WINE AROMATISATION*

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SOME OFFICIAL DEFINITIONS AND LEGISLATIVE NOTES ABOUT WINE AROMATISATION

When we talk about aromatised wine we should refer the European Council Regulation 1601/91 and subsequent amendments.

This regulation applies to the "definition, description and presentation of aromatised wines, aromatised wine-based drinks and aromatised wine-product cocktails".

Article 2 (1) of the regulation states:

Aromatised wine shall mean a drink:

- Obtained from wines defined in points 12 to 18 of Annex I to Regulation (EEC) No. 822/87, as last amended by Regulation (EEC) No. 1325/90 (12), with the exception of retsina table wine, and possible with added grape must, grape must in fermentation and/or fresh grape must with fermentation arrested by the addition of alcohol, as defined by Community legislation,
- To which alcohol has been added as defined in Art. 3 (d), and
- Which has been flavoured with the aid of:

Natural flavouring substances and/or natural flavouring preparations as defined in Art, 1 (2) (b)(i) and (c) of Directive 88/388/EEC,

Aromatic herbs and/or spices and or flavouring food/stuffs,

Which has a minimum actual alcoholic strength by vol. of 14.5% or more and a maximum actual alcoholic strength by volume of less than 22%.

The wine used in the preparation of an aromatised wine must conform to the relevant EU wine legislation (in particular as far as the minimum alcohol content is concerned), and be present in the finished product in a proportion of not less than 75%.

Vermouth itself is further defined in Article 2 (2) (a) as an:

Aromatised wine ….the characteristic taste of which is obtained by the use of appropriate derived substances, in particular of the Artemisia species, which have must always be used; this drink may be sweetened only by means of caramelised sugar, sucrose, grape must, rectified concentrated grapes must and concentrated grape must.

Denomination relating to the sugar contents, e.g. sweet, extra-dry, are defined in Article 2 (5). In addition, EU regulation 1122/94 allows for the use of the pure flavouring substance vanillin, identical to that found in natural sources.

Definitions in other parts of the world are broadly similar, with slight variations of the minimum wine content (e.g. 70% in Brazil), and minimum/maximum alcohol contents. In all cases, the base wine and botanicals used must comply with the relevant local legislation concerning these ingredients.

Finally, contrary to some popular beliefs, vermouth is not a "vin cuit" (cooked wine), and, to put to rest another long-standing rumour, it is not a particularly acidic product-in fact; the acidity is often less than that of the average table wine.

VERMOUTHS

Vermouths could be considered as the most important expression of aromatised wines. What follows describes the history, the ingredients employed and the processes used for the preparation

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of the finished product.

History

The origins of vermouths date back to the ancient Mediterranean history. The maceration of herbs and spices in wine was common practice in antiquity, and the invention of aromatised wine, the ancestor of vermouth. Has been attributed to Hippocrates.

Greece abounds of aromatic plants and Crete in particular provided the plants:

Dittany and Wormwood, both of which possess tonic and digestives properties.

It is reported that Hippocrates macerated the flowers of these plants in strong, sweet Greek wine, thereby obtaining a satisfying and digestive beverage, which throughout antiquity and Middle Ages was called *Hippocratic wine or vinum absinthianum*.

Later, the Romans elaborated on the production of such wines by introducing other herbs such as thyme, rosemary, myrtle and celery.

In the Middle Ages the Venetians, who had the monopoly of the spice trade, introduced aromatic plants into Italy, which until then were unknown in that country, and they were used in the preparation of Hippocratic wine. These plants (cardamom, cinnamon, myrrh, clove, rhubarb, ginger and sandalwood) came from East Africa, China, India and Indonesia.

Turin, along with Florence and Venice, was one of the major Italian center of production of Hippocratic wine s and liqueurs from the late eighteenth century.

Piedmont in particular possesses two assets: aromatic plants abounded in Piedmont Alps and their foot-hills, and the bouquet of Piedmont dry and sweet white wines combined very well with the fragrance of herbs.

