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Anise spirits: types, sensory properties and sensory analysis

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Abstract: In this chapter, the history, legislation and production of anise spirits are described with particular focus on the three main representatives of this class of spirits, namely pastis from France, and ouzo and tsipouro from Greece. Production procedures and the application of sensory analysis in the characterization of the final products are thoroughly described. Finally, future trends are given and some sources of further information are provided.

Key words: anise, ouzo, pastis, tsipouro, anethole.

10.1 Overview of anise spirits (pastis, ouzo, tsipouro)

The history of distillates extends way back into the mists of history. One of the first biotechnological applications known was wine and, thanks to the existence of primitive distillation techniques, its distillates. Distillation was studied by Alexandrian sages and later by Arab alchemists and constituted a significant chapter in the science of chemistry. What we do not know is precisely when distillation using copper alembic stills began. The name indicates that it was probably a Greek rather than an Arab discovery. The *ambix*, from which the word *alembic* is derived, was a vessel with a broad base and thin neck, very similar to the boiler of a still. The Greek word seems to have passed into Arabic (*al-ambiq*), and through Arabic to other European languages. The need to process metals with various reagents at high temperatures and the desire to extract the ‘spirits’ of substances led to improvements of the distillation technique.

Recommendations by Arab scholars that additives be used, to absorb one substance in the effort to isolate another, may have led to the addition of salts to wine in the container of a still. The salts absorbed part of the water and produced a ‘water’ that burned. An early description of how to produce such a water comes from Salerno, Italy via an alchemical manuscript, known as the *Mappae Clavicula* (the little key to

painting). The most recent version of the manuscript, which has survived in two versions, one from the tenth century and another from the twelfth century, but was probably written around AD 800, contains a partially encoded (perhaps out of fear of the Catholic Church) recipe, 'mixing pure and very strong wine with three parts of salt and heating it in a vessel suitable for this purpose produces a water that, when ignited, burns but leaves material unburned'. This was clearly a solution of alcohol that burned at such a low temperature that an underlying substance did not burn. This solution became known as *aqua ardens* (burning water). This concept probably originated from the ancient Greek belief in a 'spirit' that could act on anything and could possibly be transmuted into anything. From the thirteenth century on, further recipes for alcohol production materialized, although the word itself was first used by Theophrastus Paracelsus in the sixteenth century. It came from the Arabic *al-kuhl*, originally the name of very finely powdered antimony sulphide.

The history, formulation and evolution of anise spirits is closely related to the skills of coppersmiths, since without a copper still it is simply impossible to produce such distillates and therefore, as progress was made in working copper, the production of anise spirits evolved too. Later improvements in distilling equipment contributed to the large-scale distillation of marc (a by-product of wine-making) in Asia Minor and in the grape-producing regions of Greece. Until the mid-fifteenth century, Alexandria, Constantinople (today Istanbul) and Smyrna (today Izmir) were the most important centres of distillation skills. Monks in Mount Athos also knew about distillation well before the fifteenth century, and it was a customary practice of monasteries to distil the marc that remained after winemaking. Distillation, however, was affected by politics and the unchecked production of spirits was a matter of some concern to the authorities as the monk Alexandros Lavriotis wrote, '... it has been of great concern to Mount Athos, to the Turkish government and to the Ecumenical Patriarchate itself that alembics operate freely on the Holy Mountain (Athos) and produce untaxed spirits. More than twenty firmans on the matter have been issued since 1590 ...'

10.2 History of anise spirits

Anise spirits are related to two parameters: distillation techniques and grape growing. During the Ottoman period, the distillation of marc abated as grape growing declined, yet despite the Muslim prohibition of drinking wine, viniculture recovered and soon *rakitzides* (i.e. producers of tsipouro or raki) began to appear, many of whom received the special privilege of supplying the upper classes of the empire. In Europe, Chaptale in 1780 and Adam in 1805 improved the alembic still, giving it the form in which it has more or less survived to this day. In 1863, the Greek state promulgated the first law for the taxation of alcohol and in 1896 the first permits were issued for the production of a beverage distilled from marc.

It is not known precisely when production of ouzo began, nor when this name began to be used but we know for sure that it was made on Greek territory and was developed from tsipouro production. This is the reason for its initial name,

metavrasmēn (distilled again) raki. The word ouzo means nothing in Greek and appears not to have been widely used until the second half of the nineteenth century. The etymology of the word has alternative theories: according to one, ouzo comes from the word *uso* (for use), a word that, along with the destination, was stamped on the crates with the select goods that were being exported to Europe. More likely answers are that the root of the word ouzo comes from either the ancient Greek *ozo* (to smell) because of its very strong aroma or the Turkish *üzüm* (bunch of grapes and infusion of currants), although ouzo is not related to grapes or marc.

