South African Essential Oils

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Essential oils have been known and studied for nearly fifteen centuries. The uses of these natural products were originally aimed at medication and religious rituals in Egypt, India, China and Iran. Historically the first essential oil encountered perfumistically was rose oil: a Chinese emperor spread rose petals on a bathing pool and due to natural osmosis the water became pleasantly fragrant.

The first official reference to these materials appears in the late 13th Century; it is quoted that a certain Arnold de Villanova steam distilled rosemary and sage leaves, but no one really knows if he bothered to separate them from the water phase. It would, however, seem that as the end result the fragrance conveyed a pharmaceutical message: everyone in the village who de Villanova thought was ill was compelled to have a mouthful of his magic water. Once tasted, thereafter they were too afraid to get ill. So it did work!

An essential or volatile oil (these two terminologies are used synonymously) is a volatile mixture of organic compounds derived from one botanical source. These compounds are primarily responsible for the characteristic, distinctive and often diagnostic armoa of the basic product. Most essential oils exist in the source material, but certain oils are formed only as a result of a natural enzymatic reaction once the plant tissues have been crushed or macerated in an aqueous phase. These belatedly produced oils are then recovered by traditional methods.

Although we tend to emphasise the "volatiles," it should be stressed that numerous perfumistic botanical species also contain a nonvolatile component phase which invariably contributes significantly to the final odour profile.

Essential oils are located throughout the plant cellular tissue or in special cells, glands and ducts found in several parts of the plant, i.e., leaves, bark, stems, roots, flowers, fruit, twigs and seeds. For example, Buchu oil comes from the leaves, Neroli oil from the orange blossom, Clove oil from clove buds, Bergamot oil from the fruit, Petitgrain oil from Seville orange tree twigs, Cinnamon oil from the bark, Cedarwood oil from the stem, Vetiver oil from the roots, and Cardamomen oil from the seeds.

The respective oil is normally about 100 times the odour strength of the parent plant; they are fairly stable with citrus oils being the definite and notable exception. From personal experience I would prefer to comment that essential oils, if they are fairly stable, do not age well and must be correctly handled, packaged and stored if one expects a reasonable shelf life.

Essential oils display poor water solubility; however, there are instances where certain delicate and important components of an oil are water soluble and these are lost during steam distillation. Fortunately, densities are below and above water and this simplifies separation greatly.

With few exceptions, the odoriferous oil is present at a low percentage and, therefore, con-

 0272-2666/84/0005-5901$02.00/00

stitutes only a very small fraction of the total plant mass. This will vary extensively due to climate, soil, altitude and, last but not least, the elements of nature. In fact, the present severe drought in South Africa has crippled the local essential oil industry and we in the fragrance industry truly have learned to appreciate the importance of water.

In presence of these oils in the living plant is not clearly understood, but a few postulated theories are that smelly flowers might be associated with insect attraction or repulsion, thereby influencing pollination and hence some natural selection. The oils could be protection against parasites, while others with pungent aromas could repulse herbivores. Essential oils may have received their name because they were thought to be essential to the life processes of the plant; irrespective, the essential oils are an unequalled source of pre-combined complex aromatics which are invaluable to the perfumer.

There are approximately 400 essential oils used in the perfumery and cosmetic industry today. The most widely used oils are in this order of present importance and quantity:

Lavandin	Bergamot
Patchouli	Sandalwood
Lemon	Bois de rose
Geranium	Oakmoss
Citronella	Benzoin
Vetiver	Cedarwood
Ylang Ylang (I)	Rose Otto
Cananga	Galbanum
Rosemary	Civet
Petitgrain	Labdanum

Current Production Methods

Three production methods to obtain essential oils predominate today: steam distillation, expression, and extraction. The prime method is distillation which embraces three various types of "stilling" and these are:

- *Water Distillation* occurs when the diced botanical is completely covered with water and then heated with agitation to the boil; normal condensation then takes place.
- *Water & Steam Distillation* is specifically used for freshly cut green plant material (herbal types), where the mass is supported on a steel grid fixed over a layer of water in the base of the tank; the water is boiled via a steam jacket and the subsequent steam produced in the boiling vessel remains saturated and at low pressure.
- *Direct Steam Distillation* is by far the most widely practised system and this involves the cut and chopped material packed on well spaced supporting grids in fairly tall cylindrical tanks. Live steam is injected through perforated coils into the base of the "still" at pressures above atmospheric; this ensures total oil cell rupture and thereby release of the volatiles. The oil bearing steam which is forced by super heat through a water cooled condenser is then separated continuously to obtain the oil.