These two factors doubtless explain why this area became the major center of the vermouth industry in the nineteenth century, when leading names in that sector emerged.

The term “vermouth” derives etymologically from Wermut, the German name of wormwood. While the latter English terms refer to the use of the plant as a vermifuge, the German name is supposedly derived from Wer (man) and Mut (courage, spirit).

When it was introduced into Bavarian the first half of seventeenth century by the Piedmont produces Alessio, vinum absinthianum was probably translated literally as Wermutwein, which when it reached France became vermouth.

Today, most of the world’s vermouth is produced in Europe (essentially in Italy, France and Spain) and to a lesser extent in South America, but local varieties are always to be found in all wine-producing countries.

Vermouth definitions

In basic terms, vermouth is a combination of wine, aromatic plants (hereafter referred to as “botanicals”), sugar, and sometimes grape must in limited quantities and alcohol. Caramel is the only coloring substance authorised, and is used for red vermouths.

The difference between the various types of vermouth lies essentially in the presence or absence of certain botanicals in their formulas.

Broadly speaking, there are two main families – sweet and dry –, which differ in their sugar content. Sweet vermouths contain around 150 grams of sugar per liter, while dry varieties contain less than 50.

Dry vermouths are all white and serve mainly as a base for well-known cocktails, although they may also be drunk straight.

Ingredients

<u>Wine</u>

Quantitatively, wine is the most important ingredient of vermouth, since in the EU accounts for at least 75% of its volume. The quality of the final product therefore depends on the quality of the wine employed.

Generally speaking, only neutral white wines that do not oxidize are employed; they must be low in tanning and they are not to maderize with age, and turn to a darker color.

Alcohol

Ethyl alcohol also enters into the composition of vermouths, both to fortify the wine and as a means of extracting the flavouring substances from the botanicals.

It must be from agricultural origin, very pure, extra-neutral and conform to standards laid down by legislation (e.g. max level of methanol or other natural fermentation by-products).

Sugars

In order to give vermouth its required sugar content, mistelle (muted grape must) or a good dessert wine may be added to the base wine, as well as the necessary amount of good-quality white sugar.

The sugars slightly attenuate the bitterness of certain substances that would otherwise be too strong on the palate.

They give the vermouth body, firmness, and smoothness and thus play a very important role in the preparation. As mentioned above, sweet vermouths contain about $150gl^{-1}$, and dry vermouths less than $50gl^{-1}$.

Caramel

Red vermouth generally owes its amber hue to caramel, which in Europe is the only coloring matter authorized under Regulation 1601/91. Apart from imparting color, it also confers a special flavour specific to red vermouth, contributing to the body and smoothness.

Botanicals

As previously mentioned, the botanicals are the natural sources of flavor, which characterize aromatized wines. Several parts of then botanicals are used, e.g.: leaves, flowers, and fruits.

There are so many of these that it would be impossible to list them exhaustively and, of course, the composition of these mixtures is a closely guarded secret of each producer. Anyway some examples are given in Table 1, together with their respective Latin/English/Portuguese botanical names.

Geographical origin of botanicals is very varied, we can mention as examples: Europe, Mediterranean African countries, Madagascar, India, Sri Lanka, China, Nepal, Caribbean islands, Ecuador and many other.

Botanicals employed in wine aromatisation may have aromatic, bitter or both characteristics.

They are normally used in a dry form, which guarantees a better storage without a notable modification of their content of aromatic compounds.

Botanicals are natural sources of flavours and consequently their quality is related, in addition to good cultivation/harvesting practices, to the seasons.

This means that a strict control of the quality of the botanicals is mandatory to guarantee that the aromatisation of the finished product is constant.

