Flavor Classification

On the stimulus side, the study of flavors encounters one very challenging problem: The number of odorous materials, and the number of odor types is very large, and difficulty to grasp. Much of the study of flavors, then, as well as that of human olfaction, must center on the issue of how to describe this multitude of chemicals and experiences. In order to make the problem more tractable, we try to group, categorize or otherwise systematize our approach to the set. Perceptual classification is discussed in another site. Here are some approaches to the problem of classifying and describing odors (and thus volatile flavors).

1. Why classify at all?

We name odors by pointing to objects ("it smells like a lemon").
Is then every odor unique?

Three approaches, depend upon your field of training:

Classification by chemical family.
Classification by perception.
Classification by "informing" compound & source.

Being a good flavorist entails using all three systems, cross-referenced.
(Plus chemical, sensory skills; plus analytic nose & synthetic, compounding ability)

2. Flavor is odor.

But some fragrance categories rare or not represented in common food flavors -
musky, floral (but consider rose water in Indian cuisine!), aldehydic.
rosy exceptions - phenylethyl alcohol, beta-damascenone

3. Classification by chemical family.

acids - e.g. propionic - swiss cheese; butyric - parmesan
alcohols - leaf, mushroom, phenylethanol (is rose a food??)
aldehydes - fatty, waxy, oxidative flavors
ketones - methyl ketones in cheeses
esters - fruity compounds, ethyl hexanoate
lactones - coconut and peach compounds -

4. Some families have chemically related compounds with similar flavors.
This is of some help and a great relief!

anisaldehyde - anethole
eugenol - isoeugenol - isoeugenyl acetate
cinnamaldehyde - cinnamic acid - ethyl cinnamate

May proceed through an oxidation - sequence -
alkane - alkene - alcohol - aldehyde - acid --> then to esterification
each change may cause a graduate shift in odor character. However, sometimes the change is abrupt, as can occur with esterification of a fatty acid, producing a fruity odor from a cheesey one.

Problem: small changes in structure make big changes in odor quality.
e.g. enantionmers - carvones.
2-methyl isoborneol - musty, earthy but isoborneol - pine, camphor

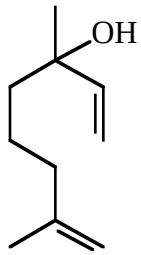
Problem: multiplicity of classifications: is benzaldehyde a substituted aromatic or an aldehyde?

Here is a brief overview of some important odor and flavor classes. This is by no means comprehensive, but is merely meant to illustrate some of the approaches

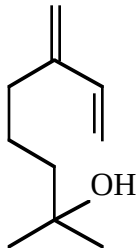
noncyclic terpenes - $C_{5n}H_{2n-4}$
These are often floral, fruity, woody, minty and mixed in character

n=2, "terpenes"; n = 3 , diterpenes; n = 4, sesquiterpenes

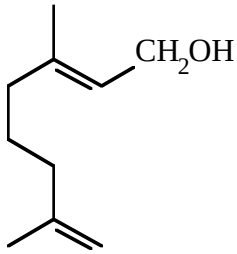
Linalool



Myrcenol



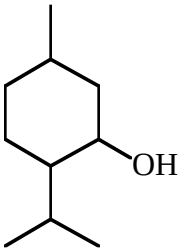
Geraniol



(nerol is cis)

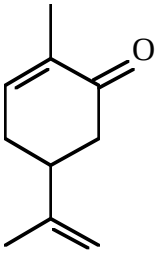
Cyclic terpenes

(-)-Menthol



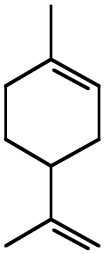
Minty (peppermint)

carvone



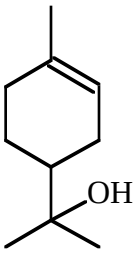
Minty(Spearming)

limonene

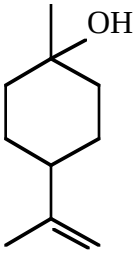


orange peel

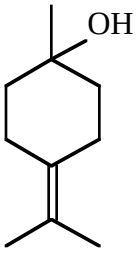
TERPINEOLS



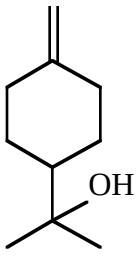
alpha



beta



gamma

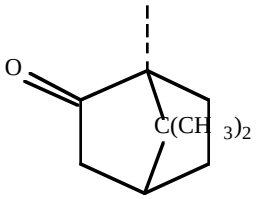


delta

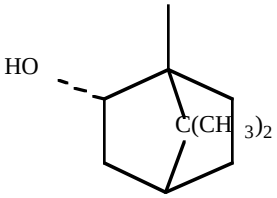
These are often pine-like.

