Green notes

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Traditionally the role of green notes in perfumery has been a minor one, but since the 1960s their use has become increasingly more important in fragrance composition. Green notes are difficult to define and to have general agreement upon. The terms *fatty*, *herbal*, and *green* are often a source of contention. Green colours in nature are associated with vegetable matter that is healthy, living, growing, fresh, young. In perfumes or natural oils green notes are linked with naturalness, freshness, diffusion, and being "alive." In general, green notes are not major constituents of natural oils, but although they are often present in trace amounts, their odour impact is disproportionally great.

Aliphatic green notes

Aliphatic chemistry is rich in green notes, both naturally occurring and of synthetic origin. They are concentrated in the C_5-C_9 bracket. Looking at the aliphatic alcohols we see that n-hexanol has a fatty somewhat fruity character yet the introduction of an appropriate double bond gives cis-3-hexen-1-ol which is called leaf alcohol, and possesses an intense green leafy, grassy note; very natural and "growing green" in character. The fatty note of the saturated alcohol has been almost totally eliminated.

Increasing the aliphatic chain we see that n-heptanol is fatty green and n-octanol is fatty green and citrus. But with n-nonanol we have a fatty floral citrus note and the green note has disappeared.

Introduction of an appropriate double bond can give more powerful notes with more distinctive character: 1-octen-3-ol (mushroom, herbal, green) and cis-6-nonen-1-ol (melon green). With two double bonds in the C_9 chain, for example, we see the fatty note changing to the very intense green cucumber violet leaf odour of trans-2, cis-6-nonadienol.

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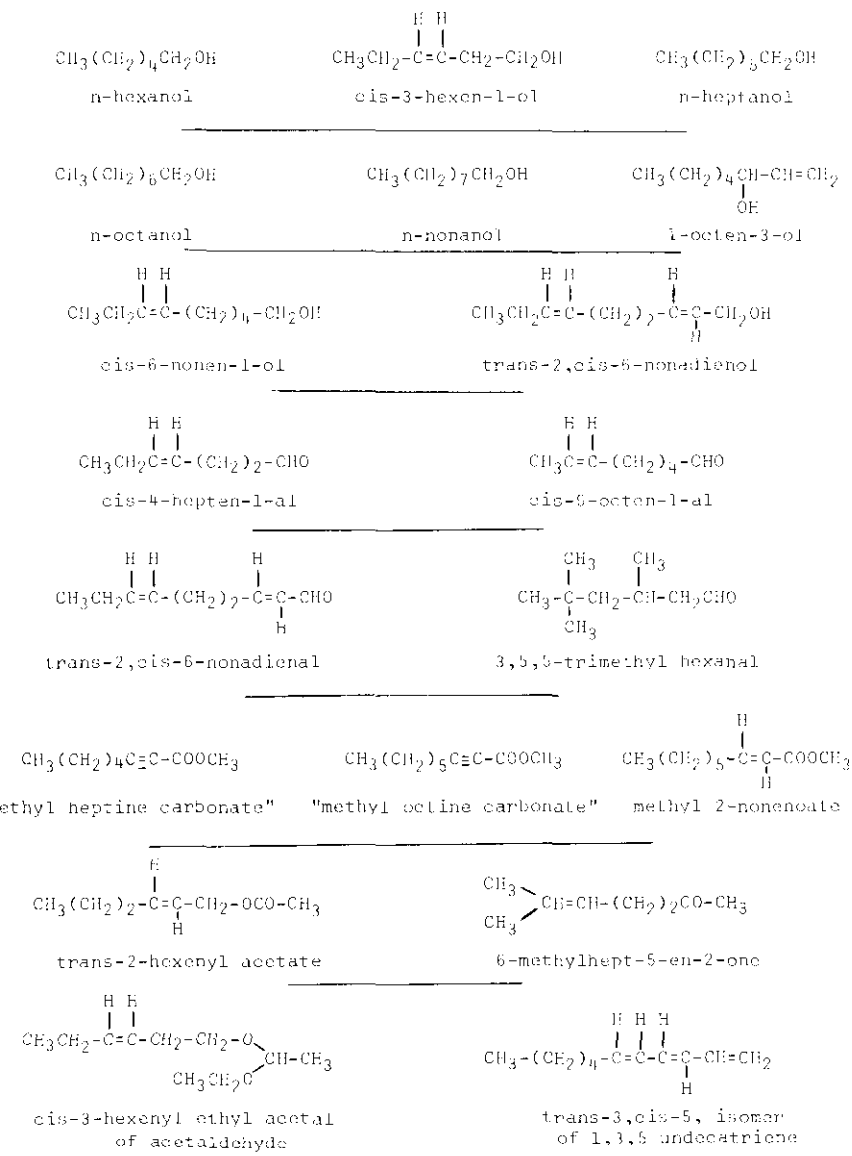