The quality control of botanicals

Complete quality control of botanicals covers many aspects:

- Macroscopic/microscopic, e.g.: respecting of a pre-determinate size, absence of foreign botanical parts, heart, etc.
- Hygiene, e.g.: absence of moulds, absence of insects or part of them, absence of micotoxins
- Analytical: moisture level, water activity, content of a certain amount of essential oils, quality and quantity of characteristic flavour compounds (volatile or not)
- Sensory: presence of the typical sensory character of the botanical in question

Table 1. Some of the botanicals employed as flavouring sources for aromatised wines. (CoE nr. Number of European Council).

CoE nr.	Botanical name	English name	Portuguese name	Botanical family
00056	*Angelica archangelica* L.	Angelica (roots)	Raízes de angélica, erva do Espírito-Santo	Umbelliferae / Apiaceae
00048	*Anthemis nobilis* L. (= *Chamaemelum nobile* (L.) All.	Roman chamomille	Camomila, macela	Compositae / Asteraceae
	Artemisia species	Artemisia	Losna, absinto,	Compositae / Asteraceae
00157	*Crocus sativus* L.	Saffron	Açafrão	Iridaceae
00128	*Cinchona calysaia* Wedd.	Cinchona bark	Quineira-amarela	Rubiaceae
00136	*Citrus aurantinum* L. subsp. *amara*	Bitter orange	Laranjeira azeda	Rutaceae
00139	*Citrus limon Risso*	Lemon peel	Cascas de limão	Rutaceae
00144	*Cnicus benedictus* L.	Holy thistle	Cardo-santo, cardo-bento	Compositae / Asteraceae
00154	*Coriandrum sativum* L.	CorianderR	Coentro	Umbelliferae / Apiaceae
00188	*Eugenia caryophyllata* [= *Syzygium aromaticum* (L.)]	Clove	Cravinho, cravinho-da-Índia	Myrtaceae
00214	*Gentiana lutea* L.	Gentian root	Genciana-das-boticas	Gentianaceae
00218	*Glycyrrhiza glabra* L.	Licorice (wood)	Alcaçuz	Leguminosae / Fabaceae
00001	*Hibiscus abelmoschus* L. (= *Abelmoschus moschatus*)	Ambrette		Malvaceae
00235	*Hyssopus officinalis* L.	Hyssop	Hissopo, hissopo-das-boticas	Labiateae / Lamiaceae
00241	*Iris florentina* L. (= *Iris x germanica* L.)	Orris	Lírio, iris	Iridaceae
00249	*Juniperus communis* L.	Juniper	Zimbro comum	Cupressaceae
00257	*Lavandula officinalis* L.	Lavender	Lavanda	Labiateae / Lamiaceae
00273	*Matricaria chamomilla* L. (= *Chamomilla recutita*; *Matricaria recutita* L.)	Camomile	Camomila, camomila-da-Alemanha, margaça-das-boticas	Compositae / Asteraceae
00280	*Melissa officinalis* L.	Melissa balm	Melissa, erva-cidreira	Labiatae / Lamiaceae
00296	*Myristica fragans* (= *Myristica officinalis*.) (Aril)	Mace		Myristicaceae
00296	*Myristica fragans* Houtt	Nutmeg	Noz-moscada, moscadeira	Myristicaceae
00316	*Origanum majorana* L.	Marjoram	Mangerona	Labiateae / Lamiaceae
00316	*Origanum vulgare* L.	Origanum	Orégão	Labiateae / Lamiaceae
00332	*Quassia amara* L. F.	Quassia wood	Madeira de quássia	Simarubaceae
00396	*Rheum palmatum* L.	Cinese Rhubarb	Ruibarbo-da-China	Polygonaceae
00405	*Rosa gallica* L.	Red rose (buds)	Rosa	Rosaceae
00409	*Rubus idaeus* L.	Raspeberry	Framboesa	Rosaceae
00414	*Salvia officinalis* L.	Sage	Salva, salva-das-boticas	Labiateae / Lamiaceae
00425	*Satureja hortensis* L.	Summer savory	Segurelha	Labiateae / Lamiaceae
00447	*Taraxacum officinale* L.	Dandelion	Taráxaco, dente-de-leão	Compositae / Apiaceae
00454	*Thymus vulgaris* L.	Thyme	Tomilho	Labiateae / Lamiaceae
00474	*Vanilla planifolia* Jacks. (= *Vanilla fragrans*)	Vanilla	Baunilha	Orchidaceae
00489	*Zingiber officinale* R.	Ginger	Gengibre	Zingiberaceae

