

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460



OFFICE OF CHEMICAL SAFETY AND POLLUTION  
PREVENTION

**MEMORANDUM**

**APPENDICES FOR HERBS AND SPICES**

DATE: June 15, 2015

SUBJECT: Crop Grouping – Part XVD: Appendices for the Analysis of the USDA IR-4 Petition to Amend the Crop Group Regulation 40 CFR § 180.41 (c) (26) and Commodity Definitions [40 CFR 180.1 (g)] Related to Herb Crop Group 25 and Spice Crop Group 26.

PC Code: NA	DP Barcode: NA
Decision No.: NA	Registration No.: NA
Petition No.: NA	Regulatory Action: Crop Grouping Regulation
Risk Assessment Type: None	Case No.: NA
TXR No.: NA	CAS No.: NA
MRID No.: MRID 474331-01	40 CFR: 180.41 (c) (26) and 180.1 (g)

FROM: Bernard A. Schneider, Ph.D., Senior Plant Physiologist and Environmental Scientist  
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THROUGH: Julie VanAlstine, Chairperson  
HED Chemistry Science Advisory Council (ChemSAC)  
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TO: Barbara Madden, Minor Use Officer  
Minor Use and Emergency Response Branch (MUERB)  
Registration Division (7505P)

And

Ramé Cromwell  
Policy and Regulatory Services Branch (PRSB)  
Field and External Affairs Division

cc: IR-4 Project, Bill Barney, Jerry Baron, Dan Kunkel, Debbie Carpenter, Van Starner

The following are Appendices to be used in conjunction with the review of

“Crop Grouping – Part XVB: Analysis of the USDA IR-4 Petition to Amend the Crop Group Regulation 40 CFR § 180.41 (c) (26) and Commodity Definitions [40 CFR 180.1 (g)] Related to Crop Group 19 Herb and Spice Group. Emphasis on New Herb Crop Group 25,” and the

“Crop Grouping – Part XVC: Analysis of the USDA IR-4 Petition to Amend the Crop Group Regulation 40 CFR § 180.41 (c) (26) and Commodity Definitions [40 CFR 180.1 (g)] Related to Crop Group 19 Herb and Spice Group. Emphasis on a new Spice crop group 26.”

## **APPENDIX A: Food and Drug Regulations and CFR Citations Regarding Herbs and Spices.**

### FDA Food definitions

Title 21, Volume 1 Revised as of April 1, 2013 CITE: 21CFR1.227

### TITLE 21--FOOD AND DRUGS

### CHAPTER I--FOOD AND DRUG ADMINISTRATION DEPARTMENT OF HEALTH AND HUMAN SERVICES SUBCHAPTER A--GENERAL

### PART 1 -- GENERAL ENFORCEMENT REGULATIONS

#### Subpart H--Registration of Food Facilities

#### General Provisions

Sec. 1.227 What definitions apply to this subpart/

a) *The act* means the Federal Food, Drug, and Cosmetic Act.

(4) *Food* has the meaning given in section 201(f) of the act (21 U.S.C. 321(f)),

(i) Except for purposes of this subpart, it does not include

(A) *Food* contact substances as defined in section 409(h)(6) of the act (21 U.S.C. 348(h)(6)), or

(B) Pesticides as defined in 7 U.S.C. 136(u).

(ii) Examples of food include fruits, vegetables, fish, dairy products, eggs, raw agricultural commodities for use as food or as components of food, animal feed (including pet food), food and feed ingredients, food and feed additives, dietary supplements and dietary ingredients, infant

formula, beverages (including alcoholic beverages and bottled water), live food animals, bakery goods, snack foods, candy, and canned food.

(ff) The term "dietary supplement"—

(1) means a product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients:

(A) a vitamin; (B) a mineral; (C) an herb or other botanical; (D) an amino acid; (E) a dietary substance for use by man to supplement the diet by increasing the total dietary intake; or (F) a concentrate, metabolite, constituent, extract, or combination of any ingredient described in clause (A), (B), (C), (D), or (E);

(B) is not represented for use as a conventional food or as a sole item of a meal or the diet; and

(C) is labeled as a dietary supplement

21CFR1.276 Revised as of April 1, 2013

## TITLE 21--FOOD AND DRUGS CHAPTER I--FOOD AND DRUG

### ADMINISTRATION DEPARTMENT OF HEALTH AND HUMAN SERVICES

#### SUBCHAPTER A--GENERAL

#### PART 1 -- GENERAL ENFORCEMENT REGULATIONS

##### Subpart I--Prior Notice of Imported Food

##### General Provisions

Sec. 1.276 What definitions apply to this subpart?

(a)*The act* means the Federal Food, Drug, and Cosmetic Act.

(b) The definitions of terms in section 201 of the act (21 U.S.C. 321) apply when the terms are used in this subpart, unless defined in this section.

(5)*Food* has the meaning given in section 201(f) of the act, except as provided in paragraph (b)(5)(i) of this section.

(i) For purposes of this subpart, food does not include:

(A) Food contact substances as defined in section 409(h)(6) of the act (21 U.S.C. 348(h)(6)); or

(B) Pesticides as defined in 7 U.S.C. 136(u).

**(ii) Examples of food include fruits, vegetables, fish, including seafood, dairy products, eggs, raw agricultural commodities for use as food or as components of food, animal feed (including pet food), food and feed ingredients, food and feed additives, dietary supplements and dietary ingredients, infant formula, beverages (including alcoholic beverages and bottled water), live food animals, bakery goods, snack foods, candy, and canned foods.**

FDA definitions spices

## CPG Sec. 525.750 Spices – Definitions

(<http://www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm074468.htm#.UoZ4vZ3Srqqo.email>)

### BACKGROUND:

No definitions for standards of identity for spices have been established in accordance with Section 401 of the Federal Food, Drug, and Cosmetic Act. Advisory standards were issued in 1918 as Food Inspection Decision (FID) 172, under the Food and Drugs Act of 1906. These defined the collective term "spices" and described a number of specific foods classified as spices. These underwent several revisions, the latest having appeared as Service and Regulatory Announcement (SRA) F.D. No. 2, Revision 5, November 1936. These advisory standards provided substantial guidance to the food industry concerning acceptable labeling of spices or flavorings, and foods in which these were used. At the same time they were useful as guides to regulatory officials, under both the 1906 Food and Drugs Act and 1938 Food, Drug, and Cosmetic Act.

These advisory standards were considered in connection with preparation of the list of "generally recognized as safe" (GRAS) spices and other natural flavorings in 21 CFR 182, and the promulgation of regulations concerning food labeling in 21 CFR 101.22.

After consultation with the American Spice Trade Association, the list has been brought up-to-date, and information from other sources has been added.

### POLICY:

In the absence of definitions and standards of identity for spices, the following descriptions provide guidance concerning acceptable names for use in labeling spices and foods in which they are used. Only the commonly used spices are included; specific questions about other substances which may be considered as spices within the general definition may be referred to the Food and Drug Administration.

### DEFINITIONS:

1. SPICES - General Definition - Aromatic vegetable substances, in the whole, broken, or ground form, whose significant function in food is seasoning rather than nutrition. They are true to name and from them no portion of any volatile oil or other flavoring principle has been removed.
2. ALLSPICE (Pimenta) - The dried, nearly ripe fruit of *Pimenta officinalis* Lindl. The whole berries are globular in form, dark reddish-brown in color, have a eugenol-like odor and a strong aromatic, pungent taste. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture.
3. ANISE (Aniseed) - The dried, ripe fruit of *Pimpinella anisum* L., an annual herb of the parsley family. The dried seeds are greenish-gray in color, crescent shaped, and possess a strong licorice-like odor. The principal active ingredient of the volatile oil is anethole. The quality characteristics are measured by the volatile oil and total and acid insoluble ash.
4. BASIL - Also known as sweet basil; the dried leaves of *Ocimum basilicum* L. The glossy leaves are grayish-green underneath and when crushed, have a delicate, sweet, warm, highly

aromatic odor. The quality characteristics are measured by the total and acid insoluble ash and freedom from stems.

5. BAY LEAVES - The dried leaves of *Laurus nobilis* L. The pale green to green and occasionally brown-hued leaves are stiff and brittle and have a smooth and slightly shiny surface. The underneath part of the leaf appears dull in color. When crushed, the leaves have a delicate aromatic odor and an aromatic, bitter taste. The principal active ingredient is cineole. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, moisture, and freedom from stems.

6. CARAWAY SEED - Caraway seed is the dried fruit of *Carum carvi* L. The small, hard seeds have an aromatic, pleasant, warm, sharp taste. The principal active ingredient of the volatile oil is d-carvone. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture. Caraway N.F. must comply with the monograph in National Formulary XIV

7. CARDAMOM (or Cardamon) - The dried, nearly ripe fruit or seed of *Elettaria cardamomum* L. Maton. The fruit pods consist of a husk which is either green or white (bleached) and in which the seeds are contained. The husk and consequently the whole pod has very little odor until it has been crushed. The hard, wrinkled, light reddish-brown to dark reddish-brown seed has a pleasant aromatic odor and a characteristic warm, slightly pungent, highly aromatic taste. The quality characteristics are measured by the volatile oil, total and acid insoluble ash and moisture.

8. CELERY SEED - The dried fruit of a biennial herb, *Apium graveolens* L. The light brown to brown-colored seeds have a characteristic celery aroma and a warm, bitter taste. The quality characteristics are measured by the volatile oil, non-volatile ether extract, total and acid insoluble ash.

9. CHERVIL - A small, low-growing annual of the parsley family. *Anthriscus cerefolium* L. Hoffm. It is similar in appearance to parsley, but sweeter and more aromatic. It has an anise-like fragrance with a slight hint of pepper flavor. Its quality characteristics are measured by total and acid insoluble ash and freedom from stems.

10. CINNAMON (Cassia) - The dried bark of *Cinnamomum zeylanicum* Sees (Ceylon cinnamon), *Cinnamomum cassia* Blume (Chinese cinnamon), or *Cinnamomum loureirii* Nees (Saigon cinnamon). It is brown to reddish-brown in color. The principal active ingredient in the volatile oil is cinnamaldehyde, which is responsible for the characteristic odor. The quality attributes are measured by volatile oil, aldehyde content of the volatile oil, non-volatile ether extract, total and acid insoluble ash, and moisture. Cinnamon N.F. is made from the dried bark of *Cinnamomum loureirii*, and must conform to the monograph in the National Formulary XIV.

11. CLOVES - The dried, unopened flower buds of *Eugenia caryophyllus* (Sprengel) Bullock et. Harrison (formerly *Eugenia caryophyllata* Thunberg). The dried buds resemble a round-headed nail, are dark reddish-brown in color, have a strong aromatic odor, and a hot pungent, aromatic taste. The principal active ingredient in the volatile oil is eugenol. The quality characteristics are measured by volatile oil, total and acid insoluble ash, moisture, and freedom from clove stems.

12. CORIANDER SEED - The dried ripe seed of *Coriandrum sativum* L. The globular, yellowish-brown seed has a slightly fragrant odor and a pleasant aromatic taste. The quality characteristics are measured by the total and acid insoluble ash.

13. CUMIN SEED - The dried seed of *Cuminum cyminum* L. The yellowish-brown seeds have a strong, distinctive aromatic odor and a warm, aromatic taste. The quality attributes are measured by the volatile oil, total and acid insoluble ash, and moisture.

14. DILL SEED - The dried, ripe fruit of *Anethum graveolens* L., an annual herb of the parsley family. The quality characteristics are measured by total and acid insoluble ash.

15. FENNEL SEED - The clean, dried, ripe fruit of *Foeniculum vulgare* Mill. The green or yellowish-tan colored seeds have a pleasant aromatic odor and possess a sweet anise-like taste. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture.
16. FENUGREEK - The clean, dried ripe fruit of *Trigonella foenum-graecum* L. The hard, brownish-yellow colored seeds have a strong, pleasant, burnt sugar-like odor and possess a farinaceous, slightly bitter taste. The quality characteristics are measured by the total and acid insoluble ash, and moisture.
17. GINGER - The dried, or decorticated and dried, rhizome of *Zingiber officinale* Rosc. The roots are irregular, varying from tan to a pale brown color, or white if limed, and have agreeable, aromatic, slightly pungent odor, and an aromatic, pungent, biting taste. The principal active ingredient is zingiberene, which is largely responsible for the pungency. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, crude fiber, and moisture.
18. HORSERADISH - The root of *Armoracia lapathifolia* Gilib. Horseradish is a hardy perennial plant of the mustard family. It is generally dehydrated and when wet, emits a characteristic highly pungent, penetrating odor, plus volatile oils that may cause tears to flow. This is due to the glycoside sinigrin, which, decomposing by enzymatic action, liberates an acrid volatile oil similar to mustard oil in taste and properties.
19. MACE - The dried outer membrane of *Myristica fragrans* Houtt. It is yellowish-tan to reddish-tan in color, is flat, with horn-like branched, shiny pieces. It has a fragrant, nutmeg-like odor, and an aromatic, slightly warm taste. Its quality characteristics are measured by volatile oil, total and acid insoluble ash, non-volatile ether extract, and moisture.
20. MARJORAM (Sweet Marjoram) - The dried leaves, with or without a small proportion of the flowering tops of *Marjorana hortensis* Moench. The round, light green to light gray-green leaves possess a pleasant, aromatic odor and have a warm, aromatic, slightly bitter taste. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture.
21. MUSTARD SEED - The seed of *Brassica hirta* Moench (white mustard), *Brassica nigra* (L.) Koch (black mustard), *Brassica juncea* (L.) Coss., or varieties or closely related species of the types of *Brassica nigra* and *B. juncea*. Except for *Brassica hirta* Moench, which contains no appreciable volatile oil, the quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture.
22. MUSTARD FLOUR ("Mustard") - The powder made from mustard seed with the hulls largely removed and with or without the removal of a portion of the fixed oil. Its quality attributes are measured by volatile oil, total and acid insoluble ash, starch and moisture.
23. NUTMEG - The dried seed of *Myristica fragrans* Houtt., deprived of its testa, with or without a thin coating of lime (CaO). The surface of the seed kernels is furrowed in an irregular pattern; they are spheroidal (some nearly spherical nuts), grayish-brown to brown in color if unlimed; they have a characteristic, strong, aromatic odor; and an aromatic, warm, slightly bitter taste. The quality characteristics are measured by the volatile oil, non-volatile ether extract, total and acid insoluble ash, and moisture.
24. OREGANO - The dried leaves of *Origanum vulgare* L. or *Origanum* spp., or *Lippia* spp. (Mexican oregano). The light green-colored leaves, when crushed, have a strong camphoraceous aroma and a warm, pungent, and slightly bitter taste. The quality characteristics are measured by volatile oil, total and acid insoluble ash, and moisture.

25. PAPRIKA - The sweet, non-pungent, or, if specified, slightly pungent, dried, ground, red, ripe fruit of *Capsicum annum* L. The quality characteristics are measured by extractable color, total and insoluble ash, and moisture.
26. PARSLEY LEAVES - The leaves and seeds from a biennial herb, *Petroselinum crispum* (Mill.) Mansf.
27. PEPPER, BLACK - The dried, immature berries of *Piper nigrum* L. The deep dark brown to black, deep-set wrinkled berries, when ground, have a characteristic, penetrating odor, and a hot, biting and very pungent taste. The principal active ingredient is piperine, which is responsible for the pungency. The quality characteristics are measured by the volatile oil, non-volatile methylene chloride extract, piperine, total and acid insoluble ash, crude fiber, and moisture.
28. PEPPER, RED (Capsicum, Cayenne) - The red, dried fruit of any variety of *Capsicum frutescens* L. or *C. annum* L. It has the characteristic red to brown-red color and a sharp pungency. The principal active ingredient is capsaicin, which is responsible for the pungency. The quality characteristics are measured by the pungency rating (Scoville units), total and acid insoluble ash, and moisture.
29. PEPPER, WHITE - The dried, mature berries of *Piper nigrum* L., from which the outer covering or outer and inner coverings have been removed. As with black pepper, piperine is the principal active ingredient. The quality characteristics are measured by volatile oil, non-volatile methylene chloride extract, total and acid insoluble ash, crude fiber, and moisture.
30. ROSEMARY - The clean, whole dried leaves of *Rosmarinus officinalis* L. The shiny, dark green to brownish-green colored, rolled, margined leaves have the shape and appearance of pine needles. It has a tea-like fragrance; when crushed, they have a slight camphoraceous odor. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, moisture, and freedom from stems.
31. SAFFRON - The dried stigma of *Crocus sativus* L., a perennial plant of the iris family. The quality characteristics are measured by the total and acid insoluble ash.
32. SAGE - The dried leaves of *Salvia officinalis* L. The green to gray-green colored, oblong to lanceolate leaves, covered with fine, short hairs possess a strong, fragrant and aromatic odor relatively free of any camphoraceous note, and free of objectionable terebinthic odor. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, moisture, and freedom from stems.
33. SAVORY - The dried leaves and flowering tops of *Satureia* (*Satureja hortensis* L. The pale brownish-green leaves have a fragrant aromatic odor and a warm, aromatic, slightly sharp taste.
34. STAR ANISEED - The dried, ripe fruit of *Illicium verum* Hook. f. The principal active ingredient is anethole. The quality characteristics are measured by volatile oil, total and acid insoluble ash.
35. TARRAGON - The dried leaves and flowering tops of *Artemisia dracunculus* L. It has a pleasant, anise-like odor and taste.
36. THYME - The dried leaf and flowering tops of *Thymus vulgaris* L. The dried, brownish-green, curled leaves, when crushed, yield a fragrant, aromatic odor, and have a warm, aromatic, pungent taste. The principal active ingredients of the volatile oil are thymol and carvacrol. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, and moisture.

37. TURMERIC - The dried root of the perennial herb, *Curcuma longa* L. The quality characteristics are measured by the volatile oil, total and acid insoluble ash, moisture, crude fiber, and color power (per cent curcumin).

NOTES:

1. Poppy seeds, sesame seeds, dried or dehydrated onions and garlic are not considered to be spices. When used as an ingredient in foods they should be declared on the label by common or usual names.

2. Paprika, tumeric and saffron are color as well as spices. When used as ingredients in foods they shall be designated as "spice and coloring," unless each is designated by its specific name, in accordance with 21 CFR 101.22(a)(2). Issued: 10/1/80

<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.22>

Title 21, Volume 2 Revised as of April 1, 2013 21CFR101.22

TITLE 21--FOOD AND DRUGS

CHAPTER I--FOOD AND DRUG ADMINISTRATION

DEPARTMENT OF HEALTH AND HUMAN SERVICES

SUBCHAPTER B--FOOD FOR HUMAN CONSUMPTION

[PART 101 -- FOOD LABELING](#)

Subpart B--Specific Food Labeling Requirements

§101.22. Foods; labeling of spices, flavorings, colorings and chemical preservatives.

(a)(1) The term *artificial flavor* or *artificial flavoring* means any substance, the function of which is to impart flavor, which is not derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or similar plant material, meat, fish, poultry, eggs, dairy products, or fermentation products thereof. Artificial flavor includes the substances listed in §§172.515(b) and 182.60 of this chapter except where these are derived from natural sources.

(2) The term *spice* means any aromatic vegetable substance in the whole, broken, or ground form, except for those substances which have been traditionally regarded as foods, such as onions, garlic and celery; whose significant function in food is seasoning rather than nutritional; that is true to name; and from which no portion of any volatile oil or other flavoring principle has been removed. Spices include the spices listed in §182.10 and part 184 of this chapter, such as the following:

Allspice, Anise, Basil, Bay leaves, Caraway seed, Cardamon, Celery seed, Chervil, Cinnamon, Cloves, Coriander, Cumin seed, Dill seed, Fennel seed, Fenugreek, Ginger, Horseradish, Mace, Marjoram, Mustard flour, Nutmeg, Oregano, Paprika, Parsley, Pepper, black; Pepper, white; Pepper, red; Rosemary, Saffron, Sage, Savory, Star aniseed, Tarragon, Thyme, Turmeric. Paprika, turmeric, and saffron or other spices which are also colors, shall be declared as "spice and coloring" unless declared by their common or usual name.



(3) The term *natural flavor* or *natural flavoring* means the essential oil, oleoresin, essence or extractive, protein hydrolysate, distillate, or any product of roasting, heating or enzymolysis, which contains the flavoring constituents derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or similar plant material, meat, seafood, poultry, eggs, dairy products, or fermentation products thereof, whose significant function in food is flavoring rather than nutritional. Natural flavors include the natural essence or extractives obtained from plants listed in §§182.10, 182.20, 182.40, and 182.50 and part 184 of this chapter, and the substances listed in §172.510 of this chapter.

<http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&rgn=div8&view=text&node=21:2.0.1.1.2.2.1.1&idno=21>

AUTHORITY: 21 U.S.C. 321, 342, 348, 371.

SOURCE: 42 FR 14640, Mar. 15, 1977, unless otherwise noted.

#### Subpart A—General Provisions

##### §182.1 Substances that are generally recognized as safe.

(a) It is impracticable to list all substances that are generally recognized as safe for their intended use. However, by way of illustration, the Commissioner regards such common food ingredients as salt, pepper, vinegar, baking powder, and monosodium glutamate as safe for their intended use. This part includes additional substances that, when used for the purposes indicated, in accordance with good manufacturing practice, are regarded by the Commissioner as generally recognized as safe for such uses.

(b) For the purposes of this section, good manufacturing practice shall be defined to include the following restrictions:

1) The quantity of a substance added to food does not exceed the amount reasonably required to accomplish its intended physical, nutritional, or other technical effect in food; and

(2) The quantity of a substance that becomes a component of food as a result of its use in the manufacturing, processing, or packaging of food, and which is not intended to accomplish any physical or other technical effect in the food itself, shall be reduced to the extent reasonably possible.

(3) The substance is of appropriate food grade and is prepared and handled as a food ingredient. Upon request the Commissioner will offer an opinion, based on specifications and intended use, as to whether or not a particular grade or lot of the substance is of suitable purity for use in food and would generally be regarded as safe for the purpose intended, by experts qualified to evaluate its safety.

(c) The inclusion of substances in the list of nutrients does not constitute a finding on the part of the Department that the substance is useful as a supplement to the diet for humans.

(d) Substances that are generally recognized as safe for their intended use within the meaning of section 409 of the act are listed in this part. When the status of a substance has been reevaluated, it will be deleted from this part, and will be issued as a new regulation under the appropriate part, e.g., “affirmed as GRAS” under part 184 or 186 of this chapter; “food additive regulation” under

parts 170 through 180 of this chapter; “interim food additive regulation” under part 180 of this chapter; or “prohibited from use in food” under part 189 of this chapter.

[42 FR 14640, Mar. 15, 1977, as amended at 53 FR 44875, Nov. 7, 1988]

## Title 21: Food and Drugs

### PART 182—SUBSTANCES GENERALLY RECOGNIZED AS SAFE

#### §182.10 Spices and other natural seasonings and flavorings.

Spices and other natural seasonings and flavorings that are generally recognized as safe for their intended use, within the meaning of section 409 of the Act, are as follows:

Common name	Botanical name of plant source
Alfalfa herb and seed	<i>Medicago sativa</i> L.
Allspice	<i>Pimenta officinalis</i> Lindl.
Ambrette seed	<i>Hibiscus abelmoschus</i> L.
Angelica	<i>Angelica archangelica</i> L. or other spp. of <i>Angelica</i> .
Angelica root	Do.
Angelica seed	Do.
Angostura (cusparia bark)	<i>Galipea officinalis</i> Hancock.
Anise	<i>Pimpinella anisum</i> L.
Anise, star	<i>Illicium verum</i> Hook. f.
Balm (lemon balm)	<i>Melissa officinalis</i> L.
Basil, bush	<i>Ocimum minimum</i> L.
Basil, sweet	<i>Ocimum basilicum</i> L.
Bay	<i>Laurus nobilis</i> L.
Calendula	<i>Calendula officinalis</i> L.
Camomile (chamomile), English or Roman	<i>Anthemis nobilis</i> L.
Camomile (chamomile), German or Hungarian	<i>Matricaria chamomilla</i> L.
Capers	<i>Capparis spinosa</i> L.
Capsicum	<i>Capsicum frutescens</i> L. or <i>Capsicum annuum</i> L.
Caraway	<i>Carum carvi</i> L.
Caraway, black (black cumin)	<i>Nigella sativa</i> L.
Cardamom (cardamon)	<i>Elettaria cardamomum</i> Maton.
Cassia, Chinese	<i>Cinnamomum cassia</i> Blume.

Common name	Botanical name of plant source
Cassia, Padang or Batavia	Cinnamomum burmanni Blume.
Cassia, Saigon	Cinnamomum loureirii Nees.
Cayenne pepper	Capsicum frutescens L. or Capsicum annuum L.
Celery seed	Apium graveolens L.
Chervil	Anthriscus cerefolium (L.) Hoffm.
Chives	Allium schoenoprasum L.
Cinnamon, Ceylon	Cinnamomum zeylanicum Nees.
Cinnamon, Chinese	Cinnamomum cassia Blume.
Cinnamon, Saigon	Cinnamomum loureirii Nees.
Clary (clary sage)	Salvia sclarea L.
Clover	Trifolium spp.
Coriander	Coriandrum sativum L.
Cumin (cummin)	Cuminum cyminum L.
Cumin, black (black caraway)	Nigella sativa L.
Elder flowers	Sambucus canadensis L.
Fennel, common	Foeniculum vulgare Mill.
Fennel, sweet (finocchio, Florence fennel)	Foeniculum vulgare Mill. var. dulce (DC.) Alex.
Fenugreek	Trigonella foenum-graecum L.
Galanga (galangal)	Alpinia officinarum Hance.
Geranium	Pelargonium spp.
Ginger	Zingiber officinale Rosc.
Grains of paradise	Amomum melegueta Rosc.
Horehound (hoarhound)	Marrubium vulgare L.
Horseradish	Armoracia lapathifolia Gilib.
Hyssop	Hyssopus officinalis L.
Lavender	Lavandula officinalis Chaix.
Linden flowers	Tilia spp.
Mace	Myristica fragrans Houtt.
Marigold, pot	Calendula officinalis L.
Marjoram, pot	Majorana onites (L.) Benth.
Marjoram, sweet	Majorana hortensis Moench.
Mustard, black or brown	Brassica nigra (L.) Koch.
Mustard, brown	Brassica juncea (L.) Coss.

Common name	Botanical name of plant source
Mustard, white or yellow	<i>Brassica hirta</i> Moench.
Nutmeg	<i>Myristica fragrans</i> Houtt.
Oregano (oreganum, Mexican oregano, Mexican sage, organ)	<i>Lippia</i> spp.
Paprika	<i>Capsicum annuum</i> L.
Parsley	<i>Petroselinum crispum</i> (Mill.) Mansf.
Pepper, black	<i>Piper nigrum</i> L.
Pepper, cayenne	<i>Capsicum frutescens</i> L. or <i>Capsicum annuum</i> L.
Pepper, red	Do.
Pepper, white	<i>Piper nigrum</i> L.
Peppermint	<i>Mentha piperita</i> L.
Poppy seed	<i>Papaver somniferum</i> L.
Pot marigold	<i>Calendula officinalis</i> L.
Pot marjoram	<i>Majorana onites</i> (L.) Benth.
Rosemary	<i>Rosmarinus officinalis</i> L.
Saffron	<i>Crocus sativus</i> L.
Sage	<i>Salvia officinalis</i> L.
Sage, Greek	<i>Salvia triloba</i> L.
Savory, summer	<i>Satureia hortensis</i> L. (Satureja).
Savory, winter	<i>Satureia montana</i> L. (Satureja).
Sesame	<i>Sesamum indicum</i> L.
Spearmint	<i>Mentha spicata</i> L.
Star anise	<i>Illicium verum</i> Hook. f.
Tarragon	<i>Artemisia dracunculus</i> L.
Thyme	<i>Thymus vulgaris</i> L.
Thyme, wild or creeping	<i>Thymus serpyllum</i> L.
Turmeric	<i>Curcuma longa</i> L.
Vanilla	<i>Vanilla planifolia</i> Andr. or <i>Vanilla tahitensis</i> J. W. Moore.
Zedoary	<i>Curcuma zedoaria</i> Rosc.

[42 FR 14640, Mar. 15, 1977, as amended at 43 FR 3705, Jan. 27, 1978; 44 FR 3963, Jan. 19, 1979; 50 FR 21044, May 22, 1985; 61 FR 14246, Apr. 1, 1996]

§182.20 Essential oils, oleoresins (solvent-free), and natural extractives (including distillates).

Essential oils, oleoresins (solvent-free), and natural extractives (including distillates) that are generally recognized as safe for their intended use, within the meaning of section 409 of the Act, are as follows:

<b>Common name</b>	<b>Botanical name of plant source</b>
Alfalfa	<i>Medicago sativa</i> L.
Allspice	<i>Pimenta officinalis</i> Lindl.
Almond, bitter (free from prussic acid)	<i>Prunus amygdalus</i> Batsch, <i>Prunus armeniaca</i> L., or <i>Prunus persica</i> (L.) Batsch.
Ambrette (seed)	<i>Hibiscus moschatus</i> Moench.
Angelica root	<i>Angelica archangelica</i> L.
Angelica seed	Do.
Angelica stem	Do.
Angostura (cusparia bark)	<i>Galipea officinalis</i> Hancock.
Anise	<i>Pimpinella anisum</i> L.
Asafetida	<i>Ferula assa-foetida</i> L. and related spp. of <i>Ferula</i> .
Balm (lemon balm)	<i>Melissa officinalis</i> L.
Balsam of Peru	<i>Myroxylon pereirae</i> Klotzsch.
Basil	<i>Ocimum basilicum</i> L.
Bay leaves	<i>Laurus nobilis</i> L.
Bay (myrcia oil)	<i>Pimenta racemosa</i> (Mill.) J. W. Moore.
Bergamot (bergamot orange)	<i>Citrus aurantium</i> L. subsp. <i>bergamia</i> Wright et Arn.
Bitter almond (free from prussic acid)	<i>Prunus amygdalus</i> Batsch, <i>Prunus armeniaca</i> L., or <i>Prunus persica</i> (L.) Batsch.
Bois de rose	<i>Aniba rosaeodora</i> Ducke.
Cacao	<i>Theobroma cacao</i> L.
Camomile (chamomile) flowers, Hungarian	<i>Matricaria chamomilla</i> L.
Camomile (chamomile) flowers, Roman or English	<i>Anthemis nobilis</i> L.
Cananga	<i>Cananga odorata</i> Hook. f. and Thoms.
Capsicum	<i>Capsicum frutescens</i> L. and <i>Capsicum annuum</i> L.
Caraway	<i>Carum carvi</i> L.
Cardamom seed (cardamon)	<i>Elettaria cardamomum</i> Maton.
Carob bean	<i>Ceratonia siliqua</i> L.
Carrot	<i>Daucus carota</i> L.
Cascarilla bark	<i>Croton eluteria</i> Benn.
Cassia bark, Chinese	<i>Cinnamomum cassia</i> Blume.

Cassia bark, Padang or Batavia	<i>Cinnamomum burmanni</i> Blume.
Cassia bark, Saigon	<i>Cinnamomum loureirii</i> Nees.
Celery seed	<i>Apium graveolens</i> L.
Cherry, wild, bark	<i>Prunus serotina</i> Ehrh.
Chervil	<i>Anthriscus cerefolium</i> (L.) Hoffm.
Chicory	<i>Cichorium intybus</i> L.
Cinnamon bark, Ceylon	<i>Cinnamomum zeylanicum</i> Nees.
Cinnamon bark, Chinese	<i>Cinnamomum cassia</i> Blume.
Cinnamon bark, Saigon	<i>Cinnamomum loureirii</i> Nees.
Cinnamon leaf, Ceylon	<i>Cinnamomum zeylanicum</i> Nees.
Cinnamon leaf, Chinese	<i>Cinnamomum cassia</i> Blume.
Cinnamon leaf, Saigon	<i>Cinnamomum loureirii</i> Nees.
Citronella	<i>Cymbopogon nardus</i> Rendle.
Citrus peels	<i>Citrus</i> spp.
Clary (clary sage)	<i>Salvia sclarea</i> L.
Clover	<i>Trifolium</i> spp.
Coca (decocainized)	<i>Erythroxylum coca</i> Lam. and other spp. of <i>Erythroxylum</i> .
Coffee	<i>Coffea</i> spp.
Cola nut	<i>Cola acuminata</i> Schott and Endl., and other spp. of <i>Cola</i> .
Coriander	<i>Coriandrum sativum</i> L.
Cumin (cummin)	<i>Cuminum cyminum</i> L.
Curacao orange peel (orange, bitter peel)	<i>Citrus aurantium</i> L.
Cusparia bark	<i>Galipea officinalis</i> Hancock.
Dandelion	<i>Taraxacum officinale</i> Weber and T. <i>laevigatum</i> DC.
Dandelion root	Do.
Dog grass (quackgrass, triticum)	<i>Agropyron repens</i> (L.) Beauv.
Elder flowers	<i>Sambucus canadensis</i> L. and <i>S. nigra</i> L.
Estragole (esdragol, esdragon, tarragon)	<i>Artemisia dracunculus</i> L.
Estragon (tarragon)	Do.
Fennel, sweet	<i>Foeniculum vulgare</i> Mill.
Fenugreek	<i>Trigonella foenum-graecum</i> L.
Galanga (galangal)	<i>Alpinia officinarum</i> Hance.
Geranium	<i>Pelargonium</i> spp.
Geranium, East Indian	<i>Cymbopogon martini</i> Stapf.

Geranium, rose	<i>Pelargonium graveolens</i> L'Her.
Ginger	<i>Zingiber officinale</i> Rosc.
Grapefruit	<i>Citrus paradisi</i> Macf.
Guava	<i>Psidium</i> spp.
Hickory bark	<i>Carya</i> spp.
Horehound (hoarhound)	<i>Marrubium vulgare</i> L.
Hops	<i>Humulus lupulus</i> L.
Horsemint	<i>Monarda punctata</i> L.
Hyssop	<i>Hyssopus officinalis</i> L.
Immortelle	<i>Helichrysum augustifolium</i> DC.
Jasmine	<i>Jasminum officinale</i> L. and other spp. of <i>Jasminum</i> .
Juniper (berries)	<i>Juniperus communis</i> L.
Kola nut	<i>Cola acuminata</i> Schott and Endl., and other spp. of <i>Cola</i> .
Laurel berries	<i>Laurus nobilis</i> L.
Laurel leaves	<i>Laurus</i> spp.
Lavender	<i>Lavandula officinalis</i> Chaix.
Lavender, spike	<i>Lavandula latifolia</i> Vill.
Lavandin	Hybrids between <i>Lavandula officinalis</i> Chaix and <i>Lavandula latifolia</i> Vill.
Lemon	<i>Citrus limon</i> (L.) Burm. f.
Lemon balm (see balm)	
Lemon grass	<i>Cymbopogon citratus</i> DC. and <i>Cymbopogon lexeus</i> Stapf.
Lemon peel	<i>Citrus limon</i> (L.) Burm. f.
Lime	<i>Citrus aurantifolia</i> Swingle.
Linden flowers	<i>Tilia</i> spp.
Locust bean	<i>Ceratonia siliqua</i> L.
Lupulin	<i>Humulus lupulus</i> L.
Mace	<i>Myristica fragrans</i> Houtt.
Mandarin	<i>Citrus reticulata</i> Blanco.
Marjoram, sweet	<i>Majorana hortensis</i> Moench.
Maté	<i>Ilex paraguariensis</i> St. Hil.
Melissa (see balm)	
Menthol	<i>Mentha</i> spp.
Menthyl acetate	Do.
Molasses (extract)	<i>Saccharum officinarum</i> L.

Mustard	Brassica spp.
Naringin	Citrus paradisi Macf.
Neroli, bigarade	Citrus aurantium L.
Nutmeg	Myristica fragrans Houtt.
Onion	Allium cepa L.
Orange, bitter, flowers	Citrus aurantium L.
Orange, bitter, peel	Do.
Orange leaf	Citrus sinensis (L.) Osbeck.
Orange, sweet	Do.
Orange, sweet, flowers	Do.
Orange, sweet, peel	Do.
Origanum	Origanum spp.
Palmarosa	Cymbopogon martini Stapf.
Paprika	Capsicum annuum L.
Parsley	Petroselinum crispum (Mill.) Mansf.
Pepper, black	Piper nigrum L.
Pepper, white	Do.
Peppermint	Mentha piperita L.
Peruvian balsam	Myroxylon pereirae Klotzsch.
Petitgrain	Citrus aurantium L.
Petitgrain lemon	Citrus limon (L.) Burm. f.
Petitgrain mandarin or tangerine	Citrus reticulata Blanco.
Pimenta	Pimenta officinalis Lindl.
Pimenta leaf	Pimenta officinalis Lindl.
Pipsissewa leaves	Chimaphila umbellata Nutt.
Pomegranate	Punica granatum L.
Prickly ash bark	Xanthoxylum (or Zanthoxylum) Americanum Mill. or Xanthoxylum clava-herculis L.
Rose absolute	Rosa alba L., Rosa centifolia L., Rosa damascena Mill., Rosa gallica L., and vars. of these spp.
Rose (otto of roses, attar of roses)	Do.
Rose buds	Do.
Rose flowers	Do.
Rose fruit (hips)	Do.
Rose geranium	Pelargonium graveolens L'Her.



Rose leaves	Rosa spp.
Rosemary	Rosmarinus officinalis L.
Saffron	Crocus sativus L.
Sage	Salvia officinalis L.
Sage, Greek	Salvia triloba L.
Sage, Spanish	Salvia lavandulaefolia Vahl.
St. John's bread	Ceratonia siliqua L.
Savory, summer	Satureia hortensis L.
Savory, winter	Satureia montana L.
Schinus molle	Schinus molle L.
Sloe berries (blackthorn berries)	Prunus spinosa L.
Spearmint	Mentha spicata L.
Spike lavender	Lavandula latifolia Vill.
Tamarind	Tamarindus indica L.
Tangerine	Citrus reticulata Blanco.
Tarragon	Artemisia dracunculus L.
Tea	Thea sinensis L.
Thyme	Thymus vulgaris L. and Thymus zygis var. gracilis Boiss.
Thyme, white	Do.
Thyme, wild or creeping	Thymus serpyllum L.
Triticum (see dog grass)	
Tuberose	Polianthes tuberosa L.
Turmeric	Curcuma longa L.
Vanilla	Vanilla planifolia Andr. or Vanilla tahitensis J. W. Moore.
Violet flowers	Viola odorata L.
Violet leaves	Do.
Violet leaves absolute	Do.
Wild cherry bark	Prunus serotina Ehrh.
Ylang-ylang	Cananga odorata Hook. f. and Thoms.
Zedoary bark	Curcuma zedoaria Rosc.