Ouzo, initially a distillation of marc, owed its individuality to the Mediterranean herbs used to give it flavour. Anise, fennel, mastic, coriander, angelica root, linden blossoms, cardamom and other aromatic plants and herbs went into the alembics to be used in the recipes of many ouzo-producing family businesses.

10.2.1 Pastis

The First World War signalled the end for absinthe, the most popular drink at the end of the nineteenth century. In 1914, all drinks with more than 16% abv alcohol were rigorously outlawed. They were destined not to be re-authorized until the end of the war except for absinthe (forbidden by law in 1915). Despite the regulations in France (similar in some extent to the ones mentioned above regarding ouzo and the Ottomans), the habit of enjoying anise spirits (fresh or mixed with water) has never stopped. The French government eventually authorized individual types of anise spirits without, however, authorizing them as a group, perhaps fearing the return of absinthe.

Toward the end of the 1920s, a young 23-year-old salesman, son of a wine merchant, put into practice his inspirational idea to commercialize an anise spirit under his own name. Flying in the face of the authorities, Paul Ricard widely distributed this forbidden drink and was constantly fined by police and customs-agents. After a lot of intense lobbying, he eventually succeeded in obtaining in 1932, the 'legal' right to make and sell the drink. The fines were transformed into taxes. Paul Ricard was obliged to find a name for his drink and to define its composition. His recipe entered the public domain and 'pastis' was officially born. Its name was derived from the Provencal 'pastisson' and the Italian 'pasticcio', a synonym for blend or mixture. Pernod profited from the authorization of the drink by bringing out 'pernod' but they never labelled the bottles as pastis, despite the drink being an anise spirit of the same family. In 1936, the first French paid holidays popularized pastis, and it soon became the most popular aperitif in France; in 1938, Ricard obtained the right to sell it at 45% abv instead of merely 40% abv. During World War Two, alcoholic drinks of over 16% were again forbidden. Only in 1951 was pastis re-allowed. The Pernod family then counter-attacked and brought out his '51', which he called 'pastis de Marseille'. Product wars ensued between the two producers until 1974, when the directors of the two companies agreed to merge. The Pernod Ricard group has gone on to well-known success and growth. In 1996, the group bought 95% of the shares of the Lesvos Union of Distillers (EPOM) and the routes of pastis and ouzo joined.

10.2.2 Ouzo

The modern origins of ouzo began on the island of Lesvos, in a small town called Plomari, by the Barbayannis family who five generations later are still making ouzo today. Its founder, Efsthios Barbayannis, moved to Lesvos from Odessa (Ukraine) where he had learnt the secrets of distillation. Visiting Constantinople (today Istanbul), he bought a bronze alembic still, which was the first piece of machinery used to found the family ouzo distillery as a cottage industry, in 1860 (Fig. 10.1). The unique aspects of the place and time were that:

- Lesvos had endemic aniseed (in fact the village of Lisvori, where still today green anise (*Pimpinella anisum*) grows is only a few miles north-west of Plomari),
- The water of the island had superior organoleptic properties,
- Distillation skills were also there.



Fig. 10.1 Old copper alembic stills resting in the Barbayannis museum.

With a combination of these three factors, it holds no surprise that Lesvos became the birthplace of ouzo. Exactly the same fortunate combination of these parameters occurred during the birth of pastis in Provence. Starting from the island of Lesvos, ouzo's reputation soon became recognized all around the world. Today, there are more than a dozen established ouzo distilleries on the island, most of which are still independent family businesses. According to EC 110/2008 (Annex III), in the 'distilled anis' category, there are six geographical indications of ouzo originating from Greece.

10.2.3 Tsipouro

The history of tsipouro is closely related not only to distillation skills but also to wine-making experience. Given that one of the raw materials for tsipouro is the remnants of the vinification procedure (i.e. marc), it is essential to have access to marc in order to make tsipouro. According to EC 110/2008 (Annex III) (European Union 2008), in the 'grape marc spirits' category, there are four geographical indications of tsipouro originating from Greece.