In the case of the aldehydes we have a similar picture. The saturated fatty C_6-C_9 aldehydes all have green characters with the fatty note modifying to citrus and then floral as the chain increases. Double bonds have a profound effect in the following examples: cis-4-hepten-1-al (very strong, fatty creamy, green), cis-6-octen-1-al (very strong, melon green), and trans-2, cis-6-nonadienal (very strong, cucumber violet leaf, green floral). The appropriate branching of the chain can also give power and character, as in 3,5,5-trimethyl hexanal (very strong, grassy green herbal and oily note).

The well known "methyl heptine carbonate," "methyl octine carbonate," and methyl 2-nonenoate all have powerful green violet notes.

The cis-3-hexen-1-ol esters are, as expected, green:

formate—green stems, floral
acetate—green fruity
salicylate—green balsamic
methyl carbonate—green violet leaf

and the trans-2-hexenyl acetate is green with apple and pear character.

Other aliphatic green structures include: 6-methylhept-5-en-2-one (green grassy "weedy") and

cis-3-hexenyl ethyl acetal of acetaldehyde (green leafy violet).

Outside of the C_6-C_9 bond we have the most interesting C_{11} unsaturated hydrocarbons, the 1,3,5, undecatrienes, especially the trans 3, cis 5, isomer which is very powerful green and galbanum. The fatty cod-liver oil note is derived from all trans isomer.

Aromatic green notes

Turning to aromatic chemistry the green notes are predominantly with floral overtones, such as phenylacetaldehyde (green, hyacinth, petal), hydratropic aldehyde (green flowery), and 3-phenyl propionic aldehyde (green flowery (red rose tone)).

The substituted derivative generally complexes the green character, as with p-methylphenylacetaldehyde (green flowery (syringa)), p-ethylphenylacetaldehyde (flowery green), p-methylhydratropic aldehyde (green, bitter, flowery), and p-isopropylphenylacetaldehyde (green herbal hay-like) to mention a few.

The acetals, phenylacetaldehyde dimethylacetal (green flowery lilac), and the mixed acetals (green nasturtium/hyacinth), are important green notes.

With the ethers, such as phenylethyl isopropyl ether (green, nasturtium leaves) and the carbinols, such as benzyl n-propyl carbinol (green fruity floral), we can see that perhaps the propyl group plays an important role in the green osmophore. "Styrallyl acetate" is the well known green fruity perfumer's gardenia note.

Miscellaneous green notes

The terpenes seem to be devoid of green notes unless one includes the acetals of citral. The alkoxy substituted pyrazines present in galbanum, petitgrain, orange flower, and other natural oils are extremely strong and difficult to use. Some of the interesting ones are shown in figure 1.

Among the group of materials first known as the "cyclenes" we find the jasmacyclene—dihydrodicyclopentadienyl acetate (green flowery herbal). This material has, subsequent to its first use in the 1950s, become known under many other names and has, by reason of its stability, cheapness, strength and substantivity, become one of today's perfumery building blocks.

A most remarkable green body is 2,4-dimethyl-3-cyclohexene carbaldehyde (green, fresh cut stems, almond) which, to the author's knowledge, was first marketed in the form of a speciality base with other interesting materials before becoming well known as a chemical in its own right. Its Schiff base also produces interesting effects.