[42 FR 14640, Mar. 15, 1977, as amended at 44 FR 3963, Jan. 19, 1979; 47 FR 29953, July 9, 1982; 48 FR 51613, Nov. 10, 1983; 50 FR 21043 and 21044, May 22, 1985]

§182.40 Natural extractives (solvent-free) used in conjunction with spices, seasonings, and flavorings.

Natural extractives (solvent-free) used in conjunction with spices, seasonings, and flavorings that are generally recognized as safe for their intended use, within the meaning of section 409 of the Act, are as follows:

Common name	Botanical name of plant source
Apricot kernel (persic oil)	<i>Prunus armeniaca</i> L.
Peach kernel (persic oil)	<i>Prunus persica</i> Sieb. et Zucc.
Peanut stearine	<i>Arachis hypogaea</i> L.
Persic oil (see apricot kernel and peach kernel)	
Quince seed	<i>Cydonia oblonga</i> Miller.

[42 FR 14640, Mar. 15, 1977, as amended at 47 FR 47375, Oct. 26, 1982]

## **§182.60 Synthetic flavoring substances and adjuvants**

Title 21: Food and Drugs

[PART 172—FOOD ADDITIVES PERMITTED FOR DIRECT ADDITION TO FOOD FOR HUMAN CONSUMPTION](#) [Subpart F—Flavoring Agents and Related Substances](#)

§172.510 Natural flavoring substances and natural substances used in conjunction with flavors.

Natural flavoring substances and natural adjuvants may be safely used in food in accordance with the following conditions.

(a) They are used in the minimum quantity required to produce their intended physical or technical effect and in accordance with all the principles of good manufacturing practice.

(b) In the appropriate forms (plant parts, fluid and solid extracts, concentrates, absolutes, oils, gums, balsams, resins, oleoresins, waxes, and distillates) they consist of one or more of the following, used alone or in combination with flavoring substances and adjuvants generally recognized as safe in food, previously sanctioned for such use, or regulated in any section of this part.

Common name	Scientific name	Limitations
Aloe	<i>Aloe pernyi</i> Baker, <i>A. barbadensis</i> Mill., <i>A. ferox</i> Mill., and hybrids of this sp. with <i>A. africana</i> Mill. and <i>A. spicata</i> Baker	
Althea root and flowers	<i>Althea officinalis</i> L	
Amyris (West Indian sandalwood)	<i>Amyris balsamifera</i> L	
Angola weed	<i>Roccella fuciformis</i> Ach	In alcoholic beverages only
Arnica flowers	<i>Arnica montana</i> L., <i>A. fulgens</i> Pursh, <i>A. sororia</i> Greene, or <i>A.</i>	Do.

Common name	Scientific name	Limitations
	<i>cordifolia</i> Hooker	
Artemisia (wormwood)	<i>Artemisia</i> spp	Finished food thujone free <sup>1</sup>
Artichoke leaves	<i>Cynara scolymus</i> L	In alcoholic beverages only
Benzoin resin	<i>Styrax benzoin</i> Dryander, <i>S. paralleloneurus</i> Perkins, <i>S. tonkinensis</i> (Pierre) Craib ex Hartwich, or other spp. of the Section <i>Anthostyrax</i> of the genus <i>Styrax</i>	
Blackberry bark	<i>Rubus</i> , Section <i>Eubatus</i>	
Boldus (boldo) leaves	<i>Peumus boldus</i> Mol	Do.
Boronia flowers	<i>Boronia megastigma</i> Nees	
Bryonia root	<i>Bryonia alba</i> L., or <i>B. dioica</i> Jacq	Do.
Buchu leaves	<i>Barosma betulina</i> Bartl. et Wendl., <i>B. crenulata</i> (L.) Hook. or <i>B. serratifolia</i> Willd	
Buckbean leaves	<i>Menyanthes trifoliata</i> L	Do.
Cajeput	<i>Melaleuca leucadendron</i> L. and other <i>Melaleuca</i> spp	
Calumba root	<i>Jateorhiza palmata</i> (Lam.) Miers	Do.
Camphor tree	<i>Cinnamomum camphora</i> (L.) Nees et Eberm	Safrole free
Cascara sagrada	<i>Rhamnus purshiana</i> DC	
Cassie flowers	<i>Acacia farnesiana</i> (L.) Willd	
Castor oil	<i>Ricinus communis</i> L	
Catechu, black	<i>Acacia catechu</i> Willd	
Cedar, white (aborvitae), leaves and twigs	<i>Thuja occidentalis</i> L	Finished food thujone free <sup>1</sup>
Centuary	<i>Centaurium umbellatum</i> Gilib	In alcoholic beverages only
Cherry pits	<i>Prunus avium</i> L. or <i>P. cerasus</i> L	Not to exceed 25 p.p.m. prussic acid
Cherry-laurel leaves	<i>Prunus laurocerasus</i> L	Do.
Chestnut leaves	<i>Castanea dentata</i> (Marsh.) Borkh	
Chirata	<i>Swertia chirata</i> Buch.-Ham	In alcoholic beverages only
Cinchona, red, bark	<i>Cinchona succirubra</i> Pav. or its hybrids	In beverages only; not more than 83 p.p.m. total cinchona alkaloids in finished beverage
Cinchona, yellow, bark	<i>Cinchona ledgeriana</i> Moens, <i>C. calisaya</i> Wedd., or hybrids of these with other spp. of <i>Cinchona</i> .	Do.
Copaiba	South American spp. of <i>Copaifera</i> L	

Common name	Scientific name	Limitations
Cork, oak	<i>Quercus suber</i> L., or <i>Q. occidentalis</i> F. Gay	In alcoholic beverages only
Costmary	<i>Chrysanthemum balsamita</i> L	Do.
Costus root	<i>Saussurea lappa</i> Clarke	
Cubeb	<i>Piper cubeba</i> L. f	
Currant, black, buds and leaves	<i>Ribes nigrum</i> L	
Damiana leaves	<i>Turnera diffusa</i> Willd	
Davana	<i>Artemisia pallens</i> Wall	
Dill, Indian	<i>Anethum sowa</i> Roxb. ( <i>Peucedanum graveolens</i> Benth et Hook., <i>Anethum graveolens</i> L.)	
Dittany (fraxinella) roots	<i>Dictamnus albus</i> L	Do.
Dittany of Crete	<i>Origanum dictamnus</i> L	
Dragon's blood (dracorubin)	<i>Daemonorops</i> spp	
Elder tree leaves	<i>Sambucus nigra</i> L	In alcoholic beverages only; not to exceed 25 p.p.m. prussic acid in the flavor
Elecampane rhizome and roots	<i>Inula helenium</i> L	In alcoholic beverages only
Elemi	<i>Canarium commune</i> L. or <i>C. luzonicum</i> Miq	
Erigeron	<i>Erigeron canadensis</i> L	
Eucalyptus globulus leaves	<i>Eucalyptus globulus</i> Labill	
Fir ("pine") needles and twigs	<i>Abies sibirica</i> Ledeb., <i>A. alba</i> Mill., <i>A. sachalinesis</i> Masters or <i>A. mayriana</i> Miyabe et Kudo	
Fir, balsam, needles and twigs	<i>Abies balsamea</i> (L.) Mill	
Galanga, greater	<i>Alpinia galanga</i> Willd	Do.
Galbanum	<i>Ferula galbaniflua</i> Boiss. et Buhse and other <i>Ferula</i> spp	
Gambir (catechu, pale)	<i>Uncaria gambir</i> Roxb	
Genet flowers	<i>Spartium junceum</i> L	
Gentian rhizome and roots	<i>Gentiana lutea</i> L	
Gentian, stemless	<i>Gentiana acaulis</i> L	Do.
Germander, chamaedrys	<i>Teucrium chamaedrys</i> L	Do.

Common name	Scientific name	Limitations
Germander, golden	<i>Teucrium polium</i> L	Do.
Guaiac	<i>Guaiacum officinale</i> L., <i>G. santum</i> L., <i>Bulnesia sarmienti</i> Lor	
Guarana	<i>Paullinia cupana</i> HBK	
Haw, black, bark	<i>Viburnum prunifolium</i> L	
Hemlock needles and twigs	<i>Tsuga canadensis</i> (L.) Carr. or <i>T. heterophylla</i> (Raf.) Sarg	
Hyacinth flowers	<i>Hyacinthus orientalis</i> L	
Iceland moss	<i>Cetraria islandica</i> Ach	Do.
Imperatoria	<i>Peucedanum ostruthium</i> (L.) Koch ( <i>Imperatoria ostruthium</i> L.)	
Iva	<i>Achillea moschata</i> Jacq	Do.
Labdanum	<i>Cistus</i> spp	
Lemon-verbena	<i>Lippia citriodora</i> HBK	Do.
Linaloe wood	<i>Bursera delpechiana</i> Poiss. and other <i>Bursera</i> spp	
Linden leaves	<i>Tillia</i> spp	Do.
Lovage	<i>Levisticum officinale</i> Koch	
Lungmoss (lungwort)	<i>Sticta pulmonacea</i> Ach	
Maidenhair fern	<i>Adiantum capillus-veneris</i> L	Do.
Maple, mountain	<i>Acer spicatum</i> Lam	
Mimosa (black wattle) flowers	<i>Acacia decurrens</i> Willd. var. <i>dealbata</i>	
Mullein flowers	<i>Verbascum phlomoides</i> L. or <i>V. thapsiforme</i> Schrad	Do.
Myrrh	<i>Commiphora molmol</i> Engl., <i>C. abyssinica</i> (Berg) Engl., or other <i>Commiphora</i> spp	
Myrtle leaves	<i>Myrtus communis</i> L	Do.
Oak, English, wood	<i>Quercus robur</i> L	Do.
Oak, white, chips	<i>Quercus alba</i> L	
Oak moss	<i>Evernia prunastri</i> (L.) Ach., <i>E. furfuracea</i> (L.) Mann, and other lichens	Finished food thujone free <sup>1</sup>
Olibanum	<i>Boswellia carteri</i> Birdw. and other <i>Boswellia</i> spp	
Opopanax (bisabolmyrrh)	<i>Opopanax chironium</i> Koch (true opopanax) of <i>Commiphora erythraea</i> Engl. var. <i>Llabrescens</i>	
Orris root	<i>Iris germanica</i> L. (including its variety <i>florentina</i> Dykes) and <i>I. pallida</i> Lam	
Pansy	<i>Viola tricolor</i> L	In alcoholic beverages only
Passion flower	<i>Passiflora incarnata</i> L	

Common name	Scientific name	Limitations
Patchouly	<i>Pogostemon cablin</i> Benth. and <i>P. heyneanus</i> Benth	
Peach leaves	<i>Prunus persica</i> (L.) Batsch	In alcoholic beverages only; not to exceed 25 p.p.m. prussic acid in the flavor
Pennyroyal, American	<i>Hedeoma pulegioides</i> (L.) Pers	
Pennyroyal, European	<i>Mentha pulegium</i> L	
Pine, dwarf, needles and twigs	<i>Pinus mugo</i> Turra var. <i>pumilio</i> (Haenke) Zenari	
Pine, Scotch, needles and twigs	<i>Pinus sylvestris</i> L	
Pine, white, bark	<i>Pinus strobus</i> L	In alcoholic beverages only
Pine, white oil	<i>Pinus palustris</i> Mill., and other <i>Pinus</i> spp	
Poplar buds	<i>Populus balsamifera</i> L. ( <i>P. tacamahacca</i> Mill.), <i>P. candicans</i> Ait., or <i>P. nigra</i> L	Do.
Quassia	<i>Picrasma excelsa</i> (Sw.) Planch, or <i>Quassia amara</i> L	
Quebracho bark	<i>Aspidosperma quebracho-blanco</i> Schlecht, or ( <i>Quebrachia lorentzii</i> (Griseb))	<i>Schinopsis lorentzii</i> (Griseb.) Engl.
Quillaia (soapbark)	<i>Quillaja saponaria</i> Mol	
Red saunders (red sandalwood)	<i>Pterocarpus san alinus</i> L	In alcoholic beverages only
Rhatany root	<i>Krameria triandra</i> Ruiz et Pav. or <i>K. argentea</i> Mart	
Rhubarb, garden root	<i>Rheum rhaponticum</i> L	Do.
Rhubarb root	<i>Rheum officinale</i> Baill., <i>R. palmatum</i> L., or other spp. (excepting <i>R. rhaponticum</i> L.) or hybrids of <i>Rheum</i> grown in China	
Roselle	<i>Hibiscus sabdariffa</i> L	Do.
Rosin (colophony)	<i>Pinus palustris</i> Mill., and other <i>Pinus</i> spp	Do.
St. Johnswort leaves, flowers, and caulis	<i>Hypericum perforatum</i> L	Hypericin-free alcohol distillate form only; in alcoholic beverages only
Sandalwood, white (yellow, or East Indian)	<i>Santalum album</i> L	
Sandarac	<i>Tetraclinis articulata</i> (Vahl.), Mast	In alcoholic beverages only
Sarsaparilla	<i>Smilax aristolochiaefolia</i> Mill., (Mexican sarsaparilla), <i>S. regelii</i> Killip et Morton (Honduras sarsaparilla), <i>S. febrifuga</i> Kunth (Ecuadorean sarsaparilla), or undetermined <i>Smilax</i> spp. (Ecuadorean or Central American sarsaparilla)	
Sassafras leaves	<i>Sassafras albidum</i> (Nutt.) Nees	Safrole free

Common name	Scientific name	Limitations
Senna, Alexandria	<i>Cassia acutifolia</i> Delile	
Serpentaria (Virginia snakeroot)	<i>Aristolochia serpentaria</i> L	In alcoholic beverages only
Simaruba bark	<i>Simaruba amara</i> Aubl	Do.
Snakeroot, Canadian (wild ginger)	<i>Asarum canadense</i> L	
Spruce needles and twigs	<i>Picea glauca</i> (Moench) Voss or <i>P. mariana</i> (Mill.) BSP	
Storax (styrax)	<i>Liquidambar orientalis</i> Mill. or <i>L. styraciflua</i> L	
Tagetes (marigold)	<i>Tagetes patula</i> L., <i>T. erecta</i> L., or <i>T. minuta</i> L. ( <i>T. glandulifera</i> Schrank)	As oil only
Tansy	<i>Tanacetum vulgare</i> L	In alcoholic beverages only; finished alcoholic beverage thujone free <sup>1</sup>
Thistle, blessed (holy thistle)	<i>Onicus benedictus</i> L	In alcoholic beverages only
<i>Thymus capitatus</i> (Spanish “origanum”)	<i>Thymus capitatus</i> Hoffmg. et Link	
Tolu	<i>Myroxylon balsamum</i> (L.) Harms	
Turpentine	<i>Pinus palustris</i> Mill. and other <i>Pinus</i> spp. which yield terpene oils exclusively	
Valerian rhizome and roots	<i>Valeriana officinalis</i> L	
Veronica	<i>Veronica officinalis</i> L	Do.
Vervain, European	<i>Verbena officinalis</i> L	Do.
Vetiver	<i>Vetiveria zizanioides</i> Stapf	Do.
Violet, Swiss	<i>Viola calcarata</i> L	
Walnut husks (hulls), leaves, and green nuts	<i>Juglans nigra</i> L. or <i>J. regia</i> L	
Woodruff, sweet	<i>Asperula odorata</i> L	In alcoholic beverages only
Yarrow	<i>Achillea millefolium</i> L	In beverages only; finished beverage thujone free <sup>1</sup>
Yerba santa	<i>Eriodictyon californicum</i> (Hook, et Arn.) Torr	
Yucca, Joshua-tree	<i>Yucca brevifolia</i> Engelm	
Yucca, Mohave	<i>Yucca schidigera</i> Roezl ex Ortgies ( <i>Y. mohavensis</i> Sarg.)	

<sup>1</sup>As determined by using the method (or, in other than alcoholic beverages, a suitable adaptation thereof) in section 9.129 of the “Official Methods of Analysis of the Association of Official

Analytical Chemists,” 13th Ed. (1980), which is incorporated by reference. Copies may be obtained from the AOAC INTERNATIONAL, Gaithersburg, MD 20877

[42 FR 14491, Mar. 15, 1977, as amended at 43 FR 14644, Apr. 7, 1978; 49 FR 10104, Mar. 19, 1984; 54 FR 24897, June 12, 1989; 69 FR 24511, May 4, 2004; 72 FR 10357, Mar. 8, 2007.

## APPENDIX B. AMERICAN SPICE TRADE ASSOCIATION. SPICE LIST

### Spices

ASTA recommends that for the purpose of complying with FDA food labeling regulations (21 CFR Sec. 101.22), the following items may be declared in a product’s ingredient statement either individually by its common or usual name or included under the term “spice” as permitted in 21 CFR Sec. 101.22(h). The spices on this list, and their derivatives (e.g. extracts and oleoresins), are considered by FDA to be generally recognized as safe (GRAS), or approved food additives (See 21 CFR Secs. 172.510, 182.10, and 182.20).

COMMON OR USUAL NAME	PLANT	BOTANICAL NAME(s) OF PLANT SOURCE(s)
Allspice (Pimento)	Berry	<i>Pimenta officinalis</i>
Anise Seed	Seed	<i>Pimpinella anisum</i>
Star Anise	Fruit	<i>Illicium verum</i> Hook
Balm (lemon balm)	Leaf	<i>Melissa officinalis</i> L.
Basil Leaves (Sweet)	Leaf	<i>Ocimum basilicum</i>
Bay Leaves (Laurel Leaves)	Leaf	<i>Laurus nobilis</i>
Black Caraway (Russian Caraway, Black Cumin)	Seed	<i>Nigella sativa</i>
Camomile, English or Roman	Flower	<i>Anthemis nobilis</i> L.
Camomile, German or Hungarian	Flower	<i>Matricaria chamomilla</i> L.
Capsicums	Fruit	<i>Capsicum</i> spp.
Caraway Seed	Seed	<i>Carum carvi</i> Maton.
Cardamoml	Fruit	<i>Elettaria cardamomum</i>
Cassia/Cinnamon	Bark	<i>Cinnamomum</i> spp.
Celery Seed	Seed	<i>Apium graveolens</i>
Chervil	Leaf	<i>Anthriscus cerefolium</i>
Chives	Leaf	<i>Allium schoenoprasum</i>
Cilantro (Coriander Leaf)	Leaf	<i>Coriandrum sativum</i>
Cinnamon/Cassia	Bark	<i>Cinnamomum</i> spp.
Cloves	Bud	<i>Syzygium aromaticum</i>



Coriander Seed	Seed	Coriandrum sativum
Cumin Seed (Cummin)	Seed	Cuminum cyminum
Dill Seed	Seed	Anethum graveolens/Anethum sowa
Dill Weed	Leaf	Anethum graveolens/Anethum sowa
Fennel Seed	Seed	Foeniculum vulgare
Fenugreek Seed (Foenugreek Seed)	Seed	Trigonella foenum-graecum
Galangal	Root	Alpinia officinarum Hance
Ginger	Root	Zingiber officinale
Horseradish	Root	Armoracia lapathfolia Gilib.
Juniper	Berry	Juniperus communis
Lavender	Flower	Lavandula officinalis Chaix.
Mace	Aril	Myristica fragrans
Marjoram Leaves	Leaf	Majorana hortensis Moench
Mustard Seed	Seed	Brassica juncea/B. hirta/B. nigra
Nutmeg	Seed	Myristica fragrans
Oregano Leaves	Leaf	Origanum vulgare/Lippia spp.
Paprika	Fruit	Capsicum spp.
Parsley (Dehydrated Parsley, Parsley Flakes)	Leaf	Petroselinum crispum
Black Pepper	Berry	Piper nigrum
White Pepper	Berry	Piper nigrum
Green Peppercorns	Berry	Piper nigrum
Pink Peppercorns	Berry	Schinus terebinthifolius
Peppermint Leaves (Peppermint Flakes)	Leaf	Mentha piperita
Poppy Seed	Seed	Papaver somniferum
Rosemary Leaves	Leaf	Rosmarinus officinalis
Sage Leaves	Leaf	Salvia officinalis/Salvia triloba
Savory Leaves	Leaf	Satureia montana/Satureia hortensis
Sesame Seed	Seed	Sesamum indicum
Spearmint Leaves (Spearmint Flakes)	Leaf	Mentha spicata
Tarragon Leaves	Leaf	Artemisia dracunculus
Thyme Leaves	Leaf	Thymus vulgaris/Thymus serpyllum/Thymus satureioides
Vanilla Bean	Fruit	Vanilla planifolia/Vanilla tahiten Moore

**FOOTNOTE:**

1Must be listed by specific form (i.e., natural or hulled). **Revised April 2012**

**Approved by ASTA Board of Directors/Government Relations Committee April 2012**

**APPENDIX C. American Herbal Products Association (AHPA) Proposed Additions to EPA Crop Group 19 revised May 21, 2013. Classification into Crop Groups.**

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Malabar nut tree</b>	<i>Adhatoda vasica</i>	ROOT		1
<b>Greater galangal</b>	<i>Alpinia galanga</i>	ROOT, RHIZOME	Proposed for 1. Root and Tuber crop group	1
<b>Marshmallow</b>	<i>Althaea officinalis</i>	root		1

Common name	Scientific name	Plant part(s)	Classification	Sort Code
Angelica	<i>Angelica sinensis</i>	ROOT		1
Silverweed	<i>Argentina anserina</i> ; <i>Argentina egedii</i> ; <i>Argentina pacifica</i>	ROOT		1
Chinese asparagus	<i>Asparagus cochinchinensis</i>	ROOT		1
Shatavari	<i>Asparagus racemosus</i>	ROOT		1
Astragalus	<i>Astragalus membranaceus</i>	ROOT		1
Atractylodes macrocephalae	<i>Atractylodes macrocephalae</i>	ROOT		1
Bupleurum	<i>Bupleurum chinense</i>	ROOT		1
Avaram	<i>Cassia auriculata</i>	ROOT		1
Vetiver	<i>Chrysopogon zizanioides</i>	ROOT		1
Codonopsis	<i>Codonopsis pilosula</i>	root		1
Coptis	<i>Coptis chinensis</i> ; <i>Coptis deltoidea</i> ; <i>Coptis teetoides</i>	RHIZOME		1
Corydalis yanhusuo	<i>Corydalis yanhusuo</i>	RHIZOME		1
Turmeric	<i>Curcuma longa</i>	RHIZOME	1. Root & Tuber vegetables	1
Cyathula	<i>Cyathula officinalis</i>	ROOT		1
Cynomorium	<i>Cynomorium songaricum</i>	ROOT		1
Sichuan Teasel	<i>Dipsacus asper</i>	ROOT		1
Echinacea	<i>Echinacea angustifolia</i> ; <i>Echinacea pallida</i> ; <i>Echinacea purpurea</i> ;	ROOT		1

Common name	Scientific name	Plant part(s)	Classification	Sort Code
	<i>Echinacea spp.</i>			
<b>Eleuthero</b>	<i>Eleutherococcus senticosus</i>	ROOT		1
<b>Licorice</b>	<i>Glycyrrhiza glabra</i>	ROOT, RHIZOME		1
<b>Devil's claw</b>	<i>Harpagophytum procumbens</i>	TUBER		1
<b>Goldenseal</b>	<i>Hydrastis canadensis</i>	ROOT, RHIZOME		1
<b>Indigo</b>	<i>Indigofera tinctoria</i>	ROOT		1
<b>Maca</b>	<i>Lepidium meyenii</i> ; <i>Lepidium peruvianum</i>	DRIED ROOT	Proposed for 1. Root and Tuber crop group	1
<b>Chinese lovage</b>	<i>Ligusticum jeholense</i> ; <i>Ligusticum sinense</i> ; <i>Ligusticum spp.</i>	ROOT, RHIZOME		1
<b>Bayberry</b>	<i>Morella cerifera</i>	ROOT		1
<b>Picrorhiza</b>	<i>Neopicrorhiza scrophulariiflora</i>	RHIZOME		1
<b>Ophiopogon</b>	<i>Ophiopogon japonicus</i> ; <i>Ophiopogon spp.</i>	ROOT		1
<b>Peony</b>	<i>Paeonia lactiflora</i> ; <i>Paeonia spp.</i>	ROOT		1
<b>Asian ginseng</b>	<i>Panax ginseng</i>	ROOT	Proposed for 1. Root and Tuber crop group	1
<b>Tienchi ginseng</b>	<i>Panax notoginseng</i>	ROOT	Proposed for 1. Root and Tuber crop group	1
<b>American ginseng</b>	<i>Panax quinquefolius</i>	ROOT	Proposed for 1. Root and Tuber crop group	1
<b>Umckaloabo</b>	<i>Pelargonium sidoides</i>	ROOT		1
<b>Platycodon</b>	<i>Platycodon grandiflorus</i>	ROOT		1

Common name	Scientific name	Plant part(s)	Classification	Sort Code
Seneca snakeroot	<i>Polygala senega</i>	ROOT		1
Polygala	<i>Polygala sibirica</i> ; <i>Polygala tenuifolia</i> ; <i>Polygala spp.</i>	ROOT		1
He Shou Wu	<i>Reynoutria multiflora</i>	ROOT		1
Pseudostellaria	<i>Pseudostellaria heterophylla</i>	ROOT		1
Radish	<i>Raphanus sativus</i>	ROOT, RHIZOME	1. Root & Tuber vegetables	1
Indian snakeroot	<i>Rauvolfia serpentina</i>	ROOT		1
Rehmannia	<i>Rehmannia glutinosa</i>	ROOT		1
Chinese salvia	<i>Salvia miltiorrhiza</i>	ROOT		1
Chinese skullcap	<i>Scutellaria baicalensis</i>	ROOT		1
Sarsaparilla	<i>Smilax aristolochiifolia</i> ; <i>Smilax medica</i>	ROOT		1
Dandelion	<i>Taraxacum officinale</i>	ROOT		1
Valerian	<i>Valeriana officinalis</i>	ROOT		1
Ashwagandha	<i>Withania somnifera</i>	ROOT		1
Ginger	<i>Zingiber officinale</i>	RHIZOME	1. Root & Tuber vegetables	1
Garlic	<i>Allium sativum</i>	stem	3. Bulb Vegetable CG	3
Radish	<i>Raphanus sativus</i>	seed sprout	Covered by crop group 4, Leafy vegetables?	4
Cabbage	<i>Brassica oleracea</i> var. <i>capitata</i>	leaf	5. Brassica Leafy Vegetables	5
Velvet bean	<i>Mucuna pruriens</i>	seed	Proposed addition to 6. Legume Vegetables	6
Adzuki Bean	<i>Vigna angularis</i>	seed	6. Legume vegetables	6
Cayenne	<i>Capsicum annuum</i>	fruit	8-10 Fruiting Vegetables	8

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Lycium</b>	<i>Lycium barbarum</i> ; <i>Lycium</i> spp.	fruit	8-10. Fruiting Vegetables	8
<b>Bitter melon</b>	<i>Momordica charantia</i>	fruit	9. Cucurbit Vegetables	9
<b>Luo han guo</b>	<i>Siraitia grosvernrii</i>	fruit	Will be proposed for 9. Cucurbit vegetables crop group	9
<b>Lemon</b>	<i>Citrus ×limon</i>	rind, peel	10-10 Citrus Fruits	10
<b>Tangerine</b>	<i>Citrus reticulata</i>	peel	10-10 Citrus Fruits	10
<b>Sweet Orange</b>	<i>Citrus sinensis</i>	peel	10-10 Citrus Fruits	10
<b>Orange</b>	<i>Citrus sinensis</i>	peel	10-10 Citrus Fruits	10
<b>Citrus</b>	<i>Citrus</i> spp.	peel	10-10 Citrus Fruits	10
<b>Sweet Cherry</b>	<i>Prunus avium</i>	fruit	12. Stonefruit Crop Group	12
<b>Tart Cherry</b>	<i>Prunus cerasus</i>	fruit	12. Stonefruit Crop Group	12
<b>Jujube</b>	<i>Ziziphus jujuba</i>	fruit	12-12 Stonefruit	12
<b>Sea buckthorn</b>	<i>Hippophae rhamnoides</i>	fruit	13-07. Berries and small fruit	13
<b>Yumberry</b>	<i>Myrica rubra</i>	fruit	Covered by bayberry, <i>Myrica</i> spp.	13
<b>Caneberry</b>	<i>Rubus</i> spp.	fruit	13-07 Berry and Small Fruit	13
<b>Chinese blackberry</b>	<i>Rubus suavissimus</i>	fruit	13-07 Berry and Small Fruit	13
<b>Elderberry</b>	<i>Sambucus nigra</i>	fruit	13-07 Berry and Small Fruit	13
<b>Schisandra</b>	<i>Schisandra chinensis</i>	fruit	13-07 Berry and Small Fruit	13
<b>Blueberry</b>	<i>Vaccinium angustifolium</i> ; <i>Vaccinium corymbosum</i> ; <i>Vaccinium</i> spp.	fruit	13-07. Berry and small fruit	13
<b>Cranberry</b>	<i>Vaccinium macrocarpon</i> ; <i>Vaccinium</i> spp.	fruit	13-07. Berry and small fruit	13
<b>Bilberry</b>	<i>Vaccinium myrtillus</i> ; <i>Vaccinium</i> spp.	fruit	13-07. Berry and small fruit	13
<b>Vaccinium</b>	<i>Vaccinium</i> spp.	fruit	13-07. Berry and small fruit	13
<b>Grape</b>	<i>Vitis vinifera</i>	seed	13-07. Berry and small fruit	13

Common name	Scientific name	Plant part(s)	Classification	Sort Code
Oat	<i>Avena sativa</i>	milky seed	15. Cereal Grains	15
Barley	<i>Hordeum vulgare</i>	malting seed	15. Cereal Grains	15
Wheat	<i>Triticum aestivum</i>	leaf/bran/ flower/germ ("Wheat- grass")	Covered by crop group 15?	15
Bermuda grass	<i>Cynodon dactylon</i>	leaf	17. Grass Forage, Fodder, and Hay Group	17
Alfalfa	<i>Medicago sativa</i>	herb	18. Nongrass Animal Feeds	18
Alfalfa	<i>Medicago sativa</i>	leaf	18. Nongrass Animal Feeds	18
Red clover	<i>Trifolium pratense</i>	flower	18. Nongrass Animal Feeds	18
Red clover	<i>Trifolium pratense</i>	herb	18. Nongrass Animal Feeds	18
White clover	<i>Trifolium repens</i>	leaf	18. Nongrass Animal Feeds	18
Malabar nut tree	<i>Adhatoda vasica</i>	flower	Edible flowers proposed for Herb and Spice CG	19
Aloe vera	<i>Aloe vera</i>	flower spikes	Flowers are said to be edible	19
Chrysanthemum	<i>Chrysanthemum indicum</i> L.	flower	Edible flowers proposed for Herb and Spice crop group	19
Sweet Orange	<i>Citrus sinensis</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
Orange	<i>Citrus sinensis</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
Lemongrass	<i>Cymbopogon</i> spp.	leaf	Proposed for Herb and Spice Crop Group 19	19
Chrysanthemum	<i>Dendranthema ×grandiflorum</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
Echinacea	<i>Echinacea angustifolia</i> ; <i>Echinacea pallida</i> ; <i>Echinacea purpurea</i> ; <i>Echinacea</i> spp.	flower	Edible flowers proposed for Herb and Spice crop group	19
Globe amaranth	<i>Gomphrena globosa</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
Hibiscus	<i>Hibiscus lunariifolius</i> ;	flower	Edible flowers proposed for Herb and Spice crop group	19

Common name	Scientific name	Plant part(s)	Classification	Sort Code
	<i>Hibiscus spp.</i>			
<b>Jasmine</b>	<i>Jasminum grandiflorum</i> ; <i>Jasminum officinale</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Lily</b>	<i>Lilium spp.</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Chamomile</b>	<i>Matricaria recutita</i>	herb	19. Herb and Spice Crop Group	19
<b>Chamomile</b>	<i>Matricaria recutita</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Peppermint</b>	<i>Mentha ×piperita</i>	aerial parts	19. Herb and Spice Crop Group - Proposed	19
<b>Parsley</b>	<i>Petroselinum crispum</i>	leaf	19A. Herb subgroup	19
<b>Rose</b>	<i>Rosa spp.</i>	flower (petal/bud)	Edible flowers proposed for Herb and Spice crop group	19
<b>Damask rose</b>	<i>Rosa ×damascena</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Sphaeranthus indicus</b>	<i>Sphaeranthus indicus</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Linden</b>	<i>Tilia ×europaea</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Linden (lime blossom)</b>	<i>Tilia spp.</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>White clover</b>	<i>Trifolium repens</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Vervain</b>	<i>Verbena spp.</i>	flower	Edible flowers proposed for Herb and Spice crop group	19
<b>Bamboo</b>	<i>Bambuseae spp.</i>	leaf	Shoot proposed for Stalk and Stem. Medicinal: Bamboo is used in Chinese medicine for treating infections and healing	22
<b>Carob</b>	<i>Ceratonia siliqua</i>	bean (pod, fruit)	Proposed for Tropical Fruit - Edible Peel	23
<b>Açaí</b>	<i>Euterpe oleracea</i>	fruit	Tropical Fruits, Edible peel	23
<b>Amla</b>	<i>Phyllanthus</i>	fruit	Proposed for Tropical Fruit - Edible	23

Common name	Scientific name	Plant part(s)	Classification	Sort Code
	<i>emblica</i>		Peel	
<b>Mangosteen</b>	<i>Garcinia mangostana</i>	fruit rind	Tropical Fruit, Inedible Peel	24
<b>Dragonfruit</b>	<i>Hylocereus undatus</i>	fruit	Tropical Fruit, Inedible Peel	24
<b>Tea</b>	<i>Camellia sinensis</i>	leaf	Beverage	B
<b>Honeybush</b>	<i>Cyclopia</i> spp.	leaf	Beverage and medicinal tea	B
<b>Loquat</b>	<i>Eriobotrya</i> spp.	leaf	Medicinal: tea	B
<b>Strawberry</b>	<i>Fragaria</i> × <i>ananassa</i>	leaf	Medicinal: Tea, Strawberry leaves are primarily used to relieve gastrointestinal distress and joint pain.	B
<b>Wild strawberry</b>	<i>Fragaria vesca</i>	leaf	Medicinal: Tea, Strawberry leaves are primarily used to relieve gastrointestinal distress and joint pain.	B
<b>Mate</b>	<i>Ilex paraguariensis</i>	leaf	Beverage: Used to make mate, a beverage traditionally consumed in subtropical South America, particularly northeastern Argentina, Bolivia, southern Brazil, Uruguay and Paraguay. Yerba mate contains three xanthines: caffeine, theobromine and theophylline, the main one being caffeine.	B
<b>Blackberry</b>	<i>Rubus fruticosus</i> ; <i>Rubus</i> spp.	leaf	Medicinal: astringent tea	B
<b>Raspberry</b>	<i>Rubus idaeus</i> ; <i>Rubus</i> spp.	leaf	Medicinal: astringent tea	B
<b>Caneberry</b>	<i>Rubus</i> spp.	leaf	Medicinal: astringent tea	B



Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Rooibos</b>	<i>Aspalathus linearis</i>	leaf	Medicinal: used to make rooibos tea. Rooibos is purported to assist with nervous tension, allergies and digestive problems. <sup>[5]</sup> Rooibos tea has been shown to inhibit <i>in vitro</i> activity of xanthine oxidase, but an <i>in vivo</i> study has not been conducted. Xanthine oxidase (XO) plays a role in conversion of purine to uric acid in humans and reducing the activity of XO could limit uric acid production, which would aid in treatment of gout. In <i>in vitro</i> tests only, for the specific concentration tested, the infusion was shown to be less than half as effective as allopurinol, which is the drug typically prescribed to inhibit XO activity in treating gout. Two flavonoids found in rooibos, quercetin and luteolin, have been known to have cancer fighting qualities. Rooibos does not contain the antioxidant Epigallocatechin-3-gallate (EGCG) found in tea. Traditional medicinal uses of rooibos in South Africa include alleviating infantile colic, allergies, asthma and dermatological problems.	B
<b>Jujube</b>	<i>Ziziphus jujube</i> var <i>spinosa</i>	seed	Medicinal: Reduce fatigue related to nervousness. It is usually served as tea, made from a powder extract.	B

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Ambrette</b>	<i>Abelmoschus moschatus</i>	seed	Seed are added to coffee; oil used for perfume; medicinal uses in India: Leaves, shoots and tuberous roots can be eaten raw or cooked and were a source of food for Aborigines (Australia); <i>A. moschatus</i> is the source of ambrette seed oil used in luxury perfumery, cosmetic products and as an additive in the preparation of some kinds of chewing tobacco, baked products, sweets, alcoholic (e.g. vermouth and bitters) and non-alcoholic drinks. Arabs sometimes flavour their coffee with the seed.	F
<b>Marshmallow</b>	<i>Althaea officinalis</i>	leaf	Most of the mallows have been used as food. The root extract (halawa extract) is sometimes used as flavouring in the making of a Middle Eastern snack called halva. The flowers and young leaves can be eaten, and are often added to salads or are boiled and fried. Medicinal uses: Marshmallow is traditionally used as a treatment for the irritation of mucous membranes, including use as a gargle for mouth and throat ulcers, and gastric ulcers.[3] A study on rats concluded that an extract from the flowers has potential benefits for hyperlipidemia, gastric ulcers and platelet aggregation.[4] The root has been used since the Middle Ages in the treatment of sore throat	F

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Flowering dogwood</b>	<i>Cornus</i> spp.	fruit	The Chinese dogwood, <i>Cornus kousa</i> , has spherical fruits about the size of a quarter. When ripe in midsummer, they turn coral red and develop their full flavor and sweetness, with a flavor comparable to some melons. The cornelian cherry, <i>Cornus mas</i> , produces a tart, elongated fruit with a hard pit in the middle and a thin layer of flesh. These bright red fruits are sometimes used to make preserves, jam, or jelly with a flavor similar to cherries.	F
<b>Rose</b>	<i>Rosa canina</i> ; <i>Rosa</i> spp.	fruit ("hips")	The fruit is noted for its high vitamin C level and is used to make syrup, tea and marmalade	F
<b>Slippery elm</b>	<i>Ulmus rubra</i>	bark	The inner bark (not the whole bark) is used as medicine. People take slippery elm for coughs, sore throat, colic, diarrhea, constipation, hemorrhoids, irritable bowel syndrome (IBS), bladder and urinary tract infections, syphilis, herpes, and for expelling tapeworms. It is also used for protecting against stomach and duodenal ulcers, for colitis, diverticulitis, GI inflammation, and too much stomach acid. Slippery elm is also taken by mouth to cause an abortion. In manufacturing, slippery elm is used in some baby foods and adult nutritionals, and in some oral lozenges used for soothing throat pain.	F

