhaling mixture of peppermint and ethanol). In order to be aware of similarity of groups, the subjects'BMI was determined and ANOVA did not show any significant differences ($p < 0.05$). The subjects of three groups ran on treadmill according to Bruce test. Heart rate, time of running, VO_2max, VO_2, VE and RER were measured by Gas Analyzer. After collecting the data, ANOVA was done ($p < 0.05$) and the results showed that in this study the inhaling of fragrant odors did not have any significant effect on the time of running,MHR, VO_2max, VO_2, VE and RER, which we think is due to the intensity and duration of training. Referring to our results of the present study; we suggest that inhaling peppermint odor during acute intensive exercise has no significant effect on pulmonary indexes and physical performance(Tab. 4, Fig. 1, Ref. 21).

Plant Cultivation

J Insect Sci. 2013;13:142. doi: 10.1673/031.013.14201.
Insecticidal activity of plant essential oils against the vine mealybug, Planococcus ficus.
The vine mealybug, Planococcus ficus (Signoret) (Hemiptera: Pseudococcidae), is a pest in grape vine growing areas worldwide. The essential oils from the following aromatic plants were tested for their insecticidal activity against P. ficus: peppermint, Mentha piperita L. (Lamiales: Lamiaceae), thyme-leaved savory, Satureja thymbra L., lavender, Lavandula angustifolia Mill, and basil, Ocimum basilicum L. Essential oils from peels of the following fruits were also tested: lemon, Citrus limon L. (Sapindales: Rutaceae), and orange, C. sinensis L. The reference product was paraffin oil. Bioassays were conducted in the laboratory by using spray applications on grape leaves bearing clusters of P. ficus of one size class, which mainly represented either 3rd instar nymphs or pre-ovipositing adult females. The LC50 values for each essential oil varied depending on the P. ficus life stage but did not significantly differ between 3(rd) instar nymphs and adult females. The LC50 values of the citrus, peppermint, and thyme-leaved savory essential oils ranged from 2.7 to 8.1 mg/mL, and the LC50 values of lavender and basil oil ranged from 19.8 to 22.5 and 44.1 to 46.8 mg/mL, respectively. The essential oils from citrus, peppermint and thyme leaved savory were more or equally toxic compared to the reference product, whereas the lavender and basil essential oils were less toxic than the paraffin oil No phytotoxic symptoms were observed on grape

leaves treated with the citrus essential oils, and low phytotoxicity was caused by the essential oils of lavender, thyme-leaved savory, and mint, whereas the highest phytotoxicity was observed when basil oil was used.

J Sci Food Agric. 2013 Jan;93(2):348-53.
Essential oils to control Botrytis cinerea in vitro and in vivo on plum fruits.
BACKGROUND: The consequence of misusing chemical biocides in controlling pests and diseases has drawn the attention of policy makers to the development of methods potentially available in nature for this purpose. In the present study the inhibitory effects of black caraway, fennel and peppermint essential oils against Botrytis cinerea were tested at various concentrations in vitro and in vivo.
RESULTS: The in vitro results showed that the growth of B. cinerea was completely inhibited by the application of black caraway and fennel oils at concentrations of 400 and 600 μLL?¹ respectively. The in vivo results indicated that black caraway, fennel and peppermint oils at all applied concentrations inhibited B. cinerea growth on plum fruits compared with the control. In addition, all three oils at higher concentrations showed positive effects on fruit quality characteristics such as titrable acidity, total soluble solids, carbohydrate content, pH and weight loss percentage. Thus the oils inhibited the infection of plum fruits by B. cinerea and increased their storage life.
CONCLUSION: This research confirms the antifungal effects of black caraway, fennel and peppermint essential oils both in vitro and in vivo on plum fruits postharvest. Therefore these essential oils could be an alternative to chemicals to control postharvest phytopathogenic fungi on plum fruits.