Iso-cyclocitral (green, bitter, stems and citrus), longer known than the above, is of course closely related.

Rose oxide (rose "green"—with cis isomer being preferred) and nerol oxide (neroli "green") are established top notes materials. Among the remaining green notes that come to mind we find nerone (green petitgrain-like), stemone (5 methyl-3-heptanone oxime) (green leafy and stem-like), verdoracine (green earthy rooty), dimethyl sulphide (green vegetable-like), dibutyl sulfide (intense green geranium, violet), and methyl methylthiopropionate (green, fruity, onion).

It is difficult to mention all the green bodies that are used and/or that have been made at some time or other. Some exciting materials still remain captive or are the basis of a house speciality. Among those which contribute to the perfumers' palette of green notes we can list Parmantheme, Rosacene, Capucine, Marjolaine, Cortexal, Agrumen aldehyde, Veraflor, Top Galbanum 18.326 SA, Jacintheme 135 SA, Galbex 183, Feuillage Vert Base 47.062, Apple Oliffac, Cassis Base 345.

Natural green notes

In the area of natural products we can aattempt a classification of materials where the green note plays a part.

Floral green —Bourgeon de Cassis, Cassie, Gardenia, Geranium, Hyacinth, Jonquille, Lilac, Mimosa, Muguet, Narcissus, Tubereuse, Sureau, Violet, Violet Leaf.

Citrus green – Bergamot, Lemongrass, Lime, Mandarin, Petitgrain

Herbal green—Artemisia, Basil, Mint, Parsley, Tagetes, Tarragon

Aromatic green—Cardamom, Celery, Cumin

Green green—Galbanum, Lentisque

Miscellaneous—Oakmoss

It is interesting to see that green notes do not play a role in the woody, spicy, animal, and balsamic materials. All these relate to oils or absolutes/concretes but in the fruity area where no such materials are available we do see the green note in the ripe apple, pear,

Aromatic green notes

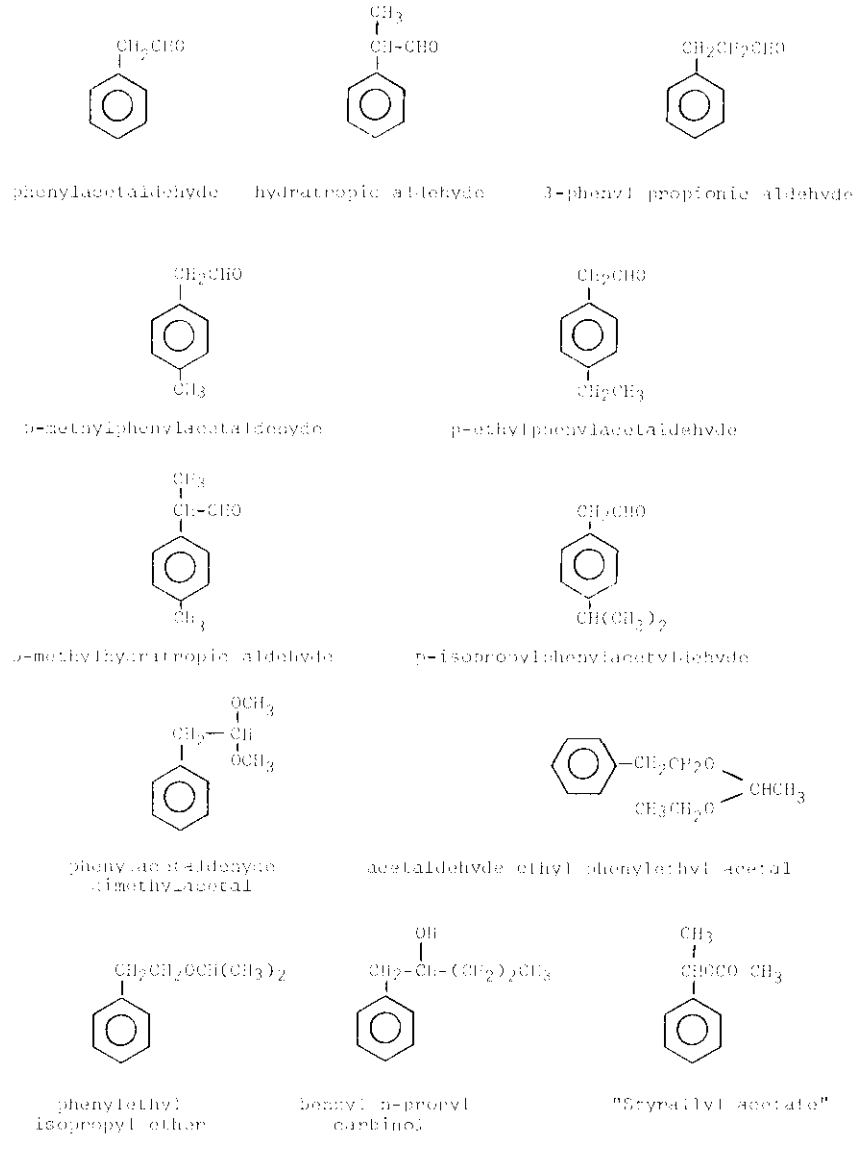
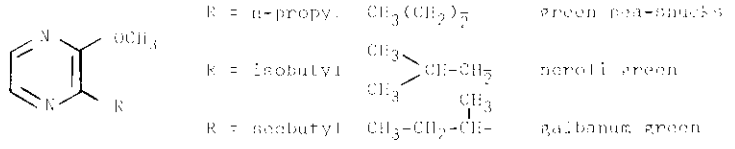


