

Valorisation of Aromatic Plants in Beverage Industry: A Review

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Abstract: Aromatic plants represent ingredients in alcoholic and therapeutically beverages dating back to the ancient history. As botanicals present new perspectives in creating new innovative spirit drinks, focus must be to the possible side effects related to the contaminants and their possible interaction with drugs or alcohol. Researches on aromatic plants provide support in establishing new legislative aspects.

Key words: history, perspective, extraction techniques, plant characteristics, EU Regulation

Introduction

Aromatic plants have various beneficial effects to human health. Many plant-based formulas with medical target were developed recently (Csernaton *et al.*, 2013; Pop *et al.*, 2013). Studies revealed the antioxidant activity, digestive stimulant action, anti-inflammatory, antimicrobial, antimutagenic, anticarcinogenic potential or hypolipidemic activities of botanicals used lately as ingredients in beverage industry (Gruenwald, 2009; Ignat *et al.*, 2011; McGovern *et al.*, 2010; Mudura and Coldea, 2015; Salanță *et al.*, 2014; Salanță *et al.*, 2015a,b).

Still, in perspective an attention must be considered regarding the possible contaminants – such as pesticides (Rusu (Coldea) *et al.*, 2010), mycotoxins (Trucksess and Scott, 2008), and the restricted aromatic plants with concern regarding the toxicological perspective, or even to possible interaction with drugs (Singh, 2005). St. John's wort, often used to treat depression and other stomach diseases, may have some adverse effect due to the presence of hypericin, a biologically-active compound. As hypericin is a non-volatile compound, St. John's wort may be used for its special bitter flavour in preparation of alcoholic beverages after distillation process (Tonutti and Peter Liddle, 2010).

Hop (*Humulus lupulus* L.) is the only aromatic plant that gives beer's the specific bitter taste (Mudura *et al.*, 2009). Until this moment, this plant could not be replaced. Still, recent studies revealed the potential use of hop in producing herb liqueurs (Vázquez-Araújo *et al.*, 2013).

The utilization of plant material as ingredient for obtaining spirit drinks represents an ancient process dating from Hippocrates period. Famous for that time was 'Hippocratic wine' or *vinum absinthianum*, the ancestor of vermouth (Tonutti and Liddle, 2010). The use of patented herbal drink formulas began in 1690, representing the precursor of today's bitter beverage type (Johnson *et al.*, 2015). The commercial bitter type beverage dates from 1800s, from Prohibition period (Lachenmeier, 2007). The most known for that period is said to be Angostura bitters, which was created firstly in Venezuela by a German physician to be a cure for sea sickness and stomach illness. Previously, these drinks were sold to sailors, and contained a medicinal bark.

Extraction techniques practiced in beverage industry

Different extraction techniques are applied in alcoholic and non-alcoholic beverage industries in order to obtain plant macerates, tinctures or other plant extract and essential oils, as base ingredients for digestives type beverages.

Distillation and cold pressing are used to obtain essential oils. Methods used for extract production from aromatic plants in beverage industry consists in infusion, maceration, percolation, ultrasonic extraction, distillation, vacuum microwave hydro-distillation (VMHD) and supercritical fluid extraction (SFE) (Tonutti and Liddle, 2010).

Infusion, similar to tea preparing method, is a traditional, rapid extraction method, but is not often used at industrial scale. As the extraction is made at high temperature, generally in water, some possible damages of the plant material can occur, namely the lost of flavour compounds.

Even if the maceration is the oldest method applied in beverages industry, it is used also nowadays. Usually, the proper alcohol concentration of the solution must be of 70 % vol. Different ratios, temperatures, homogeneity of the botanical mass and duration of maceration are key factors for obtaining high plant extraction yield. There are some traditional beverages where the solvent for maceration is wine, which is aromatized during the process as being in contact with aromatic plants. At industrial scale this method is not applied, as it is too difficult to manage.

Percolation is based on diffusion and osmosis phenomena. The principle of percolation is a simple one, being more efficient than

maceration, as the solvent is continuously recycled by passing from bottom to top of the tank through the botanical mass.