10.3 Raw materials and production process

According to EU regulations (1576/1989 and 110/2008) (European Union 1989, 2008), spirits flavoured with aniseed constitute a special category. They are made with neutral ethyl alcohol of agricultural origin to which aromatic plants or products of them (seeds, roots, blossoms, buds, leaves, fruit, etc.) or the natural extracts thereof are added either before and/or after distillation. The plants used for this purpose are common anise, fennel and any other plant that contains the basic aromatic ingredient anethole. Almost all Mediterranean countries produce beverages that belong to this category. Following this pattern, it is not surprising to meet variations of anise spirits with different names in various countries of the Mediterranean basin (e.g. pastis in France, ouzo and tsipouro in Greece, raki in Turkey, arak/arak/arraki in Jordan, Lebanon and Syria, zivania in Cyprus or ojén in Spain).

10.3.1 Pastis

By legal definition (European Union, 1989), pastis is an anise-flavoured spirit that contains the additional flavour of licorice root, and is bottled with sugar (but no more than 100 g/l). Today, pastis is prepared by simply mixing ethyl alcohol with flavourings (essences and/or extracts). Pastis is often associated with its historical predecessor (absinthe), yet the two are in fact very different, as pastis does not contain grand wormwood (*Artemisia absinthium*), the herb from which absinthe derives its name. Also, pastis obtains its anise flavour from the distillation (or industrially prepared distillates) of star anise (*Illicium verum*), a herb of Asian origin, whereas absinthe traditionally obtains its base flavour from green anise

(*Pimpinella anisum*), a European herb. Furthermore, pastis traditionally exhibits the distinct flavour of licorice root (*Glycyrrhiza glabra*) (another herb of Asian origin), which is not a part of a traditional absinthe. Traditional absinthes were bottled at 45–74% abv, while pastis is typically bottled at 45–50% abv. Unlike a traditional absinthe, pastis is a liqueur, which means that it is always bottled with sugar. Today, like ouzo and tsipouro, each distillery has its own secret recipe and variation. Pastis becomes milky white and cloudy when mixed with water (1:5 ratio). This phenomenon is known as the pastis effect (Grillo, 2003) or ouzo effect (Vitale and Katz, 2003). There is a sharp, sweet smell of aniseed and it is called ‘the milk of Provence’. The production process of pastis is the simplest of the three anise spirits in this chapter. Raw materials are mixed; water, sugar, distilled anise extract and ethyl alcohol are added; the mixture is stored in vats, filtered and bottled.

10.3.2 Ouzo

According to EU regulations, for an anise spirit to be called ouzo, it must:

- Have been produced exclusively in Greece.
- Have been produced by blending alcohols flavoured by means of distillation or maceration using aniseed and possibly fennel seed, mastic from the lentiscus indigenous to the island of Chios (*Pistacia lentiscus Chia* or *latifolia*) and other aromatic seeds, plants and fruits.
- The alcohol flavoured by distillation must represent at least 20% of the alcoholic strength of the final product.

Furthermore, that distillate must:

- Have been produced by distillation in traditional discontinuous copper stills with a capacity of 1000 litres or less,
- Have an alcoholic strength of not less than 55% abv and not more than 80% abv,
- The ouzo, as the end product, must be colourless and must have a sugar content of 50 g/l (or less) and a minimum alcoholic strength of 37.5% abv.

The label may bear the word ‘aperitif’, but not the wording ‘from distillation’, ‘doubly distilled’ or ‘re-distilled’. Only if the alcohol content of the ouzo is exclusively the product of distillation is it permitted to declare ‘100% distilled’. Nowadays, most quality ouzo labels are 100% distilled.

The production process for ouzo is as follows. Ethyl alcohol of plant origin, anise, other aromatic plants and water are distilled for 15 h. The distillate (79–80% abv) is then left to ‘relax’ for 20–25 days. Water is added to reduce the alcohol content to 37.5–45% abv. The mixture is then bottled. It is worth mentioning the practice of today’s most popular brand in Lesvos (Pitsiladis) where they use a unique and unusual technique to maximize the extraction of flavour from aniseed: the anise seeds are left to soak in the sea for 24 h prior to distillation! According to the quality manager of this distillery, the role of the sea water is two-fold: firstly, the seeds are soaked and the yield of the flavour extraction

during the subsequent distillation is maximized; secondly, the seeds absorb sea salt and this improves the overall flavour of the distillate.

10.3.3 Tsipouro

The production process for tsipouro is similar to that of ouzo with the only exception being that the initial raw material is not aniseed but marc. Marc (either from white or red grapes) is distilled and following the first distillation, a second distillation takes place when aniseed is usually added. The first few litres of the second distillation (heads) are discarded. This second distillate is usually 60–70% abv and it is diluted to 40–45% abv with water. In practice, from 100 kg of white grapes, 15 kg of marc is derived and this marc will eventually (after the second distillation) give two 750 ml bottles of final product (tsipouro of 40–45% abv).