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Nettle (dwarf nettle; stinging nettle; etc.)</b>	<i>Urtica urens</i> ; <i>Urtica dioica</i> ; <i>Urtica</i> spp.	leaf, herb	In foods, young stinging nettle leaves are eaten as a cooked vegetable. Medicinal: Stinging nettle root is used for urination problems related to an enlarged prostate (benign prostatic hyperplasia [BPH]). These problems include nighttime urination, too frequent urination, painful urination, inability to urinate, and irritable bladder	F
<b>Malabar nut tree</b>	<i>Adhatoda vasica</i>	leaf	Medicinal: bronchodilatory activity; Vasicine also exhibited strong respiratory stimulant activity, moderate hypotensive activity and cardiac-depressant effect; vasicinone was devoid of these activities.	M
<b>Malabar nut tree</b>	<i>Adhatoda vasica</i>	stem	? Same use as leaf?	M
<b>Aloe vera</b>	<i>Aloe vera</i>	leaf	Medicinal: gel used for burns, cosmetics	M
<b>Andrographis</b>	<i>Andrographis paniculata</i>	leaf, aerial parts	Medicinal: The herb has a number of purported medicinal uses, although research has found evidence of its effectiveness is limited to treatment of upper respiratory infection, ulcerative colitis and rheumatic symptoms; in particular	M
<b>Sweet Annie</b>	<i>Artemesia annua</i>	herb	Medicinal: In 1971, scientists demonstrated the plant extracts had antimalarial activity in primate models	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Bacopa</b>	<i>Bacopa monnieri</i>	herb	Medicinal: used for Alzheimer's disease, improving memory, anxiety, attention deficit-hyperactivity disorder (ADHD), allergic conditions, irritable bowel syndrome, and as a general tonic to fight stress. People also take brahmi to treat backache, hoarseness, mental illness, epilepsy, joint pain, and sexual performance problems in both men and women. It is also sometimes used as a “water pill.”	M
<b>Strobilanthes cusia</b>	<i>Strobilanthes cusia</i>	leaf	Medicinal: This is a medicinal and dye plant and is the source of "Assam indigo."	M
<b>Boswellia</b>	<i>Boswellia serrata</i>	exudate/ gum resin	Medicinal: Extracts of <i>Boswellia serrata</i> have been clinically studied for osteoarthritis and joint function, particularly for osteoarthritis of the knee. Positive effects of <i>Boswellia</i> in some chronic inflammatory diseases including rheumatoid arthritis, bronchial asthma, osteoarthritis, ulcerative colitis and Crohn's disease have been reported.[2] A <i>Boswellia</i> extract marketed under the name Wokvel has undergone human efficacy, comparative, pharmacokinetic studies.[3][4][5] Some see <i>Boswellia serrata</i> as a promising alternative to NSAIDs, warranting further investigation in pharmacological studies and clinical trials	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
Papaya	<i>Carica papaya</i>	leaf	Medicinal: In some parts of the world, papaya leaves are made into tea as a treatment for malaria. Antimalarial and antiplasmodial activity has been noted in some preparations of the plant, but the mechanism is not understood and no treatment method based on these results has been scientifically proven. In belief that it can raise platelet levels in blood, papaya may be used as a medicine for dengue fever. Papaya is marketed in tablet form to remedy digestive problems. Papain is also applied topically for the treatment of cuts, rashes, stings and burns. Papain ointment is commonly made from fermented papaya flesh, and is applied as a gel-like paste.	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Senna</b>	<i>Cassia angustifolia</i>	leaves and pod	Medicinal: The leaves and the fruit of the plant are used to make medicine. Senna is an FDA-approved nonprescription laxative. It is used to treat constipation and also to clear the bowel before diagnostic tests such as colonoscopy. Senna is also used for irritable bowel syndrome (IBS), hemorrhoids, and weight loss. Senna fruit seems to be gentler than senna leaf. This has led the American Herbal Products Association (AHPA) to warn against long-term use of senna leaf, but not senna fruit. The AHPA recommends that senna leaf products be labeled, "Do not use this product if you have abdominal pain or diarrhea. Consult a healthcare provider prior to use if you are pregnant or nursing. Discontinue use in the event of diarrhea or watery stools. Do not exceed recommended dose. Not for long-term use."	M
<b>Avaram</b>	<i>Cassia auriculata</i>	herb	Medicinal: This plant is said to contain a cardiac glucoside (sennapicrin) and sap, leaves and bark yield anthraquinones, while the latter contains tannins. The root is used in decoctions against fevers, diabetes, diseases of urinary system and constipation. The leaves have laxative properties. The dried flowers and flower buds are used as a substitute for tea in case of diabetes patients. It is also believed to improve the complexion in women. The powdered seed is also applied to the eye, in case of chronic purulent conjunctivitis. In Africa the bark and seeds are said to give relief in rheumatism, eye diseases, gonorrhea, diabetes and gout	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Gotu kola</b>	<i>Centella asiatica</i>	aerial parts	Medicinal: Used as a medicinal herb in Ayurvedic medicine, traditional African medicine, and traditional Chinese medicine.	M
<b>Celandine</b>	<i>Chelidonium majus</i>	whole plant	Medicinal: The whole plant is toxic in moderate doses as it contains a range of isoquinoline alkaloids but there are numerous therapeutic uses when used at the correct dosage. The effect of the fresh herb is of a mild analgesic, cholagogic, antimicrobial, oncostatic and central nervous system sedative	M
<b>Guggul</b>	<i>Commiphora mukul</i>	oleo gum resin	Medicinal: Guggul is made from the sap (gum resin) of the Commiphora mukul tree, which is native to India. This tree has been used in Ayurvedic medicine for centuries, and Ayurvedic texts dating back to 600 BC recommend it for treating atherosclerosis. Today guggul gum resin is used for arthritis, lowering high cholesterol, “hardening of the arteries” (atherosclerosis), acne and other skin diseases, and weight loss.	M



Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Hawthorn</b>	<i>Crataegus</i> spp.	fruit	Medicinal: Hawthorn is used for diseases of the heart and blood vessels such as congestive heart failure (CHF), chest pain, and irregular heartbeat. It is also used to treat both low blood pressure and high blood pressure, “hardening of the arteries” (atherosclerosis), and high cholesterol. So far increase urine output, and for menstrual problems. , research suggests that hawthorn might be effective in treating congestive heart failure, but there hasn’t been enough research on other heart-related uses to know if it is effective for them. Some people use hawthorn for digestive system complaints such as indigestion, diarrhea, and stomach pain. It is also used to reduce anxiety, as a sedative, to	M
<b>Psoralea</b>	<i>Cullen corylifolium</i>	fruit	Medicinal: Chinese medicine	M
<b>Citronella</b>	<i>Cymbopogon winterianus</i>	leaf	Medicinal: has medicinal properties and is used extensively in Ayurvedic medicine. It is supposed to help with relieving cough and nasal congestion.	M
<b>Artichoke</b>	<i>Cynara scolymus</i>	leaf	Medicinal: Antioxidant, extracts have been reported to reduce plasma lipids levels, including total cholesterol	M
<b>Echinacea</b>	<i>Echinacea angustifolia</i> ; <i>Echinacea pallida</i> ; <i>Echinacea purpurea</i> ; <i>Echinacea</i> spp.	herb (flower, leaf, stem)	Medicinal: immunological effects	M
<b>Eclipta</b>	<i>Eclipta prostrata</i> , <i>E. alba</i>	herb	Medicinal: traditional uses in Chinese medicine and Ayurveda	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Eleuthero</b>	<i>Eleutherococcus senticosus</i>	leaf	Medicinal: Eleuthero leaf was traditionally used as a poultice, a compress, and as an anti-inflammatory remedy	M
<b>Amla</b>	<i>Emblica officinalis</i>	fruit	Preclinical studies have shown that amla possesses antipyretic, analgesic, antitussive, antiatherogenic, adaptogenic, cardioprotective, gastroprotective, antianemia, antihypercholesterolemia, wound healing, antidiarrheal, antiatherosclerotic, hepatoprotective, nephroprotective, and neuroprotective properties. In addition, experimental studies have shown that amla and some of its phytochemicals such as gallic acid, ellagic acid, pyrogallol, some norsesquiterpenoids, corilagin, geraniin, elaeocarpusin, and prodelphinidins B1 and B2 also possess antineoplastic effects. Amla is also reported to possess radiomodulatory, chemomodulatory, chemopreventive effects, free radical scavenging, antioxidant, anti-inflammatory, antimutagenic and immunomodulatory activities, properties that are efficacious in the treatment and prevention of cancer	M
<b>Field eryngo</b>	<i>Eryngium campestre</i>	herb	Medicinal: Used in herbalism as an infusion to treat coughs, whooping cough and urinary infections. Roots were formerly candied as sweets or boiled and roasted as a vegetable	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
California poppy	<i>Eschscholzia californica</i>	whole plant	Medicinal: California poppy is used for trouble sleeping (insomnia), aches, nervous agitation, bed-wetting in children, and diseases of the bladder and liver. It is also used to promote relaxation. In combination with other herbs, California poppy is used for depression, long-term mental and physical tiredness (neurasthenia), nerve pain, various psychiatric conditions, blood vessel problems, sensitivity to weather changes, and sedation	M
Eucalyptus	<i>Eucalyptus macrorhyncha</i>	leaf	Medicinal: An oleo- resin is exuded from the tree. It can also be obtained from the tree by making incisions in the trunk. This resin contains tannin and is powerfully astringent, it is used internally in the treatment of diarrhoea and bladder inflammation, externally it is applied to cuts etc. The leaves contain up to 6.24% rutin. This is taken internally in order to strengthen capillaries. Citronellal, an essential oil found in most Eucalyptus species is reported to be mutagenic when used in isolation. In large doses, oil of eucalyptus, like so many essential oils has caused fatalities from intestinal irritation. Death is reported from ingestion of 4 - 24 ml of essential oils, but recoveries are also reported for the same amount. Symptoms include gastroenteric burning and irritation, nausea, vomiting, diarrhoea, oxygen deficiency, weakness, dizziness, stupor, difficult respiration, delirium, paralysis, convulsions, and death, usually due to respiratory failure.	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Eucommia</b>	<i>Eucommia ulmoides</i>	bark	Medicinal: antioxidant and as an anti-inflammatory drug, it is commonly used by people affected by arthritis, osteoporosis, and hypertension.	M
<b>Flickingeria fimbriata</b>	<i>Flickingeria fimbriata</i>	whole plant	Medicinal: tuberculosis cough, asthma	M
<b>Ash</b>	<i>Fraxinus</i> spp.	bark	Medicinal: bitter tonic and astringent	M
<b>Ash</b>	<i>Fraxinus</i> spp.	leaf	Medicinal: leaves have diuretic, diaphoretic and purgative properties, and are employed in modern herbal medicine for their laxative action, especially in the treatment of gouty and rheumatic complaints	M
<b>Gamboge</b>	<i>Garcinia hanburyi</i>	gum resin	Medicinal: people take gamboge for constipation, generally in combination with other laxatives. They also take it for expelling intestinal worms	M
<b>Ginkgo</b>	<i>Ginkgo biloba</i>	leaf	Medicinal: As memory and concentration enhancer, and antivertigo agent	M
<b>Gymnema</b>	<i>Gymnema sylvestre</i>	leaf	Medicinal: Chewing the leaves suppresses the sensation of sweet. This effect is attributed to the presence of the eponymously named gymnemic acids. <i>G. sylvestre</i> has been used in herbal medicine as a treatment for diabetes for nearly two millennia, and though there is insufficient scientific evidence to draw definitive conclusions about its efficacy two small clinical trials have shown gymnema to reduce glycosylated hemoglobin levels.	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Gynostemma</b>	<i>Gynostemma pentaphyllum</i>	leaf	Medicinal: A dioecious, herbaceous climbing vine of the family Cucurbitaceae (cucumber or gourd family) indigenous to the southern reaches of China, northern Vietnam, southern Korea, and Japan. Jiaogulan is best known as an herbal medicine reputed to have powerful antioxidant and adaptogenic effects purported to increase longevity. Pharmacological research has indicated a number of therapeutic qualities of Jiaogulan, such as lowering cholesterol and high blood pressure, strengthening immunity, and inhibiting cancer growth.	M
<b>St. John's wort</b>	<i>Hypericum perforatum</i>	herb, flowering tops	Medicinal: Extracts of <i>Hypericum perforatum</i> L. (St. John's wort) have been recommended traditionally for a wide range of medical conditions. The most common modern-day use of St. John's wort is the treatment of depression. Numerous studies report St. John's wort to be more effective than placebo and equally effective as tricyclic antidepressant drugs in the short-term treatment of mild-to-moderate major depression (1-3 months). It is not clear if St. John's wort is as effective as selective serotonin reuptake inhibitor (SSRI) antidepressants such as sertraline (Zoloft®).	M
<b>Henna</b>	<i>Lawsonia inermis</i>	leaf	Dye and numerous medicinal properties	M
<b>Magnolia</b>	<i>Magnolia officinalis</i>	bark	Medicinal uses: anti-anxiety, anti-angiogenic properties; reduces allergic and asthmatic reactions	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Bayberry</b>	<i>Morella cerifera</i>	bark	Medicinal: Use of Bayberry in herbalism has declined since its peak in popularity in the 19th century. The plant is still used today in the treatment of fever, diarrhea, and a few other ailments	M
<b>Olive</b>	<i>Olea europaea</i>	leaf	Medicinal: Olive leaf is used for treating viral, bacterial, and other infections including influenza, swine flu, the common cold, meningitis, Epstein-Barr Virus (EBV), encephalitis, herpes, shingles, HIV/ARC/AIDS, and hepatitis B. Olive leaf is also used for pneumonia; chronic fatigue; tuberculosis (TB); gonorrhea; fever; malaria; dengue; “blood poisoning” (bacterial infections in the bloodstream); severe diarrhea; and infections in the teeth, ears, and urinary tract, and infections following surgery. Other uses include high blood pressure, diabetes, hay fever, improving kidney and digestive function, and increasing urine flow.	M
<b>Tree peony</b>	<i>Paeonia suffruticos</i>	bark	Medicinal: Antioxidant properties	M
<b>Passionflower</b>	<i>Passiflora incarnata</i> ; <i>Passiflora</i> spp.	herb	Medicinal: still used today to treat anxiety and insomnia. Scientists believe passionflower works by increasing levels of a chemical called gamma aminobutyric acid (GABA) in the brain. GABA lowers the activity of some brain cells, making you feel more relaxed.	M
<b>Phyllanthus amarus</b>	<i>Phyllanthus amarus</i>	leaf	Medicinal: stomach, genitourinary system, liver, kidney and spleen. It is bitter, astringent, stomachic, diuretic, febrifuge and antiseptic	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Phyllanthus</b>	<i>Phyllanthus niruri</i>	leaf	Medicinal: P. niruri is an important plant of Indian Ayurvedic system of medicine which is used for problems of the stomach, genitourinary system, liver, kidney and spleen.[1][2] The plant has also been used in Brazil and Peru as a herbal remedy for kidney stones	M
<b>Psyllium</b>	<i>Plantago ispagula</i>	aerial parts	Medicinal: Source of dietary fiber	M
<b>Indian plantain</b>	<i>Plantago ovata</i>	seed, seed husk	Medicinal: Source of dietary fiber	M
<b>Peach</b>	<i>Prunus persica</i>	leaf	Medicinal: The leaves are astringent, demulcent, diuretic, expectorant, febrifuge, laxative, parasiticide and mildly sedative[21, 218]. They are used internally in the treatment of gastritis, whooping cough, coughs and bronchitis[238]. They also help to relieve vomiting and morning sickness during pregnancy, though the dose must be carefully monitored because of their diuretic action[21]. The dried and powdered leaves have sometimes been used to help heal sores and wounds	M
<b>Wild cherry</b>	<i>Prunus serotina</i>	bark	Medicinal: Anti-tussive, astringent, sedative; blood tonic, astringent, sedative, tonic and appetite stimulant, and has agents that relieve disorders of the chest and lungs, as an expectorant. Wild Cherry has been used medicinally by many native peoples.	M
<b>Red saunders</b>	<i>Pterocarpus santalinus</i>	wood	Medicinal: Red sandalwood is used for treating digestive tract problems, fluid retention, and coughs; and for “blood purification.”	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
<b>Pomegranate</b>	<i>Punica granatum</i>	seed	Medicinal: The seeds and juice are considered a tonic for the heart and throat, and classified as having bitter-astringent taste plus a range of taste from sweet to sour, depending on ripeness.	M
<b>Black currant</b>	<i>Ribes nigrum</i>	leaf	Medicinal: Black currant dried leaf is used for arthritis, gout, joint pain (rheumatism), diarrhea, colic, hepatitis and other liver ailments, convulsions, and disorders that cause swelling (inflammation) of the mouth and throat. Black currant dried leaf is also used for treating coughs, colds, and whooping cough; disinfecting the urine; promoting urine flow; treating bladder stones, and as a cleansing tea.	M
<b>Chinese blackberry</b>	<i>Rubus suavissimus</i>	leaf	Medicinal: Used to make a tea; folk medicine for various health benefits such as weight loss, diabetes and kidney malfunction.	M
<b>Figwort</b>	<i>Scrophularia nodosa</i>	flowering tops, herb	Medicinal: cutaneous eruptions, abscesses, wounds: diuretic properties	M
<b>Skullcap</b>	<i>Scutellaria lateriflora</i>	flowering tops	Medicinal: mild sedative and sleep promoter	M
<b>Milk thistle</b>	<i>Silimum eburneum</i> ; <i>Silybum marianum</i>	seed	Medicinal: extracts of milk thistle have been recognized as "liver tonics." [4] Milk thistle has been reported to have protective effects on the liver and to greatly improve its function. It is typically used to treat liver cirrhosis, chronic hepatitis (liver inflammation), toxin-induced liver damage including the prevention of severe liver damage from <i>Amanita phalloides</i> ('death cap' mushroom poisoning), and gallbladder disorders	M



Common name	Scientific name	Plant part(s)	Classification	Sort Code
Japanese sophora	<i>Sophora japonica</i>	fruit	Medicinal: has abortifacient, antibacterial, anticholesterolemic, antiinflammatory, antispasmodic, diuretic, emetic, emollient, febrifuge, hypotensive, purgative, styptic, and tonic properties	M
Tilia estrella	<i>Ternstroemia pringlei</i>	fruit, bud	Medicinal: Sedative effects	M
Linden	<i>Tilia</i> spp.	leaf	Medicinal: The flowers, leaves, wood, and charcoal (obtained from the wood) are used for medicinal purposes. Active ingredients in the Tilia flowers include flavonoids (which act as antioxidants) and volatile oils. The plant also contains tannins that can act as an astringent	M
Linden	<i>Tilia</i> spp.	wood	Medicinal: The wood is used for liver and gallbladder disorders and cellulitis (inflammation of the skin and surrounding soft tissue). That wood burned to charcoal is ingested to treat intestinal disorders and used topically to treat edema or infection such as cellulitis or ulcers of the lower leg	M
Tribulus	<i>Tribulus terrestris</i>	fruit	Medicinal: Over the years, people have taken tribulus in an attempt to enhance athletic performance and for a wide range of health issues that may include heart and circulatory conditions and sexual issues	M
Blueberry	<i>Vaccinium angustifolium</i> ; <i>Vaccinium corymbosum</i> ; <i>Vaccinium</i> spp.	leaf	Medicinal: Tea made from the dried leaves is used for sore throat and swelling (inflammation) of the mouth or the skin lining the throat. The dried fruit and leaves are used for diarrhea.	M

Common name	Scientific name	Plant part(s)	Classification	Sort Code
Ashwagandha	<i>Withania somnifera</i>	leaf	Medicinal: Ashwagandha is used for arthritis, anxiety, trouble sleeping (insomnia), tumors, tuberculosis, asthma, a skin condition marked by white patchiness (leukoderma), bronchitis, backache, fibromyalgia, menstrual problems, hiccups, and chronic liver disease. Ashwagandha is also used as an “adaptogen” to help the body cope with daily stress, and as a general tonic.	M
Corn	<i>Zea mays</i>	silk	Medicinal: Corn silk is considered to have detoxifying, relaxing and diuretic properties. Traditionally, Corn silk has been used in treatments of urinary and genital infections, stomach disorders, skin rashes and sore throat. Nowadays it is believed to reduce the formation of kidney stones, and that it can be a helpful remedy against cystitis, painful and frequent urinations.	M

**APPENDIX D. List of Botanical from the NHANES Supplement Surveys 2003-2004.**  
**There are 697 botanical ingredients (DSDBCCAT) out of 1,122 different ingredients or 61.8% of the total supplements** ([http://wwwn.cdc.gov/nchs/nhanes/search/nhanes07\\_08.aspx](http://wwwn.cdc.gov/nchs/nhanes/search/nhanes07_08.aspx)).

Commodity	EPA Commodity/ Crop Group
Acacia gum	No crop group
Acerola berry	Acerola (CG 23)
Acerola cherry	Acerola (CG 23)
Acerola cherry extract (fruit)	Acerola (CG 23)
Acerola concentrate	Acerola (CG 23)
Acerola fruit extract	Acerola (CG 23)
Acerola fruit extract 4:1	Acerola (CG 23)
Achyranthes root	Potential commodity for Root and Tuber Group 1
Agaricus blazei	Mushroom (CG 21)
Agarikon mushroom	Mushroom (CG 21)

Commodity	EPA Commodity/ Crop Group
Alaria	Seaweed
Alaria valida	Seaweed
Alfalfa	Alfalfa (CG 19)
Alfalfa concentrate	Alfalfa (CG 19)
Alfalfa concentrate (medicago sativa) (leaf)	Alfalfa (CG 19)
Alfalfa extract	Alfalfa (CG 19)
Alfalfa flour	Alfalfa (CG 19)
Alfalfa juice concentrate	Alfalfa (CG 19)
Alfalfa leaf juice	Alfalfa (CG 19)
Alfalfa leaf powder	Alfalfa (CG 19)
Alfalfa powder	Alfalfa (CG 19)
Alfalfa/watercress/parsley concentrate	Concentrate of Three RAC's alfalfa, watercress, parsley
Aloe leaf	Aloe vera (CG 22)
Aloe vera	Aloe vera (CG 22)
Aloe vera juice (inner leaf)	Aloe vera (CG 22)
Aloe vera leaf	Aloe vera (CG 22)
Aloe vera leaf powder	Aloe vera (CG 22)
American centaury (entire plant)	Agave (CG 22)
American ginseng	Ginseng (CG1)
American ginseng (root)	Ginseng (CG1)
Angelica root	Potential commodity for Root and Tuber Group 1, Angelica, leaves is a member of CG19
Anise (seed)	Anise, seed (CG19)
Anise seed powder	Anise, seed (CG19)
Apple	Apple (CG 11)
Apple fiber	Apple (CG 11)
Apple fruit powder	Apple (CG 11)
Apple pectin	Apple (CG 11)
Apple pectin extract	Apple (CG 11)
Apricot extract (fruit)	Apricot (CG12)
Apricot juice powder	Apricot (CG12)
Arrowroot flour	Arrowroot (CG1)
Artichoke leaf (2% cynarin)	Artichoke, globe (CG99)
Artichoke leaf extract	Artichoke, globe (CG99)
Ascophyllum nodosum	Seaweed
Ashwaganda root 5:1 extract	Potential commodity for Root and Tuber Group 1
Ashwagandha root extract	Potential commodity for Root and Tuber Group 1

Commodity	EPA Commodity/ Crop Group
Asian ginseng extract (root)	Ginseng (CG1)
Asparagus juice powder	Asparagus (CG 22)
Astragalus extract (root)	Potential commodity for Root and Tuber Group 1
Astragalus root	Potential commodity for Root and Tuber Group 1
Atractylodes (root)	Potential commodity for Root and Tuber Group 1
Atractylodes rhizome	Potential commodity for Root and Tuber Group 1
Avena sativa	Oat (CG 15)
Bacopa monniera extract (leaf)	Potential commodity for Herb Crop group 25
Bai-zhu root	Potential commodity for Root and Tuber Group 1
Banaba leaf extract	This is crepe myrtle no crop group.
Barberry bark	Potential commodity for Spice Group 26
Barley grass	Barley, forage (CG 15)
Barley leaves	Barley, forage (CG 15)
Barley rice (fiber)	Barley, bran (CG150)
Bayberry root	Potential Root and Tuber group 1 (Morella)
Bayberry root bark	Potential Root and Tuber crop group 1 (Morella)
Beet	Beet, garden (CG 1)
Beet (root)	Beet, garden (CG 1)
Beet fiber	Beet, garden (CG 1 and 2)
Beet juice powder	Beet, garden (CG 1)
Beet leaf	Beet, garden (CG 1)
Beet leaf juice	Beet, garden (CG 1)
Beet root powder	Beet, garden (CG 2)
Beets	Beet, garden (CG 1 and 2)
Belleric myrobalan (terminalia bellerica) (fruit)	Potential commodity for Spice crop group 26
Bilberry	Bilberry (CG13-07)
Bilberry (leaf)	Bilberry (CG13)
Bilberry 25% anthocyanins	Bilberry (CG13-07)
Bilberry extract (fruit)	Bilberry (CG13-07)
Bilberry extract 4:1 (fruit)	Bilberry (CG13-07)
Bilberry fruit concentrate	Bilberry (CG13-07)
Bilberry fruit powder	Bilberry (CG13-07)
Bilberry juice powder	Bilberry (CG13-07)
Bioperine	Pepper,black (CG19)
Bioperine	Pepper,black (CG19)
Birch leaves	No crop group
Bitter melon extract	Momordica spp. (CG9)

Commodity	EPA Commodity/ Crop Group
Bitter orange	Orange (CG10-10)
Bitter orange extract (fruit)	Orange (CG10-10)
Bitter orange peel extract	Orange (CG10-10)
Black cherry	Cherry, black (CG 12-12)
Black cherry juice concentrate	Cherry, black (CG 12-12)
Black cohosh (root)	Potential commodity for Root and Tuber Group 1
Black cohosh extract (root)	Potential commodity for Root and Tuber Group 1
Black currant powder	Currant, black (CG13-07)
Black pepper	Pepper,black (CG19)
Black pepper extract	Pepper,black (CG19)
Black tea leaves extract	Tea
Black walnut (hull, leaf)	Walnut (GC14-12)
Black walnut hulls	Walnut (GC14-12)
Blackberry extract	Blackberry (CG13-07)
Blackberry juice powder	Blackberry (CG13-07)
Bladderwrack	Seaweed
Bladderwrack (kelp)	Seaweed
Blessed thistle	No crop group noxious weed.
Blue green algae	Seaweed
Blue malva flower powder	Add to Herb crop group 25.
Blueberry	Blueberry (CG13-07)
Blueberry (berry)	Blueberry (CG13-07)
Blueberry juice powder	Blueberry (CG13-07)
Blueberry powder	Blueberry (CG13-07)
Boneset leaf	Potential for Herb Crop group 25
Borage oil	Borage, oil (CG20)
Boswellia extract	Frankinsense Indian
Brazilian ginseng	Ginseng (CG1)
Brazilian guarana seed extract	Guarana added to Spice Crop group 26
Broccoli	Broccoli (CG 5)
Broccoli (flower)	Broccoli (CG 5)
Broccoli concentrate	Broccoli (CG 5)
Broccoli dehydrate	Broccoli (CG 5)
Broccoli juice powder	Broccoli (CG 5)
Broccoli powder	Broccoli (CG 5)
Brown rice concentrate	Rice, bran (CG15)
Brussels sprout powder	Brussels sprouts (CG5)

Commodity	EPA Commodity/ Crop Group
Brussels sprouts	Brussels sprouts (CG5)
Brussels sprouts (aerial)	Brussels sprouts (CG5)
Buckthorn bark powder	No crop group
Buckwheat (seed)	Buckwheat, grain (CG15)
Buckwheat juice	Buckwheat, grain (CG15)
Bupleurum falcatum (root)	Potential commodity for Root and Tuber Group 1
Bupleurum root	Potential commodity for Root and Tuber Group 1
Burdock root	Burdock, edible (CG1)
Burdock root 5:1 extract	Burdock, edible (CG1)
Butchers broom root	Potential commodity for Root and Tuber Group 1
Cabbage	Cabbage (CG 5)
Cabbage (aerial)	Cabbage (CG 5)
Cabbage juice powder	Cabbage (CG 5)
Cabbage powder	Cabbage (CG 5)
Cactus extract 12:1 (whole plant)	Cactus, prickly Pear (CG 22)
Calendula (flower)	Marigold (CG 19)
Camellia sinensis	Tea
Cantaloupe	Cantaloupe (CG 9)
Cape aloe gel	Aloe (CG22)
Capsicum fruit	Pepper, nonbell (CG8-10)
Capsicum frutescens (fruit)	Pepper, nonbell (CG8-10)
Carrot	Carrot (CG1)
Carrot (root)	Carrot (CG1)
Carrot juice powder	Carrot (CG1)
Carrot oil	Carrot (CG1)
Carrot powder	Carrot (CG1)
Carrot pulp powder	Carrot (CG1)
Carrot root powder	Carrot (CG1)
Cascada sagrada bark	Cascada buckthorn for CG 26 Spices
Cashew fruit	Cashew,fruit (CG23)
Catechu (bark)	Add to CG 26 Spices
Catnip	Catnip (CG19)
Cat's claw	Potential commodity for Root and Tuber Group 1
Cauliflower	Cauliflower (CG5)
Cauliflower (flower)	Cauliflower (CG5)
Cauliflower concentrate	Cauliflower (CG5)
Cauliflower juice powder	Cauliflower (CG5)

Commodity	EPA Commodity/ Crop Group
Cauliflower powder	Cauliflower (CG5)
Cayenne	Pepper, nonbell (CG8-10)
Cayenne (fruit)	Pepper, nonbell (CG8-10)
Cayenne pepper (fruit)	Pepper, nonbell (CG8-10)
Cayenne powder (fruit)	Pepper, nonbell (CG8-10)
Celandine leaf, Celandine, lesser and Celandine, greater	Add to Herb Crop group 25 fresh leaves and dried leaves
Celery	Celery (CG4)
Celery (seed)	Celery, seed (CG19)
Chaga mushroom	Mushroom (CG21)
Chamaelirium luteum	No crop group
Chamomile (flowers)	Camomile (CG19)
Chamomile flowers powder	Camomile (CG19)
Chaste tree berry extract	ChasteberryproposedforCG 26
Cherry	Cherry (CG 12)
Cherry juice powder	Cherry (CG 12)
Chickweed	CheckIR-4
Chickweed (leaf)	Edible but mostly considered a weed.
Chicory root	Chicory, roots (CG1)
Chinese ephedra	No cropgroup
Chinese ginseng root	Ginseng (CG1)
Chinese licorice (root)	Licorice(Proposed forCG1)
Chinese mint leaf	Mint(CG 25)
Chinese peony root	Potential commodity for Root and Tuber Group 1
Chinese rhubarb (root)	Potential commodity for Root and Tuber Group 1
Chinese salvia extract (root)	Potential commodity for Root and Tuber Group 1
Chinese vitex, Chinese chastetree	Proposed for Spice CG 26
Chlorella	Seaweed
Chlorella (leaf)	Seaweed
Chlorella algae	Seaweed
Chlorella powder	Seaweed
Chondrus crispus	Seaweed
Cilantro (leaf)	Cilantro,leaves (CG4-15)
Cinnamon (bark)	Cinnamon (CG19)
Cinnamon powder	Cinnamon (CG19)
Cinnamon powder (bark)	Cinnamon (CG19)
Cinnamon twig	Cinnamon (CG19)
Cinnamon twig extract	Cinnamon (CG19)

Commodity	EPA Commodity/ Crop Group
Citrus	CG 10
Citrus (fruit)	CG 10
Citrus aurantium fruit extract	Orange
Citrus bioflavonoid complex	Orange
Citrus bioflavonoids	Orange
Citrus bioflavonoids (fruit)	Orange
Citrus bioflavonoids concentrate	Orange
Citrus pectin	Orange
Club moss (leaf)	Ferns, edible (CG 22)
Cocoa extract	Cacao bean
Cocoa nut extract	Cacao bean
Codonopsis	Potential commodity for Root and Tuber Group 1
Codonopsis root	Potential commodity for Root and Tuber Group 1
Coleus forskohlii	Potential commodity for Root and Tuber Group 1
Coleus forskohlii root	Potential commodity for Root and Tuber Group 1
Concord grape juice concentrate	Grape(CG13-07)
Cordyceps extract	Mushroom (CG21)
Cordyceps mushrooms	Mushroom (CG21)
Cordyceps sinensis cs4	Mushroom (CG21)
Coriander seed	Coriander, seed (CG 19)
Corn bran	Corn, field, grain (CG15)
Cornsilk	Corn,field,stover (CG16)
Costaria costata	Seaweed
Couch grass (root)	Potential commodity for Root and Tuber Group 1
Cranberry	Cranberry (CG13)
Cranberry concentrate	Cranberry (CG13)
Cranberry juice concentrate	Cranberry (CG13)
Cranberry juice powder	Cranberry (CG13)
Cubeb berries	Pepper, cubeb (CG26)
Culver's root powder	Potential commodity for Root and Tuber Group 1
Curcuma root extract	Potential commodity for Root and Tuber Group 1
Cyani flowers	Flowers, edible (CG25)
Cynanchum stauntonii extract (herb)	Potential commodity for Root and Tuber Group 1
Damiana	Damiana (Proposed CG26)
Damiana (turnera diffusa)(leaf)	Damiana (Proposed CG26)
Damiana (turnera diffusa)(leaf)	Damiana (Proposed CG26)
Damiana extract	Damiana (Proposed CG26)



Commodity	EPA Commodity/ Crop Group
Damiana extract	Damiana (Proposed CG26)
Damiana extract (leaf)	Damiana (Proposed CG26)
Damiana leaf powder	Damiana (Proposed CG26)
Dandelion (leaves and roots)	Dandelion Crop group 1 and 2 as a root crop
Dandelion leaf	Dandelion,leaves (CG2)
Dandelion root	Dandelion,roots (CG1)
Dandelion root	Dandelion, roots (CG1)
Dandelion root powder	Dandelion,roots (CG1)
Dang gui root	Potential commodity for Root and Tuber Group 1
Date fruit powder	Date (CG23)
Date seed extract (zizyphus spinosa)	Date (CG23)
Defatted almonds	Almond (CG14-12)
Defatted wheat (germ)	Wheat,germ (CG 15)
Devil's claw	Potential commodity for Root and Tuber Group 1
Dill weed extract	Dillweed (CG4-12)
Dong quai (root)	Potential commodity for Root and Tuber Group 1
Dried alfalfa juice	Alfalfa (CG18)
Dried black pepper extract (fruit)	Pepper, black(CG19)
Dried buckwheat juice (leaf)	Buckwheat, grain (CG15)
Dried corn silk extract	Corn, field, stover
Dried pea vine juice	Pea,field, vines (CG7)
Dried short buchu extract (leaves)	Buchu (Agathosma) proposed for Spice CG26)
Dried uva ursi extract (leaves)	Bearberry (CG 13-07)
Dunaliella	Seaweed
E. Angustifolia root (1:1)	Potential commodity for CG 1)
E. Purpurea (whole plant) (1:1)	Potential commodity for CG 1)
Echinacea	Potential commodity for CG 1)
Echinacea (echinacea purpurea) (herb)	Potential commodity for CG 1)
Echinacea angustifolia root	Potential commodity for CG 1)
Echinacea angustifolia root extract	Potential commodity for CG 1)
Echinacea pallida root	Potential commodity for CG 1)
Echinacea purpurea (aerial parts)	Potential commodity for CG 1)
Echinacea purpurea (root)	Potential commodity for CG 1)
Echinacea root	Potential commodity for CG 1)
Ecklonia	Seaweed
Elderberry extract	Elderberry (CG13-07)
Elderberry fruit powder	Elderberry (CG13-07)

Commodity	EPA Commodity/ Crop Group
Elecampane root	Potential commodity for CG 1
Eleuthero root	Ginseng (CG1)
Eleuthero root extract	Ginseng (CG1)
Eleuthro ginseng (root)	Ginseng (CG1)
Enoki mushroom	Mushroom (CG 21)
Epimedium	Proposed for Spices 26
Eucommia bark	Eucommia proposed for Spices 26
Eyebright flowers	Edible flowers in Herb CG 25)
False unicorn root	Potential commodity for CG 1)
Fennel (seed)	Fennel, seed (CG19)
Fennel seed	Fennel, seed (CG19)
Fennel seed powder	Fennel, seed (CG19)
Fennel seed powder	Fennel, seed (CG19)
Fenugreek	Fenugreek (CG 19)
Fenugreek powder (seed)	Fenugreek (CG 19)
Fenugreek seed	Fenugreek (CG 19)
Fenugreek seed extract 4:1	Fenugreek (CG 19)
Fig, fruit	Fig (CG 22)
Flaxseed oil	Flaxseed (CG20)
Flaxseed powder (seed)	Flaxseed (CG20)
Forsythia	Edible flowers (CG 25)
Forsythia extract (fruit)	Edible flowers (CG 25)
Fo-ti	Potential commodity for CG 1
Fo-ti (root)	Potential commodity for CG 1
Fruit	Too general
Fruit of paradise (luo han kuo)	Proposed as Monk fruit member of Cucurbit Crop group 9.
Fucus	Seaweed
Fucus gardneri	Seaweed
Fucus vesiculosus	Seaweed
Galangal root extract	Potential commodity for CG 1)
Ganoderma (mushroom)	Mushroom (CG21)
Garcinia cambogia (fruit)	Add as Malabar tamarind to Spice Crop group 26
Garcinia cambogia fruit extract	Add as Malabar tamarind to Spice Crop group 26
Garlic	Garlic (CG3)
Garlic (bulb)	Garlic (CG3)
Garlic bulb	Garlic (CG3)
Garlic concentrate (clove)	Garlic (CG3)