Pak J Biol Sci. 2010 Nov 1;13(21):1023-9.
Antifungal activity of some plant extracts on Alternaria alternata, the causal agent of alternaria leaf spot of potato.
Pure methanol (m) and methanol water (mw) extracts of 5 plants namely: peppermint, eucalyptus, lavandula, Russian knapweed and datura were screened for their antifungal ability against Alternaria alternata, the causal agent of Alternaria leaf spot of potato at 5, 10 and 15% concentrations in vitro. Fungicide mancozeb 0.2% was also used for better comparison. Poisoned technique and spore germination assay method were used to evaluate the antifungal efficacy of plant extracts. Present findings showed that methanol extracts of eucalyptus, peppermint and lavandula had impressive antifungal effects in inhibiting the mycelial growth as well as spore germination of the pathogen. It was also found that methanol extracts were quite more effective than methanol water extracts in this regard. Methanol extracts of peppermint (15%), lavandula (15%), peppermint (10%) and eucalyptus (15%) demonstrated promising ability in inhibiting the mycelial growth of A. alternata by 0.13, 0.40, 0.43 and 0.50 cm, mycelial growth respectively, while majority of methanol water extracts had either less or no effects in this connection. Spore germination of A. alternata was prominently reduced by methanol extracts, while those of methanol water extracts had very less effects in this regard. Mancozeb (0.2%), methanol extracts of eucalyptus (15%) and peppermint (10%) by 2, 6 and 7% spore germination were best, while methanol water extracts of datura 10, 15 and 5%, lavandula 15 and 10% and also Russian knapweed 5% represented no effect and by 91, 89, 87, 87, 85 and 85% spore germination were at par with control. Findings from this study confirmed that plant extracts can be used as less hazardous natural fungicides in controlling plant pathogenic fungi, thus reducing the dependence on the synthetic fungicides. Methanol extracts of peppermint, eucalyptus and lavandula might be promising materials for natural formulations in controlling Alternaria leaf spot of potato in the field.

Mosquito Repellent

Pest Manag Sci. 2008 Mar;64(3):290-5.
Insecticidal activity of menthol derivatives against mosquitoes.
BACKGROUND: The insecticidal activity of essential oil of Mentha piperita L. emend. Huds. against local mosquitoes as disease vectors was recognized and found to be due to the presence of menthol, which is the major aroma compound of the oil. The minor compounds of the oil, i.e. menthone, beta-caryophyllene, menthyl acetate, limonene, alpha-pinene and pulegone, showed either less or no activity against the mosquitoes tested. L-Menthol derivatives were synthesized and their knockdown effect and mortality were evaluated against local mosquitoes of Culex quinquefasciatus Say, Aedes aegypti L. and Anopheles tessellatus Theobald as disease vectors. This is the first report of mosquitocidal activity of menthol and its derivatives against Cx. quinquefasciatus, Ae. aegypti and An. tessellatus.
RESULTS: Derivative synthesis followed by structure-activity relationship studies identified several derivatives, i.e. menthyl chloroacetate, menthyl dichloroacetate, menthyl cinnamate, menthone glyceryl acetal, thymol, alpha-terpineol and mugetanol, with enhanced mosquitocidal activity against Cx. quinquefasciatus, Ae. aegypti and An. tessellatus relative to the parent compound L-menthone.
CONCLUSION: In ester derivatives of L-menthol the optimum activity is dependent on the size and shape of the ester group and the presence of chlorine atoms in the ester group. In structurally related derivatives of L-menthol the optimum activity is dependent on the aromaticity, the degree of unsaturation, the position of the hydroxy group and the type of functional group.

Parasitol Res. 2014 May;113(5):1813-20.
A rationale to design longer lasting mosquito repellents.
Mosquito repellents represent a cleaner and safer alternative for population control and reduce the diseases they carry in large areas of the world. Recently, research has been focused on repellents of natural origins, both crude essential oils and their main constituents. We have observed that, although a large number of compounds can be efficiently used as mosquito repellents, their efficacy is never higher than those of commercial products DEET and Icaridin. Reasoning that probably specific and exceptionally active repellents might not exist, we focused our research on products that could provide longer protection times with respect to current commercial formulations while being used at lower concentrations. Based on the structure of menthone, a moderate natural repellent, we designed and synthesised some cyclic ketals that, because of their reduced volatility, could be effective for longer periods. In particular, a 1% solution of one of such derivatives can still reduce mosquito bites by 90% after 2 h, while DEET provides the same performance only for 15 min, when used at the same concentration. The approach we illustrate can be applied to other compounds and other systems and offers the additional advantage that derivatives of reduced volatility are also endowed with weaker odours.

Ecotoxicol Environ Saf. 2014 Feb;100:1-6.
Biocontrol potential of essential oil monoterpenes against housefly, Musca domestica (Diptera: Muscidae).
Housefly (Musca domestica L.), one of the most common insects in human settlements, has been associated as vectors for various food-borne pathogens, causing food spoilage and disease transmission. The control of housefly was attempted using plant monoterpenes; menthone, menthol, menthyl acetate, limonene, citral and 1,8-cineole, against different life stages of housefly. Bioefficacy against housefly adults

revealed highest repellent activity by menthol (95.6 percent) andmenthone (83.3 percent). Against housefly larvae, menthol with anLC90 of 0.02 µl/cm(2) in contact toxicity assay and menthone with a LC90 value of 5.4 µl/L in fumigation assay were found to be most effective control agent. With respect to pupicidal activity, superior performance was shown by menthol,citral and 1,8-cineole in contact toxicity assay and citral and 1,8-cineole in fumigation assay. Limonene was found to be the poorest performer in all the assays. Overall, highest efficacy observed for menthol andmenthone in various bioassays was in agreement with the results of essential oil activity obtained previously Significant activity ofmonoterpenes against various life stages of housefly demonstrates their potential as excellent insecticides with prospects of monoterpenes being developed into eco-friendly and acceptable products for housefly control.