10.4 Description of major variants

The major variants in anise spirits are mainly the quality of aromatic herbs and the water. The process (distillation, mixing, addition of water) is rather simple without adding differentiating parameters affecting the quality (flavour) of the final products. Variation is mainly derived from differences in the quality (taste, maturity, overall flavour) of the aromatic herbs and anise used. The fact that most anise spirits are made by small independent family businesses means there is a higher degree of versatility in terms of adopting the ‘recipe’ to the likes/dislikes of the owners. In other words, the most major variant could be the individual taste of the producer that affects the ratio of raw ingredients and therefore the flavour of the final product.

Another variant is that pastis is made from star anise (*Illicium verum*) whereas ouzo and tsipouro are made from green anise (*Pimpinella anisum*). The cultivation area and climate are also parameters affecting the flavour produced by these two plants, i.e. the microclimate of Provence, France or Livorno, Livorno should give a different fingerprint on the spectrum and levels of flavour molecules biosynthesized by the plants. In general, in Greece, due to the dryer and warmer weather, the plant secondary metabolism (i.e. biosynthesis of flavour) is favoured and this leads to plant extracts (in this case seeds) with richer and more complex flavour.

In the case of ouzo and tsipouro, anise is distilled with the mixture of alcohol and other ingredients, while in pastis, anise distillate is only mixed with the rest of the ingredients. This is another technical detail that should, thus, be considered as a major variant when the overall organoleptic properties of anise spirits are studied.

10.5 Overview of flavour chemistry and sensory properties

Anise spirits are produced by flavouring ethyl alcohol with anise extracts/distillates or by distilling ethyl alcohol with extracts or seeds of star anise, green anise, fennel (*Foeniculum vulgare*) or any other plant with similar principal aromatic constituents (European Union 1989).

The aromatic component that links all three major anise spirits (pastis, ouzo and tsipouro) is *trans*-anethole, which can be obtained by steam distillation from different plants (such as green anise, star anise and fennel). Thus, the main character of the flavour of the anise spirits is closely dependant on the flavour of the plant ingredients that are used for distillation. Chemical analysis of anise spirits has been performed in a number of studies (Jurado *et al.*, 2007; Kokkinofa and Theocharis, 2005; Gerogiannaki-Christopoulou *et al.*, 2006), giving an insight into the compounds responsible for the aroma character of these products. The main flavour component is *trans*-anethole (Jurado *et al.*, 2007; Tsachaki *et al.*, 2010); isoamyl alcohol, limonene, linalool, estragole and terpene hydrocarbons have also been identified as important flavour constituents in anise spirits (Kontominas, 1986; Jurado *et al.*, 2007; Tsachaki *et al.*, 2010).

In chronological order, the first study on the flavour of ouzo was carried out by Kontominas (1986). Almost twenty years later, Apostolopoulou *et al.* (2005) studied some differences in the concentration of the principal volatile constituents in commercially produced and homemade tsipouro. Some further insight on the impact of grape variety on the flavour of tsipouro was given by the work of Gerogiannaki-Christopoulou *et al.* (2006); in this work, white and red grape cultivars were used to produce tsipouro and the final distillates were analyzed by gas chromatography (GC). The volatile composition of anise spirits was studied by headspace solid-phase microextraction (HS-SPME) coupled with GS-MS (Jurado *et al.*, 2007). In this work, the flavour of pastis and tsipouro was further studied. The main flavour components in anise spirits are given in Table 10.1.

Table 10.1 The main flavour components in anise spirits

Compound	Pastis	Tsipouro		Ouzo		Reference
	(% peak area)	(% peak area)	($\mu\text{g/ml}$)	(% peak area)	($\mu\text{g/ml}$)	
α -Pinene				0.49		(Kontominas, 1986)
β -Pinene				Trace		(Kontominas, 1986)
<i>cis</i> -Anethole				0.07–0.27		(Kontominas, 1986)
	0.77–10.36	7.50–11.39				(Jurado <i>et al.</i> , 2007)
			0.0–4.0		1.2–8.0	(Tsachaki <i>et al.</i> , 2010)
<i>trans</i> -Anethole				93.18–95.90		(Kontominas, 1986)
	79.22–97.52	56.78–89.95				(Jurado <i>et al.</i> , 2007)
			0.0–154.0		120.0–876.0	(Tsachaki <i>et al.</i> , 2010)