Commodity	EPA Commodity/ Crop Group
Garlic fresh extract 100:1 (clove)	Garlic (CG3)
Garlic juice powder	Garlic (CG3)
Gekko gecko extract	This is the animal gekko
Gentian (root)	Potential commodity for CG 1)
Gigartina	Ginger (CG1)
Ginger	Ginger (CG1)
Ginger (rhizome extract)	Ginger (CG1)
Ginger root	Ginger (CG1)
Ginger root extract	Ginger (CG1)
Ginger root powder	Ginger (CG1)
Ginkgo biloba	Ginkgo (CG14-12)
Ginkgo biloba (24:6 extract)	Ginkgo (CG14-12)
Ginkgo biloba extract (leaf)	Ginkgo (CG14-12)
Ginkgo biloba leaf	Ginkgo (CG14-12)
Ginkgo biloba leaf extract	Ginkgo (CG14-12)
Ginkgo extract (leaf)	Ginkgo (CG14-12)
Ginseng (root)	Ginseng (CG1)
Glucomannan	Konjac Potential commodity for CG 1)
Glucomannan (root)	Potential commodity for CG 1)
Golden rod	Edible flowers(CG 25)
Golden seal root	Potential commodity for CG 1
Goldenseal	Potential commodity for CG 1
Goldenseal (aerial)	Potential commodity for CG 1
Goldenseal (root)	Potential commodity for CG 1
Goldenseal rhizome	Potential commodity for CG 1
Goldenseal root extract (1:2)	Potential commodity for CG 1
Gotu kola	Potential commodity for CG 25
Gotu kola (aerial)	Potential commodity for CG 25
Gotu kola (leaf)	Potential commodity for CG 25
Grape	Grape (CG13)
Grape (skin)	Grape (CG13)
Grape concentrates	Grape (CG13)
Grape juice powder	Grape (CG13)
Grape powder	Grape (CG13)
Grape pulp powder	Grape (CG13)
Grape seed extract	Grape (CG13)
Grape seed extract (95%)	Grape (CG13)

Commodity	EPA Commodity/ Crop Group
Grape skin extract	Grape (CG13)
Grapefruit	Grapefruit (CG10-10)
Grapefruit (whole fruit and peel)	Grapefruit (CG10)
Grapefruit extract (fruit)	Grapefruit (CG10)
Grapefruit pectin	Grapefruit (CG10)
Graviola	Soursop (Spices CG 26)
Green beans	Bean,green (CG6)
Green cabbage	Cabbage (CG5)
Green pea	Pea, green (CG6)
Green pepper	Pepper,bell (CG 8-10)
Green tea	Tea
Green tea extract	Tea
Green tea leaf extract	Tea
Green tea leaves	Tea
Guar gum	Guar bean member Crop group 6
Guar gum (leaf)	Guar bean member Crop group 6
Guarana (seed)	Add to Spice Crop group 26
Guarana extract	Add to Spice Crop group 26
Guarana extract (seed)	Add to Spice Crop group 26
Guarana seed (extract)	Add to Spice Crop group 26
Guava powder (fruit)	Guava (CG23)
Guggul extract	Add to Spice Crop group 26
Gum karaya (tree)	Karaya add to Spice Crop[ group 26
Gymnema sylvestre leaf extract	Gymnema add to Herb Crop group 25
Hawthorn berries	Mayhaw (CG11))
Hawthorn berry powder	Mayhaw (CG11))
Heridium erinaceus	Mushroom (CG21)
Hibiscus flowers	Edible flower (CG 25)
Himembatsutake mushroom	Mushroom (CG21)
Hiratake mushroom	Mushroom (CG21)
Ho shou wu	Potential commodity for CG 1
Hoelen plant	Mushroom (CG21)
Hops flower	Hop,dried cones
Horseradish (root)	Horseradish (CG1)
Horseradish (root)	Horseradish (CG1)
Horsetail herb	Check with IR4
Horsetail stem powder	Check with IR4

Commodity	EPA Commodity/ Crop Group
Hydrangea (root)	Potential commodity for CG 1
Hyphomycetes mycelia extract (shiitake mushroom)	Shitake mushroom(CG 21)
Hyssop (leaf)	Hyssop leaves (proposed CG25)
Iceland moss	No crop group
Indian gooseberry (Phyllanthus emblica) (fruit)	Indian gooseberry (CG23)
Indigo (leaves & root)	Mostly a dye no crop group
Irish moss	An algae no crop group
Irish moss powder	An algae no crop group
Isatis root	Potential commodity for CG 1
Jamaican ginger	Ginseng (CG1)
Jujube (fruit)	Jujube, Indian (CG23)
Juniper berry	Juniper berry (CG19 and new Spice CG 26)
Kale	Kale (CG4)
Kale juice powder	Kale (CG4)
Kale powder	Kale (CG4)
Karaya gum	Karaya add to Herb Crop group 25
Kava kava root powder	Potential commodity for CG 1
Kawaratake mushroom	Mushroomm
Kelp	Seaweed
Kelp (ascophyllum nodosum)	Seaweed
Kelp (whole leaf)	Seaweed
Kelp (whole plant)	Seaweed
Kidney bean (seed)	Bean,kidney (CG6)
Kiwi	Kiwifruit(CG13-07)
Kiwi fruit powder	Kiwifruit(CG1-073)
Kola nut (seed)	Kola group 99
Kola nut extract	Kola group 99
Kola nut extract (nut)	Kola group 99
Korean ginseng	Ginseng (CG1)
Korean ginseng root	Ginseng (CG1)
Kudzu extract (root)	Potential commodity for CG 1
Laminaria	Seaweed
Larch gum	No crop group
Leek	Leek (CG3-07)
Lemon	Lemon (CG10-10)
Lemon (whole fruit and peel)	Lemon (CG10)
Lemon bioflavonoid	Lemon (CG10)

Commodity	EPA Commodity/ Crop Group
Lemon grass (grass)	Lemongrass (CG19)
Lemon peel	Lemon (CG10-10)
Lemon verbena (aerial parts)	Potential crop for herbs Lemon verbena
Lepiota procera	Mushroom (CG21)
Licorice	Potential commodity for CG 1
Licorice root	Potential commodity for CG 1
Licorice root extract	Potential commodity for CG 1
Licorice root powder	Potential commodity for CG 1
Ligustrum berries	No crop group
Lime	Lime (CG10-10)
Lobelia	No crop group
Long pepper	Pepper,long (CG25)
Lonicera	Honeysuckle, edible (CG13=07)
Lovage root	Potential commodity for CG 1
Luo han (cucurbitacea)	Add to Crop group 9 Cucurbits
Lycium fruit	Goji berry (CG13-07)
Ma huang extract (aerial parts)	Ephedra banned in USA
Maca root	Potential commodity for CG 1
Macrocystis	Seaweed
Magnolia bark (bark)	Potential commodity for CG 26
Magnolia extract (bark)	Potential commodity for CG 26 (Magnolia officinalis)
Magnolia extract (bark)	Potential commodity for CG 26
Magnolia extract (bark)	Potential commodity for CG 26
Maitake mushroom	Mushroom (CG21)
Mandarin (whole fruit and peel)	Tangerine (CG10-10)
Marigold	Marigold (CG19)
Marshmallow root	Potential commodity for CG 1
Matrix aloe vera (inner leaf gel)	Aloe vera (CG22)
Mesima mushrooms	Mushroom
Mexican wild yam	Potential commodity for CG 1
Milk thistle	Potential commodity for CG 26 spices
Milk thistle (seed)	Potential commodity for CG 26 spices
Milk thistle extract	Potential commodity for CG 26 spices
Milk thistle seed extract	Potential commodity for CG 26 spices
Mint leaf	Mint, leaves (CG25)
Mistletoe	No crop group
Mullein (leaf)	Add to Herb Crop group 25

Commodity	EPA Commodity/ Crop Group
Mullein leaf	Add to Herb Crop group 25
Mushroom	Mushroom (CG 21)
Myrrh gum	Myrrh (CG25)
Nereocystis luetkeana	Seaweed
Nettle	Nettle (CG26)
Nettle (root)	Potential commodity for CG 1
Nettle leaves	Nettle (CG26)
Nettle root extract	Potential commodity for CG 1
Nori	Seaweed
Oat bran	Oat, grain (CG15)
Oat bran (seed)	Oat, grain (CG15)
Oat extract (seed)	Oat, grain (CG15)
Oat flour	Oat, flour (CG15)
Oat leaf	Oat,forage (CG15)
Oat straw	Oat, straw (CG16)
Oatstraw	Oat, straw (CG16)
Okra	Okra (CG 8-10)
Olea europaea	Olive (CG23)
Olive extract	Olive (CG23)
Onion	Onion(CG3)
Ophiopogon extract (root)	Potential commodity for CG 1
Ophiopogon root	Potential commodity for CG 1
Orange	Orange (CG10-10)
Orange bioflavonoids	Orange (CG10-10)
Orange fruit powder	Orange (CG10-10)
Orange juice powder	Orange (CG10-10)
Orange peel powder	Orange (CG10-10)
Oregano	Marjoram (CG19)
Oregon grape root	Potential commodity for CG 1
Oriental ginseng	Ginseng (CG1)
Oriental ginseng root	Ginseng (CG1)
Oyster (pleurotus ostreatus) mushroom	Mushroom (CG 21)
Palm oil	Palm (CG22)
Panax ginseng (root)	Ginseng (CG1)
Panax ginseng extract	Ginseng (CG1)
Panax ginseng extract (root)	Ginseng (CG1)
Panax ginseng root powder	Ginseng (CG1)

Commodity	EPA Commodity/ Crop Group
Papaya	Papaya (CG23)
Papaya fruit	Papaya (CG23)
Papaya juice powder	Papaya (CG23)
Papaya leaf	Papaya (CG23)
Papaya powder (fruit)	Papaya (CG23)
Parsley	Parsley (CG4)
Parsley dehydrate (stem and leaves)	Parsley (CG4)
Parsley juice powder	Parsley (CG4)
Parsley leaf powder	Parsley (CG4)
Parsley leaves	Parsley (CG4)
Parsley leaves	Parsley (CG4)
Parsley powder	Parsley (CG4)
Parthenium root	Potential commodity for CG 1
Passion flower	Passionflower (CG23)
Pau d'arco bark	No crop group
Pau d'arco bark extract	No crop group
Pau d'arco tea	No crop group
Pea (vine)	Pea, field,vines (CG7)
Pea vine juice	Parsley (CG4)
Peach	Peach (12-12)
Peach fiber (fruit)	Peach (12-12)
Peach fruit powder	Peach (12-12)
Peanut (bran)	Peanut
Pear	Pear (CG11-10)
Pearl barley	Barley, pearled barley (CG15)
Peony	Potential commodity for CG 1
Peony root	Potential commodity for CG 1
Peppermint leaves	Peppermint,tops
Petasites hybridus (aerial parts)	Add to Herb Crop group 25 as Butterbur
Phellinus linteus	Mushroom (CG21)
Pine bark	Potential commodity for CG 26
Pineapple	Pineapple(CG23)
Pineapple fruit powder	Pineapple(CG23)
Pineapple juice powder	Pineapple(CG23)
Pinellia rhizome	No crop group
Piper longum	Pepper, long (CG 26)
Piper nigrum	Pepper, black (CG19)



Commodity	EPA Commodity/ Crop Group
Piper nigrum extract	Pepper, black (CG19)
Plantain herb	Plantain, buckthorn (CG 4-12)
Pleurotus tuber-region	Mushroom (CG21)
Plum	Plum (CG12-12)
Plum juice powder	Plum (CG12-12)
Polygala root	Potential commodity for CG 1
Polygonum cuspidatum extract (root)	Potential commodity for CG 1
Poria cocos sclerotium root	Mushroom (CG 21)
Poria sclerotium	Mushroom (CG 21)
Prairie dock root	Potential commodity for CG 1
Prune powder (fruit)	Prune,plum (CG12-12)
Prune powder (fruit)	Prune,plum (CG12-12)
Psyllium hulls	Psyllium (Candidate for CG15)
Psyllium husk powder	Psyllium (Candidate for CG15)
Psyllium seed husks	Psyllium (Candidate for CG15)
Psyllium seed husks powder	Psyllium (Candidate for CG15)
Pumpkin seed meal	Pumpkin (CG9)
Purslane	Purslane (CG 4-14)
Pycnogenol	Pine bark (CG 26 candidate)
Pygeum africanum	Prunus africana, or red stinkwood potential Spices CG 26
Pygeum bark	Prunus africana, or red stinkwood potential Spices CG 26
Pygeum extract 70:1(bark, 3% phytosterols)	Prunus africana, or red stinkwood potential Spices CG 26
Radish	Radish (CG1)
Raspberry	Raspberry (CG13-07)
Raspberry powder	Raspberry (CG13-07)
Red beet root	Garden, beet,roots (CG1)
Red clover	Clover (CG18)
Red clover extract	Clover (CG18)
Red clover leaf & stem	Clover (CG18)
Red clover tops	Clover (CG18)
Red dates fruit	Date (CG23)
Red raspberry extract leaf	Raspberry (CG 13-07)
Red raspberry leaves	Raspberry (CG 13-07)
Red root (root)	Potential crop for Crop group 1 Root and tuber crops

Commodity	EPA Commodity/ Crop Group
Rehmannia (root)	Mushroom (CG21)
Reishi mushroom	Mushroom (CG 21)
Rheum officinales (rhizome)	Potential commodity for CG 1 rhubarb root
Rhodiola rosea root extract	Potential commodity for CG 1
Rhodymenia pertusa	Seaweed
Rhubarb root	Potential commodity for CG 1
Rhubarb root powder	Potential commodity for CG 1
Rice bran	Rice, bran (CG15)
Rice bran extract	Rice, bran (CG15)
Rice bran oil	Rice, bran (CG15)
Rice bran powder	Rice, bran (CG15)
Rice bran seed	Rice, bran (CG15)
Rice polish	Rice, polished rice (CG15)
Rose hips	Add to Herb crop group 25
Rose hips (fruit)	Add to Herb crop group 25
Rose hips with seeds	Add to Herb crop group 25
Rosemary (aerial parts)	Rosemary (CG19)
Rosemary (leaf)	Rosemary (CG19)
Rosemary extract	Rosemary (CG19)
Rosemary extract (leaf)	Rosemary (CG19)
Rye leaf	Rye, forage (CG16)
Safflower flowers	Edible flower (CG 25)
Safflower oil	Safflower, oil (CG20)
Safflower seed oil	Safflower, oil (CG20)
Sage leaf	Sage (CG19)
Sarsaparilla	Sassafras Potential for Root and Tuber CG 1
Sarsaparilla extract (root)	Sassafras Potential for Root and Tuber CG 1
Sarsaparilla root	Sassafras Potential for Root and Tuber CG 1
Saw palmetto	Member of Crop group 22 under Palm hearts commodity definition
Saw palmetto (fruit)	Member of Crop group 22 under Palm hearts commodity definition
Saw palmetto berries	Member of Crop group 22 under Palm hearts commodity definition
Saw palmetto berry extract	Member of Crop group 22 under Palm hearts commodity definition
Saw palmetto berry powder	Member of Crop group 22 under Palm hearts commodity definition
Schizandra (fruit)	Schisandra berry (CG13-07)
Schizandra (root)	Potential commodity for Root and tuber Crop

Commodity	EPA Commodity/ Crop Group
	group 1
Schizandra extract	Schisandra berry (CG13-07)
Schizonepeta	Japanese catnip Candidate forCG 25
Schizonepeta (spica) extract	Japanese catnip Candidate forCG 25
Scullcap	Potential commodity for CG 1
Scullcap (root)	Potential commodity for CG 1
Scute root (scutellaria baicalensis)	Potential commodity for CG 1
Sea buckthorn (fruit)	Sea buckthorn (CG13-07C)
Sea vegetable	Seaweed
Sea whistle	Seaweed
Seaweed	Seaweed
Senna (leaf)	Potential for Herb crop group 25 as Avarum
Senna leaf powder	Potential for Herb crop group 25 as Avarum
Shavegrass	No crop group
Shiitake mushrooms	Shiitake mushroom (CG21)
Siberian eleuthero root	Ginseng (CG1)
Siberian ginseng	Ginseng (CG1)
Siberian ginseng (eleuthero) (root)	Ginseng (CG1)
Siberian ginseng root	Ginseng (CG1)
Skullcap	Potential commodity for CG 1
Slippery elm bark	Potential for Spices CG 26
Small flowered willow powder (flower)	Edible flowers CG25
Soy isoflavones	Soybean (CG6)
Soy lecithin	Soybean (CG6)
Soy phospholipids	Soybean (CG6)
Soy phytosterol	Soybean (CG6)
Soy powder	Soybean (CG6)
Soy protein concentrate	Soybean (CG6)
Soy protein isolates	Soybean (CG6)
Soya lecithin	Soybean (CG6)
Soybean	Soybean (CG6)
Soybean lecithin	Soybean (CG6)
Soybean oil	Soybean,oil (CG6)
Spearmint (leaf)	Spearmint,tops
Spearmint (leaf)	Spearmint,tops
Spinach	Spinach (CG4)
Spinach juice powder	Spinach (CG4)

Commodity	EPA Commodity/ Crop Group
Spinach leaf powder	Spinach (CG4)
Spinach leaves	Spinach (CG4)
Spinach powder	Spinach (CG4)
Spirulina	Seaweed
Spirulina blue-green algae	Seaweed
Spirulina pacifica	Seaweed
Spirulina powder	Seaweed
Squaw vine (vine, leaf, fruit)	No crop group
St. John's wort (aerial part) Start	Candidate CG 25 or CG 26
Stevia leaf extract	Stevia,leaves (CG25)
Stinging nettles (tops)	Nettle (CG25)
Strawberry	Strawberry (CG13-07C)
Strawberry (leaves)	Strawberry (CG13)
Strawberry juice powder	Strawberry (CG13)
Suma (root)	Ginseng (CG1)
Suma (stems)	Ginseng (CG1)
Suma ginseng root	Ginseng (CG1)
Sunflower oil	Sunflower, refinedoil (CG20)
Sunflower seed powder	Sunflower, seed (CG20)
Tangerine	Tangerine (CG10-10)
Tangerine peel	Tangerine (CG10-10)
Thea sinensis complex (leaf)	Tea
Theobroma cacao seed extract	Cacao seed
Thlaspi	Cress CheckIR4
Tibetan ginseng root	Ginseng (CG1)
Tillandsia usneoides	Spanish moss no crop group
Tomato	Tomato (CG 8-10)
Tomato fruit extract	Tomato (CG 8)
Tomato powder	Tomato (CG 8)
Trametes versicolor huelo 1	Mushroom (CG 21)
Tremella mesenterica	Mushroom (CG 21)
Tribulus terrestris extract (fruit)	Puncturevine potential crop for Spice Crop group 25 but a noxious weed.
Triphala ( gooseberry, belleric and almond fruit blend)	Mixture of commodities
Tropical almond (terminalia chebula) (fruit)	Tropical almond (CG25)
Turkish rhubarb root	Check Rhubarb roots potential CG1
Turmeric	Turmeric (CG1)
Turmeric extract	Turmeric (CG1)

Commodity	EPA Commodity/ Crop Group
Turmeric root	Turmeric (CG1)
Turmeric root extract	Turmeric (CG1)
Ulva lactuca	Seaweed
Ulva linza	Seaweed
Uncarie tornetosa bark powder	Cat's claw potential for Root and Tuber CG 1
Uva ursi (leaf)	Bearberry (CG13-07)
Valerian root	Potential commodity for CG 1
Wakame	Seaweed
Watercress	Watercress
Watercress powder	Watercress
Watermelon	Watermelon (CG())
Wheat germ	Wheat, germ (CG15)
Wheat germ oil	Wheat, germ (CG15)
Wheat grass	Wheat, forage (CG16)
Wheat grass juice powder	Wheat, forage (CG 16)
Wheat leaf	Wheat, forage (CG 16)
White grape juice concentrate	Grape(CG13-07)
White mulberry extract (bark)	Potential Spices CG 26
White peony root	Potential commodity for CG 1
White willow bark	Potential commodity for CG 26
Willow bark	Potential commodity for CG 26
Wintergreen (leaf)	Wintergreen (CG19)
Wood betony	May be a tea use Stachys officinalis
Yarrow flowers	Edible flowers (CG 25)
Yellow dock root	Potential commodity for CG 1
Yellow dock root powder	Potential commodity for CG 1
Yerba mate	Maybe in future tea group
Yerba mate (leaf)	Maybe in future tea group
Yerba mate extract	Maybe in future tea group
Yerba mate leaf extract	Maybe in future tea group
Ymabushitake mushroom	Mushroom (CG 21)
Yohimbe bark	Maybe for Spice CG Pausinystalia johimbe but FDA considers too dangerous
Yucca	Yucca (CG22)
Zhu ling mushroom	Mushroom (CG 21)

## APPENDIX E: Chemical Components of the Herbs (Uhl; Small 1997; Katzer)

Some of the most important classes of chemicals are as follows.

The terpenoids include numerous compounds differing in physical and chemical properties. These are constructed of groups of five carbon atoms, called isoprene units, which can be linked together. Acids result in a sour taste. Principal organic acids include malic acid, citric acid, oxalic acid, and tartaric acid. Several of the herbs are notably acidic. Steroids are closely related to the terpenoids, and are produced by both plants and animals (terpenoids are produced mostly in plants). Cholesterol is the best known steroid. Some steroids are responsible for the strong toxicity of some poisonous plants. Alkaloids are plant-produced compounds that contain nitrogen, but aside from this are rather difficult to define. Alkaloids generally have a ringlike configuration, with single or multiple rings, and contain nitrogen. Alkaloids may be present in 5-10% or up to 20% of plant species. Generally, alkaloids are bitter, and often they are very toxic and so plants with noticeable concentrations of alkaloids are usually not among culinary herbs. Some alkaloids are valuable medicines.

**Agrimony:** the fresh herb contains a glucoside alkaloid, a nicotinic acid amide, traces of essential oil and organic acids, ursolic acid, a derivative of  $\alpha$ -amyrin, agrimonolide, palmitic acid, stearic acid, ceryl alcohol, and phytosterol. Dried flowering tops were found to contain an average of 7.4% tannins as a principal constituent. The seeds contain 35% oil with oleic-, linoleic-, and linolenic-acids. It has been said that the volatile oil is sometimes distilled.

**Angelica:** the aroma comes from the essential oil, for which more than 60 chemical compounds have been identified. Compounds recorded for the essential root and seed oil include: *d*- $\alpha$ -phellandrene,  $\alpha$ -pinene, osthene, osthole, angelicin,  $\alpha$ -thujene, and camphene, as well as  $\beta$ -phellandrene, limonene, myrsene, and sabinene. The main constituent of the root essential oil is  $\beta$ -phellandrene, although it was found that  $\beta$ -phellandrene was the main root essential component of wild angelica in Finland, while sabinene was the main component of domesticated angelica. The fruits have a higher percentage of oil than the roots and are rich in coumarins but the root oil is considered superior. The most important aroma chemical is a lactone of 15-hydroxypentadecanoic acid. Roots and seeds contain several furocoumarins, umbelliprenin, and various phenols.

**Balm:** it has about 0.1% essential oil, mainly citronellal,  $\beta$ -caryophyllene, geranial, including neral, citronellol, linalool and limonene. Fresh leaves have about 0.1% volatile oil. Caryophyllene oxide, estragol, 4-terpineol, anethole, and linalool are abundant components in the essential oil. Components include geraniol, citronellol, citronellal, eugenol acetate, and nerol. The leaves also contain caffeic acid, protocatechuic acid, rosmarinic acid, and some flavonoids. Tannins comprise about 5% of the fresh plant. The highest levels of essential oil have been extracted in late summer from the lower parts of the plants. The petals appear to produce small amounts of essential oil with components that are different from the essential oil of the rest of the plant, probably as an attractant for pollinators. Balm leaves contain no more than 0.1% of essential oil which is of complex and variable composition. Among the more than 50 aroma compounds yet identified, citronellal (dominantly the (R) enantiomer),  $\beta$ -caryophyllene, neral, geranial, citronellol, and geraniol amount to about 70% of the oil. The

composition is similar to that of lemongrass but balm oil can be identified by its typical pattern in chiral compounds; for example, enantiomerically almost pure (R) – (+)-methyl citronellate is a good indicator of true balm oil. Determination of carbon isotope ratio by isotope ratio mass spectrometry can also distinguish between the two oils.

**Basil:** the differences in flavor among basil species are due to their different chemical components, especially methyl chavicol (or estragol), linalool, citral, methyl cinnamate, eugenol or 1, 8-cineole. The dominant aroma component in sweet basil is linalool, in holy basil is eugenol, and in Thai (anise-type) basil is methyl chavicol. Sweet basil has about 0.5-1.1% essential oil, mainly linalool (40%) and methyl chavicol (25%) with the remainder consisting of eugenol, 1,8-cineole and geraniol. In anise or Thai basil, 85% of the oil is methyl chavicol (which oxidizes when exposed to light and air), less than 1% is linalool, and the rest consists of camphor, borneol, eugenol and 1,8-cineole. Basil oleoresin is dark green and viscous and 0.75 lbs. are equivalent to 100 lbs. of freshly ground basil. Sweet basil essential oil is sweet, anise-like, and floral in fragrance. The oil is obtained by about 4 hours of steam distillation of the flowers or the whole shoot. The essential oil obtained from the flowers is considered to be of better quality than oil obtained from the leaves. Chemical constituents of the oil are rather varied, the balance determining aroma and taste. Anethole contributes an anise taste; estragole a taste like tarragon; eucalyptol is spicy; eugenol is responsible for the oil of cloves odor and taste; and linalool smells like French lavender. An oleoresin is obtained primarily from cultivars having high methyl chavicol content. The extract is very dark green and viscous. One gram of oleoresin is equivalent in flavor and odor to 134 g of freshly ground basil. Five chemical types of basil have been recognized; these are: geraniol (40-50%) + eugenol (20-30%); eugenol (20-40%); camphor 10-15%); methyl cinnamate (60-65%); and geraniol (20-30%) + linalool (30-35%) + eugenol (20-30%). The highest quality sweet basil oil is the so-called European type, produced in Europe and the U.S. it contains linalool and methyl chavicol as its main constituents but does not contain camphor. Adulteration of high-quality oils with poorer grade oil apparently occurs so that cultivar and country of origin are not the only determinants of quality. Methyl chavicol was the most desirable component and 1-octen-3-ol the least desirable for aroma. The percentage contents of linalool and methyl chavicol increases in the essential oil as water stress increases. The type of nitrogen fertilizer can also change essential oil composition. Essential oil content of field-grown plants was greater than in greenhouse-grown plants, but chemical composition remained stable. Holy basil contains 0.3-0.8% essential oil on a fresh-weight basis with eugenol usually constituting 40-71% of the oil. An analysis of the oil revealed 37.7% methyl eugenol, 27.4% caryophyllene, 9.9% methyl chavicol, as well as other compounds. The chemistry varies with populations, some oil samples high in eugenol and methyl ether, others with methyl chavicol, cineole, and linalool. A study of a form with a high percentage of oil and eugenol noted that the oil content and the eugenol percentage in the oil fluctuated widely at different growth stages. The strong, pungent, clove-like odor of the oil is due to the high eugenol content. Eugenol is useful in pharmaceutical preparations, perfumes, soaps, dental creams, and as a flavoring in foods, meats, sausages, sauces and so the species has been considered to be a potential source of the chemical. The essential oil of the leaves and stems also contains citral and methyl chavicol depending on the strain of the plant. The seed oil, which dries easily, contains about 66% linoleic acid.

**Borage:** the astringent bite comes from the tannins, malic acid (which gives immature apples a sour taste) and potassium nitrate which has a cooling pungent taste. The seed contains GLA, a long-chain fatty acid of medicinal importance. There are small amounts of allantoic acid. Pyrrolizidine alkaloids, known for their hepatotoxic and carcinogenic potential, have been found in leaves, seeds, and flowers.

**Borage, Indian:** oil yield of the plant is about 0.055% and 0.1-0.2% in leaves on a fresh weight basis, or 0.01-0.02 in the stems. The peculiar odor of the leaves is due to its essential oil which contains carvacrol (as much as 60%) and caryophyllene (ca. 3-20%). Different researchers illustrate the somewhat different composition reported. One found that the chief constituents are carvacrol and camphor, with trace amounts of limonene. Another reported thymol (41%) and carvacrol (13%). Another found  $\beta$ -selinene (17%) limonene (10%), thymol (8%), carvacrol (40%), and eugenol (7%). Another reported: carvacrol ca. 40%, caryophyllene ca. 6%, and  $\alpha$ -terpinene ca. 17%.

**Burnet:** extracted tannin/polyphenol components include hydroquinones, resorcinol, catechol, pyrogallol, and gallic acid.

**Calamint:** it was found that the constituents of the essential oil are pulegone (ca. 35%), menthone (ca. 20%), and isomenthone (ca. 15%). Another found pulegone (ca. 28%), isomenthone (ca. 25%), neoisomenthol (ca. 24%), and menthol. (ca. 11%). Another reported numerous constituents, isopinocampone predominating (ca. 53%). The main constituents of the essential oil of *C. nepeta* subsp. *nepeta* have been reported to be pulegone (ca. 40%), menthone (ca. 25%) and isomenthone (ca. 25%). Main constituents of *C. nepeta* subs. *glandulosa* have been reported to be the two diastereoisomers of piperitone oxide (ca. 55%) and bisabolene (ca. 9%). Another reported piperitone oxide (ca. 25%), piperitenone oxide (ca. 44%), and limonene (ca. 13%). Pulegone has also been reported from subsp. *glandulosa*; another found pulegone (42%) and piperitenone (40.4%). Another reported that the two subspecies produced essential with the same constituents. These analyses have been based on limited samples and additional research may reveal variability among populations and quantitative differences between the subspecies.

**Calendula:** the flowers contain bitter principles, the coloring substance calendulin (a carotenoid), saponins, malic and ascorbic acids, mucilages, and small quantities of volatile oil. Notable chemical constituents include: arnidiol, carotin, calenduline, ceryalcohol, flavoxanthin, lycopene, oleanolic acid, rebixanthin, and violaxanthin. The dried petals contain stigmasterol, sitosterol, 2-8-isofucosterol, campesterol, 2-4 methylene cholesterol, and cholesterol. The seeds contain about 14-20% oil, including 55-61% calendic acid, which has led to the species being considered as a candidate for industrial oil production (Small).

**Catnip:** it contains volatile oils, sterols, acids, and tannins. Notable constituents include nepetalactone, nepetalic acid, nepetalic anhydride,  $\alpha$ - and  $\beta$ -caryophyllene, and valeric acid. Nepetalactone constitutes 70-99% of the essential oil. The main constituent attracting cats is the *trans*, *cis*-isomer of nepetalactone, which is metabolized and excreted in the urine. Nepetalic acid, a metabolic product of nepetalactone, is the most active constituent and cats can respond to air concentrations of  $1 \times 10^{10}$  to  $1 \times 10^{11}$



**Chamomile:** drug preparations of Roman chamomile contain essential oil, flavonoid glycosides, bitter principles, and other substances. The essential oil consists mainly of chamazulene, angelic acid, tiglic acid, and several sesquiterpene lactones. Angelic and tiglic acid esters comprise about 85% of the oil, one of the highest content of esters of any known essential oil. Other constituents include anethic acid, athesterol, anethene, resin, and tannin. Double-headed flowers usually yield somewhat above 0.7% essential on a fresh weight basis, while regular flowers are higher in yield – about 1.75%. About 120 secondary metabolites have been identified, of which there are approximately 28 terpenoids and 38 flavonoids, including the flavonoids matricarin and apigenin. An extensive summary of the chemistry of the oil indicates it contains chamazulene,  $\alpha$ -bisabolol,  $\alpha$ -bisabolol oxides A and B, spathulenol and farnesene. Chamazulene and bisabolol are considered medicinally effective. Depending on geographical origin, chamazulene and other components may or may not be present in appreciable quantities. The following chemical races have been recognized: (a) types free of chamazulene but rich in bisabolol oxide, endemic to southeastern Europe and Asia Minor; (b) chamazulene- and bisabolol-oxide types, predominating in Middle Europe; and a wild chamomile rich in chamazulene and (-)- $\alpha$ -bisabolol, native to northeastern Spain. Other constituents that have been found in chamomiles include anethic acid, anethidine, matricin, *cis-trans*-dicycloethers, and tannins.

**Chervil:** it has 0.03% essential oil, mainly iso-anethole. It contains anethole glycoside, bitter principle, and essential oil. The herb contains 0.3% essential oil, with about 0.9% in the seeds. Main essential oil components are methyl chavicol (estragol), the isomer of eugenol-methyl-ether known as 1-allyl-2, 4-dimethoxy-benzene, and undecane. Relative amounts in the herb differ depending on stage of maturity. The plant contains only minor amounts of essential oil (0.3% in the fresh herb, 0.9% in the seeds); it contains methylchavicol (estragole) and hendecane (undecane).

**Chive, dried leaves:** the essential oil of chives consists mainly of dipropyl disulfide, methyl pentyl disulfide, and pentanethiol. Chives' constituents equal those of the close relatives, onion, and garlic. The following volatile components have been identified: dipropyl disulfide, methyl pentyl disulfide, pentanethiol, pentyl-hydro-disulfide and *cis/trans*-3, 5-diethyl-1, 2, 4-trithiolane. Chives contain significant amounts of the vitamins A and C.

**Coriander/Cilantro:** depending on regional varieties, coriander seed has 0.2-2% essential oil, mainly *d*-linalool (60-70%),  $\alpha$ -pinenes (6.5%),  $\beta$ -terpinene (10%), camphor (5%), limonene (1.7%), *p*-cymene (3.7%), geranyl acetate (2.6%), and geraniol (1.7%). The aldehydes, *trans*-2-tridecenal and decanal, are found in the riper seeds. The fixed oil is about 13%. Its oleoresin is brownish yellow with 3 lbs. of oleoresin equivalent to 100 lbs. freshly ground coriander seed. Coriander leaf or cilantro has 0.1-0.2% essential oil, mostly aldehydes (benzyl benzoate, cinnamaldehyde, *trans*-2-tridecenal and decanal), caryophyllene and eugenol. It has less linalool than the seed. The *trans*-2-tridecenal and decanal are responsible for the fresh taste of the leafy spice. The pungent aroma of long coriander is due to the long chain aldehydes. The seeds contain 0.3-1.7% essential oil. The most abundant constituent is *d*-linalool (composing 45-70% of the volatile oil) which imparts the distinctive flavor. Russian and East European corianders tend to be rich in linalool. Also present are camphor, *d*- $\alpha$ -pinene, camphene,  $\beta$ -pinene, sabinene,

myrcene,  $\alpha$ -terpinene,  $\gamma$ -terpinene, limonene, and other compounds. The oil is extracted by steam distillation. Coriander oil has the advantages of being more stable and retaining its agreeable odor longer than other oils of its class. The unique aroma of young seeds, due to aliphatic aldehydes, disappears on ripening. Because the aroma is often perceived as fetid and is disliked in Western markets, only ripe fruits are employed for distillation of the spice oil. The seed meal that remains contains 20% or more fixed oil, which has been used as a lubricant in Russia, and for soapmaking. An oleoresin is extracted that has been used for food flavoring. It contains 9-22% fatty acids, of which 39-79% is petroselinic acid. It is grown in Europe as a medicinal and industrial crop for its content of petroselinic acid. The aroma of the leaves is due to an extractable essential oil, as with the seeds, but the composition is distinctly different from that of the seed oil. The composition of the leaves and many volatile compounds were found, including alkanols and 2-alkenals, other aliphatic aldehydes and alcohols, and nonane. Some of these have anti-fungal properties. In the ripe fruits, the content of essential oil is comparably low (typically less than 1%); the oil consists mainly of linalool (50-60%) and about 20% terpenes (pinenes,  $\gamma$ -terpinene, myrcene, camphene, phellandrenes,  $\alpha$ -terpinene, limonene, cymene). In toasted coriander fruits, pyrazines are formed as the main flavor compounds. The taste of the fresh herb is due to an essential oil (0.1%) that is almost entirely made up of aliphatic aldehydes with 10-16 carbon atoms. One finds both saturated (decanal) and  $\alpha$ ,  $\beta$  unsaturated (trans-2-tridecenal) aldehydes; the same aldehydes appear in the unripe fruits. Similar compounds occur in a few other species and herbs, all of which share coriander's flavor; examples include long coriander, Vietnamese coriander and the Japanese chemotype of chameleon plant.

**Costmary:** three populations of Spanish costmary were examined and the oil was found to contain carvone (about 50%) as the main component. There were also minor amounts of  $\beta$ -thujone, *trans*-dihydrocarvone, *cis*-dihydrocarvone, dihydrocarveol isomer *cis*-carveol, and *trans*-carveol. Notably the toxic ketone  $\beta$ -thujone comprised about 10% of the essential oil. Some populations have been found to have camphor rather than carvone as the main component of the essential oil.

**Culantro:** the essential oil from the leaves of long coriander is rich in aliphatic aldehydes, most of which are  $\alpha$ ,  $\beta$  unsaturated. The impact compound is E-2-dodecenal (60%); 2, 3, 6-trimethylbenzaldehyde (10%), dodecanal (7%) and E-2-tridecenal (5%) have been identified. Aliphatic aldehydes appear also in other spices with coriander-like scent. Yet another essential oil can be obtained from the root; in the root oil, unsaturated alicyclic or aromatic aldehydes dominate (2, 3, 6-trimethylbenzaldehyde 40%, 2-formyl 1, 1, 5-trimethyl cyclohexa-2, 5-dien-4-ol 10%, 2-formyl 1, 1, 5-trimethyl cyclohexa-2, 4-dien-6-ol 20%, 2, 3, 4-trimethylbenzaldehyde.

**Curry:** the fresh leaf has about 2.6% essential oil, but there is a gradual decrease in volatile content with advancing maturity. The essential oils mainly consist of sabinene (35%),  $\alpha$ -pinene (27%), and dipentene (16%) with  $\beta$ -caryophyllene,  $\beta$ -gurjunene,  $\beta$ -elemene, and  $\beta$ -phellandrene. Fresh leaves are rich in an essential oil, but the exact amount depends besides freshness and genetic strain also on the extraction technique. Typical figures run from 0.5-2.7%. The following aroma components, mostly sesquiterpene hydrocarbons, have been identified in curry leaves of Sri Lanka (in parentheses, the content in mg/kg fresh leaves):  $\beta$ -caryophyllene (2.6 ppm),  $\beta$ -gurjunene (1.9 ppm),  $\beta$ -elemene (0.6%),  $\beta$ -phellandrene (0.5 ppm),  $\beta$ -thujene (0.4 ppm),  $\alpha$ -selinene (0.3 ppm),  $\beta$ -bisabolene (0.3 ppm), furthermore limonene,  $\beta$ -*trans*-ocimene and  $\beta$ -

cadinene (0.2 ppm). Newer work has shown a large variability of the composition of the essential of curry leaves. In North Indian plants, monoterpenes prevail ( $\beta$ -phellandrene,  $\alpha$ -pinene, and  $\beta$ -pinene), whereas South Indian samples yielded sesquiterpenes:  $\beta$ -caryophyllene, aromadendrene, and  $\alpha$ -selinene.