To complete the above-mentioned controls, it is necessary to apply a series of different analytical technologies and instrumentations:

- Microscopy: to look for part of insects, specific adulterations (e.g. foreign filaments in saffron pistils)
- ELISA (Enzyme Linked ImmunoSorbent Assay), e.g.: qualitative/quantitative determination of aflatoxin residues
- Microbiology, e.g.: determination of mould contents
- HPLC, e.g. qualitative/quantitative determination of non-volatile compounds, typically bitter compounds in Cinchona barks, Quassia amara
- GC, e.g. profile of characteristic volatile compounds typical of the botanical under control. When necessary, the amount of certain active principles for which a limit exists in the finished product (as established by the EU Directive 88/388/EEC) is determined
- GC/MS, e.g. identification of foreign compounds/contaminants which may be found during the GC profile evaluation
- Sensory tests: this could be considered as the most important control of the botanicals characteristics. A trained sensory panel performs this control, which consists in evaluating the aroma of the botanical as such, and of an alcoholic extract prepared for this purpose.

A good "picture" of the botanical quality allows us to define the correct use of a specific batch of this botanical, or if necessary its "dilution" with another batch having better characteristics. The maintenance of quality to ensure consistency of the finished product is the main goal.

The botanicals mixtures (recipes)

The botanical recipes will determine the final characteristics of finished products, e.g. we can mention "carvacrol" vermouths or "thymol" vermouths related to a typical aroma and the more or less pronounced bitter taste (having normally the vermouths a certain bitter taste).

For the above reason recipes are the "secret" of each brand of vermouth/aromatised wine. Recipes qualitative/quantitative composition of the recipe could be defined as complex (from a few to up to more than twenty botanicals and in a wide range of weights) and for the preparation of the finished product two or more recipes are employed.

The mixtures are prepared using weighing machines allowing the non-disclosure of recipes to the weighing operators but nevertheless keeping the traceability of this important process.

The botanical extracts

The botanicals are usually incorporated into the vermouth/aromatized wine in the form of an extract (strictly speaking a "tincture") that could be produced by macerating them in aqueous alcohol in several ways and/or a distillate obtained by distilling them in the presence of aqueous alcohol.

Techniques applied for extracts/distillates production

Infusion

Traditional extraction technique, which is little used by the industry. The extraction is obtained by introducing the botanical into a hot liquid (mainly water).

Maceration

This is one of the oldest and most employed techniques for botanical extraction. Botanicals are placed in a tank, covered with a mixture of water/alcohol, and are agitated periodically so that they remain constantly covered by the liquid.

The operation is frequently performed in rotating tanks and may last for several weeks (particularly when the botanicals are woody roots, needing in this form a longer time to be completely wetted).

Once the maceration time is completed, the extract is drawn off and the residual botanicals are pressed to collect the required amount of extract.

Some old vermouths/aromatized wines keep the traditional maceration process: botanicals are introduced into a wooden barrel and covered by wine (which is used as solvent instead of the alcohol/water mixture). An operator agitates the botanical mass periodically with a special tool in order to improve the extraction.

Today, thanks to the improvement in the grape process technology, it has been possible to “adapt” some modern wine presses for the maceration of botanicals.

The advantage of this simple technology is that no intervention is required during the maceration process, which can be exhaustive.

Some disadvantages are: the long process, extraction conditions are not consistent (or a special macerator needed) in particular in respect of temperature (classic macerators).

Percolation

This is another example of an old extraction technique based on diffusion and osmosis phenomena. The botanicals are placed in a conical container and the extraction “solvent” is added from the top.