Figure 1



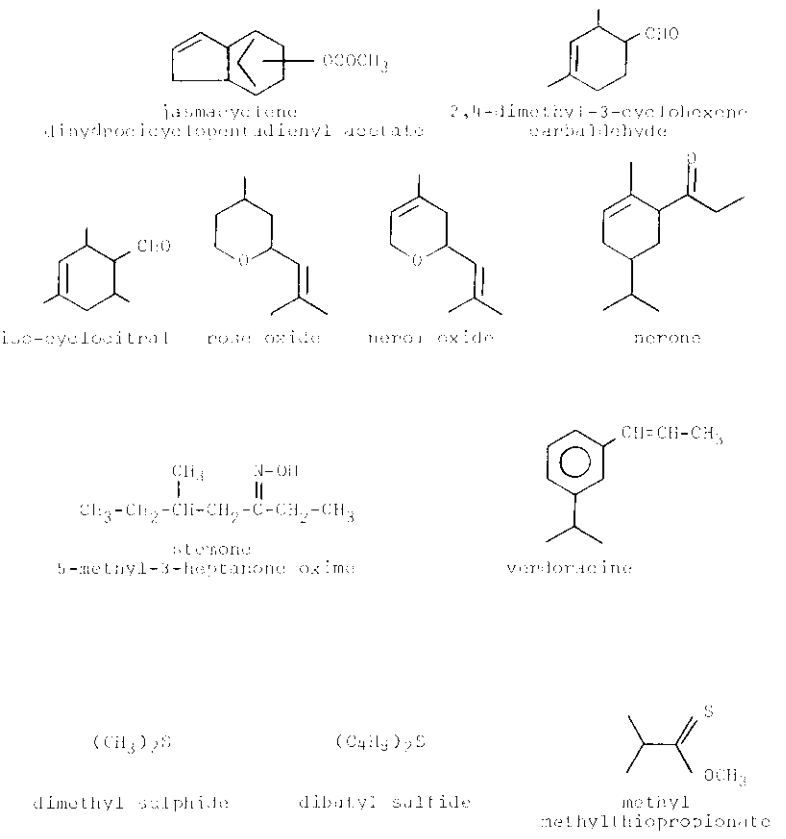
gooseberry, and so forth, that is, in the acid fruits as opposed to the lactonic fruits.