In certain instances different procedures applied to identical botanicals render essential oils exhibiting varying chemical compositions and needless to say differing odour profiles, e.g., the citral in lime oil is almost completely destroyed with steam distillation, whilst under expression or solvent extraction, this key component remains intact.

Many essential oils straight after distillation depict what is termed a "still" note and cannot be used in perfumery as they tend to be too fresh and require a maturation period of possibly one month to as long as one year to guarantee uniformity and the correct fragrant characteristic.

On investigating the normal origins of most of the essential oils, it is quite clear that the northern hemisphere countries (with few exceptions) have enjoyed the "cherry on the cake" for a very long time. A few examples are listed in Table I. It can therefore be understood why South Africa viewed the essential oil industry with much trepidation, but fortunately there are still pioneers in South Africa that make things happen and things have indeed happened.

First of all because of our citrus industry, we have for many years successfully produced orange, lemon, grapefruit and tangerine oils, the latter being of a superb quality. Nevertheless, this is only a partial basis of much yet to come.

Where then did this industry "take root"? Records tend to indicate that in the late 1950s a fair amount of oils were being produced in laboratories and pilot units spread over a wide area of our country and as overseas demands for various oils grew, so did the industry.

It should also be emphasised that one of the major hurdles to overcome was convincing farmers who had for generations cultivated maize, wheat, tobacco and fruit to now grow crops which were completely foreign to them and, even worse, inedible. The perseverance of these pioneers is today all the more clearly admired and the cosmetic industry remains indebted to a resilent and brave few.

From these streaky and, at times, vague beginnings, we have over the last fourteen years seen the following essential oils produced and sold on the international market as well as being utilised in local fragrance production.

Table I.

Oil	Country	Odour
Artemesia	France	Sweet fresh camphy herb
Bergamot	Italy	Citrussy-herbaceous
Bay	West Indies	Clovey eugenolic
Cedarwood	USA	Woodsy balsamic
Cinnamon bark	Sri-Lanka	Cinnamic
Coriander	Russia	Fresh, lily sweet wood spice
Geranium	Reunion/Algeria	Green rose fruity menth
Lavender	UK & France	Fresh herb floral wood
Neroli	Spain	Sweet, flowery refreshing
Orris	Italy & France	Violet earthy
Patchouli	Malaysia/Seychelles	Woody herbs sweet
Petitgrain	France	Orange flower
Rose	Bulgaria	Typical, peppery flowery waxy and animalic
Sandalwood	India	Woods rosy sweet
Tagetes	Morocco	Fruit herb and green
Vetiver	Indonesia	Grassy woody nutty impact
Ylang Ylang	Comoros	Sweet flowery

Cultivation For Essential Oils

Commencing with Busby Essential Oils which is owned and run by Mr. Peter Pech, this magnificent farm is situated in the Eastern Transvaal and specialises in Eucalyptus oil. The main species cultivated is *Eucalyptus Smithii* with the emphasis of quality related to the final cineole content. This tree cum bush is indigenous to South Africa and Australia and has opposite lanceolated leaves with white and pink flowers. The oil-bearing cells are located in the leaves, twigs and smaller branches and normally yeild approximately 1% of final oil. *E. Dives* is subjected to the same treatment but produces an oil rich in piperitone and phellandrene.

There are numerous other Eucalyptus species, e.g., *E. Citriodora* (Citronellol), *E. Globulus* (Cineole), *E. McArtheri* (Geraniol Acetate), and *E. Mallee* (Cineole), but most of these various oils are unrelated in aroma.

From the Eastern Transvaal we travel to Rolan Essential Oils on the outskirts of Rustenburg where the following aromatic materials are just a few of those produced.

Cassie concrete is extracted from a Mimosa type bush called *Acacia farnesiana*. The odoriferous components are situated in the yellow pom-pon umbrellatel clustered blooms which exhibit a warm floral intense odour with balsamic undertones. This material is unequalled as a fixative in soap fragrances. The main constituents are benzyl, anisic, decylic and cuminic aldehydes with taints of geraniol, farnesol and linalool. A good crop would yield ±1.5%, however, you would have to pick approximately 5

million flowers to produce 1 kilo of concrete.

