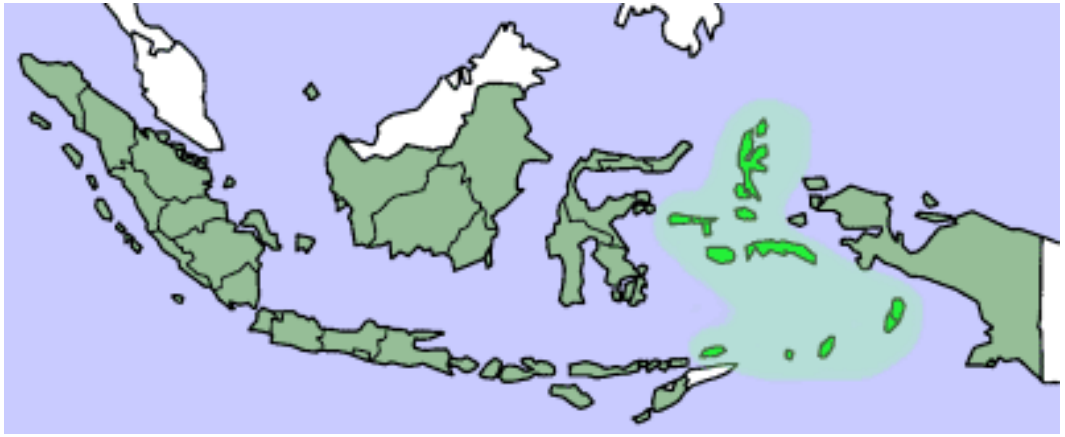
What are herbs and spices?

Plant products that are added to food or drink to provide flavor

- Herbs: Generally herbaceous part of plant: leaves or stems, fresh or dried
- Spices: dry seeds, fruits, bark, roots

Spices and history

- Turkish control of supply routes for spices from Asia led to Portuguese and Spanish exploration to get to India, China, Spice Islands
- Portuguese, then Dutch, controlled Spice Islands (Moluccas); cloves, nutmeg, mace, black pepper native to these islands
- Control of spices led to great wealth and power
- Finally French, British. and Spanish smuggled plants to colonies, breaking monopoly, greatly reducing cost of spices



- Chemicals responsible for distinct flavors, smells of spices or perfumes are essential oils or volatile oils

- Oils usually sequestered in specialized pockets or glands on plants; oils produced by plant as attractants or repellants (some compounds both attract some visitors and repel others)

- We use small amounts mixed with food for pleasant, rather than deterrent effect

- Compounds must be of fairly low molecular weight to volatilize and be perceived as odor

- Smell is 80% of what we call taste

Selection for longevity, yield, loss of odor (and thus flavor in foods like tomatoes)

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GENOMICS ARTICLE

Rose Scent: Genomics Approach to Discovering Novel Floral Fragrance–Related Genes[W]

Inna Guterman,[a] Moshe Shalit,[a,b] Naama Menda,[a] Dan Piestun,[a] Mery Dafny-Yelin,[a] Gil Shalev,[a] Einat Bar,[b] Olga Davydov,[c] Mariana Ovadis,[a] Michal Emanuel,[a] Jihong Wang,[d] Zach Adam,[a] Eran Pichersky,[d] Efraim Lewinsohn,[b] Dani Zamir,[a] Alexander Vainstein,[a] and David Weiss[a,1]

[a] Institute of Plant Sciences and Genetics in Agriculture, Faculty of Agricultural, Food, and Environmental Quality Sciences, Hebrew University of Jerusalem, P.O. Box 12, Rehovot 76100, Israel
[b] Division of Aromatic Plants, Agricultural Research Organization, Newe Ya'ar, P.O. Box 1021, Ramat Yishay 30095, Israel
[c] Department of Plant Sciences, Weizmann Institute of Science, P.O. Box 26, Rehovot 76100, Israel
[d] Department of Molecular, Cellular, and Developmental Biology, University of Michigan, Ann Arbor, Michigan 48109

For centuries, rose has been the most important crop in the floriculture industry; its economic importance also lies in the use of its petals as a source of natural fragrances. Here, we used genomics approaches to identify novel scent-related genes, using rose flowers from tetraploid scented and nonscented cultivars. An annotated petal EST database of ~2100 unique genes from both cultivars was created, and DNA chips were prepared and used for expression analyses of selected clones. Detailed chemical analysis of volatile composition in the two cultivars, together with the identification of secondary metabolism–related genes whose expression coincides with scent production, led to the discovery of several novel flower scent–related candidate genes. The function of some of these genes, including a germacrene D synthase, was biochemically determined using an *Escherichia coli* expression system. This work demonstrates the advantages of using the high-throughput approaches of genomics to detail traits of interest expressed in a cultivar-specific manner in nonmodel plants.

Most common herbs and spices from three plant families

Mints (Lamiaceae): zygomorphic flowers, usually square stems and simple, opposite leaves; defensive oil glands on leaf surface

Mints (Lamiaceae)

- Basil (*Ocimum basilicum*): domesticated in India; sacred plant to Hindus, very important to ancient Greeks

Mints (Lamiaceae)

- Mint (*Mentha spicata*—spearmint; *Mentha piperita*—peppermint; other *Mentha* species used to lesser extent): from damp habitats of Europe and Asia

Mints (Lamiaceae)

- Oregano (*Origanum vulgare*): Mediterranean genus of plants; use greatly increased in US after WWII, with introduction of pizza

Mints (Lamiaceae)

- Marjoram (*Origanum majorana*): milder flavor than oregano

Mints (Lamiaceae)

- Rosemary (*Rosmarinus officinalis*): woody shrub common in Mediterranean dry scrublands

Mints (Lamiaceae)

- Sage (*Salvia officinalis*): used medicinally from classical Greek through Middle Ages; rich in terpenes thujone and camphor, which are toxic at high concentrations

Mints (Lamiaceae)

- Thyme (*Thymus vulgaris*): Mediterranean genus; Greeks used it as an aromatic in burnt sacrifices. Phenolic compound thymol used as antimicrobial agent in mouthwashes and creams.