Southeast Asian J Trop Med Public Health. 2013 Mar;44(2):188-96.
Efficacy of herbal essential oils as insecticides against the housefly, Musca domestica L.
The insecticidal effects of 20 essential oils derived from herbs, were tested against the housefly species Musca domestica L. using a susceptibility test. Each was applied in ethyl alcohol at concentrations of 1, 5 and 10% (v/v). Ten percent concentrations of Cymbopogon citratus (lemongrass), Mentha piperita (peppermint) and Lavandula angustifolia (lavender) oils were the most effective, showing 100% knockdown at 30 and 60 minutes. The KT50 values for C. citratus, M. piperita and L. angustifolia were 5.14, 5.36 and 8.23 minutes, respectively. These essential oils caused 100% mortality among houseflies 24 hours after exposure. The LC50 values for C. citratus, M. piperita and L. angustifolia were 2.22, 2.62 and 3.26 minutes, respectively. This study reveals lemongrass, peppermint and lavender essential oils have the potential to control housefly populations and should be further studied for field applications.

Asian Pac J Trop Biomed. 2011 Apr;1(2):85-8.
Bioefficacy of Mentha piperita essential oil against dengue fever mosquito Aedes aegypti L.
OBJECTIVE: To assess the larvicidal and repellent potential of the essential oil extracted from the leaves of peppermint plant, Mentha piperita (M. piperita) against the larval and adult stages of Aedes aegypti (Ae. Aegypti).
METHODS: The larvicidal potential of peppermint oil was evaluated against early fourth instar larvae of Ae. aegypti using WHO protocol. The mortality counts were made after 24 and 48 h, and LC50 and LC90 values were calculated. The efficacy of peppermint oil as mosquito repellent was assessed using the human-bait technique. The measured area of one arm of a human volunteer was applied with the oil and the other arm was applied with ethanol. The mosquito bites on both the arms were recorded for 3 min after every 15 min. The experiment continued for 3 h and the percent protection was calculated.
RESULTS: The essential oil extracted from M. piperita possessed excellent larvicidal efficiency against dengue vector. The bioassays showed an LC50 and LC90 value of 111.9 and 295.18 ppm, respectively after 24 h of exposure. The toxicity of the oil increased 11.8% when the larvae were exposed to the oil for 48 h. The remarkable repellent properties of M. piperita essential oil were established against adultsAe. aegypti. The application of oil resulted in 100% protection till 150 min. After next 30 min, only 1-2 bites were recorded as compared with 8-9 bites on the control arm.
CONCLUSIONS: The peppermint essential oil is proved to be efficientlarvicide and repellent against dengue vector. Further studies are needed to identify the possible role of oil asadulticide, oviposition deterrent and ovicidal agent. The isolation of active ingredient from the oil could help in formulating strategies for mosquito control.

Med Vet Entomol. 2011 Sep;25(3):302-10. Repellent, larvicidal and pupicidal properties of essential oils and their formulations against the housefly, Musca domestica.
The essential oils of six plant species [peppermint,Mentha piperita, and bergamot mint, Mentha citrata (both, Lamiales: Lamiaceae); blue gum, Eucalyptus globulus (Myrtales: Myrtaceae); lemongrass, Cymbopogon citratus, and khus grass, Vetiver zizanoides (both, Poales: Poaceae), and turmeric, Curcuma longa (Ziniberales: Zingiberaceae)] were screened for repellent, larvicidaland pupicidal activities against the housefly, Musca domestica L. (Diptera: Muscidae). Subsequently, emulsifiableconcentrate (EC) formulations of the two most effective oils were prepared and tested in the laboratory as well as in the field. In repellency bioassays, M. piperita (RC(84) , 61.0 µg/cm(2)) was found to be most effective, followed by E. globulus (RC(84) , 214.5 µg/cm(2)) and C. citratus (RC(84) , 289.2 µg/cm(2)). Formulated M. piperita and E. globulus showed RC(84) values of 1.6 µg/cm(2) and 4.1 µg/cm(2) , respectively. Formulated M. piperita and E. globulus achieved larval mortality(LC(50)) in 72 h at 5.12 µg/cm(2) and 6.09 µg/cm(2) , respectively. In pupicidal bioassays, crude oils of M. piperita and E. globulus suppressed the emergence of adult flies by 100%.Field experiments with the M.piperita formulation showed reductions in fly density (number offlies/h) of 96% on treated cattle and 98% on treated plots. This study demonstrates the effectiveness of EC formulations of selected essential oils in reducing housefly populations in field conditions.