Jasmin concrete and absolute obtained from *Jasminum Grandiflorum* is solvent extracted from white flowers. This involves 3½ million hand picked blooms which weight 400 kilos and with a bit of blessing will yeild 1 kilo of concrete which can be purchased for R2500/kg.

This material conveys an intensely warm full-bodied floral impact typical of jasmin, which is due to nerol, nerolidol, terpineol and an important ketone called jasmone. Its use in perfumery cannot be measured in numbers.

Calendula, better known as marigold and sometimes referred to as pot marigold, comes from the botanical source *Calendula officinalis.* The entire flower is solvent extracted to produce approximately 0.12% of concrete which has a long-lingering herbaceous semi-harsh aroma which is based on ocimene and tagetone. An intense colour is due to calendulin which is a carotenoid.

Petitgrain Bigarade oil from the *Citrus aurantium,* better known as the Seville bitter orange tree, is obtained by steam distillation of the leaves and twigs straight after pruning; this oil needs a settling down time after distillation before being used in perfumery. It has an ethereal-citrussy-cum bitter floral profile consisting of laevo-linalyl acetate, linalool, terpineol, geranyl and nerol esters. This oil has application in every fresh and invigorating fragrance.

It must also be highlighted that the Seville orange tree is almost perfumistically classified as the tree of a thousand uses. That is, from the blossoms we distill neroli oil which has a beautiful and intense, suave, punchy flowery aroma; during initial distillation the condensate is the origin of orange flower water.

However, when the same Seville flowers are solvent extracted, the concrete and absolute depict a different and even more intense aromatic bouquet which is also more expensive.

From the rind of the actual Seville orange fruit, we express bitter orange oil or we steam distill the peel and produce a rather crude orange oil, and finally in the juice of this fruit we extract a juice oil which is extremely costly but exceptionally interesting.

From the Seville orange tree, we are therefore able to obtain seven different odour-bearing materials of which none is similar let alone identical to one another.

Tagetes, our long established Khaki Bush, once a pain in every farmers' jersey, today is a good and reliable friend, although this calamitous drought has taken its toll on this hardy weed. The successful species of *Targetes minuta,* the entire plant is cut and steam distilled yielding approximately 0.4% essential oil which is yellow-red in shade with a pungent but pleasant harsh herb-wild minty semi-rancid note. Major components are ocimene, tagetone, d-limonene and p-cymene. Tagetes is also grown and distilled in large quantities by the Centoil Project in Ciskei.

Tobacco concrete is a relatively new and exciting perfumery material; this extract is prepared from dried tobacco leaf dust, crumbs and stalks. It is solvent extracted under sophisticated conditions to produce an ingredient which is highly respected in the perfumery industry when seeking a masculine concept which must depict harmony as well as a pleasant note in contrast to hashish. Yields as high as 2% have been achieved, but certain tobacco crops have only produced 0.2%.

Tuberose, a perfumer's dream flower, starts with the *Polyanthes tuberose,* which is another labour intensive operation involving the hand-picking of 2½ million fully developed blooms which weigh about 2 ton and from which 1 kilo of concrete is eventually obtained by solvent extraction. This yellowish-brown waxy material has an overpowering, narcotically brilliant sweet floral kick and a price of R3000/kg. The major components are methyl benzoates, methyl anthranilate, geraniol, nerol and farnesol.

The Centoil Project at Fort Hare headed by Prof. Graven is enjoying much activity and success with some of its products.

Artemesia is a shrub and botanically known as *Artemesia afra* or Wormwood, but better labeled Lanyana. The leaves and flowering tops are steam distilled to yield 0.4% of a dark green to yellow brown liquid, but as the azulene content increases so the oil becomes blue-green in shade. This oil has a strong medicinal note which is due to the thujone and cineole. It is not unusual to see folk from the Ciskei rolling freshly picked Lanyana into cigarette shapes and plugging their nostrils with this respiratory relief.

Sweet Basil, which is derived from *Ocimun basilicum,* leaves, flowers and top main stem and steam distilled producing ±0.1% of oil having a strong but pleasant spicy warm mint-like camphory note caused by methylchavical, linalool and cineole.

Clary Sage *(Salvia sclarea)* flowering tops and leaves are steam distilled to yield 1.0% of oil which has a characteristic herbalistic-wine type bouquet. This oil is rich in aldehydes.