<i>p</i> -Anisaldehyde			0.10– 0.73	(Kontominas, 1986)
		1.5– 8.0	0.0– 26.0	(Tsachaki <i>et al.</i> , 2010)
Anisaldehyde diethyl acetal		1.5– 4.5	0.0– 16.0	(Tsachaki <i>et al.</i> , 2010)
Estragole	0.10– 1.37	0.97– 8.34		(Jurado <i>et al.</i> , 2007)
		3.0– 8.0	0.0– 13.0	(Tsachaki <i>et al.</i> , 2010)
Isoamyl alcohol		57.0– 65.0	0.0	(Tsachaki <i>et al.</i> , 2010)
Limonene			0.29– 0.72	(Kontominas, 1986)
			3.0– 5.0	(Tsachaki <i>et al.</i> , 2010)
Linalool			0.19– 0.36	(Kontominas, 1986)
		0.0– 2.0	0.0– 15.0	(Tsachaki <i>et al.</i> , 2010)

Finally, Tsachaki *et al.* (2010) developed a suitable lexicon for sensory studies of ouzo and tsipouro (Table 10.2). In this work, ouzo and tsipouro samples were analyzed by instrumental analytical methods (GC) and sensory analytical methods. Statistical analysis (principal component analysis (PCA), factor analysis and cluster analysis) was used with the chemical and sensory data to discriminate ouzo from tsipouro. PCA and factor analysis discriminated the products mainly

Table 10.2 Attributes (odour, taste and aftertaste) and their descriptors used during sensory analysis for testing of the ouzo and tsipouro products based on the lexicon developed by the panelists

Attribute	Descriptor	<i>p</i> -Values
Anise (odour)	Aniseed	1.39E-16
Mastic (odour)	Chios mastic gum	9.30E-02
Sweet (odour)	Icing sugar	4.63E-05
Alcoholic (odour)	Ethyl alcohol	8.58E-05
Herbs (odour)	Dill or fennel	3.69E-02
Vanilla (odour)	Vanilla rods	1.44E-03
Menthol (odour)	Menthol	3.20E-04
Strong (odour)	Alcoholic drink (e.g. vodka)	4.79E-03
Sweet (taste)	Sugar	1.51E-04
Alcoholic (taste)	Ethyl alcohol	1.69E-02
Rich (taste)	Full mouth-feel	5.12E-01
Spicy (taste)	Savoury spices (e.g. cardamom)	8.31E-01
Artificial (taste)	Rubber or dye	3.55E-01
Aromatic (taste)	Sweet aroma (e.g. vanilla-like)	3.00E-03

(Continued overleaf)

Table 10.2 Continued

Attribute	Descriptor	<i>p</i> -Values
Menthol (taste)	Cooling sensation (menthol chewing gum)	1.53E-02
Caustic (taste)	Pungent (e.g. nutmeg)	4.07E-01
Sweet (aftertaste)	Sugar	1.31E-02
Alcoholic (aftertaste)	Ethyl alcohol	2.13E-01
Artificial (aftertaste)	Rubber or dye	5.64E-01
Spicy (aftertaste)	Savory spices (e.g. cardamom)	9.14E-01
Bitter (aftertaste)	Oregano	2.38E-01

Notes: Each descriptor gives information about the standard compound (or the implied characteristic) used in the training of the panelists.

p-Values of each attribute produced from ANOVA analysis are for discrimination of how different panelists comprehend each descriptor.

into two groups, one group of ouzo products and another of tsipouro products. Cluster analysis showed that the data from sensory analysis were able to discriminate the samples better than the chemical analysis data. Sensory analysis has also showed that, when a suitable lexicon is used, it is possible to discriminate firstly the two different groups of spirits (ouzo and tsipouro) and secondly the samples of tsipouro into further groups, containing anise or not (Fig. 10.2).