Med Vet Entomol. 2014 Jun;28(2):193-200.
Repellent effectiveness of seven plant essential oils, sunflower oil and natural insecticides against horn flies on pastured dairy cows and heifers.
Plant essential oils (basil, geranium, balsam fir, lavender,lemongrass, peppermint, pine and tea tree), mixed with either sunflower oil or ethyl alcohol, were applied at 5% concentrations to the sides of Holstein cattle. Pastured cattle treated with essential oils diluted in sunflower oil had less flies than the untreated control for a 24-h period. However, the essential oil treatments were not significantly different than the carrier oil alone. Barn-held heifers treated with essential oils and sunflower oil alone had significantly less flies than the untreated control for up to 8 h after treatment. Basil, geranium, lavender,lemongrass and peppermint repelled more flies than sunflower oil alone for a period ranging from 1.5 to 4 h after treatments applied to heifers. All essential oils repelled > 75% of the flies on the treated area for 6 and 8 h on pastured cows and indoor heifers, respectively. Geranium,lemongrass and peppermint stayed effective for a longer duration. Essential oils mixed with ethyl alcohol demonstrated less repellence than when mixed with the carrier oil. Safer's soap, natural pyrethrins without piperonyl butoxide and ethyl alcohol alone were not efficient at repelling flies. Essential oils could be formulated for use as fly repellents in livestock production.

Colloids Surf B Biointerfaces. 2014 Apr 1;116:707-13.
Preparation and characterization of PEG-Mentha oil nanoparticles for housefly control.
Nanoparticles of Mentha × piperita essential oil were prepared by melt-dispersion method. The nanoparticles prepared at varying oil doses (5-10%, w/v) showed an encapsulation efficiency of 78.2-83.4%, while the oil load was observed to range between 3.64 and 7.46%. The average particle size of the nanoparticles varied between 226 and 331 nm, while polydispersity index showed variation between 0.547 and 1.000. DSC analysis indicated endothermic reaction during formation ofnanoparticles, while a 2-term exponential kinetic model was followed during oil release.Nanoparticles showed considerable mortality against housefly larvae in lab (100%) as well as simulated field condition after first week (93%) and 6th week (57%) of application. This was the first study utilizing controlled release property of nanoparticles to formulate a cost effective product for breeding site application against housefly.

Parasitol Res. 2012 Oct;111(4):1799-805.
Bioefficacy of essential oils of medicinal plants against housefly, Musca domestica L.
The housefly Musca domestica L. is recognized as a public health pest causing a serious threat to human and livestock by vectoring many infectious diseases Chemical control method commonly used against this pest, though effective, has some major disadvantages, such as development of insect resistance and bioaccumulation. Pest management strategies for populations of houseflies are needed. Presently, bioinsecticides, especially those derived from plant origin, have been increasingly evaluated in controlling insects of medical importance. In order to search for effective andecofriendly control agents, the essential oils of Mentha piperita, Zingiber officinalis, Emblica officinalis, and Cinnamomum verum were evaluated for their larvicidal, attractant/repellent, and oviposition attractant/deterrent activity against M. domestica. The highest larvicidal activity, i.e., C(50) = 104 ppm was shown by M. piperita. This oil also exhibited 96.8% repellency at the concentration of 1%. The highest oviposition deterrence activity of 98.1% was also exhibited by M. piperita oil at the concentration of 1%. Among the remaining plants, the essential oil of Z. officinalis exhibited significant bioactivities against M. domestica with larvicidal activity, i.e., lethal concentration (LC)(50) = 137 ppm, repellency of 84.9 and 98.1% oviposition deterrence both at 1% concentration. The other two plant oils, viz., C. verum and E. officinalis, showed relatively moderate bioefficacy with larvicidal activity, i.e., LC(50) = 159 and 259 ppm, repellency of 77.9 and 63.0% while oviposition deterrence of 60.0 and 42.6%, respectively. The result revealed that the essential oils of M. piperita have control potential against M. domestica and should be further explored as a component of integrated vector management program.