**Dillweed/seed:** European dill seeds have 2.5-4% essential oil, which is pale yellow in color and consists mainly of carvone (30-60%), limonene (33%), and  $\alpha$ -phellandrene (2-.61%), including *p*-cymene, 3,9-epoxy-*p*-menth-1-ene,  $\alpha$ -pinene and  $\beta$ -phellandrene and dihydrocarvone. Indian dill seeds have 1-4% essential oil, which is light brown in color. It mainly consists of dillapiole (52%) but has less carvone (21%) than the European type. It also has *trans*-dihydrocarvone (16.6%), limonene (6%), dihydrocarvone (17%) and  $\alpha$ -pinene (1%). Dillweed has much less essential oil than the seed, about 0.35%. The essential oil is pale yellow and contains a high proportion of terpenes but contains less carvone (28-40%) than the seed. It also has limonene (30-40%), phellandrene (10-20%), myristicin, dillapiole and other monoterpenes. Its typical fresh aroma is due to  $\alpha$ -phellandrene. Dill oleoresin is produced mainly from the seed and also from some European dillweed. It is greenish to pale amber in color and 5 lbs. of oleoresin are equivalent to 100 lbs. of freshly ground spice. Dill oil is composed of at least 10 different aromatic compounds. Carvone, limonene, and  $\alpha$ -phellandrene constitute approximately 90% of the total oil content. Carvone content of the seeds can reach 60%. Dill oil with less than 20% carvone is considered to most closely resemble the true aroma of dill herb, preferred for dill pickles. In North America the dill trade requires a carvone content of at least 30%, with some manufacturers preferring higher levels. The dill-like odor and flavor is chiefly due to  $\alpha$ -phellandrene, the higher the content, the more the oil resembles fresh dill herb. Indian dill (subsp. *sowa*) has a relatively high content of dillapiole and a low carvone content, a combination ideally suited for dill pickles. Dillweed oil is milder than dillseed oil and has less carvone and more  $\alpha$ -phellandrene, once again the chemical profile preferred for the finer and more appetizing flavor appreciated in dill pickles. Principal dill seed oil components include *d*-carvone, *d*-limonene, *d*-phellandrene,  $\alpha$ -pinene, diterpene, *d*-dihydrocarvone,  $\beta$ -phellandrene,  $\beta$ -pinene, 1, 8-cineole,  $\beta$ -myricene, *p*-cymene and  $\alpha$ -thujone. Dill herb oil has *d*- $\alpha$ -phellandrene, terpinene, limonene, carvone, dillapiole, isomyristicin, and myristicin. Quality of dill oil fluctuates considerably depending on the maturity of seeds. Even under the northern conditions of Alberta, the chemical constituents of dill seed and weed have proved to be close to international standards although at harvest time the dill fruits are unevenly matured. It was found that oil content increased with light intensity and temperature and often did so with longer photoperiod; exposure to far-red light increased oil production and also altered relative chemical composition of the oil. Commercial oleoresins, prepared to reproduce the flavor of the whole herb, are produced from a combination of dillseed and dillweed oil. One part of the oleoresin is equivalent to 20 parts of ground dill. The essential oils from leaves (0.35% and fruits (204%) differ slightly in composition: in the fruit oil, the main components are carvone (40-60%) and limonene (40%) but other monoterpenes appear only in traces (phellandrene, carveol, terpinene and dihydrocarvone). In the leaf oil, the aroma is determined by carvone (30-40%), limonene (30-40%), phellandrene (10-20%) and other monoterpenes; dill ether (a monoterpene ether) is characteristic of dill leaf oil. Oil from the fruits in Indian dill (*Anethum sowa*) contains the phenylpropanoid dillapiole (6-allyl-4,4-dimethoxy-1, 3-benzodioxol).

**Dokudami:** a Japanese chemotype, scented of oranges and cilantro, has been shown to have aerial parts rich in dodecanoic acid (c. 40%), 2-undecanone (ca. 10%), and methyl decanoate. A Chinese chemotype, smelling of fresh meat and cilantro, has been shown to be rich in myrcene, 2-undecanone, limonene, and decanoyl acetaldehyde. Some attribute the peculiar odor of Chinese material (from Taiwan) to decanoyl acetaldehyde and that the Chinese strain seems to be the kind available in the U.S. Several aristolactams and dioxoaporphin derivatives have been found, as well as a high amount of unsaturated fatty acids (oleic, linoleic, and linolenic acid) and unique benzene, pyridine, and dihydropyridine derivatives. The plant (Japanese chemotype) contains a variety of flavonoids, flavonoid glycosides (afzerin, quercitrin, isoquercitrin) and pyridine alkaloids; the essential oil was found to consist mainly of decanal (caprylic aldehyde), dodecanal (lauryl aldehyde) and 2-hendecanon (methyl nonyl ketone). Another work reports the essential oil's main components being dodecanoic acid, 2-hendecanon and methyl decanoate. The volatile oil of the Chinese/Vietnamese chemotype was found to contain myrcene, 2-hendecanon, limonene, and decanoyl acetaldehyde (3-ketododecanal). The latter compounds seems mainly responsible for the characteristic flavor; it is a potent antibacterial agent. The plant is thus used in traditional Chinese medicine.

**Epazote:** Epazote contains less than 1% essential oil and has mostly monoterpenes and its derivatives, such as ascaridol (up to 70%), limonene and *p*-cymene with camphor,  $\alpha$ -pinene, myrcene, terpinene, thymol, and *trans-iso-carveol*. The average oil content of commercially harvested plants is about 2% on a dry weight basis. Ascaridole is the active principle in the oil and predominates in var. *anthelminticum*, while in of other varieties other components such as pinocarvone and *trans-pinocarveol*, are the major constituents. Ascaridole content seems to rise relative to other components up to the time mature seeds are produced. Geraniol, a saponin, *l*-limonene, *p*-cymene, *d*-camphor, methyl salicylate, and numerous other compounds have also been identified in the essential oil. All aerial plant parts contain an essential oil (0.7% in the leaves, 2.5% in the unripe fruits) which is composed of various monoterpenoids ( $\alpha$ -pinene,  $\alpha$ -phellandrene, thymol, myrcene, *p*-cymene, terpinene, camphor, and *trans-isocarveol*) and ascaridole, a monoterpenoid peroxide. Oils from Latin American plants often contain comparatively less ascaridole (10%) while some monoterpenoids (limonene, *trans-isocarveol*,  $\alpha$ -pinene,  $\alpha$ -phellandrene) may reach levels of 30% and more; this results in a less intensive, but complex flavor. On the other side, plants grown in Europe or Asia have a much stronger taste due to the high levels of ascaridole (70%, one source even states 86%). Ascaridole (1, 4-peroxido-*p*-menth-2-ene) is rather an uncommon constituent in the essential oils of spices; another plant owing much of its character to this monoterpene peroxide is boldo. Ascaridole is toxic and has a pungent, not very pleasant flavor; in pure form, it is an explosive sensitive to shock.

**Fennel (common):** fennel seed contains 1-6% volatile oil and 10-20% fixed oil. The bitter fennel contains 50% *trans*-anethole, 10-15% fenchone, 10-30% limonene, 3-11%  $\alpha$ -phellandrene, 12-16%  $\alpha$ -pinene, with  $\alpha$ -thunene,  $\beta$ -pinene, estragol (methyl chavicol), myrcene and 1,8-cineole. The sweeter variety has no fenchone, but has higher levels of limonene. Its oleoresin is brownish green in color, and 6.5 lbs. are equivalent to 100 lbs. of freshly ground fennel. Both bitter fennel (var. *vulgare*) and sweet fennel (var. *dulce*) are grown as an oil crop. Seeds average 3.5% essential oil. The oil of both varieties contains anethole, fenchone,  $\alpha$ -pinene, camphene,  $\beta$ -pinene, sabenine, myrcene,  $\alpha$ -phellandrene, limonene, *cis*-ocimene, *p*-cyme,

camphor, and other chemicals. The essential oil of bitter fennel contains 50-60% *trans*-anethole and 10% or more fenchone. The presence of the ketone fenchone imparts a somewhat camphoraceous and harsh flavor. Seeds of sweet fennel do not contain any fenchone, hence the sweetness in flavor and aroma. Some analyses have indicated a lack of fenchone in sweet fennel by simply stating that bitter fennel oil is thought to contain more fenchone and less anethole than sweet fennel oil. Some analyses have also indicated a higher concentration of limonene in bitter fennel. Anethole is the main desirable flavor and aroma constituent. The odor of the essential oil has been characterized as aromatic, pleasantly fresh, warm, spicy, and anise-like. It can be slightly camphoraceous, depending on the form of fennel used. The content of the essential oil varies strongly (0.6-6%); fruits in the center of an umbel are generally greater, greener and stronger in fragrance. Time of harvest and climate are also important. The essential oil of the most important fennel variety (var. *dulce*) contains anethole (50-80%), limonene (5%), fenchone (5%), estragole (methyl chavicol), safrole,  $\alpha$ -pinene (0.5%), camphene,  $\beta$ -pinene,  $\beta$ -myrcene, and *p*-cymene. In contrast, the uncultivated form (var. *vulgare*) contains often more essential oil but since it is characterized by the bitter fenchone (12-22%), it is of little value.

**Geranium:** geranium oil is composed mainly of geraniol (often the main component), citronellol, citronellyl formate, and other compounds. All parts of the popular rose-scented geranium (*P. groveolens*), except the petals, contain citronellol and geraniol. Peppermint-scented *P. tomentosum* was found to have essential oil composed mainly of isomenthone and menthone.

**Horehound:** the main constituent is the bitter principle premarrubiin (premarrubin), a bitter diterpenoid lactone found in concentrations from 0.3-1.0%. This transforms to marrubiin (marrubin) during isolation. Also present are tannins, resins, waxes, and a volatile oil with monoterpenes and a sesquiterpene.

**Hyssop:** the essential oil contains pinocamphone, isopinocamphone,  $\alpha$ -pinene,  $\beta$ -pinene, camphene,  $\alpha$ -terpinene, pinocampheol, cineole, linalool, terpineol, and other constituents. Another states that half of the oil is made up of pinene, which contributes the smell and taste of turpentine. A review of the results of a study of 36 different strains found variation in the major components, isopinocamphone pinocamphone, pinocarvone, and 1,8-cineole. Another found an exceptional clone with 61.7%  $\beta$ -phellandrene, a very unusual principal component of essential oil in the Labiatae. One found 1,8-cineole, isopinocamphone and  $\beta$ -pinene were the major constituents of wild *H. officinalis* in Bulgaria, while commercially cultivated plants predominantly contained isopinocamphone, pinocamphone and  $\beta$ -pinene, but lacked 1,8-cineole. Another studied several chemically divergent accessions, which also differed notably in odor. They found that pinocamphone, isopinocamphone, and pinocarvone were the main volatile compounds observed and the relative proportions of these ketones served to distinguish the accessions, despite notable annual variation during the 3 consecutive years of cultivation. The content of essential is rather low (0.3-0.9%); it is mostly composed of cineol,  $\beta$ -pinene and a variety of bicyclic monoterpene derivatives (L-pinocamphene, isopinocamphone, pinocarvone). As many other plant of the mint family, hyssop contains rather large amounts of bitter and anti-oxidative tannins: phenols with a diterpenoid skeleton (carnosol, carnosolic acid), depsides of caffeic acid (=3, 4-dihydroxycinnamic acid) and several triterpenoid acids (ursolic and oleanolic acid). Very similar or the same compounds have also been found in sage and rosemary.

**Hyssop, anise:** the essential oil, obtained by steam distillation, ranged from 0.07-2.45% leaves and up to 3% in flowers. The major constituent of the oil was usually methyl chavicol (6-94%), which imparts an anise-like flavor. Plants lacking methyl chavicol do not smell of anise. Methyl chavicol (estragol) is used in perfumes and as a flavoring in foods and liqueurs, particularly root beer, and can be used as a starting material for compounds such as anethol, anisaldehyde, anisyl alcohol, and anisic acid. Other chemicals in the essential oil include spathulenol (10-49%; populations low in methyl chavicol tended to be high in spathulenol), bornyl acetate,  $\gamma$ -cadinene,  $\alpha$ -limonene, and  $\beta$ -caryophyllene. Great diversity has been demonstrated in essential oil composition of anise hyssop. Scientists with agriculture and Agri-Food Canada have selected strains of anise hyssop with improved essential oil content and agronomic characteristics. Methyl chavicol, usually obtained from basil and tarragon, might be commercially obtained from anise hyssop.

**Lavender:** it has 0.5-1.5% volatile oil (1-3% according to Bisset), tannins, coumarins (including coumarin, umbelliferone and herniarin), flavonoids (such as luteolin), and (in the leaves) about 0.7% ursolic acid. The essential oil has linalyl acetate (8-18% in English lavender, 30-60% in French lavender), linalool, 1,8-cineole, camphor,  $\alpha$ -pinene, geraniol and its esters, lavandulol, nerol, cineole, caryophyllene, limonene,  $\beta$ -ocimene, furfural, ethyl amyl ketone, thujone, and pinocamphone. Linalool has the distinct smell of lavender. The sweetly floral English lavender has little camphor compared to other lavenders, which accordingly have a medicinal or detergent-like smell. The essential oil (1-3%) is rich in linalyl acetate (30-55%) and linalool (20-35%). Further aroma components are  $\beta$ -ocimene, cineol, camphor and caryophyllene epoxide; even coumarin derivatives (coumarin, dihydrocoumarin, herniarin, umbelliferone) were found.

**Lemon verbena:** lemon verbena contains 0.1-0.2% essential oil, which is yellowish green, it is chiefly composed of citral, cineol, dipentene, limonene, linalool, borneol, geraniol, and nerol. Leaves and stems respectively contain about 0.4-0.65%, and 0.35%, essential oil. The essential oil is rich in citral (about 35% in some lines, lower in others), with some borneol, cineol, dipentene, geraniol, limonene, linalool, nerol, citronal, verbesone, acetic acid,  $\alpha$ - and  $\beta$ -caryophyllene, myrcene, and pyrrollic- and isovalerianic-acid. Another found the main constituents were d-limonene, citral and p-cymol. The essential oil is called oil of verbena, a name also used for the essential oil of *Cymbopogon citratus*. The high-priced lemon verbena oil is often adulterated with other plant oils. Essential oil components from other sources are skilfully blended in about the same proportions in which they occur in the natural verbena oil. So-called "Spanish verbena oil" is derived from *Thymus hiemalis* and perhaps also *T. hirtus*. Mean levels of 5.3% (dry weight basis) of the phenolic compound verbascoside were found in lemon verbena. The essential oil (less than 1%) is mainly characterized by the aldehydes neral and geranial (citral); further monoterpenoids found are limonene, carvone, dipentene, linalool, nerol and geraniol.

**Lemongrass:** the essential oils in lemongrass vary with the variety. *C. citratus* has 0.3-0.4% essential oil with 70% citral; and *C. flexuosus* has 0.2-0.5% essential oil with 80-85% citral. The other components are myrcene (14%), geranyl acetate (3%), methyl heptenone (2%), and linalool (1%). About 0.2 - 0.4% of the fresh grass is made up of a volatile oil. This lemon-scented essential oil is obtained by steam distillation. The major chemical component (65-85%) is generally reported to be citral. The oil is used to manufacture synthetic violet odor (ionones) for perfumed soaps and cosmetics. Tonone, produced from citral, is the name of one artificial violet perfume commonly encountered in trade. Citral is also used to adulterate lemon oil and in the synthesis of vitamin A. There was a report of Ethiopian *C. citratus* containing geraniol as the main component (about 40%) of the essential oil. Other chemical components noted include isovaleric aldehyde, furfural, myrcene, dipentene, methylheptenone, aldehyde C<sub>10</sub>, citronellal, various esters, linalool, nerol, and other terpenoids. The essential oil of lemon grass (0.2-0.5%, “West Indian lemon grass oil”) consists mainly of citral. Terpenoids in lemon grass oil are nerol, limonene, linalool, and  $\beta$ -caryophyllene. The content of myrcene is low but still enough to make the oil susceptible to oxidative polymerization. Citral is a mixture of two stereoisomeric monoterpene aldehydes; in lemon grass oil, the *trans* isomer geranial (40-62%) dominates over the *cis* isomer neral (25-38%). East Indian lemon grass oil is distilled from a related species, *C. flexuosus*. It consists of alcohols (20-30% citronellol, geraniol) and aldehydes (15% geranial, 10% neral, 5% citronellal). This species is dominantly used in the perfume industry as it contains less myrcene and therefore has a longer shelf life. Two further species have considerable relevance for the perfume industry. The so-called palmarosa oil is distilled from *Cymbopogon martini* (Rox.) J.F. Watson var. *martini* (native to India, cultivated also in Java) and contains mainly geraniol (75%) and geranyl acetate (12%). Citronella grass (*Cymbopogon winterianus* Jowitt) also stems from India but is today grown throughout the tropics; its main constituents are citronellal (35%), geraniol (25%) and citronellol (10%) plus minor amounts of geranyl acetate (5%).

**Lovage:** the fresh leaf has 0.1 - 0.2% essential oil, while the dried leaf has 0.5 - 1% essential oil, which is yellow amber to greenish color. It consists mainly of phthalides (ligustilide, butylphthalide, sedanolide) with lesser amounts of  $\alpha$ -terpineol, eugenol, and carvacrol. An essential oil is extracted from the roots and above-ground parts. The recovery of essential oil is 0.8-1.1% from seeds, 0.6-1.0% from the roots, and 0.05-0.15% from leaves. A large number of compounds have been found in the oil, mainly monoterpenes hydrocarbons and phthalides, which are lactone derivatives. The essential oil comprises mainly umbelliferone and butyl phthalidine. Several coumarins are found in the oil, including umbelliferone. Other compounds listed include *n*-butylidene phthalide, *n*-butyl-phthalide, sedanonic anhydride, *d*- $\alpha$ -terpineol, carvacrol, eugenol, and volatile acids. Resin, starch, sugars, tannins and gum are also present. There are differences in fragrance among the essential oils from different plant parts and the extracted oils may be used differently. It is reported that a key odorous component is sotolone (3-hydroxy-4,5-dimethyl-2(5H)-furanone). Root volatile oil is useful in perfumery, soaps, creams, and for flavoring tobacco products. Seed oil is used to flavor confectionary and liqueurs. Fresh leaves contain max. 0.5% essential oil; most important aroma components are phthalides (ligustilide, butylphthalide and a partially hydrogenated derivative called sedanolide). Terpenoids (terpineol, carvacrol) and eugenol are less important. Phthalides also appear in some other plants from the carrot family, in particular the related celery. Apart from this, these compounds are rare in the plant kingdom. The heterocyclic aroma compound sotolone, which

has been found both in fenugreek and in Maggi sauce, can be seen as a phthalide-related, simpler structure where the condensed benzene ring is missing. This chemical similarity might account for the similar flavor of lovage and fenugreek leaves and also that of Maggi sauce.

**Marigold:** Mexican mint marigold: the essential oil is primarily estragole (about 90%), with about 1% linalool. It is reported that the oil has a pronounced odor and acts as a repellent to flies. The plant contains acidic resin, gallic acid, tannins, glucose, pectin, gum, and mineral salts. French marigold: the principal components of the essential oil are tagetone, limonene, linalool, ocimene, and linalyl acetate. It possesses a class of compounds known as (acetylenic) thiopenes, which are found in many other species of the sunflower family. These chemicals kill insects, nematodes, fungi, and bacteria, as well as some viruses.

**Marjoram:** sweet marjoram has 0.3 - 1% essential oil, and is yellowish to dark greenish brown in color. It mainly consists of *cis*-sabinene hydrate (8-40%),  $\gamma$ -terpinene (10%),  $\alpha$ -terpinene (7.6%), linalyl acetate (2.2%), terpinen-4-ol (18-48%), myrcene (1.0%), linalool (9-39%), *p*-cymene (3.2%), caryophyllene (2.6%), and  $\alpha$ -terpineol (7.6%). Its flavor varies widely depending on its origins. The Indian and Turkish sweet marjorams have more *d*-linalool, caryophyllene, carvacrol, and eugenol. *O. majorana*: the essential oil is obtained by steam distillation. The yield is very low, often less than 1% of the fresh material. The oil is yellowish, with a spicy, aromatic quality, reminiscent of lavender. The taste is sharp and spicy. The main components of the essential oil are *cis*-sabinene hydrate and terpinen-4-ol. The oil also contains linalool,  $\alpha$ - and  $\gamma$ -terpinene, and other constituents. The oleoresin is dark-green and viscous. About one part of the oleoresin is equal to 40 parts of freshly ground marjoram in flavor and odor. "oil of wild marjoram" is obtained by *Thymus mastichina*. *O. vulgare*: a high carvacrol content in the essential oil is the key to the "oregano" flavor. The carvacrol content has been found to vary so much in subsp. *hirtum* that in one study, to the trained nose the oils were variously thought to be marjoram, thyme, or oregano. The marjoram type had high quantities of terpinen-4-ol, and little thymol or carvacrol. The thyme type was predominantly composed of thymol while the oregano type mainly had carvacrol. Commercial essential oil predominantly contains carvacrol, reflecting preference for the latter. There are differences in the oil obtained from the various subspecies, and indeed cultivars of *O. vulgare*. Greek oregano (subsp. *hirtum*) is the major source of commercial oregano oil. It contains 60-80% carvacrol. Subspecies *viride* is considerably higher in its concentration of thymol, up to 50%. *Majorana* spp.: The content of essential oil depends on soil, climate and season, but generally lies between 0.7 - 3.5 %. The main aroma component is a bicyclic monoterpene alcohol, *cis*-sabinene hydrate (max. 40%);  $\alpha$ -terpinene, 4-terpineol,  $\alpha$ -terpineol, terpinenyl-4-acetate and 1, 8-cineol are found in significant amounts. Phenolic compounds, which make up for the typical fragrance of the closely related oregano, are missing altogether. *Origanum* spp.: the essential oil (max. 4%) may contain variable amounts of the two phenols carvacrol and thymol; a variety of monoterpenes hydrocarbons (limonene, terpinene, ocimene, caryophyllene,  $\beta$ -bisabolene and *p*-cymene) and monoterpenes alcohols (linalool, 4-terpineol).

**Mint:** peppermint has 0.5 - 5% essential oil that is pale yellow. It mainly consists of menthol (24-46%), menthone (16 - 36%), menthyl acetate (3.8 - 7%), menthofurane (2 - 8%), isomenthone (2 - 8%), limonene (2.5%), pulegone (1.4 - 4%), and  $\beta$ -pinene (1.5 - 2%). Menthol



and menthyl acetate are responsible for the refreshing and cooling pungent odor and are mostly found in the older leaves. Spearmint has 0.5% essential oil, mainly 50 - 70% carvone and dihydrocarvone, including dihydrocumyl acetate, dihydrocumyl valerate, phellandrene, limonene, menthone, menthol and 1,8-cineol. Oil of cornmint is referred to as mint oil in the U.S. and is blended with peppermint oil because it is less expensive. Cornmint oil has 28-34% menthol, 16 - 31% menthone, 6 - 13 isomenthone, 5 - 10% limonene, and a higher content of  $\alpha$ - and  $\beta$ -pinenes. Peppermint oil has more than 200 chemical compounds, notably:  $\alpha$ -pinene,  $\beta$ -pinene, 1, 8-cineole, limonene, piperitone, *d*-isomenthone, neomenthol, pulegone, menthofuran, *l*-menthone, *l*-menthol, and methyl acetate. Nearly all commercial mint is steam-distilled for its essential oils. When harvested at peak conditions, black peppermint cultivars yield less than 1% oil, called peppermint oil, consisting of about 50% menthol and 25% menthone. Menthol is responsible for a cooling aftertaste of mint. All peppermint oils have varying combinations of these and many other minor constituents but the ratio varied widely with oils from different geographical areas. The pale yellow oil has a fresh, strong, minty odor, with a pronounced cooling effect on the mouth. Steam distillation yields an essential representing approximately 0.6% of the leaves and stems of spearmint. The oil is composed mainly of carvone (about 56%) with several minor constituents. The constituents that provide the characteristic flavor are dihydrocumyl acetate, dihydrocumyl valerate, and dihydrocarvyl acetate. The odor is strong, fresh, and minty and the flavor is smooth, sharp and herbaceous. Peppermint: the essential oil (up to 2.5%) in the dried leaves) is mostly made up from menthol (ca. 50%), menthone (10 - 30%), menthyl esters (up to 10%) and further monoterpene derivatives (pulegone, piperitone, menthofurane). Traces of jasmine (0.1%) improve the oil's quality remarkably. Menthol and menthyl acetate are responsible for the pungent and refreshing odor; they are mostly found in older leaves and are preferentially formed during long daily sunlight periods. The ketones menthone and pulegone (and menthofurane) have a less delightful fragrance; they appear to higher fraction in young leaves and their formation is preferred during short days. The world's most important source of menthol is, however, not peppermint but field mint. Field mint is the only mint species that became naturalized in tropical Asia; there are many different cultivars, some of which are grown for direct consumption, others for the distillation of essential oil. The Japanese variety of field mint (*Mentha arvensis* var. *piperascens* Malinv. Ex Holmes), now grown in many Asian countries, may contain up to 5% of essential in its tips; more common, however, are 1 - 2%. Chief component of the oil is menthol (50-70%, in rare cases up to 90%). After parts of the menthol have been removed from the oil, the oil is marketed as (dementholized, rectified) "Japanese peppermint oil"; it typically contains 30 - 45% menthol, 17 - 35% menthone, 5 - 13% menthyl acetate, 2 - 5% limonene and 2.5 - 4% neomenthol. Other terpenes occur but in traces (piperitone, pulegone,  $\beta$ -caryophyllene,  $\beta$ -caryophyllene-epoxide,  $\alpha$ -pinene,  $\beta$ -pinene, germacrene D, 1, 8-cineol, linalool, menthofurane, camphene). A trace component characteristic for this species and missing in other mints is  $\beta$ -hexenyl phenylacetate. The oil of this so-called "Japanese peppermint" is often attributed with an incredible wealth of useful medical properties. The menthol obtained as a by-product in the rectification of Japanese peppermint oil is used for medical products and for chewing gum. A comparatively small fraction goes in the production of menthol-flavored cigarettes, which have been quite popular in Western Europe a few decades ago. Whenever highly concentrated menthol is used, one must consider that menthol is toxic to infants; there are rumors that it can induce apnea. Other mints may contain rather different constituents: *M. pulegium* (pennyroyal) contains 80% pulegone and *M. crispata* (crispate mint) contains 50% carvone. Another famed cultivar, spearmint, owes its

fantastic aroma to carvone, limonene, dihydrocarvone, menthone pulegone, 1, 8-cineol and  $\beta$ -pinene.

**Monarda:** the essential oil is obtained by steam distillation. The yield is about 0.3 - 1.0% from the fresh flowers and leaves while the dried flowers and dried leaves yield 2.7 - 3.1%. Carvacrol is the major chemical constituent (ca. 67%) with numerous minor constituents. Hybrids of bergamot and *M. fistulosa* with distinctive fragrances for use in the perfume industry have been developed in Canada. These strains are rich in geraniol, linalool, carvacrol, thymol, or cineol. Study of a geraniol-rich selection called Morden No. 3 concluded that it had commercial potential. Geraniol is a rose-scented oil, widely used by the fragrance industry to prepare rose-scented perfumes and scented soaps. It can be obtained from high-geraniol strains of *M. fistulosa*, rose geranium (*Pelargonium graveolens*), citronella grass (*Cymbopogon nandus*), and thyme (*Thymus vulgaris*). Synthetic geraniol is produced from turpentine and petroleum and provides strong competition for the plant-based sources. *Monarda fistulosa* has a geraniol content that far exceeds that of geranium oil. Wild bergamot has yielded essential oil containing over 95% geraniol when grown in Quebec and Manitoba on a variety of soil types. The yield of essential oil, obtained by steam distillation, is 0.5 - 1.0% of the fresh leaves and stems.

**Mountainmint:** the chemical composition of the essential oil of *P. pilosum* is somewhat variable. An analysis showed 80% pulegone, 10% menthone, 3-5% limonene, 2% menthol. Another reported 44% menthone and 27% pulegone.

**Nasturtium:** it contains mustard oils, which contribute to the peppery flavor. The glucosinolate glucotropaeolin has been recorded in the seeds, and especially in the young leaves. This has antibiotic and fungistatic activity. The seed oil has the highest proportion (80%) of erucic acid of any known seed oil. The seeds have a low oil content but at least in principle represent a potential new source of commercial seed oil.

**Oregano, Mexican:** Thirty-three components of the essential oil were identified. The oil usually contains mostly thymol (40-60%) and only a little carvacrol (3-21%) unlike some other sources of "oregano." In some populations carvacrol content exceeds that of thymol. Two of 12 populations examined had a thymol content over 30% and an oil yield above 1.8% that held out the possibility of commercial exploitation. An essential oil very similar to that of the *Origanum* spp. is found. A typical analysis is as follows: 50% thymol, 12% carvacrol, 9% *p*-cymene and a number of further monoterpenoids (1, 8 cineol,  $\gamma$ -terpinene, terpinene-4-ol and terpinene-4-yl-acetate) in amounts between 1-5%

**Pandan leaf:** has a low level of essential oil, including 2-acetyl-1-pyrroline (which also gives the aroma in Thai and Basmati rice), styrene, linalool, and  $\beta$ -caryophyllene. It also contains piperidine-like alkaloids (pandamarine, pandamarilactones) that give it its milky, floral-like taste. The flavor component of pandanus leaves is not well known. It is speculated that the flavor is due to a volatile product of oxidative degradation of a yellow carotenoids pigment that forms only when the plant withers. In that respect, there are similarities to saffron and rose, which also contain carotenoids-derived aroma compounds. The best candidate is 2-acetyl-1-pyrroline, which was found at levels of about 1 ppm and which also occurs in aromatic rice cultivars; another possibility is ethyl formiate, which is also common in both rice and pandanus leaves.

Yet another study found 3-methyl-2-(5H)-furanone as the main volatile compound in pandanus leaves, besides 3-hexanol, 4-methylpentanol, 3-hexanone and 2-hexanone. The leaves also contain piperidine-type alkaloids (pandamarine, pandamerilactones) with pyrroline-derived structures. On distillation, the leaves do yield traces of an essential oil, but it is unclear to what extent the volatile oil contributes to pandanus' flavor. In Sri Lankan pandanus leaves (*P. latifolius*, allegedly synonymous to *P. amaryllifolius*), the following aroma components have been identified in concentrations less than one microgram per kilogram (ppb) fresh material: styrene 0.62,  $\gamma$ -formylthipene 0.76, linlool 0.29,  $\beta$ -caryophyllene 0.55,  $\beta$ -farnesene 0.18, 1, 2-dimethoxybenzene 0.15, and  $\beta$ -selinene 1.24 ppb.

**Perilla:** the volatile oils of *P. frutescens* contain several compounds, such as *l*-perillaldehyde, perilla ketone, egomaketone, and isoegomaketone. Oil from dried leaves and inflorescences contains about 50% perillaldehyde, which is used as a flavoring and antiseptic agent. Perilla ketone has been associated with poisoning in domestic animals. There is considerable chemical diversity in perilla and consumption of the distinct chemotypes may result in different biological effects. The chemical type which mainly contains the monoterpenes perillaldehyde is preferred for human consumption because it is agreeable fragrance; the chemotypes with ergomaketone and perillaketone have disagreeable ketone odors and are toxic; and the phenylpropene chemotype is almost odorless. The seed oil of perilla is unusual for its high iodine number; it has many unsaturated bonds. The seed oil consists mainly of the polyunsaturated fatty acid, linolenic acid. Colored leaves of some forms of perilla contain the anthocyanin perillanin chloride; such leaves are used in Japan for color in plum preparations. Perilla leaves contain about 0.2% of an essential oil, which varies widely in composition. Several different chemotypes are known: PA is the only one of culinary value; the others are PK (main component perilla ketone, minor components isoegomaketone and perillene), EK (main component elsholzia ketone, minor component naginata ketone), PL (main component perillene, minor components citral, perilla ketone, isoegomaketone), PP (phenylpropanoids: myristicin, dillapiol, elemicin, safrole) and C (main component citral, minor components perillene, perilla ketone, isoegomaketone). There is also a type rich in rosefurane, which might have potential as a cheaper substitute for rose oil in perfumery. In the most frequently cultivated chemotype (PA), the main component is perillaldehyde (*p*-mentha-dien-1, 8 (9)-al (7), 75%). Its minor constituents are limonene (13%), linalool,  $\beta$ -caryophyllene, 1-menthol, limonene,  $\alpha$ -pinene, perillene (2-methyl-5-(3-oxolanyl)-2-pentene) and elemicin. Perillaldehyde can cause skin allergies. The C type is a potentially interesting source of citral, a pleasantly lemon-scented material much used in the flavor and perfume industries. The PP type may also gain importance as a source of simple phenylpropanoids in the pharmaceutical industry. The high myristicin content makes this plant considerably toxic. The dominating constituents of the remaining types are monoterpenoid furanes, often ketones. Some of these, e.g., isoegomaketone, are severe pneumotoxins that have caused fatal poisoning in cattle repeatedly. The PK type must be considered a toxic plant that has no use in the kitchen. The oxime of perillaldehyde (perillartin) is about 2000 times sweeter than sucrose; it is used as an artificial sweetener in Japan. Perilla seeds contain a drying oil (40%) with high content of multiple unsaturated fatty acids (60%  $\alpha$ -linolenic acid, 15% both linoleic and oleic acid); their medicinal value is sometimes exaggerated. Perilla contains the pseudotannins and antioxidants typical for the mint family. The reddish-purple color of some cultivars is caused by an anthocyanin pigment called perillanin chloride.

**Rosemary:** It has 0.5 - 2.5% volatile oil, mainly 1, 8-cineol (30%) (which gives rosemary its cool eucalyptus aroma), borneol (16 - 20%), camphor (15 - 25%), bornyl acetate (2 - 7%) and  $\alpha$ -pinene (25%). Different varieties differ in flavor depending on their constituents. Its oleoresin is a greenish brown semisolid, and 5 lbs. is equivalent to 100 lbs. of freshly ground, dried rosemary. A pale yellow essential oil is obtained by steam distillation of fresh leaves, yielding approximately 0.1%. The major oil constituents of the leaves are cineole (typically 27 - 30%), borneol (16 - 20%), camphor (10%), and bornyl acetate (2 - 7%), with small percentages of  $\alpha$ -pinene, camphene, terpineol and verbenone. Borneol is responsible for the pungent odor and burning taste, cineole contributes a fresh, cooling aroma,  $\alpha$ -pinene produces a pine-like odor, and camphor contributes a cool, minty sensation. The oleoresin is a greenish-brown semisolid. About one part of the oleoresin is equivalent to 40 parts of crushed, dried rosemary leaves in flavor and aroma. Oil of rosemary is produced by distillation of flowering tops or leafy twigs and is made up of nearly 60% monoterpenes such as  $\alpha$ -pinene. The major components of the essential oils vary widely in percentage composition depending on the cultivar. Inferior quality rosemary oil (indicated by larger amounts of  $\alpha$ -pinene and borneol) has sometimes appeared on the market, due in part to harvest of wild material. In container-grown rosemary, essential oil content is higher in plants receiving low rates of fertilization. The leaves contain about 1 - 2.5% essential oil. Therein, 1, 8-cineol (30%), camphor (15 - 25%), borneol (16 - 20%), bornyl acetate (max. 7%),  $\alpha$ -pinene (max. 25%) and others contribute to the complex taste.

**Sage:** sage has 1.5 - 3% essential oil, which is pale yellow to greenish yellow. Its composition differs in different varieties. Dalmatian sage has mainly thujone (28%), 1, 8-cineol (12%), borneol (4%), camphor (23%), camphene (7.4%),  $\alpha$ -humulene (5.3%), limonene (3.2%),  $\beta$ -caryophyllene (3.3%) and bornyl acetate (1.3%). Spanish sage lacks thujone but has more 1, 8-cineol (27%) and camphor (20%). Greek sage has high levels of 1, 8-cineol (39-67%) with smaller amounts of thujone and camphor. Sage oleoresin, which is dark green to brownish green and very viscous, is usually extracted from Dalmatian sage, and 7.5 lbs. are equivalent to 100 lbs. of freshly ground spice. It is used as a natural antioxidant because of its high phenol content. Steam distillation of the freshly harvested leaves produces a pale yellow or almost colorless oil with a strong aroma and spicy, camphorous, slightly bitter flavor. The yield is about 2.5%. The essential oil shows tremendous variability in the quantity of its principal components. The oil usually contains 40 - 60%  $\alpha$ - and  $\beta$ -thujone, 5 - 15% 1, 8-cineole, up to 16% borneol, and 3 - 35% camphor, as well as other constituents. The commercial oil is sometimes adulterated with oil from Greek sage and the hybrid between it and garden sage. An oleoresin is also produced commercially, about 1 kg of it equivalent to 13.4 kg of freshly ground sage in aroma and flavor. Several chemical races of domesticated garden sage have been recognized. Garden sage oil with a combined  $\alpha$ - and  $\beta$ -thujone content of >30% and a camphor content of <20% are most valued. The essential oil (1 - 2.5%) is composed rather differently in different species and varieties of sage. Dalmatian sage (*S. officinalis* spp. *minor*) contains mostly thujone (35 - 60%), 1, 8-cineol (15%), camphor (18%), borneol (16%), bornyl esters,  $\alpha$ -pinene and salvene. Greek sage (*S. triloba*) is more strongly aromatic, but generally not accepted as legitimate spice (at least, outside Greece). This species has an interesting, yet less subtle fragrance, the essential oil is dominated by cineol (64%) and contains small amounts of thujone (5%) and camphor (8%) but hardly any borneol.