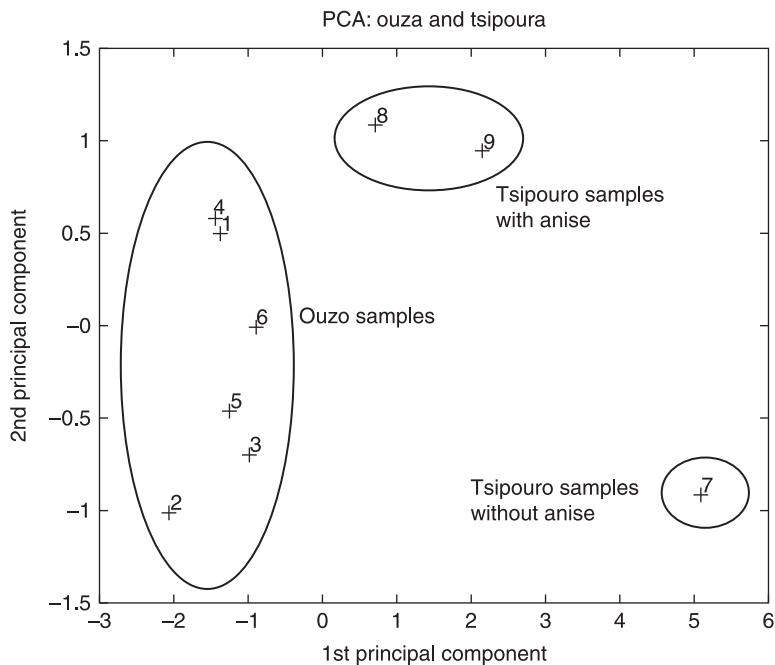


Fig. 10.2 PCA diagram demonstrating the grouping of samples from sensory analysis data. 1–6 different ouzo brands, 7–9 different tsipouro brands.

10.6 Description of sensory analysis practice in the anise spirit industry

Sensory analysis is carried out by using trained panelists (groups of 5–10 people of both sexes and various ages) on anise spirits. Each distillery uses its own lexicon adapted to the particular attributes of their own products. Panelists are asked to mark (on a scale of 1–10) different attributes using specific descriptors (as shown in Table 10.2). After marking, spider web plots are drawn and the quality differences of the samples are depicted. At this point, the link between distillers and marketing people is important in order to amalgamate the market needs with the feasible distillation improvements so that the product can satisfy changing consumer needs and tastes. Major distillers are producing at a pilot scale new products (based on new recipes with a slightly differentiated mixture of herbal plants) which are compared organoleptically with the existing marketed ones (as described above) before scaling up production and launching new brands. In Greece, however, this process is not very vigorous. Even the leading distillers follow more or less the same recipe that has been handed down by their predecessors.

10.7 How consumer research is managed and executed

Consumer research is executed in various ways. First, the final selling points of anise spirits (wine shops, tavernas, restaurants) receive feedback from consumers and, in most cases, (depending on the relationship of the owner of the catering unit with the distillery) this feedback is passed on to the relevant distillers. Secondly, the distiller's marketing team collects direct feedback from the customers by visiting the points (bars, tavernas, etc.) where their products are consumed. Unfortunately, there are no well-defined procedures for managing and executing consumer research within this industry in Greece and this is a significant problem in the development of new anise spirits. Despite the lack of such procedures, various people from the anise spirits market have confirmed that the current trend in Greece is to have anise spirits with less alcohol. Consumers are asking for more 'gentle', more 'sweet' and less 'sharp' taste and aroma.

10.8 Future trends

The future trends are towards two directions:

- Lessen the alcoholic content of anise spirits and enrich their flavour by using more natural raw ingredients and processes,
- Development of ready-to-drink (RTD) anise spirits.

Regarding the first direction, research carried out in the author's laboratory in collaboration with one of the leading distillers in Lesvos has shown that the

addition of honey and thyme to the mixture of raw ingredients before distillation can have a distinct positive impact on ‘smoothing’ the flavour character of the final products.

Regarding the second direction, three RTD ouzo samples were made in the author’s laboratory, by mixing ouzo with fruit juices in such a way so the final alcoholic content would be about 5% abv. Three juices were used (orange, lemon and peach). This (unpublished) research has shown that the lemon RTD ouzo could have a high acceptance level with young consumers. Until now, especially in Greece, Italy, Spain and Turkey and to a lesser degree in France, anise spirits are linked with the consumption of a certain type of food (*meze* in Greek) and so their consumption is mainly located in tapas bars, tavernas and restaurants. In order to widen the market, the challenge is to persuade other consumer groups (in bars, pubs and clubs) to drink anise spirits by offering them RTD anise spirits. Thus, the next challenging task is how to manage the mass production of such a drink.

10.9 Sources of further information and advice

Pastis

- <http://www.foodreference.com/html/artpastis.html>

Ouzo

- <http://www.greecefoods.com/ouzo/>
- <http://www.barbayanni-ouzo.com/ouzo-museum-lesvos.html>
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Tsipouro

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