Vet Parasitol. 2009 Oct 14;164(2-4):257-66. Lousicidal, ovicidal and repellent efficacy of some essential oils against lice and flies infesting water buffaloes in Egypt.
The lousicidal and repellent effects of five essential oils were investigated for the first time against the buffalo louse, Haematopinus tuberculatus, and flies infesting water buffaloes in Qalyubia Governorate, Egypt. For the in vitro studies, filter paper contact bioassays were used to test the oils and their lethal activities were compared with that of d-phenothrin. Four minutes post-treatment, the median lethal concentration, LC50, values were 2.74, 7.28, 12.35, 18.67 and 22.79% for camphor (Cinnamomum camphora), onion (Allium cepa), peppermint (Mentha piperita), chamomile (Matricaria chamomilla) and rosemary oils (Rosmarinus officinalis), respectively, whereas for d-phenothrin, it was 1.17%. The lethal time (50) (LT50) values were 0.89, 2.75, 15.39, 21.32, 11.60 and 1.94 min after treatment with 7.5% camphor, onion, peppermint, chamomile, rosemary and d-phenothrin, respectively. All the materials used except rosemary, which was not applied, were ovicidal to the eggs of H. tuberculatus. Despite the results of the in vitro assays, the in vivo treatments revealed that the pediculicidal activity was more pronounced with oils. All treated lice were killed after 0.5-2 min, whereas with d-phenothrin, 100% mortality was reached only after 120 min. The number of lice infesting buffaloes was significantly reduced 3, 6, 4, 6 and 9 days after treatment with camphor, peppermint, chamomile, onion, and d-phenothrin, respectively. Moreover, the oils and d-phenothrin significantly repelled flies, Musca domestica, Stomoxys calcitrans, Haematobia irritans and Hippobosca equina, for 6 and 3 days post-treatment, respectively. No adverse effects were noted on either animals or pour-on operators after exposure to the applied materials. Consequently, some Egyptian essential oils show potential for the development of new, speedy and safe lousicides and insect repellents for controlling lice and flies which infest water buffaloes.

Res Vet Sci. 2012 Oct;93(2):831-5.

Toxicity of essential and non-essential oils against the chewing louse, Bovicola (Werneckiella) ocellatus.

The toxicity of six plant essential oils to the chewing louse, Bovicola (Werneckiella) ocellatus collected from donkeys, was examined in laboratory bioassays. The oils examined were: tea-tree (Melaleuca alternifolia), lavender (Lavandula angustifolia), peppermint (Mentha piperita), eucalyptus (Eucalyptus globulus Labillardiere), clove bud (Eugenia caryophyllata) and camphor (Cinnamomum camphora). All except camphor oil showed high levels of toxicity, with significant dose-dependent mortality and an LC(50) at concentrations of below 2% (v/v). Hundred percent mortality was achieved at concentrations of 5-10% (v/v). Two essential oil components: eugenol and (+)-terpinen-4-ol showed similar levels of toxicity. The data suggest that these botanical products may offer environmentally and toxicologically safe, alternative veterinary pediculicides for the control of ectoparasitic lice.

Arch Dermatol Res. 2007 Oct;299(8):389-92. Epub 2007 Jul 24.

Effectiveness of lotions based on essential oils from aromatic plants against permethrin resistant Pediculus humanus capitis.

In Argentina, field populations of the head louse Pediculus humanus capitis De Geer (Phthiraptera: Pediculidae) have developed resistance to permethrin and other pyrethroids. Thus, the aim of this work was the development of a lotion containing essential oils from plants and an alcoholic coadjuvant to improve biological effect. Ethanol +isopropanol (1 + 1 in volume) 50% in water and ethanol 96% were taken as bases for preparation of experimental lotions containing essential oils from plants. We found that experimental lotions containing lavender, peppermint and eucalyptus oils in a 5% composition and the combination of eucalyptus and peppermint in a total concentration of 10%, dissolved in 50% ethanol + isopropanol (1 + 1) in water, showed the best knockdown effect. On the other side, lotion containing peppermint oil and eucalyptus oil (1 + 1) 10%, dissolved in ethanol 96%, showed to be as effective as the best commercial lotion now available in Argentina. Furthermore, addition of 1-dodecanol in all cases increased the effectiveness of all the experimental lotions. This difference is significantly important for 1-dodecanol concentration of 10%, reaching a toxic activity compared to the best commercial lotion available in the market.

Complement Ther Nurs Midwifery. 1996 Aug;2(4):97-101.

The potential effectiveness of essential oils as a treatment for headlice, Pediculus humanus capitis.