Slow speed allows a fairly good extraction, as the solvent is recycled from the percolator bottom to the top, the resulting process is speeded up (dynamic extraction) if compared with maceration

Advantages: no specialised operators, short extraction times

Disadvantages: non exhaustive process

Ultrasounds extraction

An ultrasound source is introduced into a liquid previously added to the botanical that is to be extracted. The botanical cells containing essential oils and other flavour compounds are disrupted, and this modification increases the solvent extraction power and speeds up the process.

Qualitative results are related to the possible thermal degradation of some aromatic active principles. This technology is not used frequently in the industry.

Distillation

Botanicals are introduced into a pot still and water and/or alcohol is added. The distillation process is started by direct heating or by water vapour.

Volatile compounds are distilled and collected in a separate container by a simple air condenser or by a dedicated water condensing system.

The distillates obtained are composed only of volatile compounds and have a limited stability. In vermouth/aromatized wine distillates are frequently used for “dry” products.

VMHD (Vacuum Microwave Hydro Distillation)

The extraction is carried out in a reactor under reduced pressure where the botanical is heated by microwaves. Under the combined effect of selective heating by microwaves and vacuum applied in a sequential manner, the contents of the botanical cells are transferred more easily to the outer surface of the tissue.

In addition temperatures inferior to 80°C during short periods protect labile substances from thermal degradation. This technology offers the advantage of obtaining an extract without residual solvents.

As with the distillation process, the product obtained is also in this case composed mainly of volatile compounds.

Supercritical Fluid Extraction

One of the latest extraction technologies. It was born in the sixties from an industrial point of view and although plants are still very expensive, this technology is becoming more and more employed in the food, flavour, fragrance and pharmaceutical industries.

Supercritical fluids are produced by heating a gas above its critical temperature or compressing a liquid above its critical pressure. Under these conditions, the molar volume is the same whether the original form was a liquid or a gas. The supercritical fluids have solvent power similar to a light hydrocarbon for most solutes.

The most widely used SCF for all industries is carbon dioxide; it is non-toxic, non-flammable, readily available at high purity, and has near ambient critical temperature of 31°C (CO_2; T_c = 31.1 °C, P_c = 73.8 bar)

VERMOUTH PRODUCTION PROCESS

Prior to the marriage of the ingredients of vermouth, the base wine blend and the botanical extracts/distillates must be prepared.

Base-wine blend

The preparation of the base-wine blend is performed using traditional processing aids common to all wines and wine-based products, e.g. gelatine, bentonite, charcoal, etc.

Blending the ingredients

The sugar required in the product is generally incorporated into the base-wine blend, which is then mixed with alcohol, water and the botanical extracts, together with caramel if required, in blending tanks, which often have a capacity of up to 200 000L.

After careful homogenisation of the liquid, the vermouth is then allowed to mature for up to several weeks, in order to achieve a proper harmony and balance of its ingredients.

Stabilisation

At the end of this maturation time, the vermouth undergoes cold stabilisation treatment. It refrigerated, and is held for several days at around –8°C, close to its freezing point. This precipitates substances (mainly potassium bitartrate), which may form a natural deposit later if vermouth is subjected to low temperature during storage and transport, or to contact with ice when served. The precipitate is removed by a low temperature filtration, guaranteeing the physical stability of the product under all conditions.

Finally, to insure perfect clarity and brilliance, and also biological stability in the case of products with alcohol strength of less thank 16% vol., the vermouth is generally subjected to a very fine sterilising filtration immediately before bottling. The latter is carried out using the modern techniques common to other sectors of the beverage industry.

Analysis

Most of the routine analyses of vermouth are of necessity those used for the analysis of wines, since wines form the basis of all vermouths. In addition modern techniques of gas and liquid chromatography are used to analyse for the volatile and non-volatile compounds which are derived from the botanicals used, and which contribute to the specific aroma and taste of vermouth.

In common with the rest of the food industry, great care is also taken today to monitor and limit any low levels of contaminants, using the same techniques, which may potentially be introduced by contact with processing or transport equipment, or packaging materials.

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