Mints (Lamiaceae)

- Lavender (*Lavendula dentata*, *L. angustifolia*): native of Mediterranean; dried flowers more commonly used for perfumes than in food; traditional ingredient in *herbs de provence*.

Carrot Family (Apiaceae): flat-topped clusters of usually small flowers (umbel); very dissected, alternate leaves.

Leaves used, fruits used, sometimes both (celery, dill, coriander/cilantro, fennel); defensive oil glands within leaves, not on surface.

Within the fruit, essential oils are concentrated in chambers surrounding seeds (protection?)

Carrot Family (Apiaceae)

- Celery (*Apium graveolens*): native of damp European habitats near sea; distinctive flavor from compounds called phthalides
- Coriander or Cilantro (*Coriandrum sativum*): native of Middle East; main component of odor is decenal, which is very volatile; thus, used more as uncooked garnish; leaves used as cilantro, dried fruits used as coriander. Cultivated more for dried fruits with floral and lemon flavor; common in many Indian dishes and distinguishing flavor in American hot dogs
- Parsley (*Petroselinum crispum*): native to SE Europe and western Asia; distinctive flavor due to compound menthatriene; leaves high in vitamins A and C. Revered by early Greeks as symbols of victory and death.
- Dill (*Anethum graveolens*): native of southwest Asia and India; common in Greek cooking. Seeds used to flavor cucumber pickles.

Carrot Family (Apiaceae)

- Caraway (*Carum carvi*): native to Europe; distinctive flavor due to terpene D-carvone; Rye bread, component of Scandinavian alcohol aquavit
- Cumin (*Cuminum cyminum*): Native to SW Asia; enjoyed by Greeks and Romans (Greeks kept it at the table in its own box). Distinctive aroma from unusual compound cuminaldehyde.

Carrot Family (Apiaceae)

- Anise (*Pimpinella anisum*): Native to central Asia and valued since ancient times; high content of phenolic compound anethole, which is aromatic and very sweet (13X sweeter than table sugar). Used as a flavoring in Pernod and ouzo. Note that star anise, which also produces anethole, is totally different; it is a tree that is closely related to magnolias.

Carrot Family (Apiaceae)

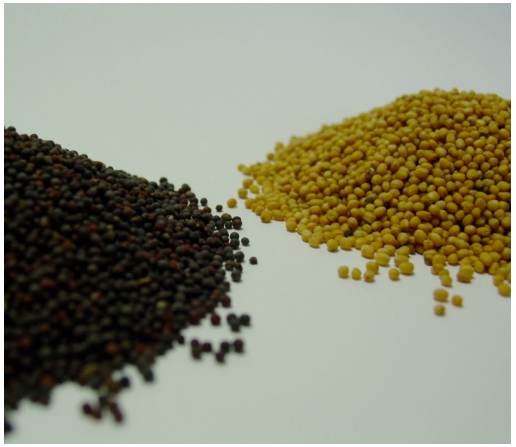
- Fennel (*Foeniculum vulgare*): Native of Mediterranean and SW Asia; distinctive flavor from anethole; seeds distinctive ingredients in Italian sausages, chewed in India as after-meal breath-freshener.

Cabbage Family (Brassicaceae)

- Pungency from same compounds as in leaves, sulfurous defense compounds called isothiocyanates
- When ground up raw they are irritating; when cooked they tend to be bitter

Cabbage Family (Brassicaceae)

- Mustard: Name comes from original European condiment of wine mixed with mustard seeds
    - Black mustard (*Brassica nigra*): native to Eurasia; high in concentration of defense compound sinigrin and thus high in pungency
    - Brown mustard (*B. juncea*): hybrid of *B. nigra* and *B. rapa* that is easier to cultivate and harvest than *B. nigra*, also less pungency. Europeans mustards usually use brown mustard.
    - White or yellow mustard (*B. alba*): European native with sinalbin as defense compound, which is less volatile than sinigrin. Commonly used in US; yellow color comes from addition of turmeric.



Cabbage Family (Brassicaceae)

- Horseradish (*Armoracia rusticana*): Native to western Asia; fleshy white roots contain sinigrin, grate raw roots to release pungency

Cabbage Family (Brassicaceae)

- Wasabi (*Wasabia japonica*): Native of Japan and Sakhalin Island where it grows by mountain streams. Not a root—actually the enlarged stem that accumulates sinigrin as defense. Difficult to grow; most wasabi served in restaurants is actually dried horseradish powder colored green and mixed with water. True wasabi has mixture of pungent, oniony, green, and sweet flavors.

Tropical spices

Cinnamon: one of oldest and most valuable spices; ancient Egyptians used it in embalming.

Cinnamon is from the phloem of *Cinnamomum cassia, C. zeylanicum* (Lauraceae); native to Sri Lanka and China. Two year old stems and twigs are cut, the outer bark (xylem) is removed, leaving quills (cinnamon sticks) of phloem. Phloem contains protective oil cells imparting distinctive aroma

Distinct spicy odor from phenolic compound, cinnamaldehyde (shown to inhibit mold growth in paper we read)

Tropical spices

Black and white pepper (Piperaceae): Climbing vine native to tropical coastal mountains of southwest India

Most widely used spice; once very precious commodity

Dried fruits (berries) of *Piper nigrum*

Black pepper: whole fruit dried; white pepper: outer fleshy fruit layer removed before drying

Pungency from piperine