Essential oils of aniseed, cinnamon leaf, red thyme, tea tree, peppermint, nutmeg, rosemary, and pine were tested in vitro against lice, Pediculus humanus. All the oils except for rosemary and pine were found to be effective in the laboratory when applied in an alcoholic solution and followed by a rinse the following morning in an essential oil/vinegar/water mixture. Peppermint and nutmeg were only used as a blend rather than as individual oils. Problems of solubility and toxicity are discussed, as are possible mechanisms of action. Phenols, phenolic ethers, ketones, and oxides (1,8-cineole) appear to be the major toxic components of these essential oils when used on lice. Aldehydes and sesquiterpenes may also play a role.

Bioresour Technol. 2010 Jan;101(1):372-8.

Repellent activity of essential oils: a review.

Currently, the use of synthetic chemicals to control insects and arthropods raises several concerns related to environment and human health. An alternative is to use natural products that possess good efficacy and are environmentally friendly. Among those chemicals, essential oils from plants belonging to several species have been extensively tested to assess their repellent properties as a valuable natural resource. The essential

oils whose repellent activities have been demonstrated, as well as the importance of the synergistic effects among their components are the main focus of this review. Essential oils are volatile mixtures of hydrocarbons with a diversity of functional groups, and their repellent activity has been linked to the presence of monoterpenes and sesquiterpenes. However, in some cases, these chemicals can work synergistically, improving their effectiveness. In addition, the use of other natural products in the mixture, such as vanillin, could increase the protection time,potentiating the repellent effect of some essential oils. Among the plant families with promising essential oils used as repellents,Cymbopogon spp., Ocimum spp. and Eucalyptus spp. are the most cited. Individual compounds present in these mixtures with high repellent activity includealpha-pinene, limonene, citronellol, citronellal, camphor and thymol. Finally, although from an economical point of view synthetic chemicals are still more frequently used as repellents than essential oils, these natural products have the potential to provide efficient, and safer repellents for humans and the environment.

Pest Manag Sci. 2013 Apr;69(4):542-52. doi: 10.1002/ps.3411. Epub 2012 Oct 19.
Essential oils and their compositions as spatial repellents for pestiferous social wasps.
BACKGROUND: The study objectives were: (1) to field test potential repellency of common essential oils against several pestiferous social wasps(Hymenoptera: Vespidae), using attractant-baited traps; (2) to identify vespid antennally active compounds from the repellent essential oils; (3) to determine potential repellency of these electroantennographic detection (EAD) active compounds in the field.
RESULTS: Of the 21 essential oils tested, 17 showed significantrepellency on yellowjackets [mainly Vespula pensylvanica(Saussure)] and paper wasps [mainlyPolistes dominulus (Christ)]: clove, pennyroyal, lemongrass, ylang ylang, spearmint, wintergreen, sage, rosemary, lavender, geranium, patchouli, citronella, Roman chamomile, thyme, fennel seed, anise and peppermint.Two essential oil mixtures - 3EO-mix (clove, geranium and lemongrass) and 4EO-mix (clove, geranium, lemongrass and rosemary) - totally blocked the attraction of vespid workers. Twenty-nine vespid antennally active compounds were identified from solid-phase microextraction (SPME) samples of 11 strongly repellent essential oils byGC-EAD/MS techniques. Among the syntheticEAD-active compounds field tested, eugenol, P/I-menthone, pulegone, a/ß-thujone, l-carvone, E/Z-citral, citronellal, methyl benzoate, benzyl acetate, methyl salicylate and 3-octanol showed a significantrepellency on vespid workers. These compounds are likely responsible for the repellency of their corresponding essential oils.
CONCLUSION: These repellent essential oils and their active compositions have great potential for efficient, environmentally soundsemiochemical-basedIPM of pestiferous vespid wasps.

Parasitol Res. 2011 Oct;109(4):1125-31. Oviposition-altering and ovicidal potentials of five essential oils against female adults of the dengue vector, Aedes aegypti L.
The oviposition deterrence and ovicidal potential of five different essential oils, peppermint oil(Mentha piperita), basil oil (Ocimum basilicum),rosemary oil (Rosemarinus officinalis),citronella oil (Cymbopogon nardus), and celery seed oil (Apium graveolens), were assessed against female adults of the dengue vector, Aedes aegypti L. Multiple concentration tests were carried out where cups containing 1 mL of different concentrations (100%, 10%, 1%, 0.1%) of the oils and 199 mL of water were used for oviposition. The number of eggs laid and the larvae hatched in each cup were scored to evaluate theoviposition deterrent and ovicidal potentials of the oils. Our investigations revealed that the addition of 100% oil (pure oil) caused complete oviposition deterrence except in A. graveolens which resulted in 75% effectiverepellency. The use of 10% oil resulted in the maximum deterrence of 97.5% as shown by the M.piperita oil while other oils caused 36-97% oviposition deterrence as against the control. The oviposition medium with 1%