Another extraction method assumes the applying the ultrasound into a liquid containing the botanicals to be extracted. Distillation employs the thermal treatment of aromatic plants with water and alcohol into a pot still. Volatiles are distilled, collected separately and used afterwards in vermouths and other aromatized wines.

By vacuum microwave hydro-distillation the extraction takes place in a reactor under reduced pressure. Plants are heated by microwave. Similar process was done in red wine processing (Moldovan *et al.*, 2015).

A one-performant extraction technology is represented by supercritical fluid extraction. For the technique the most frequent used is carbon dioxide as supercritical fluid.

Aromatic plant used determine type of beverage

The beverage industry chooses the aromatic plants to be used in different types of flavoured alcoholic beverages from an unofficial list according to plant's characteristics (Table 1) (Tonutti and Liddle, 2010).

Table 1

Natural sources of flavourings used in alcoholic beverages (after Tonutti and Liddle, 2010)

Plant characteristics	Common name
Bitter	aloe resin, quassia wood, <i>Artemisia</i> species, gentian root, bark of <i>Cinchona</i> species, artichoke
Aromatic and bitter	yarrow, dandelion, blessed thistle, angostura, rhubarb, dittany of Crete, Roman chamomile, bitter orange
Strongly aromatic	angelica, cascarilla, star aniseed, clary sage, peppermint
Spicy	clove, cinnamon, nutmeg

Plant based alcoholic beverages regulated by EU

The actual European regulation (REG. 110/2008) describes different types of plant based alcoholic beverages, but new products appear constantly.

Geist is an artificially unflavoured spirit drink obtained by the process of maceration of unfermented fruits, berries or other types of plant material in ethyl alcohol, followed by a process of redistillation to a maximum alcohol content of 86 % vol. The raw material for gentian beverage is distillate of this plant, which is obtained from the fermented gentian roots (*Gentiana lutea radix*). The addition of ethanol of agricultural origin is allowed. Gentian is also used as a therapeutically treatment (McMullen, *et al.*, 2015). Gentian alcoholic beverage must contain at least 37,5 % vol. ethanol and without any flavourings.

The process for obtaining the juniper spirit (Sádecká *et al.*, 2015) involves the flavouring of ethyl alcohol with juniper (*Juniperus communis* L. and/or *Juniperus oxicedrus* L.) berries. Juniper beverage is famous in Portugal, where is obtained traditionally (Anjos *et al.*, 2013). This spirit drink has a minimum alcohol content of 30 % vol. Nature-identical flavourings are allowed as ingredients. These beverages may be commercialized with sales denominations as Wacholder or genebra.

Gin represents also a distilled juniper-flavoured alcoholic beverage obtained by distillation process in the presence of juniper berries (*Juniperus communis* L.) (Vichi *et al.*, 2008). The minimum ethanol content of gin shall be 37,5 %. No artificial flavourings are allowed, and its taste is predominant of juniper.

London gin it has a particularity – its flavour is introduced exclusively through the redistillation in traditional stills of ethyl alcohol in the presence of all the natural plant materials used. Alcohol content is between 37,5 and 70 % vol. alc. No addition of sweetening more than 0,1 g/L nor colorants are allowed.

Caraway is an aromatic plant, used as food flavouring, therapeutically treatment or can be added to cosmetics or fragrances. Its origins come from Iran (Fatemi *et al.*, 2009).

Caraway flavoured spirit drink, is obtained by flavouring ethyl alcohol of agricultural origin with caraway (*Carum carvi* L.). It has a minimum alcoholic strength 30 % vol. Other natural and/or nature-identical flavouring substances may be used but the predominant taste must be of caraway.

Akvavit or aquavit is a caraway and/or dill seed (*Anethum graveolens*) - flavoured spirit drink with a distillate of plants or

spices. The minimum alcoholic strength by volume of akvavit or aquavit shall be 37,5 %. The use of essential oils is prohibited in akvavit production. The bitter substances must not obviously dominate the taste.