**Savory:** Summer savory has 0.1 - 0.25% yellow to dark brown essential oil, while winter savory has 0.2 - 0.25% essential oil. The essential oil of summer savory mainly consists of carvacrol (3.4 - 50.4%), thymol (trace to 22.5%),  $\gamma$ -terpinene (2.1 - 60.3%),  $p$ -cymene (3.7 - 5.3%), limonene (0.2 - 5.3%), myrcene (0.5 - 2.8%), camphene,  $\alpha$ -thujene (1.8 - 4.2%), borneol (trace to 34%). These chemical constituents vary widely, depending on its origins and types, European types have very different flavor profiles than the North African or Canadian types. The essential oil of summer savory is obtained by steam distillation of the leaves and flowering tops. The oil content is highest during flowering. The yield of oil is between 0.10 and 0.15% of the air-dried herb. The oil is a golden-yellow color and has an odor reminiscent of thyme or oregano. The major chemical constituent is carvacrol (30 - 50%), and there may be 20 - 30%  $p$ -cymene. There may also be substantial amounts of thymol. Other chemicals found in the essential oil are  $\beta$ -caryophyllene, linalool,  $\alpha$ -terpineol, camphene, myrcene, and other terpenoids. The plant also contains 4-8% tannins. The relative proportion of chemicals in the oil varies according to the source used. The essential oil of winter savory is derived by steam distillation of the air-dried leaves and flowering tops. The yield is about 0.1 - 0.2%. The major constituent is carvacrol, which comprises 35-40% of the essential oil of wild plants, up to 65% of the essential oil of cultivated plants. However, there is considerable variation in constituents, and some collections have been found to be richest not in carvacrol, but other components. Some varieties contain, in addition to carvacrol, large amounts of thymol. Simon et al. list thymol,  $p$ -cymene, 1-linalool, 1-terpineol, *d*-borneol, dihydrocumyl alcohol, 1-carvone, 1-menthone, and various organic acids. The leaves contain ursolic acid. Savory contains an essential oil in varying amounts; good quality should range between 1-2%. In contrast to the olfactorily similar thyme, savory contains only minor amounts of thymol, but the main component is carvacrol, a position isomer of thymol (30-45%).  $p$ -Cymene (max. 30%),  $\gamma$ -terpinene,  $\alpha$ -pinene (8%), dipentene, borneol, 1-linalool, terpineol and 1-carvone are reported. A related species, *Satureja biflora*, lemon savory from Africa, contains an essential oil dominated by citral (60%), and camphor, menthone and pulegone.

**Sorrel:** sorrel has a high level of binoxalate of potash, which gives it the acidic taste. It has a leaf content of about 1000 mg/100 g of potassium binoxalate, with some tartaric acid. By comparison, the reported oxalic acid content of the two most well known high-oxalate acid plants are 1336 mg/100 g for rhubarb (leaf stalks), and 658 mg/100 g for spinach. Tartaric acid is also present, as well as malic acid and tannic acid.

**Stevia:** Eight diterpene glycosides with sweetening properties have been found in leaves of Stevia. The biosynthetic pathway of these has been partly worked out. The four major components (with sweetness relative to sucrose in parenthesis) are stevioside, rebaudioside A, rebaudioside C, and dulcoside A. Stevioside is low-calorific, non-fermentable, and stable at high temperatures (100 °C), and over a range of pH (3 - 9) and does not darken when cooked. It does not serve as food for mouth bacteria. Stevioside has an unpleasant aftertaste but is converted to some extent in the plant to rebaudioside A, which has less of an aftertaste. Canadian researchers have recently developed cultivars rich in rebaudioside A. The leaves contain 7.8% tannins so that raw leaves used as a sweetener in teas could contribute significant tannin. The natural plant hormone gibberellic acid is also present in the leaves but not in commercial quantities. Steviol can be used to produce gibberellic acids and several patents for the use of stevioside and derived compounds as plant growth regulators have been registered in Japan. The essential oil (not of

commercial importance) was examined. The essential oil (constituting only about 0.025% of the dried leaves) contained more than a hundred compounds. Forty-three percent of the oil was accounted for by caryophyllene oxide and spathulenol.

**Swamp leaf:** the plants yield 0.13% essential oil, containing *d*-limonene and *d*-perillaldehyd. The leaves contain about 0.1% essential oil, whose main component is limonene. Among the other compounds identified in the oil are perillaldehyde and an unusual monoterpenoid ketone *cis*-4-caranone.

**Sweet cicely:** trans-anethole makes up about 85% of the essential oil and accounts for the odor of the plant. Trans-anethole has been associated with an anise smell. This chief flavoring ingredient is widely used by the food industry as a flavoring agent in beverages, candy, baked goods, and chewing gum.

**Tarragon:** fresh French tarragon has 0.5 - 2.5% essential oil, which is pale yellow to amber in color and consists mainly of 60 - 75% estragol (also called methyl chavicol). It also has 10% anethole (which mainly contributes to tarragon's aroma),  $\alpha$ - and  $\beta$ -pinenes, camphene, phellandrene, limonene, and myrcene. There is less volatile oil (about 0.3-0.8%) in the dried herb. Russian tarragon does not have the estragol and, thus, is considered inferior to French tarragon. The oleoresin is dark green and viscous, and 2 lbs. are equivalent to 100 lbs. of ground dried leaves. The essential oil is released by steam distillation and ranges from 1 - 2% of total leaf material. Its chief constituent is methyl chavicol [also known as methylchavicol, estragole, allyl-anisole, and *p*-methoxyallyl-benzene] (60 - 75%), with many minor chemicals including anethole (about 10%), pinene, phellandrene, ocimene, and *p*-methoxycinnamaldehyde. The yellowish-green liquid has an aroma reminiscent of anise. A dark green, viscous liquid (an oleoresin) is prepared from French tarragon. In general, 1 kg of the oleoresin is equivalent in flavor and aroma to about 40 kg of ground, dried tarragon leaves. Estragole, the main component of French tarragon oil, is almost absent from Russian tarragon, while sabinene, methyeugenol and elemicin, principal constituents of Russian oil, are almost absent from French oil. There are also different flavonols: quercetin and patuletin glycosides were found in Russian tarragon. The so-called "German tarragon" (called "French tarragon" in all other countries) is the most aromatic cultivar. It contains up to 3% essential oil, whose aroma is dominated by the phenyl-propanoids methyl chavicol (also called estragole, up to 80%) and its isomer anethole (10%). Important terpene components are *trans*- $\beta$ -ocimene (up to 22%), *cis*- $\beta$ -ocimene (up to 15%) and  $\gamma$ -terpineol (vary variable, up to 17%). Lesser amounts of *p*-methoxy cinnamaldehyde, phellandrene,  $\alpha$ - and  $\beta$ -pinene, camphene, limonene and eugenol are also reported. Another cultivar, the so-called "Russian tarragon" (which is closer to the wild form) contains less essential oil (max. 1%), the main components of which are sabinene (up to 50%), methyl eugenol (up to 30%), elemicin (up to 30%), isoelimicin (up to 20%) and  $\beta$ -ocimene (10%). Since estragole is missing from its oil, Russian tarragon lacks the sweet scent of German tarragon; flavonoids (quercetin, patuletin) contribute a harsh and astringent flavor. The Russian variety is much easier to grow in cool climates; most tarragon plants sold for home gardeners belong to this inferior variety.

**Thyme:** the essential oil content of thyme ranges from 1.5-5%. Common thyme yields about 1.5-2.0% essential oil, which is colorless to pale yellowish red and predominantly contains thymol. Spanish thyme (which proves 90% of the world's thyme oil) mainly consists of phenols with 12-

61% thymol and 0.4-20.6% carvacrol, 1, 8-cineole (0.2-14.2%), p-cymene (9.1-22.2%), linalool (2.2-4, 8%), borneol (0.6-7.5%), α-pinene (0.9-6.6%), and camphor (0-7.3%). Most other varieties, such as Moroccan thyme, have lesser thymol. Wild thymes yield less volatile oil, about 0.5%. Its oleoresin is green to brownish green and is viscous, and 4 lbs. of oleoresin are equivalent to 100 lbs. of freshly ground thyme. The dried herb yields about 1% essential oil upon steam distillation. The essential oil is a pale yellowish-red liquid with a sweet aromatic odor. A dark green or brown oleoresin is also extracted. The major constituent is thymol which comprises up to 50% of the essential oil. Generally 1 kg of the oleoresin is equivalent to 25 kg of freshly ground, dried thyme in flavor and aroma. Several chemical races of garden thyme have been described and these are associated with particular environments. Thymol is usually the major component of the essential oil but other chemicals such as geraniol, linalool, α-terpineol, carvacrol, and *trans*-thuyanol-4 may predominate in some populations. The content of essential oil varies drastically with climate, time of harvest and storage conditions; extreme values are 0.75% and 6.5%. Main components are the phenols thymol (ca. 40%) and carvacrol (ca. 15%). In winter, phenol content is lower (but mostly thymol); in summer, more phenols (up to 70%) are found, with significant amounts of carvacrol. Further components in the essential oil are thymol methyl ether (2%), cineol, cymene, α-pinene, borneol and esters of the latter two. Lemon thyme, *Thymus x. citriodorus*, was found to contain an essential oil rich in geraniol (up to 60%); other compounds identified include geranyl esters, nerol and citronellol. The lemon fragrance is due to citral (14%) and thymol was found in small (0.5%) yet not insignificant amounts. The main components in *T. serpyllum* (grown in Uttarakhand, Northern India) were found to be thymol and its methyl ether. There is also a *Thymus* species native to that area (*T. linearis*) whose essential oil contains thymol (60%), p-cymene (10%) and γ-terpinene (6%), with large variations in percentages.

**Violet:** it contains saponins, a glycoside, violarutin, methyl salicylate and salicylic acid glycosides, mucilage, an alkaloid, odoratine, and anthocyanin pigments. On hydrolysis, the root glucoside gaultherin yields methylsalicylic acid. The chemical composition of violet has been extensively studied for the perfumery industry. Over a hundred compounds have been recorded.

**Yomogi:** the essential oil (0.03-0.3%) contains a wealth of different terpenes and terpene derivatives, e.g., 1, 8 cineol, camphor, linalool, thujone, 4-terpineole, borneol, α-cardinol and further mono- and sesquiterpenes. Quantitative and qualitative composition varies strongly with soil, climate, fertilizing, and harvest time. Thujone, of the oil's main constituents, is a monoterpenoid ketone also appearing in sage, thuja and, according to some sources, in a close relative of mugwort, southernwood. It is commonly held responsible for the toxicity of wormwood-flavored alcoholics, particularly *absinthe*, the “drug of the age” in France a hundred years ago (fin de siècle). Absinthe was a potent liqueur flavored with anise, fennel, plenty of wormwood and other plants; it was drunk together with water and sugar. The high alcohol content (often exceeding 60%) and the thujone (typically 50-100 ppm) both contributed to its psycho-active properties. Since chronic consumption resulted in severe nerve damage, absinthe was banned in nearly all European countries, with the exception of Portugal and Spain. Liqueurs based solely on anise, could establish themselves as alternatives for absinthe. Within the European Union, the ban was revoked in 1998 and absinthe has become legal again, although the thujone content is now restricted to max. 35 ppm. It is an open question whether the liquor will regain its former popularity. As wormwood tastes intensively bitter, it is almost impossible to

incorporate quantities sufficient for thujone poisoning by accident. Even if the thujone is separated from the bitter absinthe by distillation, the resulting product is still too bitter to drink without sugar. Wormwood-flavored wine (*vermouth*) contains only traces of thujone.

## APPENDIX F: NUTRITIONAL VALUES FOR HERBS AND SPICES:

**Nutritional Values for the Herbs and Spices Crop Group.**

COMMODITY	NUTRITIONAL VALUES
Allspice	Good source of fiber, calcium, potassium, vitamin C, and Vitamin A.
Anise seed	Good source of iron, and potassium.
Balm	No data.
Basil dried leaves	Good source of protein, iron, calcium, potassium, vitamin C, and Vitamin A.
Basil fresh leaves	Good source of Vitamins A and K.
Bay leaf	Good source of iron and Vitamin A.
Betel vine	Leaf contains many essential vitamins and minerals
Borage	Oil from the seeds a good source of gamma linolenic acid
Calendula	Leaves rich in vitamins and minerals. Similar to dandelion in nutrition value. Petals high in vitamin A and vitamin C
Caraway seed	Good source of iron and potassium.
Cardamom	Good source of iron, and potassium.
Celery seed	Good source of iron and potassium.
Chervil	Good source of calcium, potassium, and Vitamin A.
Chia	High in protein and omega-3 fatty acids
Chive	Rich in vitamins A and C.
Chive, Chinese	Contains small amounts of vitamins A, B1, and C.
Cilantro dried leaf	Good source of iron, calcium, potassium, vitamin C, niacin, Vitamin A and Vitamin K.
Cinnamon	Good source of calcium.
Clove	Good source of potassium, and Vitamin K.
Coriander seed	Good source of potassium.
Culantro	Good source of vitamin A
Cumin seed	Good source of potassium and Vitamin A.
Curry	Good source of iron, potassium and Vitamin K.
Dill seed	Good source of iron and potassium.
Dillweed	Good source of calcium, potassium, and Vitamin A.
Fennel seed	Good source of calcium and potassium.
Fenugreek seed	Good source of iron, potassium, phosphorus, and sulfur
Juniper berry	Large doses of juniper can be toxic
Mace	Good source of calcium and potassium.



COMMODITY	NUTRITIONAL VALUES
<b>Marigold</b>	African marigold, French marigold, Mexican mint marigold, Signet marigold - No specific entry.
<b>Marjoram dried</b>	High in antioxidants. Good source of iron, calcium, potassium, and Vitamin A.
<b>Mustard seed</b>	Good source of potassium.
<b>Nettle</b>	Contains high amounts of vitamins A, C, and D, as well as calcium, iron, and other essential minerals
<b>Nutmeg</b>	Good source of niacin.
<b>Oregano</b>	Good source of calcium, potassium, niacin, Vitamin A and Vitamin K.
<b>Parsley dried leaves</b>	Good source of magnesium, potassium, Vitamin A and Vitamin K.
<b>Pepper, black</b>	Good source of potassium, Vitamin A and Vitamin K.
<b>Pepper, white</b>	Good source of iron.
<b>Peppermint fresh leaves</b>	Good source of potassium and Vitamin A.
<b>Poppy seed</b>	Good source of calcium.
<b>Rosemary dried leaves</b>	Good source of calcium, iron, potassium, and Vitamin A.
<b>Saffron crocus</b>	Good source of potassium.
<b>Sage</b>	Good source of calcium, potassium, niacin, Vitamins A, B6, and K.
<b>Savory</b>	Good source of calcium, potassium, and Vitamin A.
<b>Spearmint, fresh leaves</b>	Good source of potassium and Vitamin A.
<b>Spearmint, fresh leaves</b>	Good source of calcium, magnesium, potassium, niacin, and Vitamin A.
<b>Tarragon</b>	Good source of calcium, potassium, and Vitamin A.
<b>Thyme fresh leaves</b>	A good source of iron, calcium, and Vitamins A and K.
<b>Thyme dried leaves</b>	A good source of iron, calcium, and Vitamins A and K.
<b>Toon, Chinese</b>	High in vitamin A
<b>Wattleseed</b>	The wattleseeds are high in fiber and unsaturated fats.

## APPENDIX G: MEDICINAL USES OF THE HERB CROP GROUP:

**Table Medicinal Uses for the Herbs Crop Group.**

(ncgherbs&spices; Wikipedia; plants for a future.org; gourmetsleuth.com)

COMMODITY	MEDICINAL USES
<b>Agrimony, dried</b>	Used in a wide range of folk remedies in Europe, Russia, and North America, and in traditional Chinese medicine. Agrimony has long been used as a popular domestic herbal remedy. An astringent and mildly bitter herb, it is a helpful remedy for diarrhoea and a gentle tonic for the digestion as a whole. The whole plant is antiaphonic, astringent, blood purifier, cholagogue, diuretic, tonic and vulnerary. It contains up to 5% tannin, which has a strongly astringent effect. When taken internally, an infusion of the plant has a great reputation in the treatment of jaundice and other complaints of the liver, it is also used to treat diarrhoea and as a gargle for sore throats. Externally, a strong decoction is used to treat wounds, skin problems, haemorrhoids, etc. The plant is harvested in late spring and early summer and can be dried for later use. The plant is used in Bach flower remedies – the keywords for prescribing it are ‘Mental torture’ and ‘Worry, concealed from others’.
<b>Angelica, seed</b>	Legend has it that the name Angelica came from an angel who informed a monk about the virtues of the healing powers of the plant during the time of a plague epidemic. During the plague epidemic of 1664 people were instructed to chew on the roots of the angelica plant to help protect them from infection. Other medicinal uses include a treatment for digestive disorders, lowers fever and used as an expectorant.
<b>Balm</b>	Lemon balm is a commonly grown household remedy with a long tradition as a tonic remedy that raises the spirits and lifts the heart. Modern research has shown that it can help significantly in the treatment of cold sores. The leaves and young flowering shoots are antibacterial, antispasmodic, antiviral, carminative, diaphoretic, digestive, emmenagogue, febrifuge, sedative, and tonic. It also acts to inhibit thyroid activity. An infusion of the leaves is used in the treatment of fevers and colds; indigestion associated with nervous tension, excitability and digestive upsets in children, hyperthyroidism, depression, mild insomnia, headaches etc. Externally, it is used to treat herpes, sores, gout, insect bites and as an insect repellent. The plant can be used fresh or dried, for drying it is harvested just before or just after flowering. The essential oil contains citral and citronella, which act to calm the central nervous system and are strongly antispasmodic. The plant also contains polyphenols, in particular these combat the herpes simplex virus which produces cold sores. The essential oil is used in aromatherapy. Its keyword is ‘Female aspects’. It is used to relax and rejuvenate, especially in cases of depression and nervous tension.

COMMODITY	MEDICINAL USES
<b>Basil</b>	<p><i>O. basilicum</i>: Sweet basil has been used for thousands of years as a culinary and medicinal herb. It acts principally on the digestive and nervous systems, easing flatulence, stomach cramps, colic and indigestion. The leaves and flowering tops are antispasmodic, aromatic, carminative, and digestive, galactagogue, stomachic and tonic. They are taken internally in the treatment of feverish illnesses (especially colds and influenza), poor digestion, nausea, abdominal cramps, gastro-enteritis, migraine, insomnia, depression and exhaustion. Externally, they are used to treat acne, loss of smell, insect stings, snake bites and skin infections. The leaves can be harvested throughout the growing season and are used fresh or dried. The mucilaginous seed is given in infusion in the treatment of gonorrhoea, dysentery and chronic diarrhoea. It is said to remove film and opacity from the eyes. The root is used in the treatment of bowel complaints in children. Extracts from the plant are bactericidal and are also effective against internal parasites. The essential oil is used in aromatherapy. Its keyword is 'Clearing'. In Chinese medicine for kidney disease and gum ulcers. In Indian medicine for earache, rheumatoid arthritis, anorexia, itching, menstrual disorders, and malaria.</p> <p><i>O. tenuiflorum</i>: Recent studies suggest tulsi may be a COX-2 inhibitor, like many modern painkillers, due to its high concentration of eugenol (1-hydroxy-2-methoxy-4-allylbenzene). One study showed it to be an effective treatment for diabetes by reducing blood glucose levels. The same study showed significant reduction in total cholesterol levels with tulsi. Another study showed its beneficial effect on blood glucose levels is due to its antioxidant properties. Tulsi also shows some promise for protection from radiation poisoning and cataracts. It has anti-oxidant properties and can repair cells damaged by exposure to radiation. The fixed oil has demonstrated antihyperlipidemic and cardioprotective effects in rats fed a high fat diet. Experimental studies have shown an alcoholic extract of tulsi modulates immunity, thus promoting immune system function. Some of the main chemical constituents of tulsi are: oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool, caryophyllene, elemene (c.11.0%), caryophyllene (about 8%), and germacrene D (about 2%). -Elemene has been studied for its potential anticancer properties, but human clinical trials have yet to confirm its effectiveness. <i>O. sanctum</i> extracts are antibacterial (against <i>E. coli</i>, <i>S. aureus</i> and <i>P. aeruginosa</i>).</p> <p>Tulsi extracts are used in ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning, and malaria. Traditionally, tulsi is taken in many forms: as herbal tea, dried powder, fresh leaf, or mixed with ghee. Essential oil extracted from Karpoora tulsi is mostly used for medicinal purposes and in herbal cosmetics, and is widely used in skin preparations due to its antibacterial activity. For centuries, the dried leaves have been mixed with stored grains to repel insects.</p>
<b>Borage</b>	Many folk remedies. Borage tea is widely considered to be calming and to lift the mood

COMMODITY	MEDICINAL USES
<b>Borage, Indian</b>	<p>A poultice of the leaves is a folk remedy for burns and bite. The leaves have also had many traditional medicinal uses, especially for the treatment of coughs, sore throats and nasal congestion, but also for a range of other problems such as infections, rheumatism and flatulence. The plant is cultivated in home-gardens throughout India for use in traditional medicine, being used to treat malarial fever, hepatopathy, renal and vesical calculi, cough, chronic asthma, hiccough, bronchitis, helminthiasis, colic, convulsions, and epilepsy, Shenoy and others refer to further Indian traditional medicinal uses such as for skin ulcerations, scorpion bite, skin allergy, wounds, diarrhoea, with emphasis on the leaves being used as a hepatoprotective, to promote liver health. In Indonesia <i>Plectranthus amboinicus</i> is a traditional food used in soup to stimulate lactation for the month or so following childbirth. In Cambodia 2 uses are recorded: juice from the leaves is sweetened and then given to children as protection from colds; and leaves are applied to the lips. In Bahia, Brasil, people use the plant to treat skin lesions caused by <i>Leishmania braziliensis</i>. Just to the north, in Paraiba of the same country, the plant was extremely commonly known for use in home medication. As noted above, medicinal use also occurs in Southern India, it also documented in other parts of South East Asia and South Africa.</p> <p>Other uses include as an ornamental, and for its essential oils.</p>
<b>Burnet</b>	An astringent, used on dry skin, sun burns, and burns
<b>Calamint</b>	Various folk remedies
<b>Calendula</b>	A home remedy for various ailments, most notably skin conditions such as insect bites or stings
<b>Caraway</b>	A common household remedy for indigestion
<b>Catnip</b>	<p>Catmint has a long history of use as a household herbal remedy, being employed especially in treating disorders of the digestive system and, as it stimulates sweating, it is useful in reducing fevers. The herbs pleasant taste and gentle action makes it suitable for treating colds, flu and fevers in children. It is more effective when used in conjunction with elder flower (<i>Sambucus nigra</i>). The leaves and flowering tops are strongly antispasmodic, antitussive, astringent, carminative, diaphoretic, slightly emmenagogue, refrigerant, sedative, slightly stimulant, stomachic and tonic. The flowering stems are harvested in August when the plant is in full flower, they are dried and stored for use as required. An infusion produces free perspiration, it is considered to be beneficial in the treatment of fevers and colds. It is also very useful in the treatment of restlessness and nervousness, being very useful as a mild nervine for children. A tea made from the leaves can also be used. The infusion is also applied externally to bruises, especially black eyes.</p>

COMMODITY	MEDICINAL USES
<b>Chamomile</b>	<i>Matricaria</i> : German chamomile is a well-known herbal remedy and is much used in the West. In particular it is an excellent herb for treating various digestive disorders, nervous tension and irritability and is also used externally to treat skin problems. An infusion of the flowers is taken internally as an anodyne, anti-inflammatory, antiseptic, antispasmodic, carminative, cholagogue, diaphoretic, emmenagogue, febrifuge, sedative, stomachic, tonic and vasodilator. An infusion is particularly useful as a stomachic, nervine and sedative for young children, especially when they are teething. It is also used in the treatment of irritable bowel syndrome, Crohn's disease, peptic ulcers and hiatus hernia. In large doses, or when taken regularly for several times each day, the tea can be emetic and can also cause the symptoms it is intended to cure. The flowers are also used externally to treat wounds, sunburn, burns, haemorrhoids, and mastitis and leg ulcers. The flowers are harvested when fully open and are dried for later use. The flowers contain various volatile oils including proazulenes. Upon steam distillation these proazulenes produce chamazulene, this is remarkably anti-allergenic and is useful in the treatment of asthma and hay fever. The flowers are sometimes added to cosmetics as an anti-allergenic agent. The whole plant, harvested when in flower, is used to make a homeopathic remedy. It is especially suited to teething children and those who have been in a highly emotional state over a long period of time.
<b>Chervil</b>	Not much used medicinally
<b>Chive</b>	Rarely used medicinally, but said to aid digestion and be beneficial to the circulatory system
<b>Chive, Chinese</b>	Is antibacterial and used in a variety of folk remedies
<b>Clary</b>	Used in many folk remedies, especially for digestive issues. Pregnant women should not consume
<b>Coriander/Cilantro</b>	Coriander is a commonly used domestic remedy, valued especially for its effect on the digestive system, treating flatulence, diarrhoea and colic. It settles spasms in the gut and counters the effects of nervous tension. The seed is aromatic, carminative, expectorant, narcotic, stimulant and stomachic. It is most often used with active purgatives in order to disguise their flavour and combat their tendency to cause gripe. The raw seed is chewed to stimulate the flow of gastric juices and to cure foul breath and will sweeten the breath after garlic has been eaten. Some caution is advised, however, because if used too freely the seeds become narcotic. Externally the seeds have been used as a lotion or have been bruised and used as a poultice to treat rheumatic pains. The essential oil is used in aromatherapy. Its keyword is 'Appetite stimulant'.
<b>Coriander, Vietnamese</b>	Various folk remedies
<b>Costmary</b>	Not much used in herbal medicine, but some folk remedies
<b>Culantro</b>	Folk remedy for colds and fevers
<b>Curry</b>	Folk remedies

COMMODITY	MEDICINAL USES
<b>Epazote</b>	<p>As a medicinal herb, epazote' is used for the treatment of skin diseases (such as eczema), ulcers and wounds. The seed and flower oil is highly toxic, and it is used to kill parasites and worms in both humans and livestock. It is antispasmodic and reportedly has anti-tumor properties. In Africa it is used for colds and stomach aches. The plant and seed have a long history of use among all indigenous people in every region where the plant grows. The seed oil, first isolated for commercial use in 1895, was subsequently officially listed in the US Pharmacopoeia as a treatment for ascarids and hookworms in humans, cats, dogs, horses, and pigs. A 1970s WHO study reported a 20 gm dose of leaf decoction rapidly expelled parasites - no side effects were reported. In 1996 a clinical trial showed anti-parasitic efficacy in over half of Ascaris parasite cases treated with extract of leaf, and complete effectiveness in treating the more common intestinal parasites, Ancilostoma and Trichuris. Complete effectiveness has also been reported in eliminating human tapeworm. Epazote has been shown to have toxic action against drug-resistant strains of Mycobacterium tuberculosis.</p> <p><b>Properties:</b> Antibacterial, anti-parasitic, anti-tumorous, insecticidal, antacid, digestive stimulant, hepatoprotective, anti-inflammatory, antimicrobial, antiseptic, antispasmodic, anti-ulcer, carminative, digestive stimulant, diuretic, laxative, menstrual stimulant, nervine, sedative, and tonic. It is used in treating coughs, asthma, bronchitis, other upper respiratory conditions, and tuberculosis. Externally the decoction is used for treating hemorrhoids, bruises, wounds, contusions and fractures.</p>
<b>Fennel (common)</b>	<p>Fennel has a long history of herbal use and is a commonly used household remedy, being useful in the treatment of a variety of complaints, especially those of the digestive system. The seeds, leaves and roots can be used, but the seeds are most active medicinally and are the part normally used. An essential oil is often extracted from the fully ripened and dried seed for medicinal use, though it should not be given to pregnant women. The plant is analgesic, anti-inflammatory, antispasmodic, aromatic, carminative, diuretic, emmenagogue, expectorant, galactagogue, hallucinogenic, laxative, stimulant and stomachic. An infusion is used in the treatment of indigestion, abdominal distension, stomach pains etc. It helps in the treatment of kidney stones and, when combined with a urinary disinfectant like Arctostaphylos uva-ursi, makes an effective treatment for cystitis. It can also be used as a gargle for sore throats and as an eyewash for sore eyes and conjunctivitis. Fennel is often added to purgatives in order to allay their tendency to cause gripe, and also to improve the flavour. An infusion of the seeds is a safe and effective cure for wind in babies. An infusion of the root is used to treat urinary disorders. An essential oil obtained from the seed is used in aromatherapy. Its keyword is 'Normalising'. The essential oil is bactericidal, carminative and stimulant. Some caution is advised, see notes above on toxicity.</p>
<b>Fennel, Florence</b>	Home remedy for digestive ailments
<b>Fennel, Spanish</b>	Seeds formerly used as a folk remedy in the Mediterranean region

COMMODITY	MEDICINAL USES
<b>Geranium</b>	<p><i>P. sidoides</i>: <i>Pelargonium sidoides</i> (Umckaloabo, South African Geranium) is a medicinal plant native to South Africa. Derivative inexpensive cold and flu medicines of various brands are widely available under the Umcka ("Umca" in Turkey) name. Studies have suggested that extracts from the plant could be used in treating acute bronchitis, acute non-GABHS tonsillopharyngitis (sore throat) in children, and the common cold. A 2008 systematic review of these findings by the Cochrane Collaboration concluded that extracts of the plant might be effective in treating adults for acute rhinosinusitis and the common cold in adults, but they noted that this conclusion is not certain. They also wrote that it might be effective in relieving the symptoms of acute bronchitis in adults and children, and also the symptoms of sinusitis in adults. A 2009 systematic review concluded "There is encouraging evidence from currently available data that <i>P. sidoides</i> is effective compared to placebo for patients with acute bronchitis." It has been shown to be antimycobacterial with significant antibacterial properties against multi-resistant <i>Staphylococcus aureus</i> strains. Gallic acid and its methyl ester present in large amounts in <i>P. sidoides</i> and in its active extracts, were identified as the prominent immunomodulatory principle. The <i>Pelargonium sidoides</i> extract EPs 7630 is an approved drug for the treatment of acute bronchitis in Germany. Determination of virus-induced cytopathogenic effects and virus titres revealed that EPs 7630 at concentrations up to 100 µg/ml interfered with replication of seasonal influenza A virus strains (H1N1, H3N2), respiratory syncytial virus, human coronavirus, parainfluenza virus, and coxsackie virus but did not affect replication of highly pathogenic avian influenza A virus (H5N1), adenovirus, or rhinovirus. "<i>Pelargonium sidoides</i> extract modulates the production of secretory immunoglobulin A in saliva, both interleukin-15 and interleukin-6 in serum, and interleukin-15 in the nasal mucosa. Secretory immunoglobulin A levels were increased, while levels of IL-15 and IL-6 were decreased. Based on this evidence, we suggest that this herbal medicine can exert a strong modulating influence on the immune response associated with the upper airway mucosa." A randomized, double-blind, placebo-controlled clinical trial of 200 patients concluded "EPs 7630 was shown to be efficacious and safe in the treatment of acute bronchitis in children and adolescents outside the strict indication for antibiotics with patients treated with EPs 7630 perceiving a more favourable course of the disease and a good tolerability as compared with placebo."</p>
<b>Honewort seed</b>	Used in China to treat colds, diarrhea, and rheumatism.
<b>Hop</b>	Extracts of the plant are used in Europe in skin creams and lotions for their alleged skin-softening properties.
<b>Horehound</b>	<p>White horehound is a well-known and popular herbal medicine that is often used as a domestic remedy for coughs, colds, wheeziness etc. The herb apparently causes the secretion of a more fluid mucous, readily cleared by coughing. The leaves and young flowering stems are antiseptic, antispasmodic, cholagogue, diaphoretic, digestive, diuretic, emmenagogue, strongly expectorant, hepatic, stimulant and tonic. Horehound is a very valuable pectoral, expectorant and tonic that can be safely used by children as well as adults. It is often made into a syrup or candy in order to disguise its very bitter flavour, though it can also be taken as a tea. As a bitter tonic, it increases the appetite and supports the function of the stomach. It can also act to normalize heart rhythm. The plant is harvested as it comes into flower and can be used fresh or dried. The root is a remedy for the bite of rattlesnakes, it is used in equal portions with <i>Plantago lanceolata</i> or <i>P. major</i>.</p>

COMMODITY	MEDICINAL USES
<b>Hyssop</b>	Hyssop has a long history of medicinal use and was so highly esteemed in the past that it was considered to be a virtual cure-all. Currently an undervalued herb, it is often used as a household remedy, particularly as an expectorant and stomach tonic. It has a positive effect when used to treat bronchitis and respiratory infections, especially where there is excessive mucous production. Hyssop can irritate the mucous membranes, so it is best given after an infection has peaked, when the herb's tonic action encourages a general recovery. The plant should not be used by pregnant women, however, since in large quantities it can induce a miscarriage. The leaves and flowering tops are antiseptic, antitussive, astringent, carminative, diaphoretic, emmenagogue, expectorant, pectoral, sedative, stimulant, stomachic, tonic and vasodilator. The plant can be harvested when in full flower and dried for later use. A tea made from the leaves is used in the treatment of flatulence, stomach-aches, upper respiratory tract infections, coughs in children etc. A poultice made from the fresh herb is used to heal wounds. The essential oil is used in aromatherapy. Its keyword is 'Stability'. This oil should not be used on people who are highly strung as it can cause epileptic symptoms. The essential oil should not be used internally except under professional supervision.
<b>Hyssop, anise</b>	Various folk remedies
<b>Lavender</b>	Lavender is a commonly used household herb, though it is better known for its sweet-scented aroma than for its medicinal qualities. However, it is an important relaxing herb, having a soothing and relaxing affect upon the nervous system. The flowering spikes can be dried and used internally in a tincture, though the extracted essential oil is more commonly used. The essential oil is much gentler in its action than most other essential oils and can be safely applied direct to the skin as an antiseptic to help heal wounds, burns etc. An essential oil obtained from the flowers is antihistosis, powerfully antiseptic, antispasmodic, aromatic, carminative, cholagogue, diuretic, nervine, sedative, stimulant, stomachic and tonic. It is not often used internally, though it is a useful carminative and nervine. It is mainly used externally where it is an excellent restorative and tonic – when rubbed into the temples, for example, it can cure a nervous headache, and it is a delightful addition to the bath-water. Its powerful antiseptic properties are able to kill many of the common bacteria such as typhoid, diphtheria, streptococcus and Pneumococcus, as well as being a powerful antidote to some snake venoms. It is very useful in the treatment of burns, sunburn, scalds, bites, vaginal discharge, anal fissure etc, where it also soothes the affected part of the body and can prevent the formation of permanent scar tissue. The essential oil is used in aromatherapy. Its keyword is 'Immune system'.
<b>Lemon verbena</b>	Various folk remedies; known to be soothing to the digestive system and is useful in the treatment of yeast infections
<b>Lemongrass</b>	Important in Ayurvedic medicine
<b>Lovage seed</b>	Long used as a folk remedy; sold as a diuretic drug in Europe
<b>Marigold</b>	African marigold - Various folk remedies, and is an antibacterial, anthelmintic, aromatic, digestive, diuretic, emmenagogue, sedative and stomachic. French marigold - The whole plant is used as an aromatic, digestive, diuretic, and sedative. Mexican mint marigold - Whole plant used as an anaesthetic, digestive aid, diuretic, febrifuge, hallucinogenic, hypotensive, narcotic and sedative; various folk remedies. An extract of the plant was found to inhibit the growth of several strains of bacteria and yeast. Recent research suggests it has powerful anti-viral properties. Signet marigold - No specific entry.