The use of green notes

How perfumers have used the green notes over the years may be seen in the marketed products.

Vent Vert (1945) was green and distinctive with its application of galbanum, styrallyl acetate and phenylacetaldehyde. Around the same time Ma Griffe (1944) gave us the distinctive effect of styrallyl acetate. Although not obviously green, the superbly blended use of galbanum in Miss Dior (1947) should perhaps

Miscellaneous green notes



also be included in this summary. Diorissimo (1956) demonstrated, by huge amounts of the hexenyl family, the wonderful natural effects that can be achieved by "unnatural" dosing. The perfumers skill and creative flair are amply demonstrated in this fragrance.

The flowery green trend really became established in Fidji (1966) with the use of the cis hexenyl salicylate. Sophistication and floral green came in the form of the hugely successful Calandre (1969) by the metallic twist helped by the use of rose oxide.

Green and sporty was the theme of the unique Aliage (1972) with its green, agrume, and herbal complex. However before 1972 we saw the beautiful and exciting Chanel 19 (1970) bring the return of the use of green floral absolutes. This trend continued with Amazone (1974), First (1976) Lauren (1978), Silences (1979), Anais Anais (1978), and Metal (1979). The effects of Hyacinth, Narcissus, Bourgeon de Cassis can be seen and that is really where we are today.

In men's fragrances we have seen the green notes for some time in Signoricci I (1965) and Prestige (1972). However the newer green notes that have been launched can be regarded as masculine versions of Aliage, such as Devin (1977), Tactics (1978), and Cerutti (1979). Other fragrances to follow include Polo (1978).

In the toiletries and functional products we see evidence of the green trend in almost all areas.

Soap—Fa (green, citrus, floral, chypre) Palmolive (green, neroli, spicy, fougere) Shield (UK) (green, violet, fougere)

Shampoo—Herbalessence (green, floral, herbal) Pert (green, flowery, woody, spicy) Responds (green apples) Elseve Balsam (green, hyacinth, floral)

Bath products—Doppeldusch (green, citrus, floral) Vikä (green, citrus, woody)

Deodorants—Rexona Fresh (Germany) (green, citrus, floral, musky)

Antiperspirants—Sure (UK) (green, floral, woody)

Detergent Powders—Dash (France) (green, orange flower, floral)

Fabric Softeners—Kuschelweich (green, violet)

These examples cover some of the successful uses of the green character during recent years and show the different directions the green note can take. Of course many other examples exist in the marketplace, but some distinctive green fragrances have not been successful. The green notes have also led to "smells"

rather than perfumes, where the overall odour is unnatural or fatiguing.

Often these notes receive short-time acceptance and then fade from the market. This can perhaps be looked upon as fashion or from the other side of the coin as failure. Thus we come down once again to the use of originality for originality's sake or for the development of a long-lasting improvement over existing fragrances, with the view to the formation of a trend. It has been said that "The fragrance in a product should not have to be changed because it is not liked but because of the development of new technology either in the product or in the fragrance area."

In the creation of fragrances the perfumer is limited by the performance of the green notes in the chosen application. Will we ever obtain such a beautiful material as phenylacetaldehyde with the stability required for detergent powder?

The perfumer uses green notes because they are an important natural element in any perfume. In fine fragrances, as we have seen, green notes can give distinctiveness and originality. This is also true in toiletries and functional products, but in addition perfumes for these applications are required to be linked to the expectation of the product. With this thinking we can imagine that green notes can help us to link a fragrance with concepts of freshness, cleanness, naturalness, coolness, and perhaps efficiency. They are not usually linked with the richness, caring, and softness concepts.

Conclusion

In many products, perfumes have become the signature and the most important single ingredient. They not only support the product's concepts but also distinguish it from its competitors. The small amount of fragrance is expected to achieve miracles. Fortunately, most people believe, it would seem, in miracles.

The green trend will continue as more and more new green smelling chemicals are produced. However, let us keep green natural and beautiful—let's not try for green skies or green sunsets—and let the green men stay on their own planet!