Eriocephalee has its botanical source from *Erocephalus punculatus* but is more commonly known as Sahalahala. This is an indigenous bushy shrub with fleshy leaves which are steam

distilled to produce a deep yet bright blue oil exhibiting a semi-sweet woody-herb rough orris fruity impression. The azulene derivatives content is said to be plus/minus 16% with the other major organics being iso-butyrates. Historically, this oil also displays medicinal properties but has a definite place in the perfumer's organa.

Geraniums are the classic fruit (or agricultural-hybrid) salad of the Pelargonium family. South Africa is the only country where geraniums grow wild, weedy and successfully. There are numerous oil bearing species with Graveolens being the most acceptable and popular.

Leaves and stems are steam distilled to yield 0.2% of an oil which contains mainly geraniol and citronellol and has a penetrating green rosy top note with minty shadows. Much is happening with this oil of late, and the "Pelargonium Society" members are excited for the future.

Marjoram is derived from the family *Majorana hortensis*. The top of the flowering plant is steam distilled producing 0.3% of a yellow green oil which portrays a warm spicy odour due to terpene-4-ol and α-terpineol.

Orris or, in our garden language, the Iris comes from the species *Iris pallida*. The peeled roots named rhizomes are aged for two years and then steam distilled to produce approximately 0.3% of oil containing irone and fatty acid esters. The odour is penetratingly violet with fruity backgrounds. This is a most interesting raw material.

Pteronia, pronounced "teronia," obtained from *Petronia incana,* is termed a weed in the Eastern Cape and has spread prolifically. It is a small shrub having multi-branched stems and grey leaves. The entire plant is steam distilled to yield 0.3% of pale yellow oil which consists of sabinene pinene and the odour is reminiscent of a herby, green juniper oil. Although a weed, this plant has suffered severely from the drought.

Peppermint from *Mentha piperita* is a hybrid. The flowering tops are steam distilled producing 0.5% of a pale yellow liquid of exceptional specific identity due to its high menthol, menthone and menthyl acetate content. Sophisticated updated instrumental analysis of peppermint oils have to date revealed more than 400 individual aromatics, which is why it has not been possible to produce a high quality nature-identical peppermint oil.

Tarragon, also known as Estragon, comes from the species *Artemesia dracanculus*. The flowering tops and leaves are steam distilled to yield $\pm$1.0% of a yellow greenish liquid with a sweet green spicy anisic herbal impact. Major components are estragole, anethol and myrcene.

Vetiver from *Vetiveria zizanioides* is a type of spikey fibrous grass with a surface growth which cannot be used. However the dried rhizones after washing and drying are stored for 1-2 years so enzymatic processes can increase oil yield. They are then steam distilled to produce 1.0% of a viscous light brown oil exhibiting an entertaining sweet earthy nut-like green woody odour which is due to vetiverol and vetiveryl esters.

Finally, let us turn further south to the Cape and Waterfall Health Farms.

Buchu, which has its source from *Barosma Betulina,* is native to the southern Cape. It is a small shrub having opposite leaves and white five petalled flowers. The leaves are picked, allowed to dry and then steam distilled yielding 1.0% of a dark brown exceptionally pungent phenolic-blackcurrant semi-sweet medicinal aroma which is mainly due to diosphenol. For many years the dried leaves were exported to Europe and the USA and steam distilled there (goodness knows why); today Mr. Godfrey does it here and is indeed one of the pioneers, trendsetters, of the buchu industry.

As space does not permit any further detail, may I just mention some of the other South African essential oils being produced, some in very large tonnages whilst others in kilos, namely:

Orange
Lemon
Grapefruit
Tangerine
Ginger
Coriander
Hkalea (Galjea)
Pepper
Clary Sage
Immortelle
Leribe
Lavender
Lavandin
Cosmos
Parsley
Paprika
Rose

As a tailpiece, I can mention that research proceeds on our Grandailla, whose extract is finding some use in pharmacology as a sedative.

Acknowledgement

I would like to gratefully thank Mr. P. Pech of Busby Essential Oils, Mr. N. Limper of Rolan Essential Oils and SA Druggists, Prof. E. Graven of the Centoil Project, and Mr. Godfrey of Waterfall Health Farms for all their kind cooperation and hospitality whilst visiting their farms to complete this most interesting investigation.

Last but not least, sincere thanks to Miss C. Barnett for her able assistance with the reading and typing of my manuscript and to Mr. Israelsohn and Mr. Greyvenstein for organising and processing the hundreds of photographic slides.

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