oil showed decreased deterrent potential with 30-64% effective repellency, the M. piperita oil being exceptional. However, as the concentrations of the oil were reduced further to 0.1%, the least effective oil observed was A. graveolens (25% ER). Also, the M. piperita oil showed much reduced activity (40%) as compared to the control, while the other oils exhibited 51-58% repellency to oviposition. The studies on the ovicidal effects of these oils revealed that the eggs laid in the water with 100% essential oils did not hatch at all, whereas when 10% oils were used, only the R. officinalis oil resulted in 28% egg hatch. At lower concentrations (1%), the oils of M. piperita, O. basilicum, and C. nardus showed complete egg mortality while those of A. graveolens and R. officinalis resulted in 71% and 34% egg hatches, respectively. When used at 0.1%, the O. basilicum oil was found to be the only effective oil with 100% egg mortality, whereas other oils resulted in 16-76% egg mortality, the least mortality caused by the A. graveolens oil. These results suggest that these essential oils can be employed in a resistance-management program against A. aegypti. Further detailed research is needed to identify the active ingredient in the extracts and implement the effective mosquito management program.

Animal Delousing

Vet Parasitol. 2009 Oct 14;164(2-4):257-66. Lousicidal, ovicidal and repellent efficacy of some essential oils against lice and flies infesting water buffaloes in Egypt.
The lousicidal and repellent effects of five essential oils were investigated for the first time against the buffalo louse, Haematopinus tuberculatus, and flies infesting water buffaloes in Qalyubia Governorate, Egypt. For the in vitro studies, filter paper contact bioassays were used to test the oils and their lethal activities were compared with that of d-phenothrin. Four minutes post-treatment, the median lethal concentration, LC50, values were 2.74, 7.28, 12.35, 18.67 and 22.79% for camphor (Cinnamomum camphora), onion (Allium cepa), peppermint (Mentha piperita), chamomile (Matricaria chamomilla) and rosemary oils (Rosmarinus officinalis), respectively, whereas for d-phenothrin, it was 1.17%. The lethal time (50) (LT50) values were 0.89, 2.75, 15.39, 21.32, 11.60 and 1.94 min after treatment with 7.5% camphor, onion, peppermint, chamomile, rosemary and d-phenothrin, respectively. All the materials used except rosemary, which was not applied, were ovicidal to the eggs of H. tuberculatus. Despite the results of the in vitro assays, the in vivo treatments revealed that the pediculicidal activity was more pronounced with oils. All treated lice were killed after 0.5-2 min, whereas with d-phenothrin, 100% mortality was reached only after 120 min. The number of lice infesting buffaloes was significantly reduced 3, 6, 4, 6 and 9 days after treatment with camphor, peppermint, chamomile, onion, and d-phenothrin, respectively. Moreover, the oils and d-phenothrin significantly repelled flies, Musca domestica, Stomoxys calcitrans, Haematobia irritans and Hippobosca equina, for 6 and 3 days post-treatment, respectively. No adverse effects were noted on either animals or pour-on operators after exposure to the applied materials. Consequently, some Egyptian essential oils show potential for the development of new, speedy and safe lousicides and insect repellents for controlling lice and flies which infest water buffaloes.

Parasitol Res. 2014 Feb;113(2):593-605. doi: 10.1007/s00436-013-3688-5. Epub 2013 Nov 26. Bioactivities of some essential oils against the camel nasal botfly, Cephalopina titillator.
Nasopharyngeal myiasis of camels is caused by the larvae of Cephalopina titillator. We determined the efficacy of essential oils (EOs) of pumpkin, Cucurbita maxima; lupinus, Lupinus luteus; garlic oil, Allium sativum; and peppermint, Mentha piperita, against the third larval stage of C. titillator using larval immersion tests. The positive control group was treated with ivermectin and the negative control one was