Aniseed-flavoured spirit drinks are spirit drinks with natural extracts of star anise (*Illicium verum* Hook f.), anise (*Pimpinella anisum* L.), fennel (*Foeniculum vulgare* Mill.), or any other plant, which contains the same principal aromatic constituent, using one of the following processes or a combination thereof: maceration and/or distillation, redistillation of the alcohol in the presence of the seeds or other parts of the plants specified above or addition of natural distilled extracts of aniseed-flavoured plants. Only natural flavouring substances and preparations may be used in the preparation of aniseed-flavoured spirit drinks, with the predominant aniseed taste.

Pastis is an aniseed-flavoured spirit drink (Scholten *et al.*, 2008) (minimum 40 % vol. ethanol content) with natural extracts of liquorice root (*Glycyrrhiza* spp.) and less than 100 g of sugars per litre. Pastis de Marseille is a beverage with an anethole content of 2 g/L and minimum 45 % vol. alc. ethanol of agricultural origin.

Anis is an aniseed-flavoured spirit drink (with a minimum ethanol content of 35 % vol.) originated from Greece whose characteristic flavour is derived exclusively from anise (*Pimpinella anisum* L.) and/or star anise (*Illicium verum* Hook f.) and/or fennel (*Foeniculum vulgare* Mill.) (Moutsatsou *et al.*, 2003).

Distilled anis is an anis beverage, which contains ethanol obtained from distillation in the presence of the seeds of anise, star anise, fennel, mastic, or other aromatic seeds, plants or fruits.

Bitter-tasting spirits drinks or bitter are alcoholic beverages with a predominantly bitter taste produced by flavouring ethyl alcohol of agricultural origin with natural and/or nature-identical flavouring. The minimum alcoholic strength of this product shall be 15 % vol.

Liqueur is a spirit drink with a high sugar content, which can vary depending on the assortment, between 70 to 100 g/L. Plant liqueurs, prepared from gentian or other aromatic plants must have at least 80 g/L sugar content, and ethanol content minimum 15 % vol., respectively. The most known plant liqueurs are mint, gentian, aniseed or génépi (a traditional beverage originated from France, and Italy – as genépi) (Rubiolo *et al.*, 2009).

Sambuca is an Italian colourless aniseed-flavoured liqueur (minimum 38 % vol. alc.) made from anise (*Pimpinella anisum* L.), star anise (*Illicium verum* L.) or other aromatic herbs, having a minimum sugar

content of 350 g/L expressed as invert sugar (Ertan Anli and Mustafa Bayram, 2010).

Mistrà is a colourless alcoholic beverage flavoured with aniseed or natural anethole that may also contain a distillate of aromatic herbs. No sugar or artificial flavourings addition are allowed. Alcohol content of mistrà beverage is between 40 % and 47 %.

Väkevä glögi or spritglögg is a spirit drink (having a minimum 15 % vol. alc.) produced by flavouring ethyl alcohol of agricultural origin with natural or nature identical aroma of cloves and/or cinnamon using one of the following processes: maceration and/or distillation, redistillation of the alcohol in the presence of parts of the plants specified above. Natural or nature identical flavour of cloves or cinnamon can be added. Wine or wine products may be also added, but shall not exceed 50 % of the final product.

Berenburg or Beerenburg is a spirit drink (minimum 30 % vol. alc.) obtained using ethyl alcohol of agricultural origin with the maceration of fruit or plants or parts thereof. It contains a specific flavour distillate of gentian root (*Gentiana lutea* L.), juniper berries (*Juniperus communis* L.) and of laurel leaves (*Laurus nobilis* L.). May be sweetened to a maximum of 20 g/L expressed as invert sugar.

Conclusions

In this study, aromatic compounds were evaluated as ingredients in different types of spirit drinks regulated in the EU. This study suggests that some aromatic plants have great potential in development of new innovative functional alcoholic beverages. Depending on the strength flavour each aromatic plants contains, producers choose the right complex for a typical beverage. When creating plant macerates or extracts it is very important the maceration procedure applied. The current and most effective is supercritical fluid extraction, still the most expensive. All the ingredients used in beverage industry, when addressed to European market, must pass the EU certification. Some of them have questionable effect to consumer, and European Commission must regulate their addition in alcoholic and non-alcoholic beverages.

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