Bi-cyclic terpenes - "camphoraceous" sub-family, also sometimes called “herbal” or herbaceous.

camphor

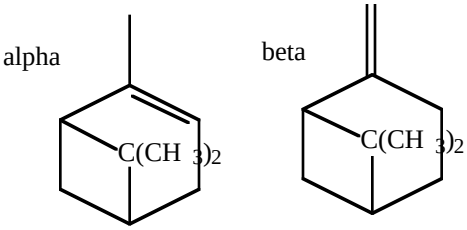


borneol



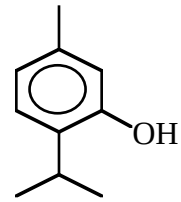
(Isoborneol is exo-isomer)

pinenes

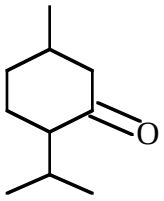


Others:

Thymol

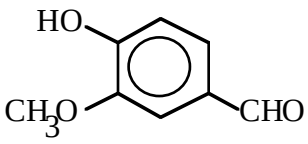


1,8 cineole, eucalyptol

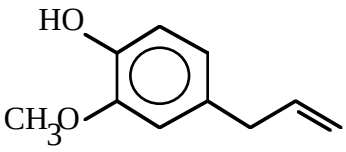


A large number of important flavor compounds ar substituted aromatics:
anisaldehyde, benzaldehyde,vanillin, eugenol, cinnamaldehyde, piperonal, methyl salicylate

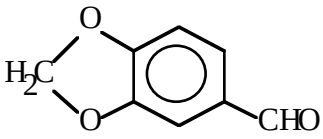
Vanillin



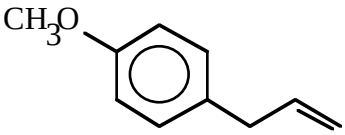
Eugenol



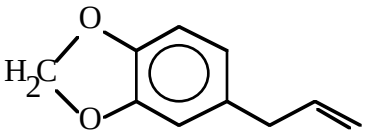
Heliotropin



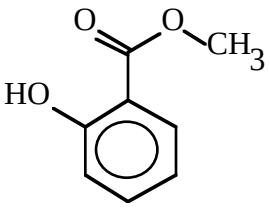
Anethole



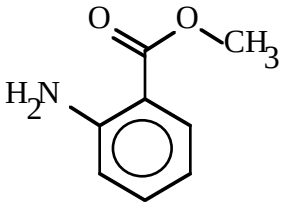
Safrole



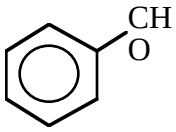
Methyl Salicylate



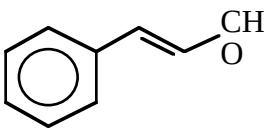
Methyl anthranilate



Benzalddehyde



Cinnamaldehyde



Other important families include the following. There is a vast literature on each family, for example in the study of pyrazine compounds that are characteristics of nutty, roasted and bell pepper aromas.

heterocycles
- furans
- pyrazines
- pyrroles
- indoles?

amines

- trimethyl amine, etc. - fishy
- putrescine, cadaverine

sulfur compounds

- methyl, dimethyl sulfides and disulfides
- thiols - mercaptans
- garlic, onion compounds?

4. Classification by perception. Similarity metric. Categorical, Hierarchical structure.

   Example - aroma wheels.
   other descriptive schemes.
   MDS, cluster analysis.

5. Classification by "informing" compound.
   Highly source-dependent.
   Classification by source common in perfumery (aldehydic)

   Problems:
   1. all herbs contain all terpenes.
   2. Combination of molecules may lead to characteristic odor.
   3. informing compound may be red herring:
      limonene in orange juice?
      linalool in wine