COMMODITY	MEDICINAL USES
<b>Marjoram</b>	Various folk remedies. Has shown antimicrobial activity, which may aid in food preservation. Oil of oregano has many health benefits and many other uses. Most people interchange the oregano spice and the oregano herb, which are different in terms of uses and benefits. The oregano spice has a scientific name of <i>Origanum marjorum</i> which is known for its minty flavoring for dishes and other delicacies. The herbal oregano where oregano oil comes from has the scientific name of <i>Origanum vulgare</i> . These two differ in uses; the first is the common oregano whilst the latter is used in producing oregano oil. There are a lot of oil of oregano uses and benefits. This herb has been used for a long time dating back to the ancient Greeks, which discovered the health benefits that the oregano herb could provide. Oil of oregano uses were discovered by the ancient Greeks and include: to cure respiratory diseases, to strengthen the immune system and to increase muscle and joint flexibility. With today's research and technology it has been discovered that the oil of oregano uses can be increased and developed to help treat other human problems—like skin and other health conditions.
<b>Meadowsweet</b>	Meadowsweet has a very long history of herbal use, it was one of the three most sacred herbs of the Druids. The leaves and flowering stems are alterative, anti-inflammatory, antiseptic, aromatic, astringent, diaphoretic, diuretic, stomachic and tonic. The plant is harvested in July when it is in flower and can be dried for later use. The flower head contains salicylic acid, from which the drug aspirin can be synthesised. Unlike the extracted aspirin, which can cause gastric ulceration at high doses, the combination of constituents in meadowsweet act to protect the inner lining of the stomach and intestines whilst still providing the anti-inflammatory benefits of aspirin. The herb is a valuable medicine in the treatment of diarrhoea, indeed it is considered almost specific in the treatment of children's diarrhoea. It is also considered to be a useful stomachic, being used to treat hyperacidity, heartburn, gastritis and peptic ulcers, for which it is one of the most effective plant remedies. It is also frequently used in the treatment of afflictions of the blood. Meadowsweet is also effective against the organisms causing diphtheria, dysentery and pneumonia. This remedy should not be given to people who are hypersensitive to aspirin. A strong decoction of the boiled root is said to be effective, when used externally, in the treatment of sores and ulcers. A homeopathic remedy is made from the fresh root.
<b>Mint</b>	Like the cultivated mints, Field Mint can be used to make a pleasant herbal tea. In humans, the floral oil of mints is more likely to disrupt populations of harmful bacteria, reducing flatulence and other digestive problems.
<b>Mioga</b>	Traditional Japanese medicine
<b>Monarda</b>	Used to treat cold and flu, digestive ailments, and to treat problems of the mouth, as it is a powerful antiseptic
<b>Mountainmint</b>	Native American remedy for headaches and general ill-health
<b>Mustard seed</b>	The oil is high in omega-3, and is very heart healthy
<b>Myrtle, anise</b>	Essential oil is antimicrobial
<b>Myrtle, lemon</b>	Oil is antimicrobial
<b>Nasturtium</b>	In the Andes used as a disinfectant and an expectorant
<b>Nettle</b>	Wide variety of folk and household remedies; often taken as a general tonic. Today, stinging nettle is in demand as a treatment for non-cancerous prostate enlargement, for high blood pressure and urinary tract infections. It is used to treat skin eruptions an eczema, and freeze-dried as a treatment for hay fever.
<b>Pandan leaf</b>	Various folk remedies

COMMODITY	MEDICINAL USES
<b>Parsley, dried</b>	<p>Parsley is a commonly grown culinary and medicinal herb that is often used as a domestic medicine. The fresh leaves are highly nutritious and can be considered a natural vitamin and mineral supplement in their own right. The plants prime use is as a diuretic where it is effective in ridding the body of stones and in treating jaundice, dropsy, cystitis etc.</p> <p>It is also a good detoxifier, helping the body to get rid of toxins via the urine and therefore helping in the treatment of a wide range of diseases such as rheumatism. The seed is a safe herb at normal doses, but in excess it can have toxic effects. Parsley should not be used by pregnant women because it is used to stimulate menstrual flow and can therefore provoke a miscarriage. All parts of the plant can be used medicinally, the root is the part most often used though the seeds have a stronger action. Parsley is antidandruff, antispasmodic, aperient, carminative, digestive, diuretic, emmenagogue, expectorant, galactofuge, kidney, stomachic and tonic. An infusion of the roots and seeds is taken after childbirth to promote lactation and help contract the uterus. Parsley is also a mild laxative and is useful for treating anaemia and convalescents. Caution is advised on the internal use of this herb, especially in the form of the essential oil. Excessive doses can cause liver and kidney damage, nerve inflammation and gastro-intestinal haemorrhage. It should not be prescribed for pregnant women or people with kidney diseases. A poultice of the leaves has been applied externally to soothe bites and stings, it is also said to be of value in treating tumours of a cancerous nature. It has been used to treat eye infections, whilst a wad of cotton soaked in the juice will relieve toothache or earache. It is also said to prevent hair loss and to make freckles disappear. If the leaves are kept close to the breasts of a nursing mother for a few days, the milk flow will cease.</p>
<b>Peppertree</b>	<p><i>S. molle</i>: In traditional medicine, <i>S. molle</i> was used in treating a variety of wounds and infections due to its antibacterial and antiseptic properties. It has also been used as an antidepressant and diuretic, and for toothache, rheumatism and menstrual disorders, with recent studies in mice providing possible support for its antidepressant effects. It has also been speculated that <i>S. molle</i>'s insecticidal properties make it a good candidate for use as an alternative to synthetic chemicals in pest control.</p>
<b>Perilla</b>	Various traditional remedies. Used to treat colds, allergic reactions, and for immune regulation. Is an antiseptic
<b>Rosemary</b>	Various folk remedies. Contains antioxidants, and may be useful in the treatment of head lice
<b>Sage</b>	Used for a wide range of herbal remedies, and is an antiseptic
<b>Savory</b>	Various folk remedies, but considered beneficial to the digestive system
<b>Sorrel</b>	Various folk remedies. Leaves are highly astringent
<b>Southernwood</b>	Various uses in folk and herbal medicine. Some species are toxic in large doses, and may cause contact dermatitis
<b>Stevia</b>	Legally available as both a sweetener and a food additive.
<b>Swamp leaf</b>	Some medicinal use in China
<b>Sweet cicely</b>	Folk remedies
<b>Thyme</b>	Used in cough syrup and cough drops

COMMODITY	MEDICINAL USES
<b>Toon, Chinese</b>	The fruit, bark, and roots are used in traditional Chinese medicine. <i>Toona sinensis</i> can induce apoptosis of cancer cells, reduce plasma glucose in diabetic rats, and improve lipolysis of differentiated 3T3-L1 adipocyte and its uptake of glucose. It has also been shown that it may increase dynamic activity of human sperm. <i>Toona</i> can safely prevent and alleviate lung cancer proliferation <i>in vitro</i> and <i>in vivo</i> . It has the potential to be developed as an anti-lung-cancer drug. Leaf extracts of <i>T. sinensis</i> have cytotoxic activity on several cancer cells including prostrate cancer cells. Gallic acid has been identified as the major anti-cancer compound. It is cytotoxic to DU145 prostrate cancer cells. Intraperitoneal injection of <i>Toona</i> extract suppressed the proliferation of ovarian cancers without toxicity.
<b>Violet</b>	Many uses in folk medicine, especially to treat headaches
<b>Wintergreen</b>	Contains an effective anti-inflammatory; various other folk remedies
<b>Yarrow</b>	Used for a large range of herbal remedies. Extended use may cause skin rashes or photosensitivity. In antiquity, yarrow was known as herbal <i>militaris</i> , for its use in staunching the flow of blood from wounds. Today <i>Achillea</i> is used internally for fevers and colds, as an antispasmodic for menstrual pain and digestive complaints, and as a pain reliever. It is used externally on cuts to stop bleeding and promote healing. A tincture of yarrow is registered with Health Canada in the Herb and Natural Product over-the-counter drug category and there are also registered homeopathic table preparations.
<b>Yomogi</b>	Yomogi is the Japanese "wonder herb" member of the Daisy family. The first mention of Yomogi as an herbal treatment is in the ancient medical book "Meibetsuroku" published in 500 AD. It describes Yomogi as a source of healing power for whatever ails a person. •Fights infections •Alleviates bacteria-induced skin conditions such as acne •Improves blood circulation •Relieves inflammatory joint discomfort and sciatic pain. <i>A. princeps</i> is one of the varieties of mugwort used as moxa in Moxibustion, a traditional medical practice of China, Japan, Korea, Mongolia, Tibet, and Vietnam. An evaluation of the efficacy of the smoke and water extracts of the herb found that both preparations inhibited the growth of a specific line of breast cancer cells in vitro. Phenolics from <i>A. princeps</i> (caffeoylquinic acids (CQA) such as 3-CQA (chlorogenic acid), 4-CQA, 5-CQA (neochlorogenic acid), 1,5-diCQA, 3,4-diCQA, 3,5-diCQA and 4,5-diCQA) alleviated the oxidative stress and enhanced the viability of certain neuronal cells in vitro.

**APPENDIX H: Herb and Spice Seeds/lb, and General Growing Practices (Johnny's Selected Seeds 2015, Harris Seeds, 2007, Rupp Vegetable Catalog, 2010, Siegers Seed, 2010, Territorial Seed Co., 2009).**

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
Agastache ( <i>Agastache aurantiaca</i> )	Apricot Sprite Golden Jubilee Heather Queen		"A staggering display of apricot spikes... erupting like flames," is how the breeder describes it. Indeed, this is one very impressive herb from England, excellent for flower beds, borders and containers. It is compact, reaching a height of only 45cm/18", and very quick growing, flowering in its first year from June on. It deservedly won the Fleuroselect Quality Award as an ornamental, but it is also a fine aromatic herb suitable for tea and beverages
Agrimony ( <i>Agrimonia</i> )			Tea has great reputation as a wash for healing

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
<i>eupatoria</i> )			wounds and skin eruptions. Internally, tea is useful for liver, kidney and bladder problems.
Agrimony, Chinese ( <i>Agrimonia pilosa</i> )			Traditional Chinese remedy against parasites, including taenia, malaria plasmodia, schistosomomas and vaginal trichomonas. Antiparasitic compound agrimophol is 95% effective against taenia. Also used to stop bleeding and to prevent infection
Agrimony, Hemp ( <i>Eupatorium cannabinum</i> )	no		Good for damp areas producing masses of lilac flowers. Good remedy for liver problems and to 'purify' the blood.
Ajmur ( <i>Trachyspermum ammi</i> )			Indian spice seed used in curries, pickles and chutneys. Leaves are used as a substitute for parsley. Medicinally used as a carminative to relieve gas and gripping bowel pain. Also for dyspepsia, bronchitis and asthma
Ajowan ( <i>Trachyspermum ammi</i> )			An important commercial spice crop in India where the pungent, aromatic seeds are in great demand in curries, pickles, confectionery and beverages. Used medicinally for sore throat, bronchitis and cough. Potent antifungal against pathogenic fungi. Grows like cumin or dill
Alfalfa ( <i>Medicago sativa</i> )			Well known forage crop. Infusion with mint is an excellent nutritious tea for daily use; rich in easily assimilated vitamins, minerals and trace elements. Alfalfa sprouts are popular in sandwiches and salads
Alkanet ( <i>Anchusa officinalis</i> )			Root decoction has blood cleansing action. Once used to treat rabies. Also used as a diuretic and to induce perspiration
Allheal ( <i>Prunella vulgaris</i> )			As name suggests, infusion is effective medicine for most internal and external wounds due to its astringent action. Also as a gargle for sore throat.
Aloe, False (Rattlesnake-Master) ( <i>Manfreda virginica</i> )			Native to southeastern North America and found on dry soils. American Indians used the diuretic root tea for dropsy and as a wash for snakebite. The roots were nibbled for severe diarrhea and worms. Has laxative properties also
Aloe, Cape ( <i>Aloe ferox</i> )			Pharmaceutical source of aloe used as a purgative. Contains anthraquinone glycosides, principally barbaloin, which are responsible for the purgative action. Also, an ingredient of the 'Swedish Bitters' popularized by European herbalist Maria Treben. Attractive succulent from South Africa. Adapts well to home or greenhouse environment.
Amaranth ( <i>Amaranthus hypochondriacus</i> )	Burgundy Chinese Red Star Giant Orange Grain Vegetable ( <i>Amaranthus</i>		

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
	<i>tricolor</i> )		
Ambrosia ( <i>Chenopodium botrys</i> )			Oakleaf-shaped leaves possess spicy fragrance. Fresh sprigs add a new touch to gin drinks. Dried foliage is lovely in fall arrangements
Andrographis ( <i>Andrographis paniculata</i> ) creat			In Scandinavia this is now the main herb used to fight the common cold, flu, and upper respiratory infections. Clinical trials have shown that this herb really works and many believe that it is better than echinacea. Like echinacea, it works by boosting the immune system, helping the body to battle infections and to prevent them from reoccurring in the future. But it does more: it has adaptogen-like properties, it has anticancer activity, it is a bitter tonic, and it is an antioxidant that has been shown to protect the liver. In China and India the plant is commonly used to treat a wide range of infections such as gastrointestinal complaints, hepatitis, herpes, and throat infections. In short this is one amazing medicinal herb!
Angelica ( <i>Angelica archangelica</i> )		88,000	Large, lobed leaves and thick, hollow stems. Leaves and stalks are sweet tasting. Medicinal: Root is used to fight infection, to improve energy, and to stimulate circulation. DAYS TO GERMINATION: 30 days. SOWING TIME: Spring or Fall. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun to Part Shade. PLANT HEIGHT: 72-96". PLANT SPACING: 12-24". HARDINESS ZONES: Zones 4-9.
Anise ( <i>Pimpinella anisum</i> )			Best known for flavouring liqueurs such as anisette. Seeds are used in baked and confectionary goods. Fresh chopped leaves are appealing in soups, stews, sauces and salads. Aids digestion and eases cough
Anise Hyssop ( <i>Agastache foeniculum</i> )		960,000	DAYS TO GERMINATION: 7-16 days. 75-80 days to harvest; SOWING TIME: Spring or Fall. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 24-36". PLANT SPACING: 6". HARDINESS ZONES: Zones 6-9
Annatto ( <i>Bixa orellana</i> )			Seeds are source of natural bright-yellow food colouring, used in butter, margarine, cheese and other foods. Used by South American Indians to paint their bodies red. Easy to grow shrub or small tree; nice compact bushy habit
Arnica	American ( <i>Arnica chamissonis</i> ) European ( <i>Arnica montana</i> )		Famous Swiss herb used externally for bruises, burns and inflammations.
Ashwagandha ( <i>Withania somnifera</i> )			Highly regarded Ayurvedic (Indian) medicine herb sometimes called "Indian ginseng." It is the

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			primary strengthening tonic in Ayurveda; used for everything from general weakness, rheumatism, insomnia, infertility, impotence and “weakness of the mind.” A root crop.
New England Aster ( <i>Symphyotrichum novae-angliae</i> )			Native people have used the roots of this plant for fever, catarrh and pain. The Iroquois used it as a ‘love medicine’ and as a ‘smudging’ herb to revive the unconscious. This showy North American native displays its deep violet flowers in the fall.
Avens ( <i>Geum urbanum</i> )			Infusion is used to treat diarrhea and indigestion. Also as an external application to wounds. Formerly used to add unique flavour to ale.
Bai Zhi ( <i>Angelica dahurica</i> )			Root used in Chinese medicine to treat toothache and headache and externally for mastitis and infected wounds. Has antipyretic, analgesic and antibacterial action.
Bai Zhu ( <i>Atractylodes macrocephala</i> )			Chinese medicinal herb noted for strengthening the spleen and building <i>chi</i> energy. Rhizomes are used to treat diarrhea, fatigue, lack of appetite and vomiting related to deficiencies of spleen or stomach. Animal studies suggest it strengthens endurance. Also used as a diuretic and to reduce excessive sweating. Purple flowers; grows up to 60cm/2 ft high.
Balloon Flower ( <i>Platycodon grandiflorus</i> )			Interesting profuse blue flowers resemble balloons just before opening. Important herb of the Orient: cough remedy is prepared from the roots; wholesome young foliage added to salads.
Balsam ( <i>Impatiens balsamina</i> )			Familiar garden annual. A medicinal herb in China where it is used to clear obstructions in the throat. Flowers mixed with alum are used to paint fingernails.
Basil ( <i>Ocimum basilicum</i> )	Ararat; Italian Large Leaf; Genovese; Amethyst Improved; Sweet Thai; Lemon (Mrs. Burns’); Aroma 2 (F1); Genovese Compact; Red Rubin; Nufar; Pistou; Dark Opal; Lime; Christmas; Thai Magic; Spicy Bush; Superbo; Purple Ruffles; Queenette; Holy Red and Green; Lemon, Sweet Dani; Napoletano; Basil, Serata; Holy; Blue Spice; Osmin Purple; Mozzarella;	240,000 - 1,064,000	Large plant with medium-dark green leaves up to 4" long. Compared to Genovese, the scent and taste are sweeter and less clove-like. Ht. 24-30". 78 days to harvest.
			Tall and relatively slow to bolt with large, dark green leaves about 3" long. Ht. 24-30". 68 days to harvest.
			Nice, thick, turned-down leaves like the classic Genovese. This almost-black basil is a real stunner. Ht. 16-20". 60 days to harvest.
			Green, 2" long leaves have a spicy anise-clove flavor. Attractive purple stems and blooms. Called "Horapha" in its mother country, "Hun Que" in Vietnam. Ht. 12-18".
			Very bright green, 2 1/2" long leaves with white blooms make this basil both attractive and intensely flavorful. Ht. 20-24". 60 days to harvest.
			Classic basil appearance, with glossy, dark green, 3" long leaves and classic aroma. A good choice for growers who need fusarium resistance

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
	Fino Verde; Red Osmin Type; Queen of Sheba; Bush; Greek Bush; Minette; Stella; Indian; Rosie; Rubin; Purple Delight; Marseilles; Medinette; Sweet; Edwina; Emily; Gecofure; Marian; Martina; Envigor; Superbo; Magical Michael; Anise; Lemon; Green Sacred; Purple Sacred; Oriental Breeze; Spice; Blue Spice; Queenette; Thai; Siam Queen Thai		<p>combined with the desirable appearance of a Genovese basil. Compared with 911, Johnny's Genovese, Aroma 2 is slightly shorter with smaller leaves. Ht. 20-24". 70 days to harvest.</p> <p>Best basil for containers. Similar flavor, appearance, and leaf size as Genovese in a more compact plant. Ht. 16-18". 74 days to harvest.</p> <p>2" long leaves. Beautiful in casual flower bouquets. Ht. 26-30". 64 days to harvest.</p> <p>Flat, 3" long leaves stand out horizontally, and are a copper-tinged purple color. Ht. 18-24". 76 days to harvest.</p> <p>Large leaf type for field, greenhouse, and hydroponic growing. Almost identical in appearance to our 944 Italian Large Leaf. Leaves up to 4" long, sweet scent and flavor. Ht. 24-30". 77 days to harvest.</p> <p>Perfect for small pots, in mixed containers, or in the front of the garden. Compared to Spicy Bush, Pistou is half the size with a more uniform leaf size. Ht. 6-8". 30 days to harvest.</p> <p>Mostly purple plants, with 20% variegated or green plants. Ht. 16-18". 80 days to harvest</p> <p>Compact plant has 2" long, bright green leaves. Ht. 16-20". 60 days to harvest.</p> <p>big, glossy green leaves with dark purple flowers; Ht. 16-20". 55 days to harvest.</p> <p>Shiny, thick green leaves are up to 3" long. Ht. 18-22". 64 days to harvest</p> <p>1" long leaves. Decorative plants can be grown in pots or used in garden beds. Ht. 8-14". 70 days to harvest.</p> <p>Genovese-type basil; DAYS TO GERMINATION: 5-10 days. SOWING TIME: After last frost. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: Varies. PLANT SPACING: 4-8".</p> <p>3" long leaves. Ht. 16-20". 85 days to harvest.</p> <p>Thai basil; Queenette has small olive-green/purplish leaves, red stems and purple flowers. Leaves are just slightly larger than Sweet Thai.</p> <p>Slender leaves, hairy purplish stems, and purple flower bracts; Ht. 16-22". 90-100 days to harvest.</p> <p>Tall, upright plant with high yields. 3" long, light olive-green leaves. Ht. 26-30". 61 days to harvest.</p> <p>"Lettuce leaf" type with huge, frilly leaves. Leaves are up to 4" long. Ht. 14-16". 75 days to harvest.</p> <p>Ruffled leaves with good basil flavor. Ht. 12-16".</p>



Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			65-75 days to harvest.
			Sacred to Hindus. Slender leaves, hairy purplish stems, and purple flower bracts. Medicinal: Aromatic and warming, benefits digestion. Ht. 16-22". 90-100 days to harvest.
			Ht. 21-24". 64 days to harvest.
			Glossy, slightly ruffled, 2" leaves on a sturdy, medium-sized plant. Contrasting pale lilac flowers. 5-7% of plants are all green or variegated red/green. Ht. 16-20". 80 days to harvest.
			Recommended for greenhouse production. Genovese type basil with good, dark color. Good resistance to fusarium DAYS TO GERMINATION: 5-10 days. SOWING TIME: After last frost. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: Varies. PLANT SPACING: 4-8".
			High yields of small, flavorful leaves. Medium-sized, upright plant. Ht. 18-24". 63 days to harvest.
			DAYS TO GERMINATION: 5-10 days. SOWING TIME: After last frost. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: Varies. PLANT SPACING: 4-8".
Bayberry ( <i>Myrica pensylvanica</i> )			Aromatic shrub, native to the Maritimes. Astringent action of root bark abates diarrhea and hemorrhages; and as a gargle, soothes sore throat. Wax-covered berries are used to make aromatic candles and soap. Berries are boiled in water, liberating the wax which floats on top. Berries produce blue dye and with various mordants, leaves produce yellow, gold and greyish-green dyes.
Bay Laurel ( <i>Laurus nobilis</i> )			Like wine, thyme and leeks, bay leaf is a foundation flavour of French cuisine. Meat, fish and poultry dishes almost always have a touch. Frost-sensitive small trees; best grown in tubs that afford easy movement indoors during winter.
BeardTongue ( <i>Penstemon barbatus</i> )			Considered a 'life medicine' by the Navajo people who have used it for menstrual pain, stomach ache, wounds, swellings and coughs. Brilliant red tubular flowers.
Yellow Bedstraw ( <i>Galium verum</i> )			Tops and roots are sources of yellow and red dyes. Decoction is useful for bladder and kidney complaints, and has the ability to curdle milk (hence its other name, cheese rennet).
Belladonna ( <i>Atropa belladonna</i> )			Source of atropine, valuable in treating eye diseases and spasms. Externa applications lessen



Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			local inflammation and pain. Do not use without medical supervision. Germination is difficult; usually slow and sporadic.
Bergamot ( <i>Monarda fistulosa</i> )	Panarama Red Shades Red Lemon Bergamo Wild	1,408,000	Citrus-scented leaves and flowers make a pleasant, soothing tisane. DAYS TO GERMINATION: 7-14 days. SOWING TIME: Spring. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun to Part Shade. PLANT HEIGHT: 36-48". PLANT SPACING: 8-12"
Betony ( <i>Stachys officinalis</i> )			Good substitute for black tea; infusion resembles the taste and is caffeine-free. Helps relieve headache, and has general tonic action.
Bittersweet ( <i>Solanum dulcamara</i> )			A perennial, shrubby plant found in moist areas in the eastern and north-central Americas and in Europe. The flowers are bluish-purple tint in loose, drooping clusters. The scarlet, bitter berries hang on the vine for months after the leaves have fallen and give the plant an attractive appearance in autumn. Ointment made with chamomile is effective for swellings, bruises, sprains and corns. Combined with curled dock it helps skin diseases. Also used for chronic bronchial irritations, asthma and whooping cough. Caution: Use only with supervision: can cause paralysis and respiratory failure.
Bloodroot ( <i>Sanguinaria canadensis</i> )			One of our most beautiful woodland wildflowers. Conspicuous white flowers, 5cm/2" across, appear in early spring. Important dyeplant: roots yield red-orange colour for dyeing wool. Indians dyed their bodies and clothes with bloodroot
Boneset ( <i>Eupatorium perfoliatum</i> )			Eastern North American native found in swampy areas and along streams. White flowers; 30-150cm/1-5ft high. Excellent remedy for colds and intermittent fever, especially for flu. Medical evidence suggests that it enhances the immune system. Caution: contains pyrrolizidine alkaloids; not recommended for long term use.
Borage ( <i>Borago officinalis</i> )	Borage White Borage	24,000	Known as the Herb of Gladness for its exhilarating effect. Try adding chopped young leaves and flowers to salads or summer drinks. On those sweltering summer days, cool off with iced borage tea, adding honey and lemon juice to taste. DAYS TO GERMINATION: 7-14 days. SOWING TIME: Spring. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 18-30". PLANT SPACING: 12". HARDINESS ZONES: Annual.
Scotch Broom ( <i>Cytisus scoparius</i> )			Infusion of the dried tops is recommended for dropsy as well as bladder and kidney diseases. Restores normal rhythm to feeble, irregular heartbeat but large doses cause respiratory

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			paralysis. Flowers and stems are used to produce greenish-yellow and olive dyes.
Spanish Broom ( <i>Spartium junceum</i> )			Said to be 5-6 times more potent medicinally than Scotch broom. Shrub of Mediterranean climatic zones; naturalized in California. Fragrant flowers yield a yellow dye
Burdock ( <i>Arctium lappa</i> )			Roots of this common wild plant are said to have "blood-purifying" properties. Useful for skin diseases, including eczema. Recent medical evidence supports folkloric use for tumours. One of four herbs in the Essiac® anti-cancer formula
Salad Burnet ( <i>Poterium sanguisorba</i> )			Nut-cucumber flavour of leaves is welcome in all salads with French dressing or mayonnaise. Also in soups, casseroles, herb vinegars and cream cheeses. Improves skin in facial treatments
Burnet Saxifrage ( <i>Pimpinella saxifraga</i> )			A tea made from the root and sweetened with honey was recommended for the bubonic plague! Used for stomach and intestinal inflammations, catarrh, cough and asthma.
Butterbur ( <i>Petasites hybridus</i> )			Clinical studies show that it significantly reduces the risk of migraine attack, and relieves asthma and chronic bronchitis. New research shows that it relieves the symptoms of hay fever and other seasonal allergies without the drowsiness that antihistamine drugs cause. Traditionally used since the Middle Ages for whooping cough and as a mucus-reducing cough remedy
Butterfly-Pea ( <i>Clitoria ternatea</i> )			Annual climber, reaching 4m/15ft, with very showy bright dark blue flowers with lighter markings. Seeds and roots are used in India as a purgative; roots also as a cathartic and diuretic
Calamus ( <i>Acorus calamus americanus</i> )			Medicinally useful for flatulent colic, gastritis and dyspepsia. This is the North American variety which lacks the carcinogen, cis-isoasarone, found in European varieties. Root powder is valuable as a fixative in potpourris. Esteemed in India as a vermifuge and insecticide, especially for fleas.
Calendula ( <i>Calendula officinalis</i> )	Alpha Resina	59,200	Days to Germination: 7-14 Sowing Time: Spring  Seeding Method: Direct or Transplant  Light Preference: Sun to part shade Plant Height: 24-30" Plant Spacing: 4-8" Hardiness Zones:

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			Annual
Bitter Candytuft ( <i>Iberis amara</i> )			Attractive British wildflower with masses of milky white or purplish flowers. Found mainly in the English and Scottish limestone areas. All parts are bitter. Used for gout, rheumatism, asthma, bronchitis, dropsy and cardiac ailments. Commonly used in homeopathy
Catmint ( <i>Nepeta mussinii</i> )		448,000	<b>Profuse lavender blooms on spiky stems.</b>  Good for containers and the perennial garden. Soft, crinkled, gray-green leaves on a compact, mounding plant. Medicinal: In tea for sleeplessness, nervous tension.
Caper Bush ( <i>Capparis spinosa inermis</i> )			Capers, a fixture of Mediterranean cuisine for 2000 years, are made from the unopened flower buds of this plant. The buds are pickled in strongly salted wine vinegar to develop their characteristic aromatic pungent flavour used to such advantage in French mayonnaise-based sauces, vinaigrette, and savoury butters. Capers tend to reduce oiliness in foods, and possess a natural affinity for garlic and lemon. A straggly, slow growing shrub of dry, rocky areas of the Mediterranean and North Africa
Caraway ( <i>Carum carvi</i> )			Spicy caraway seeds add European character to all cabbage dishes, including coleslaw and especially sauerkraut. Traditionally used in ryebread, buns and cakes, as well as in soups and stews. Fresh leaves, used as a garnish, add flavour to vegetables. Anti-flatulent
Catnip ( <i>Nepeta cataria</i> )	Faassen's Lemon Japanese	736,000	Cat-attracting perennial with gray-green leaves and white flowers. Markets for catnip include cat toy crafters, herbal tea companies, and retail plant sales. Medicinal: Leaves and flowering tops are used as a gentle antispasmodic and very mild sedative. 75-85 days to harvest when started indoors
Catsfoot ( <i>Antennaria dioica</i> )			Ameliorates the appetite for it stimulates bile flow, gastric juices and pancreatic secretions
Celandine ( <i>Chelidonium majus</i> )			Latex juice mixed with vinegar is said to remove warts and corns. Decoction is useful for stomach pains and inflammation of the biliary duct. New research indicates it has potent anticancer properties
Centaury ( <i>Centaurium erythaea</i> )			Traditional European panacea for many complaints including lack of appetite, sluggish digestion and stomach disturbances. Highly

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			useful during convalescence
Camomile (Chamomile) ( <i>Matricaria recutita</i> )	Common Chamomile Bodegold Roman German	4,960,000	Small, sweet-smelling, aromatic, daisy-like flowers. Medicinal: Leaves and flowers are soothing and antiseptic. Makes a relaxing tea with the scent of apple and pineapple. 60-65 days to harvest when started indoors
Chastetree ( <i>Vitex agnus-castus</i> )			(Chasteberry; Vitex) So named because the seeds reputedly subdue the sexual urge and have long been used by monks to produce this effect. But be forewarned: some suggest the aromatic seeds have exactly the opposite effect! Whatever the effect on the libido, it is clear that it has an effect on hormonal balance. Recent German studies indicate that seed extracts regulate menstrual bleeding or too frequent menstruation, and may do this by stimulating progesterone and regulating estrogen. In Germany, women who are stopping oral contraception, use chastetree to help reestablish normal menstruation and ovulation
Chervil ( <i>Anthriscus cerefolium</i> )		204,800	DAYS TO GERMINATION: 10-14 days. SOWING TIME: Spring. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Part Shade. PLANT HEIGHT: 10-24". PLANT SPACING: 6".
Chia ( <i>Salvia hispanica</i> ) Moving to Cereal grain group 15.			(Mexican chia; Chia sage; Spanish sage) Incredible supergrain! The Aztecs called chia the "running food" because messengers could run all day on just a handful of seeds. Today it is called a "supergrain" because the seeds are an astonishing source of nutrients. An ounce of seeds has as much omega-3 as 8 ounces of Atlantic salmon, as much calcium as a cup of milk, as much fibre as 1/3 cup of bran, as much iron as 1/3 cup of spinach leaves, as much vitamin C as 2 oranges, and as much potassium as half a banana. Seeds can be added to cereals and baked goods or just chewed raw like the Aztecs did. And remember "chia pets"? When moistened the seeds stick to surfaces and germinate, creating a fun "hairy" look on any shaped object
Chickweed ( <i>Stellaria media</i> )		928,000	Nutritious salad ingredient.  Sometimes thought of as only a common weed, Chickweed delivers many health benefits. Low-growing plants with small, star-like white blooms. Sell in bunches or promote as a medicinal salad ingredient. Medicinal: A nourishing tonic. Use fresh or dried leaves in tinctures and salves. Treats inflammation, skin rashes, insect bites. ATTENTION: Harvest plants before flowering to prevent future weed problems

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
Chicory ( <i>Cichorium intybus</i> ) This is a root and tuber crop			A food and medicine plant, going back to the ancient Egyptians, Greeks and Romans, who used the roots and the young shoots in spring like dandelion. Has diuretic, tonic and laxative properties, and is said to protect the liver from effects of excessive coffee drinking. Leaves yield a dye of clear blue colour, much like the colour of its lovely daisy flowers. A wild flower in much of North America.
Coffee Chicory ( <i>Cichorium intybus</i> 'Magdeburg')			Coffee substitute costing pennies a pound. Large roots, roasted and ground, can be adulterated with your favourite brand or enjoyed alone as a nourishing caffeine-free drink
Chinaberry ( <i>Melia azedarach</i> )			(Bead tree) Beautiful tree, native of China and India; much cultivated in southern U.S. Bark used as an emetic and to expel worms. Hard nuts are used for making rosaries
Chives, dried <i>Allium schoenoprasum</i> )	Purly Staro Fine Leaf Groulau Grande Nelly Garlic Kobold Garlic Mauve Garlic	500,800	DAYS TO GERMINATION: 7-14 days. SOWING TIME: Spring or Fall. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun to Part Shade. PLANT HEIGHT: 12". PLANT SPACING: 4-8". HARDINESS ZONES: Zones 3-9.
Sweet Cicely ( <i>Myrrhis odorata</i> )			Sugar saver. Sweet, anise-scented leaves and stalks (fresh or dried) add delightful flavour to sweets and desserts, saving about half the sugar. Of particular interest to diabetics.
Clary ( <i>Salvia sclarea</i> )			(Clary sage) Seeds soaked in water produce mucilaginous eye bath which safely removes particles, hence its name 'clear eye' or 'clary'. Used as a fixative in potpourris
Clivers ( <i>Galium aparine</i> )			(Cleavers) Fresh juice or infusion is applied to skin diseases and eruptions with good success. Said to remove freckles
Red Clover ( <i>Trifolium pratense</i> ) Member of crop group 18.			Many herbalists assert that the flowers taken as an infusion help prevent and even cure cancer. In his legendary book, Back to Eden (see book section of this catalogue), Jethro Kloss wrote, Red clover is an exceedingly good remedy for cancer on any part of the body. Red clover is also efficacious for bronchial troubles, whooping cough, gastric troubles and ulcers
Siberian Cocklebur ( <i>Xanthium sibiricum</i> )			Chinese herb used traditionally to treat headache and to nasal congestion. Also used for pain of the extremities, sciatic neuralgia, eczema and itching.

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			Thorn-covered berries harvested in autumn all over China. Pungent, bitter flavour. Can be toxic if improperly used
Codonopsis ( <i>Codonopsis pilosula</i> )			(Dang shen) Important Chinese medicinal herb similar in action to ginseng. Sweet tasting roots have been shown to boost red cell and hemoglobin counts in rabbits. Used as a tonic in anemia, fatigue, shallow and strained breathing, poor appetite, dyspepsia, and diabetes
Coltsfoot ( <i>Tussilago farfara</i> )			Popular remedy for coughs, colds, hoarseness, bronchitis and bronchial asthma. Also useful in herbal smoking mixtures designed for the relief of asthma and bronchitis
Coltsfoot ( <i>Tussilago farfara</i> )			Popular remedy for coughs, colds, hoarseness, bronchitis and bronchial asthma. Also useful in herbal smoking mixtures designed for the relief of asthma and bronchitis. Seeds can be slow to germinate. Flowers and leaves in combination with mordants yield yellow, gold, tan, grey and taupe dyes.
Cilantro/Coriander ( <i>Coriandrum sativum</i> )	Calypso Delfino Santo Santo Monogerm Xiang Cai	56,000	DAYS TO GERMINATION: 7-10 days. SOWING TIME: Spring thru Summer. SEEDING METHOD: Direct. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 12-18". PLANT SPACING: 2-4". HARDINESS ZONES: Annual.
Cornsilk ( <i>Zea mays</i> )			Cornsilk refers to the soft, hair-like layer that grows inside the leaves next to the husk. Used by the ancient Incas to treat urogenital infections and is still a popular homeopathic remedy for many urinary complications. Valuable source of silicon, B vitamins, many other minerals
Cornflower ( <i>Centaurea cyanus</i> )			Striking brilliant blue blossoms, infused in water, have both curative and calming action for nervous disorders. Eyewash is reputed to strengthen weak eyes
Culantro ( <i>Eryngium foetidum</i> )		1,240,000	Ethnic specialty with the flavor of Cilantro!  Small and slow-growing, with a rosette of toothed, lance-shaped leaves. Needs to be started indoors and must be grown under shady conditions. Makes a great container plant. Also known as "Spiny Coriander", "Ngo Gai" and "Reciao". Medicinal: Traditionally used to treat fever and flu. 75-90 days to harvest when started

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			indoors.
Crampbark ( <i>Viburnum opulus</i> )			Bark used as a sedative and antispasmodic. Used for nervous complaints, cramps, spasms, convulsions
Cranesbill ( <i>Geranium maculatum</i> )			(Wild geranium) Woodland native; rose-purple flowers, 30-60cm/1-2ft. Root is astringent owing to its high tannin content. Excellent for diarrhea, piles, external bleeding, dysentery, and as a gargle. Folk remedy for cancer. Also useful for treating animals, Especially for diarrhea. Needs frost to germinate.
Cumin ( <i>Cuminum cyminum</i> )		136,000	Seeds flavor Mexican and Indian dishes.  Fragrant, ferny foliage is similar to dill. Young leaves make a nice addition to salad mixes. Grows best in warmer areas, but will produce seeds in northern areas if started early. Medicinal: Seed aids digestion. 100-115 days to harvest
Curryleaf ( <i>Murraya koenigii</i> )			(Mitha-neem) The fresh curryleaf provides <i>the</i> distinctive flavour of South Indian and Sri Lankan cooking. Anyone who has had the good fortune to savour <i>dosas</i> -- thin pancakes with a spicy curryleaf-drenched filling -- will know how wonderful this herb is. It is also a feature of Cambodian, Loatian, Thai, Indonesian and Malay cuisines. Best used fresh, the leaves of this shrub or small tree have a strong curry aroma when bruised. The leaves are best added to curries at the last stage of cooking. A typical South Indian curry is made with mustard seeds, shallots and fresh curryleaf. Medicinally, the leaves and other parts of the plant are used for constipation, colic and diarrhea. Curryleaf requires a minimum temperature of 15-18C, sun or partial shade, and moist, rich soil.
Damiana ( <i>Turnera diffusa</i> )			Said to be an aphrodisiac. Used in Mexico for tea, and to flavour candies, baked goods and the Guadalajara liqueur called Damiana
Dandelion ( <i>Taraxacum officinale</i> )		720,000	Young leaves are used in salads. Roots are roasted for a coffee substitute. Medicinal: Roots and leaves are a blood cleanser, diuretic and liver stimulant DAYS TO GERMINATION: 7-21 days. SOWING TIME: Spring, Summer & Fall. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 8-18". PLANT SPACING: 4-6".
Devil's Claw ( <i>Harpagophytum procumbens</i> )			Clinical studies in Germany suggest that this native of southern Africa has anti-inflammatory properties. Has been recommended for arthritis,

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			rheumatism, and other conditions
Devils Club ( <i>Oplopanax horridus</i> )			Used by the native North Americans for a wide variety of ailments. The roots and bark have been used for indigestion, stomach pains, bowel cramps, rheumatism, sores, swellings and as a tonic and blood purifier. It was also used in rituals because it had 'magical' powers and 'protective charm'
Dill ( <i>Anethum graveolens</i> )	Fernleaf; Bouquet; Hercules; Vierling; Superdukat; Mammoth	256,000	DAYS TO GERMINATION: 7-21 days. SOWING TIME: Spring thru Summer. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 36-60". PLANT SPACING: 2-4". HARDINESS ZONES: Annual.
Dong Quai ( <i>Angelica polymorpha sinensis</i> )			(Dang gui; Chinese angelica) This is the most important herb in China, used more often and in larger quantities than even ginseng or licorice. The thick root lowers blood pressure, strengthens the heart, increases coronary flow, moderates arrhythmia and improves circulation. It is strongly antibacterial, analgesic and anti-inflammatory, and it is used widely to regulate menstruation, to treat hepatitis and cirrhosis of the liver, shingles and to relieve the pain of rheumatism. No herb has so many documented medicinal uses! Bittersweet, aromatic relative of the European angelica ( <i>A. archangelica</i> ) reaching 1m/3ft high.
Echinacea ( <i>Echinacea purpurea</i> )	Echinacea Purpurea Echinacea Paradoxa Echinacea Pallida Echinacea Tennesseeensis Echinacea Angustifolia	120,000	One of the most important genera of indigenous American medicinal plants. Members of this species are very hardy perennials with long bloom periods. Medicinal: Both the roots and aerial parts are used in teas and tinctures. All the echinaceas are used for support and stimulation of the immune system, and as backup treatment for the common cold. Normally grown for 3-4 years for harvest of sizable roots. GERMINATION NOTE: Seeds germinate most readily if stratified first (kept moist and refrigerated, or sown in a cold frame in the winter). Spp. angustifolia: Narrow-leaved Purple Coneflower. Smallest plant of the echinaceas, with narrow leaves and short, pink-purple petals. High level of isbutylamides in this species causes the "tongue tingling" associated with echinaceas. Ht. 8-18". Stratify for min. 21 days.
Elder ( <i>Sambucus nigra</i> )			Elderflower tea promotes perspiration, often prescribed for colds and rheumatic complaints
Elecampane ( <i>Inula helenium</i> ) for root and			Dried root preparations quiet coughing, stimulate digestion, and tone the stomach. Flowers yield



Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
tuber vegetable group			yellow and orange dyes
Epazote ( <i>Chenopodium ambrosioides</i> )		3,040,000	Indispensable ingredient in traditional Mexican chili sauces and bean dishes.  Pungent flavor with refreshing camphor and minty overtones. Plant every 2-3 weeks from spring through early summer to ensure a steady harvest. Medicinal: Aids digestion and helps prevent flatulence. 55 days to harvest.
Eyebright ( <i>Euphrasia officinalis</i> )			Popular remedy for eye inflammation, eye strain and other eye problems. Weak infusion is used as an eyewash; also taken internally. Semi-parasitic annual that feeds on grasses
Eucalyptus ( <i>Eucalyptus globulus</i> )			Cough drops and sore throat lozengers are made with the oil. Powerful antiseptic. Helps deodorize the air when grown indoors
Fennel ( <i>Foeniculum vulgare</i> )	Bronze and Green Grosfruchtiger Bronze	152,000	Feathery foliage with sweet flavor. Nonbulbing type. Medicinal: Seeds used in teas and tinctures as a digestive aid, expectorant, and a spleen, kidney, and reproductive tonic.
Fenugreek ( <i>Trigonella foenum-graecum</i> )			Common ingredient of curry powder. Used in oriental sauces, soups, stews, and for seasoning and preserving butter. Enjoys much commercial use for making imitation maple, vanilla, caramel and butterscotch flavours
Feverfew ( <i>Tanacetum Chrysanthemum parthenium</i> )		3,600,000	<b>Small, yellow and white, daisy-like blossoms.</b>  Pungent, aromatic perennial self-seeds easily in areas where it doesn't winter over. Medicinal: Long history of using leaves for fevers, menstrual cramps, and migraine headaches
Fo-Ti ( <i>Polygonum multiflorum</i> )			(He-shou-wu) Legendary Oriental Elixir of Life said to possess fantastic rejuvenating properties. Some believe fo-ti was used by a certain Professor Li Chung Yun who lived to the ripe old age of 256! So the story goes, early in life Li developed the penchant for taking a daily concoction containing the elixir of life. He is said to have outlived 23 wives, and left behind 11 generations of descendents when he died in 1933. Virility- and longevity-promoting prowess aside, fo-ti is one of the most widely used tonic herbs in traditional Chinese medicine. Roots are used to restore blood, liver and kidneys, and is prescribed for conditions as varied as vertigo, insomnia, lumbago, and constipation. Recent evidence shows it to be effective against high blood pressure and hardening of the veins and arteries.