treated with distilled water and few drops of Tween 80. Larvae were reared until adult emergence. The data indicated that complete larval mortalities were reached 24 h post treatment (PT) with 2 % pumpkin, 7.5 % garlic and peppermint, 30 % lupinus, and 0.15 % ivermectin. The lethal values, LC50s, were 0.20, 0.44, 0.42, 0.47, and 0.03 %, respectively. Pumpkin and ivermectin were 2 and 17 times, respectively, more effective than the other EOs. Ivermectin was seven times more intoxicating than pumpkin oil. Formation of pupae had been stopped after treatment of larvae with 2 % pumpkin, 7.5 % garlic and peppermint, 30 % lupines, and 0.04 % ivermectin. Adult emergence had been completely ceased following treatment of larvae with 0.5 % EOs and 0.04 % ivermectin. Morphological abnormalities were pronounced after treatments, and peppermint oil was the foremost cause of deformation in larvae (44 % PT with 7.5 %) and pupae (40 % PT with 2 %). Pumpkin oil (6 %) was selected to be the drug of choice for controlling C. titillator. Besides their insecticidal effects, EOs are much safer than ivermectin regarding health and environmental issues.Consequently, EOs described herein merit further study as potential nasal drench for C. titillator control.

Food Storage

J Food Prot. 2014 Oct;77(10):1819-23.
Acaricidal activity of constituents derived from peppermint oil against Tyrophagus putrescentiae.
The acaricidal activities of peppermint oil and menthol isomers against mites in stored food were evaluated using fumigant and contact bioassays and were compared with the activity of benzyl benzoate as a synthetic acaricide. Based on the 50% lethal dose (LD50) values against Tyrophagus putrescentiae in the fumigant bioassay, menthol (0.96 µg/cm(2)) was approximately 12.18 times more effective than benzyl benzoate (11.70 µg/cm(2)), followed by (+)-neomenthol (1.33 µg/cm(2)), (-)-menthol (1.60 µg/cm(2)), and (+)-menthol (1.90 µg/cm(2)). In the filter paper bioassay, menthol (0.55 µg/cm(2)) was about 15.18 times more active than benzyl benzoate (8.35 µg/cm(2)), followed by (-)-menthol (0.84 µg/cm(2)), (+)-menthol (0.92 µg/cm(2)), and (+)-neomenthol (1.72 µg/cm(2)). However, (+)-isomenthol did not exhibit any acaricidal activity against T. putrescentiae in the fumigant and filter paper bioassays. These results indicate that peppermint oil and menthol isomers could be effective natural acaricides for managing mites in stored food.

Meat Sci. 2012 Dec;92(4):667-74.
Antioxidant and antibacterial effects of Lavandula and Mentha essential oils in minced beef inoculated with E. coli O157:H7 and S. aureus during storage at abuse refrigeration temperature.
The essential oils (EOs) of Lavandula angustifolia L. and Mentha piperita L. were analyzed by gas chromatography mass spectrometry (GC/MS). The major constituents were linalool (22.35%), linalyl acetate (21.80%), trans-ocimene (6.16%) and 4-terpineol (5.19%) for L. angustifolia and menthol (33.28%), menthone (22.03%), and menthyl acetate (6.40%) for M. piperita. In vitro antibacterial activity of both EOs against Escherichia coli O157:H7 and Staphylococcus aureus CECT 4459 showed high inhibition against S. aureus. The lowest minimal inhibitory concentrations (MIC) were obtained with L. angustifolia (0.25 ?L/mL) against S. aureus; M. piperita exhibited a MIC of 0.50 L/mL against both microorganisms. Both EOs caused a significant decrease of bacterial growth in minced beef ($p<0.05$) stored at 9±1 °C. Minced beef treated with EOs showed the lowest TBARS values (lipid oxidation). Moreover, the results showed that the addition of EOs significantly extended fresh meat odor even at abuse temperature.

Pharmacogn Mag. 2010 Jul;6(23):147-53.
Protective effects of bioactive phytochemicals from Mentha piperita with multiple health potentials.
Mentha piperita essential oil was bactericidal in order of E.coli> S. aureus > Pseudomonas aeruginosa > S. faecalis > Klebsiellapneumoniae. The oil with total phenolics of 89.43 ± 0.58 µg GAE/mg had 63.82 ± 0.05% DPPH inhibition activity with an IC (50) = 3.9µg/ml. Lipid peroxidation inhibition was comparable to BHT and BHA. A 127% hike was noted in serum ferric-reducing antioxidant power. There was 38.3% decrease in WBCs count, while platelet count showed increased levels of 214.12%. Significant decrease in uric acid level andcholesterol/HDL and LDL/HDL ratios were recorded. The volatile oil displayed high cytotoxic action toward the human tumor cell line. The results of this study deserve attention with regard to antioxidative and possible anti-neoplastic chemotherapy that form a basis for future research. The essential oil of mint may be exploited as a natural source ofbioactive phytopchemicals bearing antimicrobialand antioxidant potentials that could be supplemented for both nutritional purposes and preservation of foods.