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			Climber.
Forsythia ( <i>Forsythia suspense</i> )			(Lian Qiao) Important Chinese antibacterial herb used to treat flu and cold. Forsythiaside found in the fruits is effective against a wide spectrum of bacteria and fungi. Also effective against inflammations and helps to reduce fever and boost immunity. Hardy shrub with yellow flowers that appear before the leaves in spring.
Gentian ( <i>Gentiana lutea</i> )			Famous European alpine herb unrivalled as a bitter tonic. Root tincture made with brandy strengthens the human system, particularly in cases of weak digestion and lack of appetite
Ginger ( <i>Zingiber officinale</i> )			One of the oldest known and most widely consumed spices: in the East the fresh roots are prominent in numerous savoury dishes of meat, poultry and fish, while in the West ground dried ginger is a traditional baking and pudding spice. The Chinese have long recognized its potent stimulating and digestive properties; even today it is still the best home remedy for flatulence, nausea nervous diarrhea, indigestion and dysentery.
Ginkgo ( <i>Ginkgo biloba</i> ) member Tree nut crop group			An extremely hardy tree, resistant to pollution and disease. Very attractive fan-shaped foliage. In the West, the male tree is preferred because the female produces a foul-smelling fruit. However, the fruit contains a delicious nut which is a delicacy in China roasted or added to rice dishes. Medicinally, ginkgo is rapidly gaining a reputation as a brain tonic. According to recent European studies, the leaf extract increases blood supply to the brain and improves neural functioning and memory
Ginseng ( <i>Panax quinquefolius</i> ) member root and tuber vegetable group		8,000	Famous invigorating, rejuvenating tonic. A woods plant native to eastern North America. Harvest roots in fall of 5th or 6th year. Medicinal: Roots are a bittersweet general energy tonic
Goldenrod ( <i>Solidago virgaurea</i> )			Easily taken for granted in North America when the countryside is awash with its yellow flowers in fall, goldenrod is better appreciated in Europe as a medicinal plant. The European species is officially recognized in the German Pharmacopoeia for the treatment of kidney and bladder disorders and for its excellent diuretic and antiphlogistic activities. It is used to treat bladder and kidney stones and inflammation and to prevent the same. A cocktail of chemical constituents has been found to be medicinally active, including flavonoids, saponins and glycosides. One triterpenoid glycoside has been shown to have an antifungal effect against candida. A 700 year history of use in Europe and numerous modern labs studies attest to the safety

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			and efficacy of European goldenrod. An infusion of the flowering tops is used, often in conjunction with echinacea for urinary problems, and for upper respiratory infections, mucus congestion and postnasal drip
Goldenseal ( <i>Hydrastis canadensis</i> ) consider for root and tuber vegetables		Sold as roots	The famous root of American Indian medicine.  Large palmate leaves and big, bright red berries in summer. Grows best in dappled to full shade in well composted, humus-rich soil. Medicinal: Intense golden-yellow root is used for its astringent, cleansing qualities. Fights infection. General tonic.
Gotu Kola ( <i>Centella asiatica</i> )			Small creeping tropical plant used for centuries in India. Believed to have remarkable rejuvenating properties. One or two freshly chopped leaves daily in salads or liquefied in juice are said to be sufficient to revitalize the cells of the brain and to retard the aging process. Research shows that it is valuable for the treatment of burns, wounds, scars and varicose veins because it stimulates the development of connective tissue
Gynostemma ( <i>Gynostemma pentaphyllum</i> )			Jiaogulan; Southern Ginseng) In southern China this vine is called the 'immortality herb' because people who regularly drink the tea made from leaves are said to live a very long time. The plant contains saponins chemically similar to those found in ginseng, and which are believed to be responsible for the plant's reputed adaptogenic quality. It is also known for its antioxidant and anti-cancer properties. It is often recommended for weight control, and for general protection against stress and toxins
Horehound ( <i>Marrubium vulgare</i> )			Horehound candies were once the standard remedy for coughs in Europe and North America. An infusion of the herb is good for weak stomach, lack of appetite and persistent bronchitis
Hyssop ( <i>Hyssopus officinalis</i> )		400,000	Popular ornamental for the perennial bed. Medicinal: Tea has a soothing quality. Colds, flu, bronchitis, sore throat, bruises, burns
Lavender ( <i>Lavandula angustifolia</i> )	Munstead-Type; Ellagance Purple; Lady; Spanish Eyes; Hidcote Blue; English; French Long; Rosea; Sancho Panza	348,000	DAYS TO GERMINATION: 14-21 days. SOWING TIME: Spring. SEEDING METHOD: Transplant. LIGHT PREFERENCE: Sun. PLANT HEIGHT: 12-18". PLANT SPACING: 12-18". HARDINESS ZONES: Zones 5-8.
Lemon Balm ( <i>Melissa officinalis</i> )	Citronella Balm; Lemonella Balm; Quedlingburger Lemon Balm	752,000	Sweet lemon-mint scent. Fresh leaves for tea and salads. Easy to grow in moist, well-drained fertile soil. Mulch if winter goes below 0°F. Medicinal: Aerial parts in tea for colds, flu,

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			depression, headache, and indigestion. Sedative. Antiviral. 70 days to harvest when started indoors
Lemon Grass ( <i>Cymbopogon flexuosus</i> )	East Indian West Indian	1,248,000	Fibrous leaves have a stiff midrib, sharp edges, and purple bases.  Aromatic grass from India. Essential oil contains large amounts of citral and geraniol, used for flavorings and perfumes. Medicinal: Tea used to treat digestive problems and fever. Anti-inflammatory. 75-100 days to harvest when started indoors
Lovage ( <i>Levisticum officinale</i> )		139,200	Specialty culinary herb. Young leaves taste like celery and are used in spring tonic salads and with potato and poultry dishes. Medicinal: Aromatic stimulant; warming digestive tonic. Roots have similar activity to "Dong Quai". 90 days to harvest when started indoors.
Marjoram ( <i>Origanum majorana</i> )	Sweet Marjoram; Zaatar; Wild Marjoram	1,920,000	Aroma is similar to oregano, but sweeter and more balsam-like. Medicinal: Calming and soothing. Used in aromatherapy preparations. Edible flowers: use as you would the herb
Mexican Mint Marigold ( <i>Tagetes lucida</i> )		576,000	Aromatic leaves are a substitute for French Tarragon. Sweet licorice flavor brightens salads and main dishes. Pretty, golden yellow flowers bloom all summer. Thrives in warmer climates where French tarragon will not grow. Medicinal: Stimulant and diuretic. Improves digestion. 80-90 days to harvest when started indoors.
Milk Thistle ( <i>Silybum marianum</i> )		17,600	Increasingly popular medicinal herb.  Large plant with shiny, spined leaves mottled with white. Outstanding, solitary, 2" purple flowers. All parts are edible. Medicinal: The active component, silymarin, is found in the seeds and is known for its liver rebuilding properties.
Mint ( <i>Mentha spp</i> )		6,168,000	Mint does not grow true-to-type from seed. Medicinal: Leaves are used in tea to aid digestion. 60 days to harvest when started indoors
Mountain Mint ( <i>Pycnanthemum pilosum</i> )		3,568,000	Mint flavor and aroma in abundance.  White flowers attract bees, butterflies and other beneficial insects. Needs staking in windy locations. Used in potpourri, incense and as an ingredient in natural insect repellent formulas. Medicinal: In teas for indigestion, fevers and to regulate the menstrual cycle.
Mullein ( <i>Verbascum thapsus</i> )		4,800,000	Helps relieve respiratory ailments. Downy, gray-green foliage with a dramatic spike of yellow

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			blooms the second year. Medicinal: Flowers are used in infused oil for earache, rheumatism. Respiratory ailments. Relaxing expectorant.
Stinging Nettle ( <i>Urtica dioica</i> )		2,880,000	Vitamin and mineral rich. Used medicinally to strengthen and support the entire body. Leaves and stems are covered with tiny, hollow, silica-tipped hairs that release a skin irritant when touched. Dried or cooked, nettles lose their sting and are safe to ingest. Medicinal: Leaves are rich in iron and vitamin C. Ingested in infusions or tinctures to treat eczema. Fresh, stinging leaves are applied to skin to treat arthritis. Root is used for prostate complaints.
Oregano ( <i>Origanum vulgare subsp. hirtum</i> ( <i>O. heracleoticum</i> ))	Greek	4,800,000	Heavy oregano aroma; great for pizza and Italian cooking. Characteristic dark green leaves with white flowers. Medicinal: In tea for indigestion. 80-90 days to harvest when started indoors.
Papalo (called Bolivian coriander)		41,600	DAYS TO GERMINATION: 7-21 days. SOWING TIME: Spring or Summer. SEEDING METHOD: Direct or Transplant. LIGHT PREFERENCE: Sun/Part Shade. PLANT HEIGHT: 36-60". PLANT SPACING: 12". HARDINESS ZONES: Annual
Parsley ( <i>Petroselinum crispum</i> )	Giant of Italy Forest Green Titan Arat	224,000	Flavorful leaves and roots for garnish and cooking. Use fresh or dried in a variety of dishes. Medicinal: A bitter, aromatic, and diuretic herb that stimulates the digestive process. One of the most nutritious herbs, Parsley is packed with vitamins and minerals like calcium, vitamin C and potassium
Passion Flower ( <i>Passiflora incarnata</i> )		14,400	Vining herb with stunning blooms. Fragrant lavender and white flowers followed by delicious yellow fruits, which usually ripen only in warm, sunny climates. May not flower the first year. Climbing habit requires trellising. Medicinal: Aerial parts are an effective sedative and sleep aid.
Pennyroyal ( <i>Mentha pulegium</i> )			Just 4 to 16 inches tall, it spreads rapidly for a great barrier to fleas, mice, and other pests. Pennyroyal is a most useful member of the mint family. Traditionally used to repel fleas, mice and other pests, it is also a main ingredient in herbal insect repellents. This upright, creeping perennial reaches 4 to 16 inches tall and spreads indefinitely. Narrow stems are lined with 1 1/2 inch oval leaves and topped with whorls of lilac flowers
Peppermint ( <i>Mentha x piperita</i> )			Strongly aromatic peppermint can be used in both cooking - in drinks, salads, and baked goods - and

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			in potpourri and other fragrant decorative items. In hot tea, it is said to help stomach upset. This perennial grows to 3 feet tall and spreads rapidly to indefinite widths. The 3 inch smooth, lance-shaped, toothed leaves are tinged with purple around the edges. Oblong terminal spikes of lilac-pink flowers appear all summer.
Pleurisy Root ( <i>Asclepias tuberosa</i> )		88,000	Showy orange flowers. Attracts butterflies. Grows well in arid soils. Medicinal: Was valued by the Plains Indians for healing lung ailments and wounds. Roots are a respiratory expectorant and diaphoretic.
Pyrethrum ( <i>Tanacetum cinerariifolium</i> )		350,400	Pyrethrum is economically important as a natural source of insecticide. The flowers are pulverized and the active components called pyrethrins, contained in the seed cases, are extracted. Pyrethrins attack the nervous systems of all insects, and inhibit female mosquitoes from biting. When not present in amounts fatal to insects, they still appear to have an insect repellent effect. They are harmful to fish, but are far less toxic to mammals and birds than many synthetic insecticides and are non-persistent, being biodegradable and also breaking down easily on exposure to light.
Rosemary ( <i>Rosmarinus officinalis</i> )		336,000	Pine-scented, ornamental evergreen. Popular for potted plant sales and with chefs. Medicinal: In tea to treat headaches. Stimulates circulation
Rue ( <i>Ruta graveolens</i> )		224,000	Lacy blue-green ornamental. Bushy habit is ideal for short hedges or borders. Pungent aroma. Limited culinary use due to strong bitter flavor. Medicinal: Warming herb primarily used as an antispasmodic. CAUTION: Can be toxic when taken internally. Handling the fresh herb can cause skin irritation.
Sage ( <i>Salvia officinalis</i> )	Common Sage; Extrakta; White Sage; Berggarten	54,400	Handsome dusty green leaves. Use in dressings, sausage, salted herbs, sauces, and tea. Makes a good base for dried floral wreaths. Medicinal: Leaves are used as digestive and nerve tonics. Astringent, antiseptic.
Salad Burnet ( <i>Sanguisorba minor</i> )		44,800	Unique leaf shape for salads, garnishes. Mild cucumber flavor. Oval-toothed leaflets and deep crimson flowerheads. Medicinal: The root is used as a wound herb to stop bleeding.
Saltwort ( <i>Salsola komarovii</i> )		124,000	Traditional Japanese culinary herb. Long, succulent leaves with an incredibly appealing, crunchy texture. Native to the salt marshes of Japan, but well adapted to less saline soils. Harvest promptly to prevent woody stems and

Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			prickly leaf tips. Add tender young leaves to salads and sushi, or steam longer stems for a unique and healthy side dish. Also called land seaweed or "Okahijiki" in Japan. Medicinal: Rich in vitamins and minerals, including Vitamin A, calcium, and potassium. Juice from the plant is used as a diuretic.
Spearmint ( <i>Mentha spicata</i> )			This 3-foot-tall plant really takes off, perfuming the air and offering great flavoring for jellies, mint jelly and sauces -- and in potpourri and other fragrant decorative items. This perennial grows to 3 feet tall and spreads rapidly to indefinite widths. The 2-3 1/2 inch lance-shaped leaves are a unique wrinkled texture. Oblong terminal spikes of lilac-pink to white flowers appear all summer.
Summer Savory ( <i>Satureja hortensis</i> )		752,000	SUMMER: Peppery flavor adds spice to dishes. A favorite herb for flavoring fresh and dry beans, cabbage, and sauerkraut. Medicinal: Tea is gargled for sore throat. Used for diarrhea, indigestion, and as an aphrodisiac.
Winter Savory ( <i>Satureja montana</i> )		944,000	Perennial cousin to summer savory, with thicker and shinier leaves. Flavor is more pungent and biting. Has a higher proportion of Thymol than Summer Savory.
Shiso ( <i>Perilla frutescens</i> ) called Perilla		432,000	Spicy Oriental favorite. Distinct cinnamon/clove flavor and aroma, with the spiciness of cumin. Used in oriental cooking, sushi and salad mix. Red Shiso colors radish pickles and "umeboshi" plums.
St. Johnswort ( <i>Hypericum perforatum</i> ) a root and tuber vegetable crop		3,760,000	A highly esteemed medicinal herb since ancient times. Well known for its antidepressant activity. A shrubby plant with yellow flowers which impart a bright red color to oil. <i>Medicinal:</i> Aerial parts are used. Wound healing, antidepressant, sedative.
Stevia ( <i>Stevia rebaudiana</i> )		1,200,000	Incredibly sweet leaves are an herbal alternative to sugar. Use fresh, dried, powdered, or as a liquid to sweeten a variety of foods and beverages. Bushy, high yielding plants. Do not transplant outdoors until low temperatures are above 45°F/7°C. Medicinal: Plaque retardant and tooth decay inhibitor.
Thyme ( <i>Thymus vulgaris</i> )	Summer; Orange; German Winter; Creeping	2,272,000	Classic culinary and ornamental herb. Small, round to needle-shaped evergreen leaves on woody stems. Mulch in cold winter climates to prevent damage. Medicinal: Leaves used in tea for sore throat, coughs
Valerian ( <i>Valeriana officinalis</i> )		496,000	One of nature's best herbal sedatives. Medicinal: Root used for anxiety, insomnia, and pain relief.



Herb (Scientific Name)	Cultivars/Variety	# Seeds Per Pound	General Information/Growing Practices
			Also used in calming treatments for animals
Wormwood ( <i>Artemisia absinthium</i> )		6,400,000	Feathery, silver-green foliage. An attractive background in wreaths and bouquets. Medicinal: Infused leaves make a bitter tonic. Wormwood is the main ingredient in absinthe liqueur. Expels worms

## APPENDIX I : Chemical Components of the Spices (Uhl; Small 1997; Katzer)

Some of the most important classes of chemicals are as follows.

The terpenoids include numerous compounds differing in physical and chemical properties. These are constructed of groups of five carbon atoms, called isoprene units, which can be linked together. Acids result in a sour taste. Principal organic acids include malic acid, citric acid, oxalic acid, and tartaric acid. Several of the herbs are notably acidic. Steroids are closely related to the terpenoids, and are produced by both plants and animals (terpenoids are produced mostly in plants). Cholesterol is the best known steroid. Some steroids are responsible for the strong toxicity of some poisonous plants. Alkaloids are plant-produced compounds that contain nitrogen, but aside from this are rather difficult to define. Alkaloids generally have a ringlike configuration, with single or multiple rings, and contain nitrogen. Alkaloids may be present in 5-10% or up to 20% of plant species. Generally, alkaloids are bitter, and often they are very toxic and so plants with noticeable concentrations of alkaloids are usually not among culinary herbs. Some alkaloids are valuable medicines.

**Agrimony dried:** Dried flowering tops were found to contain an average of 7.4% tannins as a principal constituent. The seeds contain 35% oil with oleic-, linoleic-, and linolenic-acids. It has been said that the volatile oil is sometimes distilled.

**Angelica seed:** the aroma comes from the essential oil, for which more than 60 chemical compounds have been identified. Compounds recorded for the essential root and seed oil include: *d*- $\alpha$ -phellandrene,  $\alpha$ -pinene, osthenele, osthole, angelicin,  $\alpha$ -thujene, and camphene, as well as  $\beta$ -phellandrene, limonene, myrsene, and sabinene. The main constituent of the root essential oil is  $\beta$ -phellandrene, although it was found that  $\beta$ -phellandrene was the main root essential component of wild angelica in Finland, while sabinene was the main component of domesticated angelica. The fruits have a higher percentage of oil than the roots and are rich in coumarins but the root oil is considered superior. The most important aroma chemical is a lactone of 15-hydroxypentadecanoic acid. Roots and seeds contain several furocoumarins, umbelliprenin, and various phenols.

**Celery seed:** celery oil is dominated by terpenes, mostly limonene (70-80%) and the sesquiterpenes  $\beta$ -selinene (10%) and humulene; its characteristic fragrance is caused by phthalides (3-butylphthalid and its 5, 5-dihydro derivate sedanenolid) although the latter occurs



only in traces. The furano-coumarin bergaptene is a potent photosensitizer and may cause photo-dermatitis in field workers.

**Coriander seed:** depending on regional varieties, coriander seed has 0.2-2% essential oil, mainly *d*-linalool (60-70%),  $\alpha$ -pinenes (6.5%),  $\beta$ -terpinene (10%), camphor (5%), limonene (1.7%), *p*-cymene (3.7%), geranyl acetate (2.6%), and geraniol (1.7%). The aldehydes, *trans*-2-tridecenal and decanal, are found in the riper seeds. The fixed oil is about 13%. Its oleoresin is brownish yellow with 3 lbs. of oleoresin equivalent to 100 lbs. freshly ground coriander seed. Coriander leaf or cilantro has 0.1-0.2% essential oil, mostly aldehydes (benzyl benzoate, cinnamaldehyde, *trans*-2-tridecenal and decanal), caryophyllene and eugenol. It has less linalool than the seed. The *trans*-2-tridecenal and decanal are responsible for the fresh taste of the leafy spice. The pungent aroma of long coriander is due to the long chain aldehydes. The seeds contain 0.3-1.7% essential oil. The most abundant constituent is *d*-linalool (composing 45-70% of the volatile oil) which imports the distinctive flavor. Russian and East European corianders tend to be rich in linalool. Also present are camphor, *d*- $\alpha$ -pinene, camphene,  $\beta$ -pinene, sabinene, myrcene,  $\alpha$ -terpinene,  $\gamma$ -terpinene, limonene, and other compounds. The oil is extracted by steam distillation. Coriander oil has the advantages of being more stable and retaining its agreeable odor longer than other oils of its class. The unique aroma of young seeds, due to aliphatic aldehydes, disappears on ripening. Because the aroma is often perceived as fetid and is disliked in Western markets, only ripe fruits are employed for distillation of the spice oil. The seed meal that remains contains 20% or more fixed oil, which has been used as a lubricant in Russia, and for soapmaking. An oleoresin is extracted that has been used for food flavoring. It contains 9-22% fatty acids, of which 39-79% is petroselinic acid. It is grown in Europe as a medicinal and industrial crop for its content of petroselinic acid. The aroma of the leaves is due to an extractable essential oil, as with the seeds, but the composition is distinctly different from that of the seed oil. The composition of the leaves and many volatile compounds were found, including alkanols and 2-alkenals, other aliphatic aldehydes and alcohols, and nonane. Some of these have anti-fungal properties. In the ripe fruits, the content of essential oil is comparably low (typically less than 1%); the oil consists mainly of linalool (50-60%) and about 20% terpenes (pinenes,  $\gamma$ -terpinene, myrcene, camphene, phellandrenes,  $\alpha$ -terpinene, limonene, cymene). In toasted coriander fruits, pyrazines are formed as the main flavor compounds. The taste of the fresh herb is due to an essential oil (0.1%) that is almost entirely made up of aliphatic aldehydes with 10-16 carbon atoms. One finds both saturated (decanal) and  $\alpha$ ,  $\beta$  unsaturated (*trans*-2-tridecenal) aldehydes; the same aldehydes appear in the unripe fruits. Similar compounds occur in a few other species and herbs, all of which share coriander's flavor; examples include long coriander, Vietnamese coriander and the Japanese chemotype of chameleon plant.

**Dillweed/seed:** European dill seeds have 2.5-4% essential oil, which is pale yellow in color and consists mainly of carvone (30-60%), limonene (33%), and  $\alpha$ -phellandrene (2-6.1%), including *p*-cymene, 3,9-epoxy-*p*-menth-1-ene,  $\alpha$ -pinene and  $\beta$ -phellandrene and dihydrocarvone. Indian dill seeds have 1-4% essential oil, which is light brown in color. It mainly consists of dillapiol (52%) but has less carvone (21%) than the European type. It also has *trans*-dihydrocarvone (16.6%), limonene (6%), dihydrocarvone (17%) and  $\alpha$ -pinene (1%). Dillweed has much less essential oil than the seed, about 0.35%. The essential oil is pale yellow and contains a high proportion of terpenes but contains less carvone (28-40%) than the seed. It also has limonene (30-40%), phellandrene (10-20%), myristicin, dillapiol and other monoterpenes. Its typical

fresh aroma is due to  $\alpha$ -phellandrene. Dill oleoresin is produced mainly from the seed and also from some European dillweed. It is greenish to pale amber in color and 5 lbs. of oleoresin are equivalent to 100 lbs. of freshly ground spice. Dill oil is composed of at least 10 different aromatic compounds. Carvone, limonene, and  $\alpha$ -phellandrene constitute approximately 90% of the total oil content. Carvone content of the seeds can reach 60%. Dill oil with less than 20% carvone is considered to most closely resemble the true aroma of dill herb, preferred for dill pickles. In North America the dill trade requires a carvone content of at least 30%, with some manufacturers preferring higher levels. The dill-like odor and flavor is chiefly due to  $\alpha$ -phellandrene, the higher the content, the more the oil resembles fresh dill herb. Indian dill (subsp. *sowa*) has a relatively high content of dillapiole and a low carvone content, a combination ideally suited for dill pickles. Dillweed oil is milder than dillseed oil and has less carvone and more  $\alpha$ -phellandrene, once again the chemical profile preferred for the finer and more appetizing flavor appreciated in dill pickles. Principal dill seed oil components include *d*-carvone, *d*-limonene, *d*-phellandrene,  $\alpha$ -pinene, diterpene, *d*-dihydrocarvone,  $\beta$ -phellandrene,  $\beta$ -pinene, 1, 8-cineole,  $\beta$ -myricene, *p*-cymene and  $\alpha$ -thujone. Dill herb oil has *d*- $\alpha$ -phellandrene, terpinene, limonene, carvone, dillapiole, isomyristicin, and myristicin. Quality of dill oil fluctuates considerably depending on the maturity of seeds. Even under the northern conditions of Alberta, the chemical constituents of dill seed and weed have proved to be close to international standards although at harvest time the dill fruits are unevenly matured. It was found that oil content increased with light intensity and temperature and often did so with longer photoperiod; exposure to far-red light increased oil production and also altered relative chemical composition of the oil. Commercial oleoresins, prepared to reproduce the flavor of the whole herb, are produced from a combination of dillseed and dillweed oil. One part of the oleoresin is equivalent to 20 parts of ground dill. The essential oils from leaves (0.35% and fruits (204%) differ slightly in composition: in the fruit oil, the main components are carvone (40-60%) and limonene (40%) but other monoterpenes appear only in traces (phellandrene, carveol, terpinene and dihydrocarvone). In the leaf oil, the aroma is determined by carvone (30-40%), limonene (30-40%), phellandrene (10-20%) and other monoterpenes; dill ether (a monoterpene ether) is characteristic of dill leaf oil. Oil from the fruits in Indian dill (*Anethum sowa*) contains the phenylpropanoid dillapiole (6-allyl-4,4-dimethoxy-1, 3-benzodioxol).

**Grains of Paradise:** grains of paradise contain 0.5-1% essential oil, which is yellow in color and contains mostly eugenol. Their mild pungency is due to paradol, shogol and gingerol. The essential oil from grains of paradise is dominated by the sesquiterpene hydrocarbons humulene,  $\alpha$ - and  $\beta$ -caryophyllene (together 83%) and their oxides (together 9%). In the acetone extract of grains of paradise from Ghana, the following hydroxyarylalkanones were found: 1-(4-hydroxy-3-methoxyphenyl)-decan-3-one (called (6)-paradole), 1-(4-hydroxy-3-methoxy-phenyl)-3-hendecan-3-one (called (7)-paradole) and 1-(4-hydroxy-3-methoxyphenyl)-3-deca-4-ene-3-one (called (6)-shoagole) in approximately equal parts. Other work reports (6)-paradole, (6)-shoagole and (6)-gingerole (5-hydroxy-(6)-paradole) are reported as the main hydroxyarylalkanones. On storage, gingerols can interconvert to shoagols, which means a loss of pungency.

**Honewort seed:** compounds present include isomesityl oxide, mesityl oxide, methyl-isobutyl ketone, *trans*- $\beta$ -ocimene, and terpinolene. The sesquiterpene constituents of the essential oil were investigated and it was found that the main components to be cuparene (ca. 24%), (+)- $\beta$ -selinene (ca. 20%), (+)- $\alpha$ -selinene (ca. 19%), and eremophilene (ca. 9%)

**Hop, dried cones:** the commercial value is due to the resin in the lupulin glands which give beer its bitterness and essential oils that contribute to flavor. Most domesticated hops are of European origin and the content of the chemicals of brewing interest are different from the relatively few cultivated hops derived in part from American parentage. The important brewing chemicals include alpha-acids ( $\alpha$ -acids) and the beta acids ( $\beta$ -acids), also referred to as humulones and lupulones, respectively. Both contribute bitterness to beer but the  $\alpha$ -acids are much more intense than the  $\beta$ -acids. The  $\alpha$ -acids are a mixture of chemical analogues, including humulone, cohumulone, and adhumulone; similarly the  $\beta$ -acids are a mixture of lupulone, colupulone, and adlupulone. Since the  $\alpha$ -acids are the chief source of bitering, the content needs to be known to determine the rate at which hops are added to the brew. Content of  $\alpha$ -acid varies from about 3.5% in traditional European types to as much as 15% in newer bitter varieties. The European forms of hop have a relatively low content of “soft resins” ( $\alpha$ - and  $\beta$ -acids collectively), a ratio of  $\alpha$ : $\beta$  approaching one, low cohumulone, moderately low essential oil content and relatively low myrcene in the essential oil fraction. Native American hops are quite high in cohumulone and colupulone content and have a pungent unpleasant aroma. Yields of 0.5 to 1.5% are typically obtained from hops. Seeded hops have more oil and seedless. The essential oils give odor and flavor to hops. Over 200 constituents are present. The chief aromatic constituents are myrcene, humulene, and caryophyllene, with minor amounts of dipentene, linalool, and farnesene and methyl nonyl ketone. Tannins are also present. A volatile alcohol (2-methyl-3-butene-2-ol or dimethylvinyl carbinol) comprises up to 0.15% of the dried leaves and has been found to have sedative activity; it is thought to account for at least some of the plant’s alleged sedative properties. The leaves also contain rutin.

**Lovage seed:** An essential oil is extracted from the roots and above-ground parts. The recovery of essential oil is 0.8-1.1% from seeds, 0.6-1.0% from the roots, and 0.05-0.15% from leaves. A large number of compounds have been found in the oil, mainly monoterpenes hydrocarbons and phthalides, which are lactone derivatives. The essential oil comprises mainly umbelliferone and butyl phthalidine. Several coumarins are found in the oil, including umbelliferone. Other compounds listed include *n*-butylidene phthalide, *n*-butyl-phthalide, sedanonic anhydride, *d*- $\alpha$ -terpineol, carvacrol, eugenol, and volatile acids. Resin, starch, sugars, tannins and gum are also present. There are differences in fragrance among the essential oils from different plant parts and the extracted oils may be used differently. It is reported that a key odorous component is sotolone (3-hydroxy-4,5-dimethyl-2(5H)-furanone). Root volatile oil is useful in perfumery, soaps, creams, and for flavoring tobacco products. Seed oil is used to flavor confectionary and liqueurs. Fresh leaves contain max. 0.5% essential oil; most important aroma components are phthalides (lingustilide, butylphthalide and a partially hydrogenated derivative called sedanolide. Terpenoids (terpineol, carvacrol) and eugenol are less important. Phthalides also appear in some other plants from the carrot family, in particular the related celery. Apart from this, these compounds are rare in the plant kingdom. The heterocyclic aroma compound sotolone, which has been found both in fenugreek and in Maggi sauce, can be seen as a phthalide-related, simpler structure where the condensed benzene ring is missing. This chemical similarity might account for the similar flavor of lovage and fenugreek leaves and also that of Maggi sauce.

**Parsley dried:** Commercial parsley oil is manufactured from the whole herb or seed. Parsley leaf has 0.06-0.1% essential oil and has a more desired aroma than the seed oil. The leaf has

mainly myristicin (20.6%), apiole (18.3%),  $\alpha$ -pinene (5.1%),  $\beta$ -phellandrene (12.1%), myrcene (4.3%), limonene (3.6%), *p*-mentha-1, 8-triene (9.2%),  $\alpha$ -*p*-dimenthylstyrene (7.2%), aldehydes, ketones, and phenols. The seed has 1.5-3.5% essential oil, with mature seeds containing up to 6%. Its apiole content is 36.2%, and its myristicin content is 13.3%. Apiole gives its characteristic odor and taste. It is toxic at higher levels so only small quantities of fresh parsley should be eaten at any one time. Oleoresin parsley is prepared from the seed and blended with the leaf oil. **The oleoresin from the leaf is deep green; 1/3 lb is equivalent to 100 lbs. of fresh parsley, and 3 lbs. are equivalent to 100 lbs. of dried parsley).** Over 75 aromatic volatile components have been characterized in parsley oils. The most prevalent constituents in leaf oil are 1, 3, 8-*p*-menthatriene, myristicin, apiol,  $\beta$ -phellandrene, myrcene, and 4-isopropyl-1-methylbenzene. Apiol is often dominant in the oil. Just which of these components is responsible for the flavor and aroma of parsley has been debated. The oil is obtained by steam distillation and is chiefly used as a flavoring for food products. Commercially, seed oil is extracted mainly from the seed or the entire aerial parts of the plant at seed formation, prior to ripening. The leaf oil, which is much more characteristic of parsley aroma, is usually not extracted because of the low yield. Yield from the herb varies from about 0.04-1.15% on a fresh weight basis. Yield from the mature fruits is about 7%. The herb oil may be adulterated with seed oil, which is of lower quality. There are three cultivated varieties, which in part differ by their chemism. var. *latifolium* (broad-leaved) and var. *crispum* (curly-leaved) are grown for their leaves, and var. *tuberosum* is grown for its root. The essential oils of leaves and root show approximately the same composition. The main components (10-30%) are myristicin, limonene and 1, 3, 8-menthatriene; minor components are mono- and sesquiterpenes. The curly varieties (var. *crispum*) tend to be richer in myristicin, but contain much less essential oil than var. *latifolium* (0.01 and 0.04%, respectively). In contrast, the essential oil from the fruits (3-6%) is either dominated by myristicin (60-80%; mostly var. *tuberosum* and var. *crispum*) or by apiole (70%; mostly var. *latifolium*). A third chemical race shows allyl tetramethoxy benzene (55-75%) which can also appear in apiol-dominated oils (up to 20%). Toxic poly-ynes have been found in parsley, though in very low concentrations. Another matter of concern is that the photosensitizing furano-coumarins bergaptene and isoimperatorin have been found in the root .

**Wasabi:** like its relatives in the cabbage family, wasabi owes its pungency to isothiocyanates. Two glucosinolates have been identified in the root: sinigrin (90%), which is also the characteristic aroma compound of black mustard and horseradish, and traces and glucocochlearin. These tasteless compounds are enzymatically hydrolyzed to the pungent “mustard oils” allyl isothiocyanate ( $\text{CH}_2=\text{CH}-\text{CH}_2-\text{NCS}$ ) and *sec*-butyl isothiocyanate ( $\text{CH}_3-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{NCS}$ ), respectively. Isothiocyanate total of fresh wasabi is around 0.2%. Further trace components identified in the volatile fraction are 6-methylthiohexyl isothiocyanate, 7-methylthioheptyl isothiocyanate and 8-methylthiooctyl isothiocyanate. These compounds,  $\omega$ -methyl-thioalkyl isothiocyanates, are characteristic for wasabi and are often suspected to be responsible for the characteristic taste so much loved by Japanese connoisseurs. Short-chain homologues of these compounds also appear in the Italian herb rocket.

**Waterpepper, Japanese:** a bicyclic sesquiterpenoid, polygodial (tadeonal, an unsaturated dialdehyde with a drimane backbone) has been found responsible for the pungent taste; rutin is the source of the bitter taste impression. Polygodial also appears in an exotic Australian spice, Tasmanian pepper, and, in small quantities, in the Brazil paracress. The plant contains an

essential oil (0.5%), which is mainly made up of monoterpenoids and sesquiterpenoids:  $\alpha$ -pinene,  $\beta$ -pinene, 1, 4-cineol, fenchone and  $\alpha$ -humulene,  $\beta$ -caryophyllene, *trans*- $\beta$ -bergamotene. Carboxylic acids (cinnamic, valeric, capronic acid) and their esters were present in traces. The composition depends strongly on genetic factors.

**Yomogi:** the essential oil (0.03-0.3%) contains a wealth of different terpenes and terpene derivatives, e.g., 1, 8 cineol, camphor, linalool, thujone, 4-terpineole, borneol,  $\alpha$ -cardinol and further mono- and sesquiterpenes. Quantitative and qualitative composition varies strongly with soil, climate, fertilizing, and harvest time. Thujone, of the oil's main constituents, is a monoterpenoid ketone also appearing in sage, thuja and, according to some sources, in a close relative of mugwort, southernwood. It is commonly held responsible for the toxicity of wormwood-flavored alcoholics, particularly *absinthe*, the “drug of the age” in France a hundred years ago (*fin de siècle*). Absinthe was a potent liqueur flavored with anise, fennel, plenty of wormwood and other plants; it was drunk together with water and sugar. The high alcohol content (often exceeding 60%) and the thujone (typically 50-100 ppm) both contributed to its psycho-active properties. Since chronic consumption resulted in severe nerve damage, absinthe was banned in nearly all European countries, with the exception of Portugal and Spain. Liqueurs based solely on anise, could establish themselves as alternatives for absinthe. Within the European Union, the ban was revoked in 1998 and absinthe has become legal again, although the thujone content is now restricted to max. 35 ppm. It is an open question whether the liquor will regain its former popularity. As wormwood tastes intensively bitter, it is almost impossible to incorporate quantities sufficient for thujone poisoning by accident. Even if the thujone is separated from the bitter absinthe by distillation, the resulting product is still too bitter to drink without sugar. Wormwood-flavored wine (*vermouth*) contains only traces of thujone.